Collaborative Inquiry Project

Annotated Bibliography and Literature Review

The Maker Movement & Inquiry-Based Learning in the Arts and Humanities Classroom

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Annotated Bibliography

Frenette, M., & Chan, P. C. W. (2015). *Academic Outcomes of Public and Private High School Students: What Lies Behind the Differences?.*

A research study released by Statistic Canada, stating the academic differences between Public and Private High school students in Canada. It looks at the students' academic performance under the different environments. The article points out that there are two major academic differences that affect the academic outcome of the two sectors. These differences help students in private schools score much higher than students in public schools completing the same work. The two differences are mostly related to the background and environment the students are in. Private school students "were more likely to have socio-economic characteristics positively associated to with academic success", they were likely "to also have school peers with university educated parents." The article also points out, with data, that school resources don't affect the academic outcome of the students as much indicating that private school students do better when compared to public school students because of the quality of students themselves.

Ha, T. (2015, April 23). Inside the world's best kindergarten. Retrieved July 21, 2016, from http://ideas.ted.com/inside-the-worlds-best-kindergarten/

An online article published on Ideas.Ted.Com, by Thu-Huong Ha, about a kindergarten in Japan that uses a new design to let kids be kids and inspire their learning by creating a kid-centred learning environment. The author states point presenting the school's innovative method to teach students the idea of infinite possibilities through own creation in the open classroom, open learning environment. The article reviewed the differences seen in the children in the new kindergarten versus a traditional classroom.

Hatch, M. (2013). *The Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers*. New York: McGraw-Hill. ISBN: 978-0-07-182113-1

The Maker Movement Manifesto by Mark Hatch (2013) provides readers with a look at the maker movement and why it is essential for education and our society as a whole. Hatch proposes that the maker movement includes the following categories: make, share, give, learn, tool up, play, participate, support, change (p. 1-2). Because "technology has begun to make creating easy enough that everyone can make," (p. 15) Hatch advocates the value of maker spaces and that these spaces should be accessible to all.

High Tech High. (n.d.). Retrieved July 21, 2016, from http://www.hightechhigh.org/

A school founded by high tech industry leaders in San Diego, to "develop and support innovative public schools where all students develop the academic, workplace, and citizenship skills for post-secondary success." It was an attempt to attack the "digital

divide" problem, their industry was facing. The number of schools/campuses have been increasing over the years, expanding to thirteen schools since it was founded in 1999, indicating the importance and increasing demand in this field of study and in this type of learning environment. It has developed and grew into a school that not only educate students to excel in their inquiry based learning, but also certifies teachers to teach in such learning environments.

Learning, I. B. (2013). Capacity Building Series.

A Ministry of Education of Ontario published article about Inquiry-based learning. It discusses the benefits of such learning environments and includes some basic principles and guides for educators to lead a successful inquiry-based classroom. It was pointed out in the article that educators need to help students "develop the skills and knowledge they need to function in today's world." And such learning practices can support the student "to become thoughtful, motivated, collaborative and innovative learners" capable of handling their own explorations in the constant changing world.

Loertscher D. (2015). The Virtual Makerspace: A New Possibility? *Teacher Librarian*, 43(1), 50-51.

In this article, Loertscher (2015) advocates extending the theoretical concepts underlying makerspaces into the digital realm. The accessibility of low-cost online apps, tools and

programs allows students to move away from the consumption of online material towards creative learning. He envisions K – 12 schools setting up "a virtual environment where students and adults can create, build, and invent and where all the other creative, informal, educational self-directed learning passions can develop" (p. 50). He argues that virtual makerspaces should include a diverse range of tools that can accommodate a variety of learners and that students should be involved and have influence in the design process.

