Developing Open Access Materials to Support Professional Learning: Taking Making into Classrooms Toolkit and Companion Online Experience

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Abstract

Globally, the Maker Movement has been steadily gaining traction in educational settings as a way of preparing for the 4th Industrial Revolution. Combined with a Design Thinking process, it invites educators and students to engage in active production rather than passive consumption of products, media, materials and objects and consider innovative practices (Martinez & Stager, 2013). In British Columbia, Canada, Design and Making have been used to reframe the previous *shop class* experience (now Applied Design, Skills and Technologies – ADST) which is viewed as both a curriculum to be studied and a pedagogical approach to encourage and support innovative teaching and learning. ADST builds "on students' natural curiosity, inventiveness, and desire to create in meaningful ways. It harnesses the power of learning by doing, and provides the challenging fun that inspires students to dig deeper, work with big ideas, and adapt to a changing world" (British Columbia Ministry of Education, 2015, ¶1). The *Taking Making into Classrooms Toolkit* and supporting online experience were created in partnership with industry, higher education, and government. These open access resources were designed to assist educators in taking up the ADST curriculum through immersive professional learning experiences and self-study.

Keywords
Design and Making, immersive professional learning, open access resources

Problem Statement

If educators are to help prepare students for a changing world and the 4th Industrial Revolution that is impacted by technological developments, they must fully understand those changes and adapt their own learning and teaching. Re-training educators is not an easy task, recognizing that most teachers teach in the manner in which they were taught (Christian, 2014) and many professional learning opportunities provide experiences using traditional approaches to knowledge dissemination, and ironically, often contracting an expert to lecture on change.

The perennial challenge for any curricular renewal effort, even one grounded in established instructional theories such as constructionism and experiential learning, is developing a sustainable / scalable professional learning intervention that supports teachers as they come to understand and adopt changed practices. This paper shares a professional learning approach piloted in western Canada, and focused on providing teachers with immersive learning opportunities to experience a new curriculum – British Columbia's innovative Applied Design, Skills and Technologies – ADST curriculum (https://curriculum.gov.bc.ca/curriculum/adst). This approach has impacted over 6000 educators since 2013 using hands-on workshops and access to open materials including toolkits (https://commons.royalroads.ca/takingmaking/category/toolkit/) and an online course (https://www.openschool.bc.ca/show_takingmaking/). We define toolkits as digital texts that include background information providing a contextual framework, educational theory, pedagogical connections, tips and pointers, assessment strategies, suggested resources, and proven curricular links positioned as design challenges or suggested resources. This professional learning approach was also used in East Africa to introduce Design Thinking and Making as an example of student-centred pedagogy and a way to leapfrog traditional practices and prepare youth for a changing world.

Globally, Design Thinking coupled with the Maker Movement has steadily been gaining traction in educational settings as a way to help students understand and become proactive in the tackling the complex or "wicked problems" facing their societies. The introduction of Design Thinking and Making and the cultivation of an intentional mindset toward the work has enabled the re-consideration of the constructionist pedagogy called for by Papert (Papert & Harel, 1991) in the mid 1980s and experiential learning suggested by Dewey (1938) in the

early 1900s. Our work suggests that when these concepts are introduced to educators through immersive professional learning opportunities, change happens and teaching and learning begins to pursue the active production of ideas rather than passive consumption of products, media, materials and objects (Martinez & Stager, 2013) and the regurgitation of facts. The notion of an intentional mindset is discussed later in this paper.

Our work suggests that when educators are allowed to participate in immersive professional learning, they begin to engage in the essential conversations they need in order to embrace the potential, place and promise of innovative practices in their classrooms. By creating opportunities for educators to experience design, making, and experiential learning for themselves, we have found that they can then begin to consider how they might embed these approaches into their practice.

Literature Review

"Research tells us that teachers often teach the way they were taught" (Christian, 2014, **¶1**). Further, it is ironic to note many professional development opportunities teach teachers new approaches "using the same irrelevant pedagogies, sitting in rows … [and] taking notes, and memorizing disconnected facts" in the hopes of changing pedagogical practices (Owens, 2013, p. 1). It would appear that approaching professional learning by modeling innovative pedagogies using traditional pedagogies, is a missed opportunity to allow teachers to experience changed practice first as learners before they are called upon to use it in their own teaching.

