

From Cafe to Reggio – An Inspired Makerspace
A Holistic Approach to Makerspaces and Pedagogy: Linking 20th Century Pedagogy with the
21st Century Makerspace Classroom

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Abstract

This major research paper is a narrative account of Makerspaces and my experiences as a teacher who has embraced this pedagogy. Educational reformers are calling for a dramatic shift in educational practice to meet the needs of the 21st Century learner. A Makerspace is an innovative 21st Century concept and describes a space where people can meet to share ideas, collaborate, invent and use hands-on approaches. It is a do-it-yourself movement that often involves technology, such as a 3-D printer, but also may involve knitting needles and a sewing machine. I examine the content, processes and guiding pedagogies within Makerspaces in education. Alternative forms of education such as Reggio Emilia, Waldorf and Montessori are explored to make connections to the Maker Culture. Chapter 4 offers an e-book that is intended as an educator resource. This resource may help educators and school leaders to implement a Makerspace in their own contexts.

Acknowledgements

I would like to acknowledge and dedicate this project to my family. First, I thank my father, Douglas Branigan (1944-2017), an accomplished wood worker, designer and artist for inspiring me to be a Maker and activist. Many of his artifacts and designs remain in both Makerspaces showcased in this project. My mother, Sheri Selway, an experienced teacher and social activist has always been my mentor and support. My focus on social justice, community action and relationships are a direct result of her influence. Also, my husband Brad has not only supported my ideas and enthusiasm toward this project, but he has supported every single crazy project and idea that has led up to this. He has been my sound board, a shoulder to cry on, an editor, a cook and whether it be early in the morning or late at night - he has also been my driver and the delivery person from Makerspace to Makerspace. My sons, Jackson and Nathan, motivated me throughout my journey to be a constructivist educator and leader and they helped me see a different way of learning and encouraged me to try different approaches - not to mention, helped me learn to code and build in Minecraft and Java.

Second, I would like to acknowledge my co-workers, Beth Carey, Kristy Luker, Ben Nywening and Tammy Faux who worked with me as we all have made the shift from a traditional classroom model, to teach using a Reggio constructionist approach.

Last, I would like to thank my supervisors of this project, Dr. Susan Drake and Dr. Camille Rutherford who have been patient, flexible and understanding every time my vision or direction of this project changed. It has been a privilege to work with academics who recognize that teaching and learning are changing and who continue to support new and current research.

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CHAPTER ONE: INTRODUCTION TO THE STUDY

In June 2016, my teaching team's Makerspace classroom was awarded the first place "Ken Spencer Award" Award for Innovation in Teaching and Learning by the Canadian Education Association (CEA) (CEA, 2016). See Figure 1 for an announcement of this award. This award set in motion the funding for further research and the creation of a second Makerspace classroom. This second Makerspace is the focus of this Major Research Paper (MRP) and is a teacher resource in the form of an e-book in Chapter Four. The e-book offers insight into what a Makerspace learning environment looks like in practice.

This MRP is a narrative account of Makerspaces and my experiences as a teacher who has embraced this pedagogy. Educational reformers are calling for a dramatic shift in educational practice to meet the needs of the 21st century learner. A *Makerspace* is an innovative 21st century concept which describes a space where people can meet to share ideas, collaborate, invent, and use hands-on approaches. It is a do-it-yourself movement that often involves technology, such as a 3-D printer, but also may involve knitting needles and a sewing machine. I examine the content, processes, and guiding pedagogies within Makerspaces in education. Alternative forms of education, such as the Reggio Emilia, Waldorf, and Montessori approaches, are explored to make connections to the Maker Culture. Chapter Four of this study offers an e-book that is intended to be used as an educator resource. This resource may help educators and school leaders implement a Makerspace in their own contexts.

FIRST PLACE – \$7,000

HWDSB Enrichment & Innovation Centre

A hands-on learning space where students can feel at home

Hamilton-Wentworth District School Board

Hamilton, Ont.

The HWDSB Enrichment & Innovation Centre is a hands-on learning and inquiry Makerspace with a 'coffeeshop' atmosphere that serves over 400 gifted students per month from across the district. Each day starts with a cup of tea to set the tone for group conversations. Students are offered a variety of seating arrangements, from traditional desks to a kitchen table and comfy beanbag chairs. This relaxed learning community atmosphere has proven to be so vital for student success. The room design recognizes the need for quiet and individuality when learning and includes a cozy living room space with lamps, curtains, a carpet, a couch and books for "chilling" where even the most anxious learner can find a comfortable place to engage in inquiry.

The two teachers who co-facilitate this program are constantly trailblazing with a relentless drive to engage and empower students. This program is all about students pushing boundaries, taking risks, asking and answering good questions, and thinking critically. No two days are alike with students debating and exploring global issues, designing 3D-printed inventions to solve world problems, tinkering with robots, programing mini computers, recreating historic events and poetry using Minecraft, using a giant green screen for video productions and storytelling, and co-authoring their own books. By connecting their learning directly to global goals, nothing is done without a purpose.



Websites: <http://pipedreams-education.ca>
<http://gifted.commonshwdsb.on.ca>
<http://mindsonminecraft.blogspot.ca>

Video: <https://www.youtube.com/watch?v=p7xVW70jtbs>

Photo

Gallery: <https://www.flickr.com/photos/zoebriganpipe/albums/72157661520434530>

Figure 1.

HWDSB Enrichment & Innovation Centre's Receipt of the Ken Spencer Award (Canadian Education Association, 2016).

The Maker Movement

Joining the Maker Movement and participating in it locally will open up your life to the highest concentration of creative people in your community. You will meet poets, laser etching their words on oak panels, you will meet a financial planner building sets for her children's play. You will see someone start a hobby that leads to an avocation and then a business employing a dozen locals. You will enjoy the excitement and joy of giving those you love a piece of yourself through gifting to them something you made just for them.

Join me, join us, join the movement—it will help you become you. (Hatch, 2014, p. 13)

Dale Dougherty coined the term *Makerspace* in 2005 in MAKE Magazine (Cavalcanti, 2013). *Makerspace*, (also known as Hackerspace), refers to open creative spaces that provide local communities with access to tools, training, and materials that are typically unavailable to them because of cost, physical size, or lack of specialized training (Kemp, 2013). Cavalcanti (2013) notes that Makerspaces are understood to be community workshops where members share tools for professional gain or hobbyist pursuits (Cavalcanti, 2013). The Makerspace supports a range of structured making formats, including workshops that dive deeply into a project or open shop time, where members are free to work on whatever they want, with facilitators around for just-in-time mentoring (Peppler, 2013; Peppler & Bender, 2013).

The rise of Makerspaces in schools comes at a time when pedagogy is beginning to shift from content-specific, teacher-directed instruction back to a more hands-on, student approach to learning, much like the educational practices before standardized curriculum (Grassick, 2016). There is growing interest among educators in bringing the Maker culture into K to 12 education to enhance opportunities for students to engage in design and engineering practices, specifically in science, technology, engineering, and mathematics – otherwise reference to as STEM or STEAM, when art is included (Martin, 2015). Makers are found in fields ranging from food to

crafts to technology (Morin, 2017). Makers are self-directed learners who are able to figure out, in one way or another, how to learn what they need to know. Like artists, they are motivated by internal goals, not by extrinsic rewards. They are inspired by the work of others. Most importantly, however, Makers do not wait until the future to create and make (Dougherty, 2013); instead, they learn to use tools and technology to create new things (Dougherty, 2017) because they are actively engaging in the process of creating, inventing, and learning based on their discoveries, as well as being inspired by others. Makers are enthusiasts who played with technology to learn – but are motivated through problem-solving, community action, collaboration and activism, rather than extrinsic rewards (Dougherty, 2017). Makerspaces are not always about technology, however, as my experiences will show.

Makers are individuals who are part of the Maker community, which engages actively in the creative process and can be identified in roles such as social activists, journalists, bloggers, online creators, artists, writers, technology enthusiasts, mathematicians, crafters, tinkerers, and sewers.

Makers and Makerspaces

Makerspaces are very popular in the 21st century learning context. The Maker Movement was named a top educational technology (ed-tech) trend in 2012 for its potential for education; some even see it as the next revolution in education (Schön, Kumar, & Ebner, 2014). With careful thought and consideration of past and present theories, we now have a chance to use design thinking to teach and develop sophisticated skills of creativity (Sverko, Therien & Roffey, 2016). Makerspaces may provide an ideal format and opportunity to delve into cross-curricular and inquiry-based teaching. As noted by Resnick and Rosenbaum (2013), perhaps all this enthusiasm surrounding the Maker Movement, “will provide a new opportunity for

reinvigorating and revalidating the progressive-constructionist tradition in education” (p.163) – one that is not technology-centric but one that looks at a balanced approach which recognizes the whole child.

Makerspaces link intimately to constructivist theorists whose research, for many decades, has pointed to the fact that when students are active participants in their learning, through processes like play and making, they engage in learning processes that enable deep and meaningful learning to take place. But, making things is just not enough (Resnick & Rosenbaum, 2013). At the heart of the Makerspace is an environment that is supportive, that embraces the community, and that respects the environment and the varying needs of people whether it be their age, race, religion, gender, or learning ability. Makerspaces provide an opportunity for mentorship, developing and nurturing relationships, and placing value on community and family.

Martin (2015) warns,

the history of the adoption of computers in schools suggests a lurking danger: The Maker Movement that assumes its power lies primarily in its revolutionary toolset, and that these tools hold power to catalyze transformations in education. Given the growing enthusiasm for making, there is a distinct danger that its incorporation into school settings will be tool-centric and thus incomplete, (p. 37)

Martin (2015) also points out that, “as we consider the promise of the Maker Movement for education, we must actively resist this tendency to oversimplify” (p. 36).

Purpose of the Study

There is a growth of Maker communities online as well as in the development of community workspaces, called *Makerspaces*, and the spread of the *Maker Faire* around the world. If Makerspaces are becoming central to teaching and learning in the 21st century, then it is important to know what such a space look like. The intention of this paper is to show how a Makerspace looks in practice and to facilitate capacity-building in educators who wish to create a Makerspace in their classroom or school.