Martinez, S. L., & Stager, G. (2013). *Invent to Learn: Making, Tinkering, and Engineering in the Classroom.* Torrance, CA: Constructing Modern Knowledge Press. ISBN: 978-0-9891511-0-8

Martinez & Stager (2013) portray the intricate parts of the maker movement in *Invent to Learn: Making, Tinkering, and Engineering in the Classroom*. Drawing from personal experience and research, the authors present an extensive look at the history, teaching, and supplies of maker spaces advocating that "the active learner is at the center of the learning process" (p. 2). Drawing from knowledge and findings of pioneers of alternative learning spaces such as Seymour Papert, Jean Piaget, and Maria Montessori, Martinez & Stager cater to educators of all levels and abilities interested in bringing about change to the 21st century classroom.

Peppler, K.A. (2010). Media Arts: Arts Education for a Digital Age. *Teachers College Record*, 112(8), 2118-2153.

This article explores youth media art creation and the contributions that media arts can make to a 21st century classroom design. Peppler (2010) writes that at the "heart of youths' media art production lies the ability to build a more democratic society, one that fosters the inclusion of youth from marginalized communities, provides them with the capacity to participate in the 21st century, and actively reengages them in the learning process" (p. 2146). Peppler focuses on new literacy, constructionist and constructivist theories to advocate for the potential of media arts to engage students in complex forms of multimodal creation and expression.

Peppler, K., & Bender, S. (2013). Maker movement spreads innovation one project at a time. *Phi Delta Kappan, 95*(3), 22-27.

This publication looks into the shift from traditional to innovative classrooms. It emphasizes the new-age maker movement as "an innovative way to reimagine education", and the importance of understanding the maker's mindset of enabling learners to make nearly anything from nothing. It communicates the idea that maker movement trainings can promote makers to be more creative and develop the skills needed to keep up with the rapidly changing society, especially through self-interest development to be better equipped users for out-of-school society. It also speaks of the needed components to create successful maker movement spaces.

Private Schools Versus Public Schools | Private Vs Public. (n.d.). Retrieved July 21, 2016, from http://www.ourkids.net/private-schools-versus-public-schools.php

An online article comparing the differences between Private and Public schools in North America. The cost of sending children to the schools is compared, along with the differences in admittance process, student population, school's standards, class size, curriculum differences and faculty requirements. The article points out the differences to help readers understand the pros and cons of the two types of schools and how such differences result in different quality of education.

program, extensive Performance Arts and Music programs also give students many opportunities to discover their own interests in non-technological fields of interest. The article points out the importance of educators directing students to facilitate self-learning instead of traditional instruction methods.

R. (2014). Building Futures - Airdrie. Retrieved July 22, 2016, from https://www.youtube.com/watch?v=s6ULotfyLKg

R. (2016). Building Futures with McKee Homes. Retrieved July 22, 2016, from https://www.youtube.com/watch?v=Vi6eREaCnkk

These two videos are from a program called Building Futures in Rockyview Schools, Alberta. This could be called the ultimate makerspace in a high school setting. Students in grade 10 apply to the program and 30 are accepted. Over the course of a year students build two houses from the ground up. They report to a regular classroom in high school once a week, the other 4 days their classroom is set up in a garage of one of the houses. They get credits for the same classes all high school students in their grade take, but they also gain several other credits in Career and Technology Studies. They work side by side with tradespeople to learn hands on skills. This program is not an alternative program for students that struggle, but for any student that wants to try something else for their grade 10 year. This program is innovative and takes the foundations and theories of the maker movement and explodes it, pushing it into not just understanding the real world, but really exploring real world issues, careers and skills.

Rendina, D. (2016, July 18). Home | Renovated Learning. Retrieved July 21, 2016, from http://renovatedlearning.com

This blog is written by Diana Rendina, a librarian/media specialist at a Florida middle school. It reflects her journey as she transformed her school library into a makerspace and STEM learning environment. She offers great insight into defining the term makerspace, offering help on how to get started, growing a space you already have and a popular blog post of step by step instructions for creating an Epic Lego Wall. This blog is teacher friendly as it addresses realistic issues that educators face when trying to introduce and

implement forward-thinking pedagogy, from budget to dealing with naysayers. As Rendina states, this blog is about "rethinking, remaking, and renovating learning and how we create learning experiences as educators."