In a recent Learning Policy Institute Report (Darling-Hammond, Hyler, & Gardner, 2017), seven elements of professional development were identified as being key factors influencing and impacting professional learning. These factors include:

1. Curriculum focused content that provides supported opportunities for teachers to consider, experience and explore new strategies / approaches situated within specific curriculum content;
2. Active learning that engages teachers in designing and trying new strategies, providing them opportunities to engage in and experience the same style of learning they are designing for their students. Key to this factor is allowing teachers to be learners first and see and feel the changed practice;
3. Collaboration with other teachers and opportunities to share ideas and personalize the new ideas within their own contexts and experiences, both during the professional development and beyond;
4. Models of effective practice that are shared and provide teachers with field tested clear vision of what best practices might look like, including lesson plans, etc. These models should be open access so they can be modified for various contexts, re-purposed and shared;
5. Coaching and expert support both during and after professional development;
6. Feedback and opportunities for reflection both during and after professional development; and
7. Adequate time for teachers to learn, practice, implement, and reflect upon new strategies that facilitate changes in their practice.

The literature suggests that when the factors presented above inform professional learning, professional development can begin to meet its intended purpose – the support for continuous learning amongst educators involved in educating our youth for both existing realities and addressing the potential and promise of changes suggested with the 4th Industrial Revolution. The recent OECD Learning Compass 2030 report identifies three transformative competencies that students need in order to "contribute to our world and shape a better future: creating new value, reconciling tensions and dilemmas, and taking responsibility" (OECD, n.d., p.1).

- When students create new value, they ask questions, collaborate with others and try to think "outside the box" in order to find innovative solutions. This blends a sense of purpose with critical thinking and creativity.
- In an interdependent world, students need to be able to balance contradictory or seemingly incompatible logics and demands, and become comfortable with complexity and ambiguity. This requires empathy and respect.
- Students who have the capacity to take responsibility for their actions have a strong moral compass that allows for considered reflection, working with others and respecting the planet.

We embrace the competencies identified in the OECD report, recognizing the strong connections amongst critical thinking, creativity, working with complexity and ambiguity, and developing empathy and learning Design Thinking and engaging in purposeful Making. Central to our approach of developing design challenges as provocations for design is the importance of situating the challenges within authentic contexts and real wicked problems and linking those challenges to integrated curriculum learning outcomes and just in time skill development.

A question driving our work is how can we prepare teachers to help their students achieve these competencies when the teacher themselves may not have achieved them? Hiebert (2018) describes a commonly held notion that you cannot expect someone to give something they do not have. Therefore, it appears that professional learning must attend to the gap in teacher knowledge and pedagogical understanding by providing meaningful professional development and access to relevant, open access resources in ways that model changed teaching and learning.

In our experience, the toolkits and open course shared in this paper provide ways to address the gap in teacher learning by incorporating many of the features shared previously that influence professional learning. Our toolkits and course are offered through Creative Commons licensing and therefore are freely accessed, downloaded and used by educators, globally. The goal of Creative Commons – "to increase the amount of openly licensed creativity in 'the commons'" (Creative Commons, 2019, **¶1**) is consistent with our belief that *None of us is as smart as all of us* (Japanese Proverb), recognizing when we share our thinking with others we can all grow both professionally and personally.

Research Design / Methodology

The research design for this paper was a challenge. Due to the nature of open access resources (the online toolkits and course), the researchers did not have access to user names or contact information. The toolkits were posted on various websites – none of which required unique log in information or application for a membership. The course is hosted by Open Schools BC – an agency within the provincial government so login and user data was not available. Therefore, the information informing this paper consists of limited amounts of data retrieved from some sites and anecdotal comments from professional development facilitators. In the next few months we will be expanding and connecting with educators who have participated in past events to gain a sense of the impact their professional learning has had on their teaching.