Research Problems and Inquiry Questions

This problem is heavily rooted in the desire to standardize education. In order to evaluate their success and analyze their progress over time, schools and districts need a metric in which to do so. Ultimately, this has fallen on the shoulders of standardized testing, which has become so ingrained in our current educational system that it is hard to disseminate one from the other. Herein lies the problem. If these tests are in place to measure and compare how well schools are preparing students for their futures, then by this metric a good school is simply one whose students perform well on tests. Unfortunately, this then places the focus of schools not on preparing students for the real world, but rather preparing them to do well on a test. (“Why MakerSpaces?,” 2015)

Traditional structures of schooling, “make it very hard to create learning environments that result in deeper understanding” (Sliwka, 2008, p. 10), and a failure to effectively integrate the Maker Culture in the classroom or school may lead teachers to revert to these outdated practices and result in students feeling disengaged from learning. This MRP will recognize that the problems faced by teachers and leaders when implementing Makerspaces into the classroom are multi-faceted: not only are educators faced with the complexity of learning new tools, new

technologies, and social media, but they also must learn how to integrate this new approach into curriculum and assessment in a meaningful way – one that is current and engaging for students and presents a profound and useful context to learning.

The following questions guided this inquiry, research, and project:

- What is a Makerspace?
- What does a Makerspace look like?

Significance of the Study

If Makerspaces can enhance learning and also engage students in intrinsically motivating ways, then it is important for educators to know what such a space looks like, the theories that ground such a pedagogy, and how to implement such a space in their own context. The teacher resource in Chapter Four has been created to address these issues in a teacher-friendly way.

CHAPTER TWO: THE CONTEXT AND PERSONAL NARRATIVE

Changing Pedagogy

It is difficult to talk about pedagogy and the shift in teaching towards including Makerspaces and the Maker Culture in education without mentioning the significant changes that school systems underwent at the end of the 20th century and into the 21st century. There are connections made to how and why the Maker Culture has been an essential aspect to student learning for decades, which has provided tremendous guidance and insight in the literature review that follows in Chapter Three.

Historically, alternative models of education have coexisted with the public education system ever since its inception in the first half of the 19th century (Raywid, 1999, as cited in Sliwka, 2008, p. 1). The context of this paper, however, is to highlight how education in the 20th and 21st century has shifted in and out of the constructivist learning approaches to argue that while the concepts behind the Makerspace culture are not new, the term itself is new in education. It is crucial to understand that, “the history of alternative education is a colourful story of social reformers and individualists, religious believers and romantics” (Miller, 2007, as cited in Sliwka, 2008, p. 1). The Makerspace has many roots in strong pedagogies, especially those that have significant influence from both the United States and Europe, as well as influences from Indigenous cultures.

During the 1960s and 1970s, alternative education grew into a widespread social movement. Writers like Ivan Illich, A.S. Neill, and Hartmut von Hentig in Europe, John Holt, Jonathan Kozol, and Herbert Kohl in the United States, and Paulo Freire in Brazil questioned the values and methods of public schooling (Sliwka, 2008). The period between 1967 and 1972 in particular saw profound criticisms of public education, resulting in student demonstrations and

teacher strikes in many countries (Sliwka, 2008) and resulted in changes in how education would be delivered in public schools.

The Hall-Dennis Report (1968), a name associated with the two chairs of the committee that drafted the document, *Living and Learning*, offered a wide set of recommendations which challenged educationists to focus on the individual learner's inclination towards self-discovery and exploration, to limit competition, to re-vision classroom spaces, and to abolish corporal punishment. Here, Educationists wrestled to make sense of new technologies in the classroom, such as television programming, and conceptions of individual rights and responsibilities” (Christou, 2012).

Not long after in Ontario, *The Formative Years* document (1975) guided the pedagogy and the curriculum (Anderson & Ben Jaafar, 2013). Many of the philosophies were steeped in recommendations made by the Hall-Dennis Report, with *Living and Learning* (1968) adding to the curriculum, “areas such as the individual and society, decision-making, values, perception and expression, and Canadian Studies (Ontario Ministry of Education, 1994, p.17).

During the *Formative Years* curriculum period in Ontario, students were exposed to shop and woodworking classes at younger ages (namely, in middle school), home economics and cooking, and arts; these courses were often still very scripted and lacked creativity, perhaps because they were a mandated part of curricula. While skilled teachers facilitated the subjects in these specific disciplines, this also resulted in educators teaching in isolation rather than through a cross-curricular and project-based approach, one which could have encompassed a wide variety of disciplines. Students sometimes traveled to other schools to go to these programs – for instance, having homeroom at one school and shop class at another. Arguably, this approach puts more focus on the “knowing” or “doing” rather than the “being.”

By the 1990s, the transformation of the industrial economy to a knowledge economy had stimulated a debate about the future of the standard model of schooling (Bransford, Brown, & Cocking, 2000; Bereiter, 2002; Hargreaves, 2003). In 1993, the *Common Curriculum* (Ontario Ministry of Education, 1994) was developed and adopted by the Ministry of Education under New Democratic Party (NDP) leadership, and eventually replaced the *Formative Years* curriculum. The *Common Curriculum* specified outcomes that students were expected to learn by division (i.e., by the end of Grades 3, 6, and 9). There were 10 goals that acted as an umbrella for all Grades from 1 to 3. The curriculum outcomes were holistic in nature and the outcomes were integrated across subjects for Grades 1 to 9.

A major turn in how Ontario would approach teaching and learning happened in June 1995 when the Conservative government in Ontario replaced the NDP as the elected government. “The Ontario Curriculum (current) defined subject specific learning outcomes and standards by grade level (abandoning progressive notions of non-grades and flexible progress)” (Anderson & Jaafar, 2003, p. 14).

At the time, changes were made to the education system under what was coined, ‘The Common Sense Revolution’ and these changes impacted how teachers would teach, how schools and classrooms would be organized, and even how educators were trained and evaluated. Government committees were charged with developing plans for the instatement of the Education Quality and Accountability Office (EQAO), the Ontario College of Teachers (OCT), school board amalgamations, and Education Finance Reform (Anderson & Jaafar, 2003).

By 2000, teachers and school staff across Ontario received copies of the new provincial curriculum documents that provided clearer expectations for teaching and learning. Educators were given a direction and even given time to learn and map the curriculum, photocopy, and

enlarge and laminate the language and math curriculum documents to be posted on classroom walls. Often, staff would post it so they could easily reference and check off expectation after expectation as it was covered for strands in the subjects they taught. In fact, some schools required teachers to post the specific expectations on the bulletin board – as if this was something that would motivate the student to learn. This curriculum was much more specific than the *Common Curriculum* and had more expectations per grade to cover. At the time, it seemed like everything students learned was assessed and that everything had a rubric or checklist attached to it. Teachers were focused on teaching and grading every expectation. Teachers often graded the homework, workbooks, worksheets, group work, quizzes, home reading log books, and even journals.

This was also the first cohort of students who participated in the EQAO standardized testing – for myself, I was part of the first cohort of teachers to administer the test. The mandate for EQAO is to develop and manage the administration and marking of standardized tests of elementary and secondary school pupils keyed to provincial curriculum expectations, to develop systems for evaluating the quality and improvement of education (Anderson & Jaafar, 2003).

The new Ontario Curriculum documents; the new report cards; the constant discussion and planning for the standardized tests; the new leadership model;¹ new staff professional development mandates; new schools and districts (as many school districts were amalgamated); and new mandates in place regarding home and school interactions and how parent councils would be regulated were all the key drivers that changed how teachers taught, formed their practice, followed pedagogy, and organized and designed classrooms at the turn of the century -- which ultimately informed how teachers shaped their methodology which, most commonly, were

¹ Bill 160, passed by the Conservative government, removed principals from the Ontario Teacher's Union.

very scripted, organized, scheduled and planned. Worksheets, workbooks, and agendas were the norm; in fact, they were not only accepted, but encouraged.

Yet within the context of the Ontario curriculum, many teaching practices developed in alternative schools, such as student-centred and independent learning, project-based and cooperative learning, as well as authentic assessment emerged (Sliwka, 2008). *Growing Success*² (Ontario Ministry of Education, 2010) opened the door to practices such as assessment for learning and authentic assessment. This continues to be the picture of education in Ontario today: there is much more emphasis on and support for open-ended, flexible, and student-centred teaching and grading with the use of project-based and problem-based methods.

Technology and Blogs

It is ironic that this was how Ontario education was changing at the start of the 21st Century and, with all these changes, there was still minimal mention of how technology would impact our young learners and the teaching profession. Teachers were introduced to new, more structured curriculum, but they were also being pressured to adapt and use new technologies in the classroom.

The early 2000s were a period of growth for blogs (Chapman, 2013); this impacted education since teachers could access more information and begin experiencing transparent reflection. Today, the *weblog* is frequently characterized (and criticized) as (only) a set of personal comments and observations (Downes, 2004). A blog, therefore, is and has always been more than the online equivalent of a personal journal. Though consisting of regular (and often dated) updates, the blog adds to the form of the diary by incorporating the best features of *hypertext*: the capacity to link to new and useful resources. But a blog is also characterized by its

² Released in 2010. *Growing Success* is a document that provides a guide for Assessment and Evaluation in Ontario Schools.

reflection of a personal style, and this style may be reflected in either the writing or the selection of links passed along to readers. Blogs are, in their purest form, the core of what has come to be called *personal publishing* (Downes, 2004).

Many educators and teachers began blogging as a way to document these changes not only in their professional journey, but changes they were seeing in education itself. An entry from my own blog called, “Bringing Back the Makerspace” is an example of a presentation that focuses on the notion that the pedagogy behind Makerspaces is not a new concept (see Figure 2). This post discusses the hands-on constructivist nature of learning, the connection of Makerspaces to inquiry-focused teaching and learning, with the student as the center and the teacher as facilitator. Makerspaces, programming, robotics, and project-based learning are emphasized and intended to ‘bring back’ teachers that may have felt alienated by the new rigid curriculum.

Interestingly, concepts of individualized learning and flexible concepts are rooted in the very nature of the Maker Culture and Makerspaces in classrooms today. The Maker Culture in education and its constructivist approach as we know it has taken us back to a time in education even before the origins of the *Formative Years* (1975) recommendations from the Hall-Dennis Report of 1968 (Christou, 2012).

In 2017, in Ontario as well as many other jurisdictions, many powerful approaches to teaching and learning have been expanded to include full-day kindergarten (FDK) and *play-based learning*, a term defined in the proceeding chapters. These concepts, in many ways, can be closely linked to what we consider to be the fundamental principles of Makerspaces today: those that encourage interested amateurs and creators to share their ideas with experienced experts and mentors who could help them to design, prototype, and iterate novel solutions to their real-world problems (Dougherty, 2013; Hatch, 2014).

APRIL 29, 2016 BY ZPIPE

Bring Back the Maker in Learning...