Rivas, L. (n.d.). Let's Make. Retrieved July 22, 2016, from http://www.diygirls.org/#home

How can we engage more girls in STEAM (Science, Technology, Engineering, Art, Math)? The goal of DIY Girls is to answer that question. The website provides support for teachers looking for help with projects, or starting after school groups that engage girls. They offer kits you can purchase for students in grade 4-12 that not only teach the basics of coding and circuits, but girls can also make projects out of their learning. Light up tutus, art-bots, and 'smart' friendship bracelets are a few examples. When creating a makerspace, teachers need to think about how to reach all academic levels of students, but also how to reach girls. Girls are very underrepresented in STEM fields and it is thought that what you can't see, you can't be. This site helps encourage girls and shows them the possibilities within the fields of technology and engineering.

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technologies. *The future of children*, 76-101.

This is an article that stresses the increasing importance for students to be "well equipped to enter the workforce" and be able to survive in the real world. Based on the publication, to gain and improve these skills, computers in classrooms along with educator input, play a major part in supporting learning and developing advanced skills in critical thinking. It looks into key characteristics of learning that enhance learning with computer technology, stating that active engagement, interaction, group participation and real-world contexts support learning. Roschelle also argues that the setup of traditional classrooms is poor at supporting learning, whereas technology when used effectively allows for better ways to help children learn.

Sheridan, K., Halverson, E. R., Litts, B., Brahms, L., Jacobs-Priebe, L., & Owens, T. (2014). Learning in the making: A comparative case study of three makerspaces. *Harvard Educational Review, 84*(4), 505-531.

A publication that looked at how makerspaces may function as learning environments, through the analysis of case studies conducted by the authors. The authors look at and compare three makerspaces in America that come from different backgrounds and setup to determine and understand "how different makerspaces function as a learning environment." (Sheridan, 2014) The authors first discussed the learning and teaching theory employed in such learning spaces, then ventured into the examination of the environment. Data presented were collected through the course of one school year,

through field observations, interviews and extensive analyses of completed works and related documentations.

Stewart, L. (2014). Maker movement reinvents education.

An article published on Newsweek by Louise Stewart, about a new trending type of learning environment for students that is based around inquiry-based learning classrooms. The author emphasized the importance of such learning as it promotes the development of skills through problem solving instead of traditional methods of learning specific skills. The article contains testimonials from educators and students, in such learning environments, in regards to their successful experiences. Most importantly, the author highlights a key aspect of such learning environments from the feedbacks she received, that such learning environments "make learning so powerful and memorable."

Stockman, A. (2016). *Make Writing: 5 Teaching Strategies That Turn Writer's Workshop Into a Maker Space*. Cleveland, OH: Times 10 Publications. ISBN: 978-0-9861049-3-0

This resource is packed with simple, explicit ways teachers can transform their writing lessons to foster the inherent maker nature of children. Stockman (2016) portrays that "in the most effective learning communities all teachers are learners and all learners are teachers, regardless of title or age" (p. 24). Stockman also emphasizes the value of talking to your students about their interests to see how they can be tied into the

classroom. Even teachers on a budget can incorporate these maker space aspects with Stockman's clever *What YOU Can Do Tomorrow* sections scattered throughout the book.