An area for further study, beyond the scope of this paper, is the exploration of the ways in which educators and academics can share their open resources to the widest audience. A challenge for our work was we initially used the platform ISSUU (https://issuu.com) for publishing and distribution. It allowed us to distribute the resources in a polished manner and distribute access via a link. As with many social software platforms, things change and access to editing, downloading PDF versions of documents and data analytics are no longer free and require premium membership. Additionally, many educators located in challenging contexts did not have robust enough Internet connectivity to read content online or the bandwidth to download it, even if access were possible, so ironically, print versions provide the most equitable access.

Discussion

In British Columbia, Canada, the Ministry of Education (MoE), working with provincial educators, renewed the K-12 curriculum, focusing on key Core Competencies, Big Ideas and Learning Standards rather than using the traditional approach of expressing content to be studied in the form of numerous smaller learning outcomes (https://curriculum.gov.bc.ca/curriculum/adst/core/introduction). One of the authors informed the direction the Applied Design, Skills and Technologies (ADST) curriculum, and it is this curriculum, along with the OECD Core Competency work and the global call for addressing learner needs concerning the 4th Industrial Revolution, that created the urgency for professional learning in the province.

The intent of ADST was to move away from the traditional view of "shop class" and reimagine ways in which the application of design and learning of the skills needed to use emerging as well as traditional technologies could support innovation and promote a 21st century economy in the province. ADST builds "on students' natural curiosity, inventiveness, and desire to create and work in practical ways. It harnesses the power of learning by doing, and provides the challenging fun that inspires students to dig deeper, work with big ideas, and adapt to a changing world (British Columbia Ministry of Education, 2015, ¶1). The ADST curriculum is a mandated curriculum in grades K-12, and it invites educators to teach in ways that they have not experienced as learners.

In support of this work, the authors, in partnership with the Industry Training Authority, Cove Ocean, and Aga Khan University, Institute of Educational Development – East Africa; have offered immersive professional learning experiences to over 6000 educators, globally, since 2013. These professional learning experiences focus on "elements we find to be critical to understanding the role Making can plan in … learning" (Crichton & Childs, p. 2). They provide opportunities for educators to experience Design Thinking and Making and begin to foster an intentional mindset needed to support changed practice. Figure 1 illustrates the thinking and experiences needed if educators are to personalize their learning and work toward developing an intentional

mindset and adopting Design Thinking and Making in their teaching, not just as a curricular connection but as a pedagogical stance.

Insert Figure 1

We use provocations such as design challenges or sample resource descriptions to nurture innovative and creative thinking and fuel curiosity, recognizing "design depends largely on constraints" (Eames, cited in Sutton, 2016, ¶3). Sutton elaborates, stating "Research on creativity and constraint demonstrates that, when options are limited, people generate more, rather than less, varied solutions—apparently because their attention is less scattered."

The workshops support the educators to extend their thinking in lateral and connected ways, linking existing practice to research informed ideas and curricular examples. As the educators become more empowered, they gain confidence and expand their capacity for risk taking and trying new things. It is through this supported immersive experience that we found that educators develop their own capacities to embrace innovation and make thoughtful change in their teaching and learning environments.

The *Taking Making into Classrooms toolkit* and companion online course were created, in part, to provide a scalable approach for professional learning capable of reaching the diverse and geographically dispersed educator population in British Columbia. Building from the work of Crichton and Carter (2015) and the immersive professional learning opportunities that work provided, the *Taking Making into Classrooms Toolkit* and the *Taking Making into Classrooms Companion Online Course* position Design Thinking and Making into specific curricular contexts, making links between pedagogical theory and actual classroom practice.

These resources help educators explore key components of Design Thinking and Making and provide them with resources, educational rationale, numerous grade appropriate, curriculum aligned design challenges, case studies, and multiple examples of ways to embrace the D (design) of ADST in their classrooms and their teaching practice. As is the practice with the other toolkits in this series, the *Taking Making into Classrooms* toolkit and online companion course are openly available, Creative Commons licensed and intended to be used, remixed and broadly shared. The online companion course is intended to provide educators with a way to both dig deeper into the *Taking Making* toolkit and translate that into their classroom practice. It has been designed with multiple pathways for completion, resulting in a certificate of completion that can be used as part of professional development credits.

