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# Full STEAM Ahead: Building Preservice Teachers' Capacity in Makerspace Pedagogies

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# FULL STEAM AHEAD: BUILDING PRESERVICE TEACHERS'

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### Abstract

The classroom landscape is changing rapidly with schools transitioning to bring your own device (BYOD) programs as a way to engage students and to prepare them for the real world. As a result of increased technology in the classrooms, there has been a shift in pedagogy to a more student-centered model. Students now have increased autonomy over the tools they use in class to complete assignments and they have ubiquitous access to information from the Internet. As a result, teachers are being repositioned in the classroom as facilitators and guides in the learning process. Classrooms have become transformation-based, rather than transmission-based learning environments. However, some pre-service teacher education programs do not always adequately prepare teacher candidates for this reformed teaching and learning structure that draws heavily on technology, collaboration and problem-based learning (Horizon Report, 2015, p. 28). One way to address the upskilling of pre-service and in-service teachers is to offer them professional development in the area of makerspaces as these are creative, educational, collaborative spaces that capitalize on current technology and help prepare students with the kinds of skills required for active participation in modern society – politically, socially and economically. The 2015 Horizon report indicates that “Makerspaces are places where anyone, regardless of age or experience, can exercise their ingenuity to construct tangible products. For this reason, many schools are seeing their potential to engage learners in hands-on learning activities” (p. 38). The educational benefit of makerspaces reflects a clear need for professional development for pre-service and in-service teachers and a pressing need to simultaneously incorporate makerspaces into schools to keep pace with society and students’ out-of-school literacy practices.

This paper explores teacher candidates' understandings of 1) makerspace/constructionist pedagogies; 2) the issue of bullying; and, 3) working with at-risk youth, as they evolved over the course of a six-month partnership. The partnership included researchers and teacher candidates at a Faculty of Education and the teacher librarian at a local elementary school who were participating in a larger Social Sciences and Humanities Research Council of Canada (SSHRC)-funded project that focuses on building, implementing and evaluating an effective model for a school improvement program that increases teachers' capacity, experience and specific fluency and expertise with technologies supporting STEAM learning and digital literacies. In this paper, we discuss qualitative ethnographic case study research, which examines in depth the experiences of five teacher candidates as they worked with 20 students in a grade 6 class in a high needs school on makerspace activities related to bullying prevention in their school community. Qualitative research documentation includes digital video and audio recordings, on-the-ground field notes and observational notes, pre and post interviews with participants and focus group sessions. Results from this study contribute new knowledge in the areas of preservice teacher development and digitally-enhanced learning environments for K-6 learners.

*Keywords:* makerspace/production pedagogies, preservice teacher education, bullying prevention, at-risk youth

## Full STEAM Ahead: Building Preservice Teachers' Capacity in Makerspace Pedagogies

### **Introduction**

The classroom landscape is changing rapidly with schools transitioning to BYOD programs as a way to engage students and to prepare them for the real world. As a result of increased technology in the classrooms, students now have increased autonomy over the tools they use in class to complete assignments and they have ubiquitous access to information from the Internet. As a result, teachers are being repositioned in the classroom as facilitators and guides in a transformation-based learning environment. However, some teacher education programs do not always adequately prepare teacher candidates for this reformed teaching and learning structure that draws heavily on technology, collaboration and problem-based learning (Johnson, Adams Becker, Estrada & Freeman, 2015, p. 28). One way to address the upskilling of pre-service and in-service teachers is to offer them professional development in the area of makerspaces as these are creative, educational, collaborative spaces that capitalize on current technology and help prepare students with the kinds of skills required for active participation in modern society – politically, socially and economically.