Tishman, S. (n.d.). Educator Resources. Retrieved July 20, 2016, from http://www.agencybydesign.org/

Agency by Design is a "multiyear research initiative… investigating the promises, practices, and pedagogies of maker-centered learning experiences" They focus on three guiding questions surrounding the benefits and outcomes of maker learning experiences, characteristics of successful maker environments and interventions that support reflection. As part of their teacher resources, A*b*D offers a three step process to creating a "sensitivity to design". That includes looking closely, finding opportunity and exploring complexity. A*b*D offers real life examples for each of these steps, which would be helpful in the beginning steps of designing a makerspace. They also offer teachers online professional development courses through Harvard Graduate School of Education. Although there are some real world examples and step by step strategies to get started with design thinking and maker education, this site is most helpful with theory and research that supports the maker movement.

Tondeura, J., De Bruynea, E., Van Den Driesscheb, M., McKenney, S., Zandvliete, D. The physical placement of classroom technology and its influences on educational practices. *Cambridge Journal of Education*, 2015, 45 (4),537–556.

This research study critically examines the various ways in which technology is physically integrated into classrooms and explores its effect on teaching and learning. The authors maintain that educators "should be considering more deeply the positioning of technological devices within physical school surroundings, and how these interact with the teaching and learning activities" (p. 538). They examine various classroom designs through case studies and make connections between the physical environments and learning present in each context. They argue that the physical placement of technology does not determine pedagogical approaches, but that it can enable or hinder various types of learning activities.

Verbanic, A. (2010). Perceiving architecture: A experiential design approach.

A thesis publication that looked into the understanding of how learners, particularly young learners, "perceive and interact with their environments." The publication includes case study analyses, educational theory discussions and research into the learning programs employed in some schools now that physically build learning environments that promote learning.

Why Do Grade 1 Private Schools in Richmond Hill Choose Inquiry-Based Learning? (2015). Retrieved July 21, 2016, from http://www.richlandacademy.ca/articles-of-interest/why-grade-1-private-schools-richmond-hill-choose-inquiry-based-learning

Richland Academy is a K-8 private school in Richmond Hill, Ontario, that focuses their curriculum teaching around inquiry-based learning. Building on the learner's own natural curiosity to spark and drive learning in Science, Technology, Makerspace classes and Arts. The school's art program also provides students with many different types of art materials to let students explore and create creative ideas. Alongside the Visual Arts program, extensive Performance Arts and Music programs also give students many opportunities to discover their own interests in non-technological fields of interest. The article points out the importance of educators directing students to facilitate self-learning instead of traditional instruction methods.

Winske, C. (2015). The latest trends in classroom design. K-12 Tech Decisions. Retrieved July 20th, 2016 from http://www.k12techdecisions.com/article/designing_modern_classroom_spaces.

This article is written by Chrissy Winske, who is the K-12 editor for TechDecision Media. Within the article, she provides an overview of the underlying philosophical and practical considerations relevant to designing learning spaces that support constructivist styles of teaching. Pedagogy "has evolved and the role of the teacher has shifted from the bestower of knowledge to the facilitator of it. Educators now flip their classrooms, encourage active, project-based learning and increasingly use online tools to deliver a more personalized education experience" (p. 1). She also discusses the psychology

related to the design of spaces and how certain designs affect student's behavioural expectations.

Learning Spaces for Inquiry and Maker Minds

Inside the heart of the maker movement lies a search for the ultimate classroom design to foster the inherent making and tinkering tendencies of children. Mark Hatch (2013), CEO and co-founder of TechShop, the first international open-access workshop full of tools and equipment, claims "making is fundamental to what it means to be human" (p. 1). Whether learning in a primarily face-to-face classroom or virtual learning environment, the access to affordable hardware, software, and applications continues to grow. Educators need to take advantage of the tools available in order to effectively prepare their students with skills necessary for the 21st century learner. The booming computer and technology industry adds an interesting element to the maker movement (Loertscher, 2015). As we progress, technologies that support making and inquiry, such as the 3D printer, continue to become cheaper to facilitate learning, especially for education (Hatch, 2013). With tight school budgets and ever-changing upgrades to technologies, educators can quickly become overwhelmed with all of the options available. The key is to be able to implement some of the following tools into our classrooms over time so that educators and schools can stay current without making extensive investments into expiring skills and technologies. The maker movement looks to reinvent education through the use of real world problem solving and making, using inquiry-based learning (Stewart, 2014). By investing time to get to know our students' interests and bringing these topics into our classrooms, educators can make learning real and more meaningful for their students (Stockman, 2016). This collaborative inquiry project will showcase classroom designs and tools that are most conducive to making, inquiry, and technology integration throughout primary, intermediate, secondary, and private education.