It is always an honour to present at a conference. To have such incredibly passionate and engaged educators, leaders, academics and friends dedicate time to listen and reflect on my words might be one of the most humbling experiences of a lifetime. I sincerely thank you for empowering me and reminding me of the support and kindness that exists in our field – it is that that helps me (and you) to move forward. Christ Hatfield, our closing Keynote on Thursday reminded us that innovation is not just about one single person but it is a combination of so many people’s experiences, skills and talents. That is how I feel. Please continue to connect, share and dialogue. I look forward to continuing and deepening the connection that already started!

Here is the slide presentation



Figure 2.

Blog Post: “Bring Back the Maker in Learning” (Branigan-Pipe, April 29, 2016). Retrieved from <http://pipedreams-education.ca/2016/04/29/bring-back-the-maker-in-learning>.

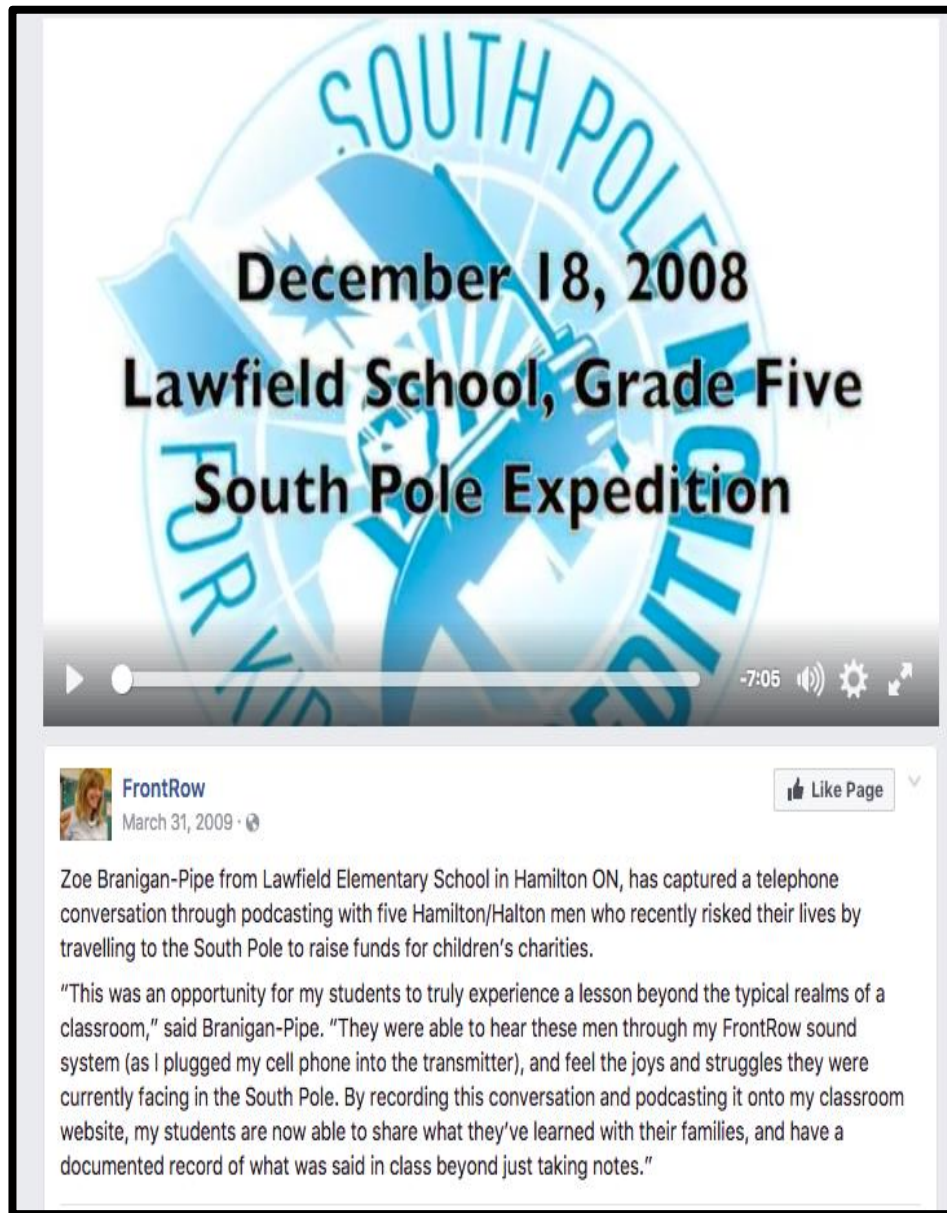
Social Networks and Key Technology Influencers

The new Ontario curriculum explained above was released to schools in 1998, which was also the first year for standardized tests administered by EQAO, the first year of the implementation of the new report card, and the first year where Shop and Home Economics would be removed from the middle school classroom. At the time, professional development offered by school districts was focused on curriculum, assessment, and standardization, which meant that teachers who were interested in the constructivist approach had to find a network to learn from outside the school.

Between the years 2002 to 2005, many teachers wishing to adopt a constructivist approach became absorbed in social networks such as Twitter and Facebook – which, at the time, had a small community of users. Teachers developed supports and connections that some would never imagine possible, and that continue to offer guidance and support even today more than a decade later. Teachers continued to share and broadcast how they were using tools and strategies to engage digital learners. Figure 3 demonstrates an example of using (what was then) new tools to extend classroom learning in an experiential approach outside of the classroom.

It was these online connections that helped me to understand better that it was not the technological tools alone that facilitated Maker education; rather, it was about challenging the status quo so that more children could learn. It was about social justice and equity. It was the idea of pushing boundaries: being an educator outlier and blazing the trails to help others to create conditions so that all children, regardless of ability, socio-economic background, culture or religion, health or intellectual ability, could learn and feel engaged to explore and create. It was difficult at times, however, because it was not always supported by the district or school principals, who tended to slap down the innovators. Moreover, teachers that ‘disagreed’ were

sometimes seen as outcasts. By 2005, social networks like Twitter and Facebook enabled a network to be formed with other innovative educators and leaders, giving them the confidence to grow and experiment with different ways of teaching. The role of the network and community in this change is thus incredibly important.



December 18, 2008
Lawfield School, Grade Five
South Pole Expedition

FrontRow
March 31, 2009 · 🌐

Like Page

Zoe Branigan-Pipe from Lawfield Elementary School in Hamilton ON, has captured a telephone conversation through podcasting with five Hamilton/Halton men who recently risked their lives by travelling to the South Pole to raise funds for children's charities.

"This was an opportunity for my students to truly experience a lesson beyond the typical realms of a classroom," said Branigan-Pipe. "They were able to hear these men through my FrontRow sound system (as I plugged my cell phone into the transmitter), and feel the joys and struggles they were currently facing in the South Pole. By recording this conversation and podcasting it onto my classroom website, my students are now able to share what they've learned with their families, and have a documented record of what was said in class beyond just taking notes."

Figure 3.

Blog Post, Facebook Announcement, "South Pole Expedition

Informal networks of teachers and academics were thus formed with those who considered themselves change agents and leaders. Influencers such as Will Richardson ([@willrich45](#)); Rodd Lucier ([@thecleversheep](#)); Ben Hazzard ([@benhazzard](#)); Kathy Cassidy ([@kathycassidy](#)); Dr. Alec Couros ([@courosa](#)); Dr. Camille Rutherford ([@crutherford](#)); Jenny Ashby ([@jjash](#)); Doug Peterson ([@dougpete](#)); Andy Forgrave ([@aforgrave](#)); and Dean Shareski ([@shareski](#)) were already active on Twitter even prior to formal organizations, such as Ministries of Education or school boards, joining the networks themselves.

Even today, these education leaders continue to share their learning through blogging, Twitter, and attending or presenting relentlessly at conferences across Canada and the world. These people took risks that were above and beyond system initiatives. However, at the time, very few people in the school districts—at least, those that made themselves visible – were yet to join Twitter, which meant those small networks that were forming became significantly dependent on one another. These networks would eventually be called *personal learning networks* (PLN).

In 2008, Will Richardson presented at a conference sponsored by the Ontario Teachers' Federation (OTF) where he walked through the process of blogging with about 300 educators. He showed teachers how to use a simple and free format ([Blogger](#)) and gave examples of how this online tool could change how information could be delivered and accessed, and, more importantly, how it connected individualized instruction. Doubtfully, Richardson likely did not have any idea that he was speaking to some of the trail-blazers, front-runners, and leaders in the areas of 21st century practices, those which helped create the paths for change for school districts internationally over the last 15 years. What resonated the most for many teachers, and for me, was a story he shared about the US Airways flight 1549 crashing in New York's Hudson River

(which had just recently happened), and how social media broke the story before the established media institutions. Telegraph News reported this news on January 16, 2009:

Twitter, the increasingly popular microblogging service, was, as ever, leading the pack. When dozens of New York-based Twitter users started sending 'tweets' about a possible plane crash in the city, the news spread like wildfire across the Twitterverse. Indeed, Twitter users broke the news of the incident around 15 minutes before the mainstream media alerted viewers and readers to the crash. The first recorded tweet about the crash came from Jim Hanrahan, aka Manolantern, four minutes after the plane went down, who wrote: "I just watched a plane crash into the Hudson in Manhattan."

(Beaumont, 2009)

The power of Twitter impacted the world, and almost a decade later in 2017, it continues to help teachers dialogue and learn outside the walls of the classroom. Transparency gave 'regular' teachers the ability to lead from below. Twitter provided a platform to begin to lead system change. The idea that classroom teachers could be leaders was something very new, and Twitter opened the door for many of us to become leaders in our right.

Teachers as Leaders in a Networked World

Around this same time, Dr. Camille Rutherford of Brock University introduced, wrote about, and delivered presentations on the concept of *distributed leadership*; this concept has played a significant role for teachers who have used technology to become leaders in education. At a time when technology and social networks were helping to expand networks, Rutherford (2009) recognized that leadership in schools had the potential of becoming more distributed, and that authority to lead is not exclusively located in formal positions, but is rather dispersed throughout the organization across structures, roles, and routines.

Teacher leadership is defined as, “when teachers intentionally transfer knowledge that influences one’s ability to meet educational objectives” (Rutherford, 2006, p. 58), and specific structural elements are required if teacher leadership is to flourish. Rutherford (2006) suggests that the leadership elements are comprised of procedures that allow teachers to play a greater role in the decision-making process; programs that supply teachers with frequent and ongoing opportunities to participate in, produce and deliver professional development training; and systems that create scheduled opportunities for teachers to cooperate and collaborate with their colleagues. Social networks, online learning, and an increase in sharing and transparency allowed more and more teachers to flourish as education leaders.