Argument and Analysis

Data from the ISSUU site, where two of the toolkits are initially published, suggests in the last three years, there have been 92,925 instances where people have viewed the content online and 3703 instances where viewers have stayed online, exploring individual pages of content. Interestingly, the *Toolkit for Challenging Contexts*, which will be discussed later in this paper, was not downloaded during the period of time in which the content could have been, which reflects known issues with bandwidth and connectivity.

Since October 2017, in the absence of any official promotion or advertisement, 580 individuals have registered for online course. There are three course options, and data from the Ministry of Education reports:

- 256 individuals completed the 8 hour certificate
- 62 individuals completed the 5 hour Certificate
- 66 individuals completed the 3 hour Certificate

The toolkits are available on several websites hosted by industry partners and other institutions, so there is no way to track the number of downloads or viewings on those sites (i.e., https://skillsalberta.com/skills-exploration-days). It is also interesting to note in preparing this paper, we found that individual school districts are re-posting our content on their sites (i.e., http://learningcommons62.sd62.bc.ca/files/2019/02/Ocean-Toolkit-COVE-2019.pdf) which is absolutely consistent with our ideas around sharing. The resources have also been distributed on social media (i.e., Twitter and Facebook) and via individual email interactions.

Since 2013 when the first Maker Day workshop was offered and then documented in the Maker Day Toolkit 2 (http://media.royalroads.ca/owl/media/takingmakingwordpress/makerday-2-toolkit.pdf), we have created seven toolkits and offered immersive professional learning to over 6000 educators in Canada, Ghana, Tanzania, and South Africa. We have also provided several maker opportunities for school children using the design challenges included in the toolkit offerings.

Data from the BC Industry Training Authority (ITA), the primary funder for skills development and certification in British Columbia and the original supporter of our approach, suggests since the first events in 2013, there has been a steady uptake in participation. ITA had initially planned to focus its activities on students, but following the success of the 2013 teacher event and the shift in the Ministry of Education toward adoption of the ADST curriculum, funds were focused on the educators. In 2018, ITA felt that a critical mass of educators had engaged in the activities that funding could shift back to supporting teachers, if they had completed a professional learning activity (an immersive workshop or the online course), working with their students. As the Youth Outreach Lead for ITA stated, "I think you [author] were largely responsible for the growth of this movement" (Lisa Ayton, email communication, June 20, 2019).

Participants	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Student	30	80	523	691	2010	5018
Teachers	80	270	755	1266	534	Funding in this period was targeted to student projects not teacher learning.
Events	2	3	25	27	36	43

Additionally, ITA has set up "training for FNSA Educators [First Nations School Association – 106 educators from 44 schools] on a key programs that link trades and ADST goals through Design Thinking. ITA arranges two dates of Workshops. FNSA Educators write trades applications that include Youth Discover the Trades events. To date, 1287 students participated in Discover the Maker Way Projects.

Based on the continued requests for our facilitation and the encouragement to create additional resources and translate them into several languages (i.e., Kiswahili, French and Mi'kmaq), we believe our approach has been successful and our insistence on using Creative Common licensing and open access opportunities has served us and our educators well. As we write this paper, the *Ocean Toolkit* is being used across Canada, and 46 teachers committed three days of their summer vacation in 2018 to participate in first Maritime offering. Three workshops are planned for July 2019. In the three months since the Ocean Toolkit has been available, 143 people have visited the site (https://coveocean.com/download/16b8311c4c3d07949eb5df9927134cc1/COVE_OceanToolkit%20May%202019.pdf).

Implications for Practitioners

One of the authors has also taken this immersive professional learning approach into a variety of challenging contexts. We use the term challenging context in our work (Crichton, 2013) rather than more commonly used terms such as developing world, third world, global south, etc., recognizing challenging contexts exist everywhere, at various times and to various degrees. We define challenging contexts as settings in which individuals, due to a variety of circumstances, conditions or environmental constraints, do not have access to some or all of the components associated with a civil society (United Nations, n.d. a) and therefore are prevented or limited from reaching their potential.