The Maker Movement

With the advent of inexpensive computers, easy to build and control robots, and student friendly 3D printers, many schools are jumping on the makerspace bandwagon. The first steps in being part of the makerspace movement is defining the term, deciding what the purpose of the space will be in your school and then creating the physical space. Diana Rendina is the author of the blog "Renovated Learning", where she reflects on her journey into creating a makerspace in her middle school's library. When Rendina first started her makerspace in her middle school's library, she faced criticism that is was not a 'real' makerspace. The critic pointed out that the school had a woodshop which was where, in the opinion of this person, a real makerspace should be located since that is where all the power tools were housed. Rendina researched the term and combed through an extensive list of books, websites and posed the question to her more than 6000 Twitter followers. She found that in all the definitions, the common thread was that a makerspace is a place where people can create. She provides her definition of makerspace as a "place where students can gather to create, invent, tinker, explore and discover using a variety of tools and materials" (Rendina). The tools are not the important piece. A room with bins of arts and crafts supplies is as much a makerspace as a studio with a 3D printer and laser cutter. It is less about the tools and more about offering the space for students to create something.

Once a makerspace has been created, many students will be drawn to it and participate in it without being directed. They will embrace the chance to work independently and collaboratively to tinker with robots, or code, or building structures for a specific purpose. However, there are troubling statistics that exist among girls and how they view their place in and interest in areas of STEM. According to www.diygirls.org, between grades 4 and 8, only

15% of girls show an interest in STEAM. This number drops significantly among girls of colour. The mission of diygirls.org is to serve girls in under-resource communities in the Los Angeles area. How to get girls more interested in technology is a question that educators and companies are trying to answer. Organizations like DIY Girls, Girls Who Code and Girls in Tech, offer programs, support and inspiration for girls and educators who want to help girls be successful in the male dominated world of technology. Although in the 21st century we may think that the playing field is even and girls have the same access to technology their male counterparts do, there is something preventing them from really diving into STEAM projects past middle school.

Creating a makerspace beyond middle school is more challenging for schools, as generally high schools begin to narrow the focus by offering distinct spaces throughout the building as makerspaces, such as foods rooms, science labs, shop classes etc. It is less common to find a makerspace in a central location, such as a library, in a high school setting. Libraries in high schools are changing from quiet spaces filled with books, to media centres or learning commons, but it is a slow process. One school board in Alberta created a program called Building Futures, which could be called the ultimate makerspace. Inspired by a visit to High Tech High in San Diego, two teachers created a program for grade 10 students, called Building Futures that sees 30 students build two houses from the ground up in the span of a school year. They learn directly from tradespeople and experts in other fields related to the designing, building and selling a house. Throughout the year they study all necessary core courses, but their teachers infuse real life problems, relevant to home building and the community into these core areas. Students make presentations to companies, Dragon's Den style, with ideas that have ranged from everything from building greener houses to building a community college in their

town. At the end of the year the students showcase their homes through a celebration of learning, which offers tours of the homes, with student projects on display. This program offers incredible opportunity for students to build, create and make in a real world setting. At the high school level, erecting a Lego wall may not be met with the same enthusiasm as it is in middle school. But offering students a chance to not just tinker or play, but build homes for real people and think about the issues their community faces meets the needs of high school students to experience and be guided into the real world.