For many teachers, including myself, early participation in an online PLN via Twitter or other social media platforms became the catalyst for advocating for change in how schools and classrooms were being run. Educators no longer depended upon the out-of-date methods, books, or leadership styles that existed within the walls of our school buildings. Instead, practitioners could reach out to anyone, at any time, from anywhere. These conditions helped their networks to constantly grow and adapt as technology changed within our schools and, eventually, these practitioners become leaders themselves.

On July 1, 2009, my blog post (Figure 4) offered an example of how strong this PLN can be. This excerpt demonstrates how a PLN greatly influenced one teacher’s philosophy of education by connecting practice to researched-based theories, particularly as it relates to inquiry, experiential learning, and the Maker Movement.

At NECC, I met these people. Like these people, I am an educator that believes that we need to embrace change, embrace new possibilities – allow a new generation to guide their (and our) learning, teaching and exploration. As spoken by Gladwell, “change is possible, people can transform their behaviour or beliefs in the face of the right kind of impetus.” Is participating in social networks the right kind of impetus? Has the World Wide Web provided the impetus for bringing like minded groups together and the context for a social epidemic? It is my intention in this article to prove that it has.

Many months before the conference, I began developing a vast network of people from all over the world. This learning network was not instant, nor was it easy. It took time, effort, and hours of sorting and reading through profiles and blogs. I learned that if I shared a resource, article, or tool, that it would be reciprocated and instead of coming from just one person, the sharing would come from as many as I choose. With Twitter as my primary platform for sharing globally, I found myself in a Professional Learning Community with a support group that stemmed from Australia, England, all over the United States and Canada. Because of common interests, of education and the changing nature of technology, many of these people joined me at NECC.

Figure 4.

Blog Post: “NECC Brings a New Meaning to Social Network” (Branigan-Pipe, July 1, 2009).

Retrieved from <http://pipedreams-education.ca/2009/08/01/necc-brings-a-new-meaning-to-social-network/>.

My Story as Innovator and Makerspaces

I did not always know why or what influenced me as a teacher. Mostly, I used my intuition and let the students guide me based on their interests and what worked best for them. Technology was only on the cusp of entering the classroom and district leaders and principals seemed stuck in a 20th century paradigm, still being resistant to using social networks like Twitter as a way of connecting more broadly. While online networks were becoming more active and supportive, often, I felt alone or misunderstood at my school district. Times were changing, but slowly.

At this point, it became more necessary to connect my practice with strong research, the tools and the methods I was using, and real-world examples. Here is how the process unfolded: In 2001, I fought for permission to use my handheld device (a Palm Pilot) as a teaching tool because it aided with documentation and assisted me as a new teacher. The policy was soon changed, allowing for principals' discretion when devices were allowed to be used by teachers.

Today, 15 years later, conversations about cell phones in the classroom continue to be a heated debate, and yet more students and teachers are using them as part of the instructional process. In 2003, I sought for permission to use a Blogging platform (edublogs.org) with my students to connect them to the wider world. I recall a meeting that year where I was asked to ensure my students never included their names on their blogs; the district wanted to collect some data, but needed the blogs to be completely anonymous. This was laughed at by my students who asked, "What is the point of writing if our name is not attached?" The students wanted to be transparent, and they wanted the world to hear their voices: they wanted to have a purpose.

By the end of the school year in 2005, together, my students and I had written and published over 1,000 blog posts. These students would be the first in their school – and in the

school district – to begin to share their work transparently. Today, blogging is funded and supported by many districts, including at the Hamilton-Wentworth District School Board HWDSB) (Bennett, 2013). Ontario, for example, has licensed the Desire to Learn (D2L) platform used around the world as a learning management site (LMS).

In 2006, I asked for permission to use a non-approved device (an iPad) in my classroom as an assistive technology for my students. This would be the first iPad in the school, the cluster of schools, and, in fact, one of the few in the school district. I remember one day when a group of superintendents stopped by my classroom during a school tour. There was buzz that day about the potential this device could have for our students. Today, many school districts including my own have purchased iPads for all students, calling it a 1:1 iPad program.

In 2009/2010, I requested to get Skype and YouTube unblocked at my district so that I could use it as a way of extending my students' learning outside the classroom. Our first experience of a virtual trip was connecting through a satellite system to a group of expeditioners in the South Pole (Figure 3). We used my Blackberry phone to connect. This led to several weeks of inquiry projects where students used this experience to understand the purpose of the science station at the South Pole, and to investigate how the data collected at the South Pole can help scientists across the globe understand the impacts of global warming.

The stories and descriptions they listened to stuck in their minds and guided their curiosity, their concern, and their discontent for what was happening in their world. This one connection lit them up – not because of a grade or reward, but because they began to care more. This was also a way that I could start to blend curriculum. Here, students explored concepts around Geography and History, Science, Math, and even Art. This lesson and connections to pedagogy are included in Chapter Four.

This South Pole opportunity was directly connected to my participation in social networks and my willingness to be transparent. My blog entitled, “Travel the World in a Day: Experiential Learning” (Branigan-Pipe, 2017) is a short blog explaining how and why my students and I traveled (via Skype) over 90,000 km, connections with over 23 classrooms worldwide (see Figure 6). These experiences are examples of experiential learning and of how innovations in the 21st century have opened opportunities to connect.

SEPTEMBER 8, 2009 BY ZPIPE

Travel the world in a day...

Today was the first day of school, September 8, 2009. This was like no other first day. We started the morning by welcoming and congratulating JK/SK students in Sault Saint Marie, Ontario via Skype, thanks to Mr. Poluk. Many of my students were stunned and they quietly watched as I read the primary students, 500 km's away a story called "10 Dinosaurs".

My students then gathered in groups of 5 and with a list of curriculum/standard items, they began to plan their own activities. Their list was something that I have never seen and was an excellent example of what students in 21st Century expect. Students talked about using Google Docs as a method of writing and some of my students (from last year) excitedly told the others how we could "collaborate" and "edit" and "share" their work. Some asked if they would be getting their own blogs and would be able to make their own Wiki's. Some students suggested that they create wiki pages about the Winter Olympics (our theme for the year) and others asked if they could do math on the "Smartboard". Many students talked about doing "hands on activities" and experiments.

Figure 5.

Blog Post: "Travel the World in a Day – Experiential Learning" (Branigan-Pipe, September 8, 2009). Retrieved from <http://pipedreams-education.ca/2009/09/08/travel-the-world-in-a-day/>.

In 2010, I was questioned on my use of certain blended learning tools with my students, including using Google Documents, because these tools were not approved and at the time, there was not a policy in place to protect the students – or the teacher, for that matter – from online bullying, predators, identity theft, trickery, data mining, or whatever other risks were presented. In sum, there was a good reason to be questioned, and I welcome the inquiry. At that time, I had each student create their own Google accounts from home with their parents. Google Apps for Education (GAFE) was, unfortunately, not an option at that time as it did not exist. Today, many of these students continue to connect with me through these accounts and many are finishing up University or College as digitally literate citizens. Many school districts now have GAFE, a safe and dynamic platform for students and teachers to use Google Tools.

In 2011, I began using an alternative network – one that was different from my school district) to access games – [Minecraft](#), [Portal](#), and [Game Maker](#), to name a few – because, again, they were not considered approved sites. However, in 2015, I was featured in the Microsoft Education Magazine (“Stealth Games at School,” 2015) as being a leader and example for using these very tools for teaching and learning; this article indicated that these tools were entering mainstream education and eventually would be approved within the school district. I successfully used Minecraft to teach poetry, Math, History and Science; this allowed me to capitalize on play-based learning opportunities and to use a cross curricular approach (see Figure 7).

For the fun of learning

Zoe Branigan-Pipe, a gifted and enrichment teacher in Ontario's Hamilton Wentworth District School Board whose use of Minecraft is supported by funds from Ontario's Teacher Leadership and Learning Program, says game-based approaches are so new, pioneers can expect to encounter some challenges.

Branigan-Pipe recently used Minecraft to interest a group of grade six students in a poetry lesson. Each one was handed a specific line of Robert Frost's *The Road Not Taken* and the assignment was to recreate the poem in Minecraft in a way that visually depicted its meaning and metaphors.

As she watched her students collaborate, construct and go beyond the original task to include their own works of poetry, she realized she had far surpassed her intention. "It was the best literacy lesson I ever delivered," she says.

The students' virtual Robert Frost poem clearly showed the road less travelled as full of obstacles, mazes and challenges whereas the road taken was straight, paved and clearly marked. They also added feedback boxes inviting comments on their individual poems, which in turn helped Branigan-Pipe assess the exercise.

"Students may go home and tell their parents they 'played' Minecraft, but what they actually did was delved deeper into literature, collaborated, created, problem solved and shared," she says. "And most of all, they had fun!"

Figure 6.

Excerpt: "For the Fun of Learning" (Branigan-Pipe, 2017). Retrieved from

<https://www.microsoft.com/en-ca/sites/education-discovered/game-based-learning.aspx>.

Circa 2017

In 2017, almost two decades into the 21st century, each of the tools and programs identified in the personal narrative above – for example, Skype, blogging, Google Education, YouTube, and Minecraft – are not only accepted as educational tools by mainstream education, but they also have educational platforms of their own – an “Edu” version. It took the perseverance, risk-taking, and leadership from cutting-edge educators who, through their networks and blogs, provided not only an extensive repertoire of tools and skills for teachers, but also used their influence and passion for advocating for a more equitable and current education in public schools.

Hattie (2012) emphasized the value of teacher activism as essential to school and student improvement: “Teachers need to see themselves as change agents – not as facilitators, developers or constructivists ... Teachers, believing that achievement is changeable or ‘enhanceable’ and is never immutable or fixed” (p. 162). This is part of my lived experience and why I have chosen to write the teacher resource on Makerspaces found in Chapter Four.

CHAPTER THREE: CONNECTING TO THE LITERATURE

The ideas and practices associated with the Maker Movement resonate with a long tradition in the field of education (Resnick & Rosenbaum, 2013). With her influential book, *The Century of the Child* (1909), the Swedish educator Ellen Key was among the first of several advocates of child-centred education. Waldorf, Montessori, and Reggio Emilia methods focus on the whole child. Esteemed researchers advocate teaching the whole child: John Dewey (1859-1952), an academic, philosopher and educator; Jean Piaget (1896-1980), a psychologist and pioneer of child development; Lev Vygotsky (1896-1934), a social development theorist, who researched the benefits of play in learning; and Seymour Papert (1928-2016), a mathematician, computer scientist, and educator whose research led to a constructionist (learning through making) approach to teaching children. These pioneers in constructivism encouraged a project-based, experiential approach to learning (Resnick & Rosenbaum, 2013).