A recent World Economic Forum article (Edmond, May 2019, ¶ 1 & 2) supports our position when it stated

> Picture a country where a fifth of the population lives in poverty. People have to choose between eating or heating their homes and children go to school hungry. Homelessness is rising. And basic services are in crisis, leaving many struggling to cope. This is the damning indictment, delivered by a UN official, not of a developing economy or war-torn nation but of the UK – the world's fifth biggest economy (cited in Veldhoen & Crichton, submitted, p. 2).

Taking Making Into Classrooms In Challenging Contexts: A Toolkit Fostering Curiosity, Imagination and Active Learning (Crichton & Nicolas, 2018) was developed with colleagues from the Aga Khan University - Institute of Educational Development, East Africa (AKU-IED, EA). There it is used in the master level teaching as a resource for

- Introducing the concept and pedagogy of maker spaces and facilitating making and educational resources;
- Teaching design thinking and the importance of developing a growth mind set;
- Promoting innovation in leadership for education; and

- Teaching educators in the Early Childhood Development program the importance of making and purposeful play and ways to make cultural relevant teaching and learning resources – this is done for both Med and outreach certificate course activities.

Since 2017, IED colleagues and one author have co-developed, with local instructors and administrators, makerspaces in two teacher training colleges. In those settings,

> The toolkit is borrowed quite extensively to the point where each has asked for more copies (unfortunately they do not have access to the online version- internet data is expensive). Primary users of the toolkit and makerspace are teachers and student teacher who were part of the programme and are using it to get ideas on resources they could develop" (Nicolas, 2019, email communication).

Currently, these makerspaces are used by local schools and college community. Nicolas reports there is evidence that the teachers are using the space to make teaching resources which was the intended use of both the toolkit and the makerspace.

- In Tanzania, the makerspace is used by 12 schools, each with 4 classes, so the space is impacting 4 teachers and almost 300 students. The college has about 300 student teachers and 10 instructors using the space.
- In northern Uganda the makerspace is used by 8 active schools, each with 4 classes, so the spaces is impacting 4 teachers and an average of 320 students. The college has about 500 students teachers and 7 instructors using the space.

Nicolas further reports, "We have gained mileage as IED and show case it [the toolkit] a lot as a resource we have developed to support schools in marginalized areas." The toolkit has also been used in IED's outreach program for rural educators who are completing an Early Childhood Learning certificate in Certificate in Educational Leadership and Management training program. Between the graduate and certificate programs, the toolkit has been used with almost 200 students.

We are heartened by the update of our work and the impact it has had both locally, nationally and internationally. Canada, like Tanzania and Uganda, cannot be complacent about the potential impact the 4th Industrial Revolution will have on education, economic stability and meeting the Sustainable Development Goals (United Nations, n.d. b). We believe it would be naïve not believe that education has a significant role to play, and we know sharing open access resources and professional learning models is both the right thing to do but also an essential way to disseminate knowledge in the 21st century.

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References

British Columbia Ministry of Education. (n.d.). Applied design, skills, and technologies. Retrieved from https://curriculum.gov.bc.ca/curriculum/adst/core/goals-and-rationale

British Columbia Ministry of Education. (August 2015). *Applied Design, Skills and Technologies Framewor*k. Retrieved from https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/pdf/applied-skills.pdf

Christian, J. (May 7, 2014). The way I was taught: In honour of teacher appreciated week, one of our teaching and learning specialists reflects on how three exceptional teachers shaped her as a person – and as an educator. *Teaching Tolerance Magazine*. Retrieved from https://www.tolerance.org/magazine/the-way-i-was-taught.

Creative Commons. (2019). *Use & remix*. Retrieved from https://creativecommons.org/use-remix/.

Crichton, S. (2013, June 26). *Leapfrogging pedagogy: A design approach to transforming learning in challenging contexts*. 8th International Conference on eLearning (ICEL 2012), Cape Town, South Africa.