Inquiry-Based Learning

Inquiry-based learning, a learning environment where educators don't just educate students with facts and knowledge like they would in a traditional classroom. The educators act more like facilitators, who questions the learners, and give problems or scenarios to the learners to solve instead. This method of learning is becoming more popular as the choice of education for children as it greatly supports the development of critical thinking and problem solving skills, and better equips the learners for real world situations. This method often works best for the learner, if the learning environment allows for more discovery time, smaller class-sizes, and most importantly such the environment allows for self-ownership for their learning. The importance for such an environment to exist was also emphasized by the Ministry of Education of Ontario in their publication in 2013, stating that such learning environments can support the student "to become thoughtful, motivated, collaborative and innovative learners capable of engaging in their own inquiries and thriving in a world of constant change." (Learning, 2015)

Inquiry-based learning can also be known as learner centred learning, where the teaching and learning is based around the learner's questions, responses and ideas. So educators in these settings present open-ended questions or problems at the start, to engage the students and have them respond to the questions as they see fit. It creates a learning environment where there are no set right or wrong answers, and students feel less pressure to get the one correct answer. As Stewart pointed out in their article, "Maker Movement Reinvents Education", "A childhood of creative play led to their development of deep-seated interests and curiosities", and as they grow older such interests become the intrinsic motivation that help them achieve more career and life goals. (Steward, 2014) As Benjamin Franklin once said "Tell me and I forget, teach me and I may remember, involve me and I learn." If the learners can be involved in the planning of their own learning, and not just take part in but also have a say in their learning, it can stay with them much longer than traditional teaching methods of educators regurgitating information and knowledge to them to memorize.

Integrating Technology

As more educators begin exploring teaching practices related to constructionist learning theories, designing physical environments that enable creation, collaboration and self-directed engagement becomes essential. Constructionism "places learners in designer roles and ties together the importance of designing artifacts that are of relevance to a larger community" (Peppler, 2010, p. 2122). Related teaching practices such as inquiry-based learning, makerspaces and project-based learning all rely on the ability of students to interact collaboratively within a flexible physical learning environment to engage their unique interests and abilities. Classroom

designs characterized "by a fixed, more static, more traditional classroom layout is becoming obsolete. It just can't support those new behaviors and activities and, in fact, gets in the way of them" (Winske, 2015, p. 1). The design of more flexible learning spaces that enable active styles of engagement requires many considerations. Questions regarding mobility, accessibility, customization and functionality in relation to the resources and spaces that make up a physical classroom environment are essential.

A major consideration concerns the integration of technology within the redesigned learning space. The development of 21st century skills has become a central issue in many schools across Canada. The need to integrate new technologies has "changed the way learning spaces are designed. With Smart boards, laptops and iPads, the flow of the classroom naturally shifts and teaching and learning becomes more flexible. There has to be room to move and collaborate in this type of environment. Teachers need to easily create custom workspaces for class, group or individual activities" (Winske, p. 1). Educators are searching for ways in which technology can be used to enhance constructionist pedagogies. For example, the physical placement of technology within the classroom can affect its pedagogical use. It is "apparent that space can be a partner within pedagogy, and such a partnership is precisely what could be interesting when we consider ICT integration in education" (Tondeur, 2015, p. 554). Furthermore "technological devices do not embody one single pedagogical orientation; instead they enable the integration of a spectrum of approaches to teaching and learning" (Tondeur, p. 554). Flexibility of use is essential when utilizing learning theories that relying on self-directed learning and engage the diversity of interests within all learners. Traditional methods of incorporating technology within the school environment, such as the use of computer labs, do not

allow for the seamless support of interdisciplinary, multimodal learning typical of makerspaces or inquiry learning environments. The inclusion of activities related to product design, coding, robotics, movie making, photography etc. within the classroom relies on the underlying support of various forms of hardware and software, which each present unique challenges to maintain functionality and achieve full seamless integration. Practical issues regarding mobility, accessibility, device compatibility, space and charging requirements need to be considered when designing supportive spaces.