Constructivism, Constructionism, and Makerspaces

Constructivism holds that students construct their knowledge and connect new learning to past experiences; here, learning is student-centred and the student is an active learner. Making and building can foster learning in a variety of ways that mesh with long-established theories of how learning unfolds including constructivism (Martin, 2015), Dewey's assertions that our experiences are vital to authentic learning, and Jean Piaget's notion that the basis of learning is discovery (Ultanir, 2012).

Constructionism builds on to the theory of constructivism and can be characterized as "learning-by-making" (Papert & Harel, 1991). In this ideology, knowledge is not transmitted, but rather, is constructed through the process of making (Schön, Kumar, & Ebner, 2014). Makerspaces are ideal environments to promote learning by doing both inside and outside the

classroom (Paganelli 2017). Papert (1999) was influenced by Piaget's theories that children are not empty vessels to be filled with knowledge, but are instead active builders of knowledge. To Piaget, knowledge is not information to be delivered at one end, and encoded, memorized, retrieved, and applied at the other end; rather, knowledge is an experience that is acquired through interaction with the world, people, and things (Ackermann, 2001). Knowledge is achieved through the effective restructuring of the individual over time and not as, "a passive copy of reality" (Ultanir, 2012, p. 207).

The Maker Movement stresses the idea that the child's own experience must be acknowledged as the heart of both the content and the process of education; this concept was at the core of Dewey's constructivist philosophy (Ultanir, 2016). Individuals must reconstruct knowledge, and this learning process happens within a material environment, a culture, and a supportive community of practice (Stager, 2001). Papert (1980) also asserts that children build their intellectual structures with materials drawn from the world around them. Noss and Clayson (2015) describe the concepts behind Papert's constructionism: "when we build, we build with things – not just ideas ... if designed properly, the things we build with have an epistemic foundation – of powerful ideas" (p. 285). Papert (1999) describes learners as, little scientists who are constantly creating and testing their theories of the world; in this process, learning occurs through the construction of meaning rather than through passive reception (Ultanir, 2012). As noted by Grassick (2016), "constructionism came about when Papert recognized that students seemed more engaged in art classes compared to when they were working in math class on more abstract intangible tasks" (p. 17).

Arguably, the Makerspace can be defined as a mix between both a constructivism and constructionism because students are learning by being active and self-directed, using an inquiry lens where they are not passive in their learning, but are active agents who “construct meaning.”

Early Influencers

Making is fundamental to what it means to be human. We must make, create, and express ourselves to feel whole. There is something unique about making physical things. Things we make are like little pieces of us and seem to embody portions of our soul. (Hatch, 2014, p. 13)

Making and building can foster learning in a variety of ways that mesh with long-established theories of how learning unfolds (Gandini, 2003; Martin, 2015). The concept of making and experiential learning have been established for centuries; even early scientists such as Galileo, da Vinci, and Newton were originally makers because they made their own tools and used a multidisciplinary approach to discover the world. This real example supports the idea that making is more than using a tool to design and create, but is using the tool to solve a problem and make a difference in the world. Further, Good (2013) provides examples of Makerspaces that date back to the 1800's including those in Gowanda, New York in 1873, when the Gowanda ladies' social society formed a group to learn how to quilt, knit, sew, socialize, and discuss books.

These are examples of the community and collaborative nature of makerspaces – a place of gathering where people share ideas and collaborate on significant problems through the process of design thinking. Robbins and Smith (2016) also pull from theories of Dewey, Vygotsky, and Papert in describing Makerspaces as, (1) the social-constructivist belief that social interaction amongst numerous individuals enhances learning; (2) that the constructionist idea that

design activities can provide personally meaningful contexts for “learning-by-making” (Papert & Harel, 1993 and (3) despite its diversity, the Maker Movement is unified by a shared commitment to open exploration, intrinsic interest, and creative ideas (Peppler & Bender, 2013). Interestingly, as pointed out by Centre for Educational Research and Innovation (2013), to a certain extent, broader renewal of mainstream education is already adopting these longstanding ‘alternative’ approaches.

Mark Hatch, the author of *Maker Movement Manifesto* (2014), notes that, “creativity is fundamental to what it means to be human” (p. 12) and describes secular philosophers like Georg Wilhelm Friedrich Hegel, Carl Jung, and Abraham Maslow, who all concluded that creative acts are fundamental to learning (Hatch, 2014). Schön, Kumar, and Ebner (2014) also recognize that reformist and progressive educators from the first half of the 20th century such as Maria Montessori, Friedrich Fröbel, Johann Heinrich Pestalozzi, Célestin Freinet, and John Dewey promoted the usage of physical artefacts and tools in education to promote the creative process and hands-on learning.

In their book, *Invent to Learn*, Martinez and Stager (2015) document the educational roots of the Maker Movement; these roots include Piagetian constructivism, the progressivist movement of John Dewey and Reggio Emilia, as well as Montessori’s exploratory curriculum (Wardrip & Brahms, 2015). These are all approaches that strongly link to Papert’s work on constructionism, and are seen as strong educational alternatives to traditional education and as sources of inspiration for progressive educational reform (Edwards, 2002).

In Chapter Four, these examples are fleshed out in more detail for the educational practitioner.

Makerspaces Today

Today, Makerspaces are popping up all over the world, with a surge of interest in making and the do-it-yourself (DIY) movement (Resnick & Rosenbaum, 2013) in response to the need to teach students 21st century skills (Smay & Walker, 2015). New technologies are making it easier and more affordable for people to create and share things in both the physical and the digital world (Resnick & Rosenbaum, 2013). Makerspaces are emerging internationally (Peppler & Bender, 2013) through online Maker communities, physical Makerspaces, and Maker Faires, and are continually increasing in size and participation (Dougherty, 2013).

The Maker Movement has also given educators a context in which to teach 21st century skills including nurturing creative thinking, collaboration, problem-solving, and critical thinking (Fullan, 2013). Many of the teaching strategies that have been advocated for at least a century by Dewey, Piaget, Montessori, and Vygotsky are beginning to emerge and be embraced by educators today; perhaps, now, our systems of education can embrace the idea behind constructivism, personalized learning, community learning, and mentorship (Fullan, Barber, & Langworthy, 2014). Makerspaces in education have increasing relevance in the educational realm today, and are being described as vehicles that will allow schools to be part of the necessary return to constructivist education (Roffey, & Therien, 2016) given their strong connections to cross-curricular approaches, problem-solving, and higher-order thinking in the classroom (Paganelli et al., 2017). The Maker Culture in education can thus reinvigorate this progressive-constructionist tradition in education (Resnick & Rosenbaum, 2013).

But, there needs to be a reason to make, a connection to the world, a purpose, and communities of learners that can provide not only a context for making, but also support and guidance for the process, too. All too often, as noted by Resnick and Rosenbaum (2013), “we

have seen schools introduce making into the curriculum in a way that saps all the spirit from the activity” (p. 167). Dewey’s (1986) canonical research in education stressed that the child’s own experience must be acknowledged as the heart of both the content and the process of education.

The education systems in the past did not necessarily allow these ideas to flourish. But the time is better now: “now, rather than in the past, there is a stronger emphasis on collaboration, the relevance of relationships, learning networks and professional development and they acknowledge the influence of social networks and media have had” (Fullan, Barber, & Langworthy, 2014, p. 2).

Makerspaces, Community and Relationships

Makerspaces, especially in academic contexts, should not just be approached as spaces of making and creating but should be collaboration and learning spaces aligned with information seeking and extensive knowledge (Fourie & Meyer, 2015). Maker activities organically invite cross-generational and cross-cultural participation, ranging from parents with expertise in fixing or modifying cars, to grandparents who sew or crochet, to aunts and uncles who carve at home in a wood shop (Peppler & Bender, 2013; Pierce, 2013).

In *The Maker Manifesto*, Hatch (2014) points out that Makers can be anyone who wants to “make” – designers, writers, practitioners of medicine or law, architects, and other white-collar types who start making things for themselves, their families, and friends. Hatch (2014) recognizes that Making is more than just about providing tools and working areas, but rather, it is a mindset about creating conditions where people want to make, share, and collaborate with a sense of purpose – or, what Hatch (2014) calls *give*. This is important because while it relates to the concept of Making, it is also directly linked to design thinking, to social justice, and to the notion of self and community (see Figure 9).