Crichton, S. & Nicolas, W. (2018). Taking making into classrooms in challenging contexts: A toolkit fostering curiosity, imagination and active learning. Available from https://issuu.com/ubcedo/docs/tmintocc_25may2018

Crichton, S. & Carter, D. (2015). Taking making into the schools: An immersive professional development approach. In M. Niess & H. Gillow-Wiles (Eds.). *Handbook of Research on Teacher Education in the Digital Age*. Hershey, PA: IGI Global, pp. 412 – 438

Crichton, S. & Carter, D. (2015). *Maker Day Toolkit* v2. Retrieved from http://innovativelearningcentre.ca/our-space/maker-days/maker-day-toolkit/

Crichton, S. & Childs, E. (2016, October). *Taking making into schools through immersive professional learning - Research findings on an immersive professional development model.* European Conference on eLearning, Prague, Czech Republic.

Darling-Hammond, L., Hyler, M., & Gardner, M. (June 2017). *Effective teacher professional development.* Palo Alto, CA: Learning Policy Institute. Retrieved from https://learningpolicyinstitute.org/sites/default/files/ product-files/Effective_Teacher_Professional_Development_REPORT.pdf

Dewey, J. (1938). *Experience and education*. New York: Collier Books.

Edmond, C. (May 24, 2019). The UN went to one of the world's richest countries to look at poverty – This is what it found. *World Economic Forum.* Retrieved from https://www.weforum.org/agenda/2019/05/the-un-went-to-one-of-the-worlds-richest-countries-to-report-on-poverty-this-is-what-it-found/.

Hiebert, G. (2018). *You can't give what you don't have: Creating the seven habits that make a remarkable life.* Grayline Publishing.

Martinez, S. & Stager, G. (2013). *Invent to learning: Making, tinkering and engineering in the classroom.* Torrance, CA: Constructing Modern Knowledge Press.

Open School. (2019). *Taking making into classrooms*. Retrieved from https://www.openschool.bc.ca/show_takingmaking/.

OECD (n.d.). *In brief: Transformative competencies for 2030*. Retrieved from http://www.oecd.org/education/2030-project/teaching-and-learning/learning/transformative-competencies/in_brief_Transformative_Competencies.pdf

Owens, S. (2013). We teach how we've been taught: Expeditionary learning unshackling sustainability education in U.S. public schools. *Journal of Sustainability Education.* Vol. 5, pp. 1 – 9.

Papert, S. & Harel, I. (1991). Situating Constructionism. In S. Papert & I. Harel. *Constructionism.* New York: Able Publishing Corporation.

Sutton, B. (June 9, 2016. *Want some creativity? Crank-up the constraints*. Stanford d.school. Retrieved from https://medium.com/stanford-d-school/want-some-creativity-crank-up-the-constraints-5728a988a635

United Nations (n.d. a). *Civil society*. Retrieved from https://www.un.org/en/sections/resources-different-audiences/civil-society/.

United Nations (n.d. b). *Sustainable development goals*. Retrieved from https://sustainabledevelopment.un.org/?menu=1300

Veldhoen, K. & Crichton, S. (Submitted). *Expanding Notions of Literacy: Developing Creative Commons Resources to Cultivate 21st Century Literacies.* Paper submitted for the Pan Commonwealth Forum 9, Edinburgh, Scotland.

Figure to be inserted in the text

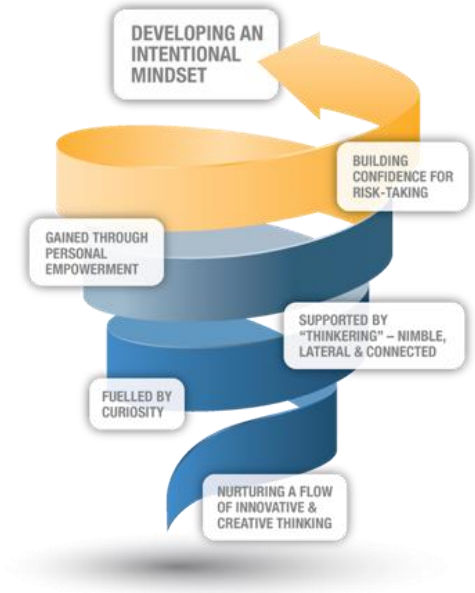

Figure 1: Fostering an Intentional Mindset