Another manner is which technology has been integrated with specifically the Maker Movement is through the creation of virtual makerspaces. The goal is to create "a virtual environment where students and adults can create, build, and invent and where all the other creative, informal, educational self-directed learning passions can develop" (Loertscher, 2015, p. 1). Provided schools have access to necessary technology, the cost and space requirements typical of setting up a physical Makerspace can be reduced. The accessibility of technologies that allow for creativity, design and construction has increased in recent years. Many platforms offer "a plethora of such apps, tools, or experiences—whatever you want to call them—begging for an audience of children, teens, and adult users. Best of all, many are free or low cost" (p. 2). Various online hosting platforms such as social media, blogs, wikis, etc. allow for students to share their work with wider audiences. Furthermore, the availability of online participatory cultures dedicated to new media can provide access to informal forms of mentorship allowing students to pursue a wide range of creative experiences while receiving support beyond what classrooms have traditionally offered.

The use of virtual makerspaces also creates new opportunities for the inclusion of Media Arts in the classroom. Media art "encourages designing, creating, and critiquing genres that connect to youth culture and engage youth in the process of learning more actively than what is traditionally offered in schools, especially in marginalized communities" (Peppler, 2119). Students are able to bring their experiences into the classroom and develop them in an environment that encourages creativity, collaboration and reflection. The interdisciplinary approach characteristic of makerspaces and inquiry learning allows for art education to meaningfully connect to other forms of learning. Furthermore, "viewing creative digital production with new media from the perspective of the arts connects us to the twofold transformative potential that the activity of art making can have both on evolving the identity of an individual and on the aesthetic experiences that the art object can have on the viewer" (Peppler, 2120). A classroom layout that promotes this type of learning has to foster collaboration, communication and reflection. Spaces that enable focus, discussion, creation and presentation are necessary to fully support learning.

Conclusion

Students need to be able to imagine, create, play, share, and reflect on their experiences in the classroom in a cyclical fashion that is not prescribed. Through exploration in thoughtfully designed classrooms with purposeful tools for tinkering, students will have the opportunities to engage in their inherent maker abilities. Maker spaces and inquiry can help accomplish these goals for students to be successful (Martinez & Stager, 2013). The opportunity to participate,

play in, and share a space with inquiry in mind supports the inquisitive learner as well as others in the same environment.

The concept of making in education is not new. Famous constructionist, Dr. Seymour Papert, recognized the important and inherent nature of making for children through numerous research projects and identified eight big ideas: learning by doing; using technology as a building material; engaging in hard fun; learning to learn; taking time; accepting failure; learning alongside your students; knowing, learning, and using digital technology (Martinez & Stager, 2013, p. 73-74). Schools need to jump into the age of technology and make the move from traditional to innovative classrooms (Martinez & Stager, 2013; Peppler & Bender, 2013). Promoting technology as a tool or vehicle to enhance or share learning is an important distinction to relate to students; technology is not necessarily learning itself, but rather another means to showcase learning.

There is more than one solution or way to design a classroom for students to benefit from maker and inquiry experiences. Creating a class manifesto with your students to bring together what is important in your learning space can personalize the space for everyone. Recognizing that everyone is a learner in the classroom, regardless of age can be most effective (Hatch, 2013; Stockman, 2016). Making small changes to the layout and supplies within a classroom over time and watching how students interact with these changes can be a starting place that is more cost-effective. Martinez & Stager (2013) suggest that "[t]he DIY, reuse, and recycling values of the maker movement urge you to squeeze every last drop out of the technology you already have" (p. 124). Regardless of budget, there are many different ways that educators can bring meaningful learning to the classroom to promote inquiry and exploration.