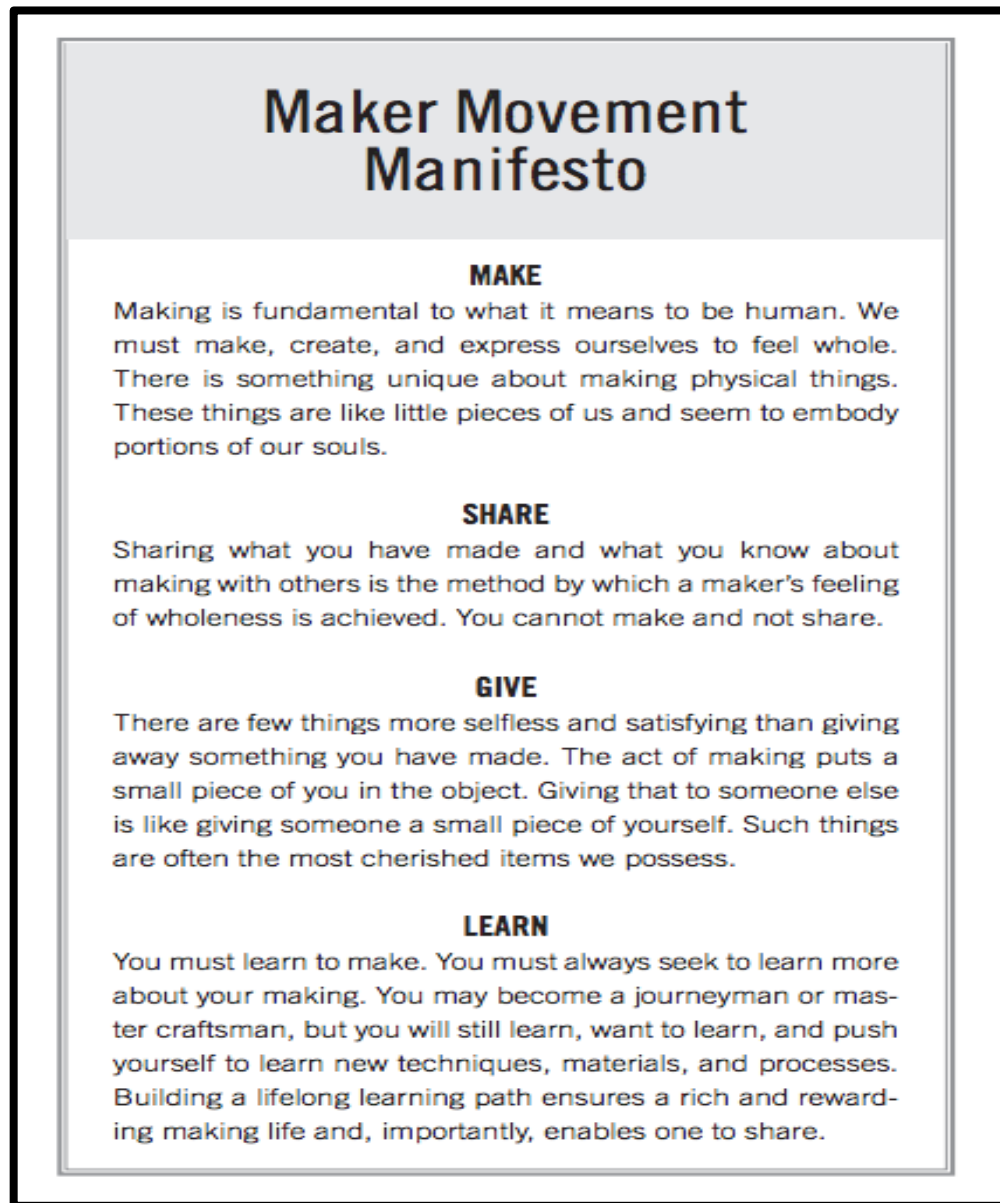


Figure 7.

Excerpt: *The Maker Manifesto* (Hatch, 2014).

New Pedagogies, Technology and Makerspaces

Learning Futures³ recognized a strong need for change in our education systems because of the growing technology infrastructure, globalization, and connections. As Hannon (2011) notes, “the 21st century requires people to be lifelong learners (because technology, politics, economics and the environment are changing so quickly) and this demands a shift away from being ‘schooled’ to engagement in learning” (p. 3). Making has the capacity to transform the way we think about school, pedagogy, and learning (Sverko, Therien & Roffey, 2016) and can foster learning in a variety of ways that mesh with the changing nature of our society, student engagement, and long-established theories of how learning unfolds (Martin, 2015).

Hattie (2012) found a lower that the use of technology had a lower than average impact on learning relative to other teaching and learning strategies. In response, Fullan (2013) argues that the reason for this is clear: that is, technology in education thus far has been primarily premised on traditional pedagogies. But with the Maker Movement, there can be a necessary return to constructivist education (Turlik, 2014). Makerspaces will allow students to be creative, innovative, independent, and technologically literate (Stager, 2014).

Student engagement might be seen differently from the engagement criteria of traditional education, including markers like attendance, participating in class, work completion, and attitude. Hannon, from The Learning Futures Program (2011), recognizes engagement as going beyond school through a few characteristics when the student:

- Cares and not just about the tangible outcome of their learning (test scores), but also about the development of their learning

³ The Learning Futures program began as a development and research initiative focused on schools between the Innovation Unit and the Paul Hamlyn Foundation, both UK-based organization. The purpose was not only to create innovative learning environments but to address the ‘endemic’ problem of the lack of engagement. More information can be found at <http://www.oecd.org/edu/ceri/Valerie%20Hannon.Learning%20Futures.pdf>.

- Takes responsibility for their own learning
- Brings discretionary energy to the learning task
- Can locate the value of their learning beyond school and wish to prolong learning beyond school hours
- ‘Everyone becomes a teacher and everyone becomes a learner’ is a concept that permeates the Makerspaces culture. There is a strong emphasis on relationships, experiential learning, inquiry-focused lessons, design thinking, and authentic problems. In a Makerspace, most projects tend to be open-ended and community-focused; the tools are varied and the tasks are scaffolded depending on the problem, the context, and the student. The product can also create a context for social engagement around a shared endeavor (Martin, 2015).

In their research in finding what work students need to be exposed to in order to feel a strong sense of engagement and excitement to learn, The Learning Futures Program identified The 4 Ps of Engaging Activities that can be applied beautifully to all Makerspace lessons:

- Place – the activity is located, either physically or virtually, in a world that the student recognizes and is seeking to understand
- Purposeful – the activity feels authentic, practical, has intellectual value and fosters a sense of agency
- Passion-led – the activity enlists the outside passion of both students and teachers enhancing engagement by encouraging students to choose areas of interest with matter to them;

- Pervasive – the activity enables the students to continue learning outside the physical temporal constraints of the classroom, drawing on family members, peers, local experts and online sources (Hannon, 2011)

Makerspaces, Inquiry and Curriculum

Education and learning is grounded in inquiry, problem-solving, understanding of self, and with an emphasis on the local or global mindset (Ontario Ministry of Education, 2013). The Maker Movement incorporates components of Inquiry-Based Learning (IBL) and Project or Problem Based (PBL) learning because, according to the Ontario Literacy and Numeracy Secretariat of Ontario (2013), the process of inquiry often involves open-ended investigations into a question or a problem, requiring students to engage in evidence-based reasoning and creative problem-solving, as well as “problem finding” (p. 2).

Inquiry Based Learning (IBL), a learning model that has gained considerable momentum in recent decades and includes a variety of instructional models, is grounded in constructivist learning theory (Buchanan, Harlan, Bruce, & Edwards, 2016). IBL is a cornerstone of curriculum reform throughout North America and is characterized by some or all of the following key components: (1) a driving question; (2) authentic, situated inquiry; (3) learner ownership of the problem; (4) teacher-supported, not teacher-direction; and (5) artifact creation (Darling-Hammond & Barron, 2007),

Over the last five years, Ontario has released newer curriculum documents which encourage a constructivist approach and IBL that resemble the Reggio, Montessori, and Waldorf classrooms. For instance, the Social Science and Humanities curriculum for Grades 9 and 10 (2013) recognizes that learning depends on fundamental skills – skills which are pulled directly from the principles of constructivism – but also recognizes the importance of integrated

curriculum and addresses, albeit implicitly, the framework proposed by Susan Drake (2010) – Know, Be, Do (KBD) – because of the combination of skill, understanding, integration, and involvement in the curriculum and a strong emphasis on the human side of learning (Drake & Reid, 2013).

This is demonstrated in the newer Ontario Social Sciences and Humanities curriculum (2015) which focuses on four areas:

- (1) **Disciplined Inquiry and Critical Literacy:** Social sciences and humanities courses focus on the use of disciplined, structured inquiry to understand human beings, human behaviour, and human nature. These courses promote the use of reason as part of the structured inquiry process, while also recognizing the limitations of reason as a way of learning, knowing, and understanding. They encourage students to identify and question assumptions and values that underlie individual behaviour and family and social/cultural life;
- (2) **Problem Solving:** This requires students to engage actively in solving problems confronted by individuals, families, diverse groups, institutions, and societies;
- (3) **Understanding of Self and Others:** Students in social sciences and humanities courses are provided with rich opportunities to enhance their self-understanding and understanding of others through an examination of their personal belief systems and also of the foundations and implications of different viewpoints and lived experiences of others;
- (4) **Emphasis on Local and Global Mindedness:** This develops students' awareness that people do not live in isolation; each person affects and is affected by his or her social, cultural, economic, and environmental context. (Ontario Ministry of Education, 2013)

Design Thinking

Students are most engaged when what they are learning is meaningful in their lives beyond the classroom because they can see its relevance and application – something people do in the real world (Hannon, 2011). With the Maker Movement finding its way into our schools, we have a chance to use design thinking to teach and develop complex skills of creativity (Roffey, Sverko, & Therien, 2016) and encourage students to use innovation to solve meaningful problems. This approach to learning is widely understood as being inquiry-focused and human-centered (Matthews & Wrigley, 2017) because it is so dependent on interactions between people, products, or technology, with a goal of making those interactions simple, intuitive, empathetic, and solving a problem (Meyer, 2015). The point is to give the student a purpose when they are engaged in a Making activity.

Despite a project perhaps being viewed as hands-on learning, it may not be considered constructionism just because a student ‘constructed’ something (Roffey, Sverko, & Therien, 2016). Design thinking insures rigour in Making, as it is procedural and students follow a structured process. This process is similar to the IBL process outlined above.

Wicked Problems

Wicked problems are ones that are so complex that it is impossible to find a solution to them; solving wicked problems involves looking at the problem from many different lenses. Brown (2008) suggests that such problems are social problems that need to be solved through innovation; he offers real-world examples such as healthcare, poverty for billions of people, energy usage, and education as instances of wicked problems or *human-centred problems*. Design thinkers are inherently optimistic, inquisitive, constructive, and experiential, and work to address the needs of the people who will consume a product or service and the infrastructure that

enables it (Brown & Wyatt, 2010). Design thinking recognize the importance of experimentation, creativity, and innovation as part of the problem-solving process – which is undoubtedly connected directly to the Maker Movement and wicked problems.

The term *wicked problems* was coined by Rittel and Webber (1973), and refers to the complexity of problems in social planning (Howard & Davis, 2011). In his research, Coyne (2005) asserts that, “wicked problems are always changing are subject to redefinition and resolution in different ways over time” (p. 7). In 2017, education and schools are experiencing constant changes and challenges that did not exist five – or even two – years ago (Howard & Davis, 2011); this includes the increase of the Makerspace environment and the implementation of design thinking within the curriculum, which is a wicked problem in itself! How can we ensure that students are exposed to the tools and concepts that focus on Making and creating when the innovations and technologies are changing so quickly? How can we ensure that students are creating something that has meaning and value?

The very nature of a Makerspace setting provides a context to dive into wicked problems collaboratively and deeply, and to help teachers and learners understand the power of life problems as, “tools for carrying a range of curriculum and options” (Murgatroyd, 2010, p. 279) – thus, the more wicked the problem, the more learning that is possible. Central to the learning process in a Makerspace are opportunities to look at these wicked problems facing the world and to challenge students to produce tangible products, services, or activities which are valued by others (Murgatroyd, 2010) and instill a sense of community, empathy, and civic engagement both locally and globally.

CHAPTER FOUR: MAKING A MAKERSPACE – A HOLISTIC APPROACH

DESIGN PROJECT

Through a year-long process of blogging, researching, and creating two Makerspace classrooms, a final resource package was created. The resource, *A Classroom Makerspace and Resource*, is divided into four parts: (1) the history and background of Makerspaces in Education; (2) the role of classroom physical space; (3) the lessons; and finally, (4) the classroom tools and resources. This resource can be used as a demonstration for educators seeking ways to enrich their own programs through inquiry and project-based learning spaces. This resource is intended to:

- (1) Inspire and support educators who wish to better understand, articulate, and reflect on the pedagogies and teaching approaches that connect to the design and implementation of Makerspaces in the classroom or school environment. While there are many methods and approaches identified in this resource, I hope that educators can take what they need – a lesson, a classroom design idea, or even a better understanding of the theories that are related to constructivism
- (2) Showcase *The Makerspace Design Project* (creation of a Reggio Inspired Makerspace) pictures and design examples to help educators collect ideas and connect practice with pedagogy.
- (3) Bring transformative and progressive approaches to teaching in a mainstream education program by demonstrating how past practices are being embraced through the Makerspace Movement.
- (4) Provide a conceptual framework that links to the development of a holistic Makerspace

- (5) Provide a template and lesson examples that connects Makerspaces to deep thinking pedagogies
- (6) Assist teachers in articulating and reflecting on their own practices
- (7) Offer insight into how and why teachers are central to teaching and learning in the 21st century, and what a holistic and constructivist inspired approach looks like in practice – specifically as it relates to a Makerspace learning environment

CHAPTER FIVE: REFLECTIONS

For me, the knowledge society's need for more integrated and usable knowledge is best met by more integrated and deep – rather than broad – curricula. The Maker Movement builds upon a broader cultural shift toward a do-it-yourself (DIY) approach to life, where people take pride and pleasure in creating things personally, rather than only consuming mass-produced goods (Resnick & Rosenbaum, 2013). This connects directly with the ideas that more independent, negotiated forms of learning, as practiced in alternative schools, prepares students for the knowledge society's demand intrinsically motivated individuals who are able to take responsibility for their own continuing, lifelong learning (Sliwka, 2008).

The teacher resource demonstrates the range of features inspired by alternative schools such as the Montessori, Waldorf, and Reggio Emilia approaches, and makes direct connections to the Maker Movement. Learning in the 21st century is much less about acquiring information or submitting to other people's ideas or values than it is about putting experiences into the world, finding our voice, and exchanging our ideas with others. This paper assisted in the creation of a Framework, see Figure 8, which can be used when developing and assessing Makerspaces, or components of a Makerspace.

Conceptual Framework for Connecting Makerspaces with Pedagogy ~ Holistic Approach

Impacts → Concepts and Approach ↓	Impact on Students	Impact on Teachers	Impact on Family, Community	Impact on Curriculum	Impact on Assessment and Evaluation	Impact on Social Justice, Global Awareness	Impact on Classroom Environment
Reggio Emilia Approach	<ul style="list-style-type: none"> *Discovery is emphasized through facilitated inquiry, play and exploration *Strong relationship with teacher and classmates over extended period *Exposure to Arts, history and literature *Exposure to plants and natural materials * Autonomy and flexible learning spaces, responsive to needs of student and teacher * Students assigned Jobs, duties to contribute to community *Exposure to real-world materials and problems 	<ul style="list-style-type: none"> *Opportunity for team teaching and strong collaboration *Teachers are encouraged to plan based on unique qualities of each child *Opportunity to learn through practice and on-going research *Availability and support to use atypical resources and tools *On-going learning through reflection and observation of students and self * High degree of trust in the teacher's creative abilities 	<ul style="list-style-type: none"> *Supportive parent, school partnership *Strong partnership with classroom, school *Varied age-groups provided a variety of perspectives *Parents are often seen as "teacher" and invited to play that role in the classroom 	<ul style="list-style-type: none"> * integrated and weaves in the Arts *Students present knowledge in different ways * curriculum is not a free-for-all – Requires that educators seek out interests of the children. *non-standardized curriculum *Play-Based learning emphasized *Use of physical space is important for curriculum instruction *Curriculum is approached through authentic experiences 	<ul style="list-style-type: none"> *non standardized curriculum and assessment remains open, *Assessment guides instruction through on-going documentation *Assessment is flexible and depends on individual learning needs *Assessment can be done in a variety of ways *Self-Assessment is encouraged *documentation can be represented by photographs, written conversations, videos, or displays of children's work 	<ul style="list-style-type: none"> *Exposure appropriate and current topics *Natural and authentic tools allow students to discover the world *Activities are purposeful and connected to the world in some way 	<ul style="list-style-type: none"> * "Third Teacher" implies that the use of room provides strong learning opportunities *Flexible environment *Common areas are available for students and teachers to meet *Atelier (ARTS are emphasized) *Natural artifacts *Detail to aesthetics and beauty in room * environment that is inviting and encourages creativity, play and discovery
Montessori Approach	<ul style="list-style-type: none"> *Individualized learning *Exposure to a variety of tools, resources * drive their own learning based on interest, learning needs, style *Strong relationship with teacher *Benefits from strong partnerships between family and school *Exposure to environmental Education and use of real materials *Flexible day, hours and hours 	<ul style="list-style-type: none"> *Availability of variety of resources that encourage different methods *Creative and innovative approaches and lessons are encouraged *Commitment to learn along with students *Use of Environmental Education as part of everyday learning *Team Approach emphasized 	<ul style="list-style-type: none"> * community oriented projects *Community Partnerships are emphasized *Parent/family contribution activities *Student Projects are often focused on community issues *Parent and community members are invited to share in celebrations *Community events are abundant, regular 	<ul style="list-style-type: none"> *Curriculum has an Inquiry focus * Environmental Education *Curriculum is individualized * cross-curricular approach *Curriculum focuses on Big Ideas and concepts *Strong emphasis on critical thinking skills 	<ul style="list-style-type: none"> *Assessment is individualized, not standardized *Assessment guides student learning *Assessment approaches are varied depending on student needs *Observation and discussion are strongly emphasized *Strong emphasis Student Portfolios 	<ul style="list-style-type: none"> *Strong focus on local and global issues *Interaction with current resources, newspapers, local global news * use real-world problems *Inquiry approach involves local and global activism *Curriculum emphasizes history and geography which are interwoven in other subjects 	<ul style="list-style-type: none"> *Subject defined learning centres * Hands-on activities available around room *Abundance and variety of supplies *Attention to nature inside and outside classroom *Classroom is set-up in stations and group areas *Classroom allows for a variety of teaching methods (1:1, small-groups, whole group)

<p>Waldorf Approach</p>	<p>*Hands-on and self-directed learning emphasized *Students learn to approach learning through imagination, creativity and self-guided inquiry *Student leadership is encouraged and supported through real-world experiences/opportunities *Authentic experiences are emphasized, including wilderness trips, hiking, survival activities *Strong relationship with mentors, peers and community is prompted *Social and emotional well-being is supported *Physical and Mental health is valued</p>	<p>*Teachers committed to reflective practice and documentation *work together in creating curriculum that is guided by a model of child-development *Strong relationship with students *Trained to use a holistic approach that values the body, mind and spirit *Teachers explore innovation and creativity to encourage Students to be imaginative and creativity from a young age *trained to integrate artistic methods (fine arts, music, drama) * Reflective teaching involves planning, anticipating, and preparing lessons. * Teachers understand not only human learning but also human development from an anthroposophical perspective.</p>	<p>*The community is invited into the learning through use of guest teachers and community experts *Exposed to many community trips *encouraged to be "actively part of" the community through leadership activities (fundraisers, team-businesses, engaging in humanitarian groups *Encouraged to volunteer *Naturally occurring evidence</p>	<p>* Curriculum is structured in years and grades * Curriculum is broad rather than specific * strong focus on humanities, history, geography *Focus on environment and outdoors * Readiness of students is important *Multi-disciplinary * Exposure to a variety of languages from an early age *Exposure to myths, legends, history from a young age *Curriculum intertwined with fine-arts, use of nature, craft materials *project based activities *Experiential learning is emphasized *Use of play is often used *Physical activity, health. social/emotional well-being is emphasized</p>	<p>*Assessment "for" and "of" learning is emphasized *Relationship between student and teacher strong factor *Evaluation of student in relation to individual starting point. *Assessment involves a cycle of reflecting on, in, and for teaching. (Rawson, 42) * Grades offer little incentive and have a negligible effect on learning (Rawson, pg41) *Whole person emphasized with careful consideration of impact *judgement may have on student learning *assessment, based on students own starting point *Assessment demonstrated through experiences *personal growth is seen as being different for each individual</p>	<p>*Students are regarded as important members of a global community from the start of school *Humanities Civics and community activism encourage *As students mature through different developmental stages, at different times, their interaction with local and global issues increase *Student leadership activities often focus humanitarian needs, volunteerism and helping others</p>	<p>*Use of outdoors is emphasized *Collaboration spaces, indoor and outdoor are implemented *Physical space emphasizes beauty with painted walls, plants, variety of lighting, soft music, relaxing atmosphere *Calm environment is viewed as important part of learning *Nature is recognized as a strong element to mindfulness, and attention to whole self (spirit, mind, body)</p>
<p>Constructivism</p>	<p>*students exposed to hands-on projects enabling authentic problem solving opportunities *Building, designing and creating artifacts is fun and open-ended and encourages students to take risks</p>	<p>*Teachers benefit from learning in collaboration with students *Making and Constructing learning allows for more variety and creativity in teaching *Teachers are empowered to use personal interests and skills to enhance a Maker Culture</p>	<p>*Makerspaces accessible in libraries, community centres and pop-up MakerFaires. *constructing through learning is supported by the strong culture of "do it yourself" craft shops, art shows, and music venues which provide authentic opportunities for students to Learn through Making without the stress of evaluation</p>	<p>*Curriculum embedded through Maker Activities and not taught in isolation</p>	<p>*Assessment is through observation and self-reflection and tends to happen based on the needs of students during an activity *Assessment isn't always pre-planned but depends on students' needs at the time of a project or inquiry *Assessment happens through error, mistakes and problem solving *Standardized testing is not supported</p>	<p>*Maker projects have a strong link to Design Thinking and Wicked Problems *Maker projects allow students to understand how to build, fix, edit and create in order to improve or solve</p>	<p>*Availability of materials, instructions *Availability of technology *Group mentorship is encouraged but not forced</p>