Finally, Martinez & Stager (2013) suggest to "[d]esign a space that encourages creativity by taking into account both functionality and flexibility" (p. 169). Less can be more, and blank spaces can be left open to interpretation and discovery. Let students explore their own fascinations; "[r]emain open to the possibilities inherent within a space and seek to open possibilities for your students, permitting them engagement in ways we as adults might not imagine" (Stockman, 2016, p. 35). Remake your space with inquiry and making in mind.

References

Frenette, M., & Chan, P. C. W. (2015). *Academic Outcomes of Public and Private High School Students: What Lies Behind the Differences?.*

Ha, T. (2015, April 23). Inside the world's best kindergarten. Retrieved July 21, 2016, from http://ideas.ted.com/inside-the-worlds-best-kindergarten/

Hatch, M. (2013). *The Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers*. New York: McGraw-Hill.

High Tech High. (n.d.). Retrieved July 21, 2016, from http://www.hightechhigh.org/

Learning, I. B. (2013). Capacity Building Series.

Loertscher D. (2015) The Virtual Makerspace: A New Possibility? Teacher Librarian. 43.1, 50-51.

Martinez, S. L., & Stager, G. (2013). *Invent to Learn: Making, Tinkering, and Engineering in the Classroom.* Torrance, CA: Constructing Modern Knowledge Press.

Peppler, K., & Bender, S. (2013). Maker movement spreads innovation one project at a time. *Phi*

Delta Kappan, 95(3), 22-27.

Peppler, K.A. (2010). Media Arts: Arts Education for a Digital Age. Teachers College Record, 112(8), 2118-2153.

Private Schools Versus Public Schools | Private Vs Public. (n.d.). Retrieved July 21, 2016, from http://www.ourkids.net/private-schools-versus-public-schools.php

R. (2014). Building Futures - Airdrie. Retrieved July 22, 2016, from https://www.youtube.com/watch?v=s6ULotfyLKg

R. (2016). Building Futures with McKee Homes. Retrieved July 22, 2016, from https://www.youtube.com/watch?v=Vi6eREaCnkk

Rendina, D. (2016, July 18). Home | Renovated Learning. Retrieved July 21, 2016, from http://renovatedlearning.com

Rivas, L. (n.d.). Let's Make. Retrieved July 22, 2016, from http://www.diygirls.org/#home

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how

and what children learn in school with computer-based technologies. *The future of children*, 76-101.

Sheridan, K., Halverson, E. R., Litts, B., Brahms, L., Jacobs-Priebe, L., & Owens, T. (2014). Learning in the making: A comparative case study of three makerspaces. *Harvard Educational Review*, *84*(4), 505-531.

Stewart, L. (2014). Maker movement reinvents education.

Stockman, A. (2016). *Make Writing: 5 Teaching Strategies That Turn Writer's Workshop Into a Maker Space*. Cleveland, OH: Times 10 Publications.

Tishman, S. (n.d.). Educator Resources. Retrieved July 20, 2016, from http://www.agencybydesign.org/

Tondeura, J, De Bruynea E, Van Den Driesscheb M., McKenneyc S., Zandvliete D., The physical placement of classroom technology and its influences on educational practices. Cambridge Journal of Education, 2015 Vol. 45, No. 4, 537–556.

Turner, A., Welch, B., & Reynolds, S. (2013). Learning Spaces in Academic Libraries – A Review of the Evolving Trends. *Australian Academic & Research Libraries, 44*(4), 226-234. doi:10.1080/00048623.2013.857383

Verbanic, A. (2010). Perceiving architecture: A experiential design approach.

Why Do Grade 1 Private Schools in Richmond Hill Choose Inquiry-Based Learning? (2015). Retrieved July 21, 2016, from http://www.richlandacademy.ca/articles-of-interest/why-grade-1-private-schools-richmond-hill-choose-inquiry-based-learning

Winske, C., (2015) The latest trends in classroom design. K-12 Tech Decisions. Retrieved July 20th, 2016 from http://www.k12techdecisions.com/article/designing_modern_classroom_spaces