Design Thinking and Inquiry	*exposed to problems that inspire innovative solutions and encourage deep and critical thinking	*Teachers learn to use a layered approach to Problem Solving that involves critical thinking, creativity *Teachers do not need to follow a template or have the answer but instead, help students think deeply about atypical solutions	*Problems and Inquiries' are authentic and usually focus on local or global issues *Community integration and Critical Literacy allows students to their role and their voice in activism and being change agents	*Integrated approach that uses Big Ideas and Concepts to drive an Inquiry	*Assessment is focused on process of learning rather than the actual product *Observation and on-going discussion can help student reflect on their own learning growth and needs. *Use of prompts and guided questions assist in directing student learning	*Global Goals can drive all Inquiries and help students and teachers see a variety of perspectives locally and globally	*Questions, Big Ideas Posted *Artifacts in the room enhance and inspire inquires (an indoor garden, a worm centre, rocks, shells and natural materials)
First Nations Metis Inuit	*benefits from worldviews and principles that value mentorship and leadership	*Teachers can incorporate Indigenous world views in classroom with or without Aboriginal students *Teachers implement mentorship opportunities, respect for group process, and respect for environment	* bringing in parents, grandparents and community members emphasizes the role of the elders and storytelling. *Relationship with community, peers, teachers help students see their place	*Curriculum is holistic in nature and focuses on needs of individual student	*Assessment is natural and driven by student needs	*Past, present and future perspectives are interwoven into curriculum and Big Ideas in order for students to better understand the role they play in social justice and restorative practices	*Use of artifacts connected to environment demonstrate a deep respect for the environment
New Pedagogies and 21 st Century	*exposed to collaborative projects *access to current tools and resources *Blended Learning and online learning supports curriculum and allows multi-approaches and individualized instruction *Integrated curriculum allows students to see the interconnectedness of learning and project management	*Teachers are encouraged to be reflective, innovative and use a variety of approaches *Teachers have access to online networks for support and leadership *Transparency and availability of resources and tools allows teachers that address learning needs *teachers are designers of the learning experiences * teachers become models of the learning attitudes and creative, connected, collaborative, skills they seek to instill through their learning activity designs. (Fullan and Langworth , 2013)	*Digital Citizenship allows students to use new tools in meaningful, respectful ways *Community Engagement is emphasized through digital and non-digital means * Teachers and students form partnership - school clusters who are at the forefront of developing and using new pedagogies (Fullan, p.10)	*Curriculum is standardized but individualized and differentiated instruction is emphasized *	*Use of Standardized assessment to drive instructional practices	*Learning is driven through authentic topics, problems and projects	*Availability of current tools, resources *Areas promote collaboration *Room promotes discovery and inquiry through available materials, use of prompts and questioning

Figure 8:

Framework for Developing or Assessing Makerspace Pedagogies

Makerspaces also have a strong connection to the First Nations, Metis and Indigenous worldviews. Constructivist approaches to learning and Makerspace environments are connected to Indigenous principles that invest high value in learning from the community, the elder, learning through experiences, and situating the child at the center with an emphasis on mentorship. These rooted approaches provide a strong backing for the experiential, project- and problem-based, collaborative learning that many alternative schools have been focusing on (Sliwka, 2008). Further, the connections to learning environments, space, community, and family are recognized as essential in the Reggio Emilia classroom (Biermeier, 2015), along with Montessori and Waldorf schools which emphasize connections to history, geography, social justice, and environmental education. Each of these approaches view children as active authors of their development, strongly influenced by natural, dynamic, self-righting forces within themselves, opening the way toward growth and learning (Edwards, 2002). They all indicate that a child actively constructs his/her knowledge and that they provide their students with a more customized learning experience, often mixing students of different ages in the same classroom – a practice at the heart of the Makerspace classroom.

A Final Story

Many years ago, I made the discovery that teaching is not about the tools or the teacher's lesson, but rather is about the environment, the relationships, the community, and the constructivist pedagogies that made it work. At the time, I was unaware that the Makerspace would be the key to opening the doors to this type of learning!

Early on in my career, I developed an afterschool program called, "The Forget-Me-Nots." When I look back at this program, I am stunned at the fact that the students attended the sessions each week. What motivated them to learn? We were not programming a robot or playing on Minecraft or Magic the Gathering. We were not creating [Arduino](#) projects, making radios with circuits, or designing a 3D object to print. We were not building with Lego, using Wii to build a bridge with [Goo](#), or collaboratively solving physics problems in [Portal 2](#), a Physics game intended to combine game-play with math, engineering, and science.

School was not fun. In fact, we extended the school day by two hours, once per week, for these students to work (initially) solely on the pencil-to-paper literacy and math activities. There was no formal grade given for their work, only verbal feedback – and, on-the-spot). I concluded that they were motivated to come under these fairly bleak teaching conditions because they got to spend this time with their parents, and also with students from a variety of age groups and abilities. Their learning was collaborative and non-competitive, and above all, we tackled problems and projects that were authentic, "wicked," and interesting and engaging for a variety of age groups and abilities. Students and families were served food and tea, and they ultimately established a learning community of support, encouragement, and belonging that they often felt were missing elsewhere.

Knowledge building can also be defined as *intentional learning*, “the deliberate enhancement of skills and mental content” (Scardamalia & Bereiter, 2010, p. 4). I set out to do intentional learning with this after-school literacy program – but, what we were really doing was knowledge building. What resonates with me the most from this reflection is that knowledge building improved the knowledge of the community. For Scardamalia and Bereiter (2010), and for me, there can be intentional learning with no knowledge building, and knowledge building without intentional learning – but intentional learning with knowledge building is a powerful combination.

Even the parents and grandparents began relying on the comfort of one another, the discussion, the questions, and the support. The room set-up, as I recall, was always in a circle and the adults were asked to participate (model) along with the students. Each week, we set aside time for an art of some sort that ultimately sparked the idea to perform a play.

This was my first time fully integrating the ideas and concepts around Papert’s constructionism, Reggio Emilia’s play-based learning, and Montessori’s use of real world projects to engage students. It would be my first experience teaching a project-based learning activity. And, most importantly, it was the first time that I witnessed how incredible teaching and learning can be when passion, community, integrated curriculum, and collaboration all intertwined, and when people truly worked together to reach a goal to create something meaningful to them.

Toward the end of the school year, the students in the Forget-Me-Not group wanted to shift their focus from a more traditional way of learning – and prepping for the standardized test – to something more fun and more useful, something with a purpose beyond a test score. They taught me a lot here: the intentional learning that we set out to do resulted in an authentic task, an

application of what they had learned throughout the year. But none of it would have impacted them to that degree without their level of understanding that their success directly influenced their contribution to the community, to something or someone outside of themselves. Along with other students in the school, the students in the Forget-Me-Not program directed, produced, and performed in a play that year – *The Lion, the Witch and the Wardrobe* – where they performed to more than 1,000 people across the school district.

Since then, I have been involved in some pretty exciting projects, all of which have been documented in my [blog](#), but none stick to my heart as close as this one. These students were so committed to this project, that even in extreme heat, power outages, and long days, they performed in heavy costumes under bright lights as if it were the best thing they ever did. Students who could not read at the start of the year memorized every single line of the play, just in case they had to fill in. Those who were self-proclaimed ‘bad’ artists and builders spent days painting backdrops and sets, and those that could not build or sew learned the art – and there was no YouTube at that time!

It was the final night and the curtains closed for the last time. I remember feeling incredibly proud as I watched the cast and crew, one by one, come onto the stage to perform the last bow for the cheering crowd. I sat behind the switchboard in the middle of the audience. As co-director of the play, I was charged with the many rehearsals, leading different groups – stage managers, choreographers, sets, costumes and the transitions from scene to scene. This would also be my first time using a sound and light board and creating a mixed CD that would be used to control sound effects during the performance. I had to pause and play through the entire presentation. The rest was up to the students: the set change, the lighting, and even line assistants who sat at the front of the stage, looking up at the little actors and actresses reading line by line,

waiting for the cue to help. Ironically, at the start of the year, these were my low readers. By the final applause, I could hardly breathe as the emotion had overtaken me. It was more than the play; these students learned so much more in those eight weeks than they ever did during that Forget-Me-Not program.

I learned that providing my students with a chance to build, design, and create actually, “allowed time to think, to dream, to gaze, to get a new idea and try it and drop it or persist, time to talk, to see other people’s work and their reaction” (Papert & Harel, 1991, p. 1). The play itself formed a Maker Culture. Could this type of teaching and learning be the norm? How could I engage my students enough on a daily basis so that they fully and completely wanted to learn – not for a grade, an assessment, a point, or a reward, but because they felt purpose and wanted to contribute to something bigger than themselves? The emotion that I felt that night was because I recognized that the best thing I could do as a teacher was to provide my students with authentic experiences that matter to them, always.

Next Steps

Around the same time, it was the key messages of the new Ontario curriculum that truly impacted my thinking about education; it had me wondering why we were so rigid in our teaching methods and about the strategies and pedagogies that were being used in the classroom. In fact, it was the message that I posted in my classroom and my daybook that struck me the most, a message that perhaps acted as my catalyst to become what others may see as an outlier – but what I consider to be an activist and advocate for change. This is the message that led me to become an innovative educator with a strong focus on social justice:

Literacy is about more than reading and writing – it is about how we communicate in society. It is about social practices and relationships, about knowledge, language, and

culture. Literacy ... finds its place in our lives alongside other ways of communicating. Indeed, literacy itself takes many forms: on paper, on the computer screen, on TV, on posters and signs. Those who use literacy take it for granted – but those who cannot use it are excluded from much communication in today’s world. Indeed, it is the excluded who can best appreciate the notion of “literacy as freedom.” (UNESCO, 2003).

The above quote has far greater impact now that students and educators are connected and have greater access to information and tools than we have ever had – at least, in the Western hemisphere. This quote was written as a precursor for what would come and how we would turn education upside down, turning back the clock on a student-centred, inquiry-driven pedagogy where students discover, create, interact, and make.

As next steps, I would like to continue to interact with other educators who are embracing the maker movement, inquiry based learning and using a cross-curricular approach. The e-book resource created as part of Chapter Four will not only be available for teachers across Ontario, but will continue to be updated as new information, research and tools are introduced into the maker community. The resource book provides many resources and suggestions for classrooms, schools and districts who are interested in creating an authentic Makerspace, one that is more than just the tools and programs, but that has a strong focus on social justice, community and the world. I conclude with a quote from Hatch (2014):

Whenever one joins a movement, one changes. This is a good change. Embrace it.

Participating in the Maker Movement is a personal journey. Each will look different. No two makers are exactly the same. No two paths will be the same. But you will change.

You will begin to see the world through the eyes of someone who participates in creating.

You will look with wonder again at great artisanship. You will wonder how someone

could design this or that, and you will begin to appreciate local artists, designers, architects, and artisanship in your community. You will wonder where something was produced and who made it – you will look for the story behind the artisanship You will ask about local talent and local sources for things you never dreamed you cared about before. (p. 31)

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