This research addresses the need for concerted attention by faculties of education to the conceptual and operational challenges of assuring “digital literacy” across the digital divide. This school-university collaboration aims to bring the resources and expertise of all partners directly to bear on addressing the “digital divide” evidenced in low socio-economic status (SES), high need schools. The partnership in this project involves a small group of preservice teachers and a class of high needs elementary students in a local public school. This study is part of a larger school improvement SSHRC-funded project that focuses on how a university-school partnership intervention might have a significant impact on student achievement in literacy and the

development of digital literacy. For the purposes of this paper, we focus on a specific program intervention that took place over the course of three months, in which five teacher candidates in an initial teacher education program worked with 21 grade six students on a variety of “maker” activities. The overarching goal of the study was to investigate how teacher candidates might use digital tools to induct this group of under-performing students into a community of practice and improve student achievement. More specifically, we examined how the use of maker pedagogies might potentially transform their teaching, while at the same time, help them reframe their constructions of “at-risk youth” and prepare them to address social challenges such as bullying.

The 2015 Horizon report indicates that “Makerspaces are places where anyone, regardless of age or experience, can exercise their ingenuity to construct tangible products. For this reason, many schools are seeing their potential to engage learners in hands-on learning activities” (Johnson et al., 2015, p. 38). The educational benefit of makerspaces reflects a clear need for professional development for pre-service and in-service teachers and a pressing need to simultaneously incorporate makerspaces into schools to keep pace with society and students’ out-of-school literacy practices. In this research project we explore teacher candidates’ understandings of: 1) makerspace/constructionist pedagogies; 2) the issue of bullying; and, 3) working with at-risk youth, as they evolved over the course of a three-month partnership. The partnership included researchers and teacher candidates at a Faculty of Education and teachers and the teacher-librarian at a local elementary school.

### **Makerspace Pedagogies**

Halverson and Sheridan (2014) define the maker movement as “the growing number of people who are engaged in the creative production of artifacts in their daily lives and who find physical and digital forums to share their processes and products with others” (p. 496). The

maker movement is associated primarily with STEM or STEAM education (where there is a focus on embedding the arts into science, technology, engineering and math); however, maker pedagogies more generally, promote important principles including inquiry, play, imagination, innovation and design thinking, critical thinking, problem solving, collaboration, and personalized learning. A current need in this area is to define best practices and to better understand how to utilize making for the purpose of learning (Halverson & Sheridan, 2014).

DIY paradigms have recently re-emerged and have gained popularity as a medium for creative expression (Buechley, Eisenberg, Catchen & Crockett, 2008; Buechley & Perner Wilson, 2012; Kuznetsov & Paulos, 2010; Tanenbaum, Williams, Desjardins & Tanenbaum, 2013) and self-directed learning (Martinez & Stager, 2013; Qiu, Buechley, Baafi & Dubow, 2013; Kafai et al., 2014). The maker movement for education has broadened the level of participation in DIY activities across several demographics leading to increased activity in terms of creation of new makerspaces for practicing hands on learning, encouraging girls to participate in STEM activities, and generally placing emphasis on the idea that every child can become an innovator (Halverson & Sheridan, 2014). Situated within a constructionist approach to education (Papert & Harel, 1991), making bridges the physical processes of constructing with digital media. Making with digital media is not new in education; teachers have been working with their students to create digital stories and other digital texts for many years now. However, access to user-friendly digital tools is making it easier for students to create multimodal, multimedia content, positioning them as producers rather than just consumers (Hughes & Morrison, 2014; Groff, 2013). Unlike more traditional instructionist approaches to learning (where the knowledge to be received by students is already embedded in objects delivered by teachers), constructionist learning encourages learners to learn from their own active engagement with raw materials.

Central to the makerspace movement are questions concerning impact, implementation, and influence, including: *How do these spaces impact student learning? How might they promote civic engagement, innovative and design thinking and entrepreneurship? What makes school-based makerspaces distinct from community makerspaces? How can they promote equity and sustainability in education?*

In our study, the form of civic engagement which underpinned the makerspace activities was bullying prevention – a topic which emerged as one of importance to the students involved with our study, and one which has garnered increasing attention from schools and school boards due to the prevalence of this form of school violence (Nansel, Haynie & Simons-Morton, 2007; Zins, Elias & Maher, 2007). Surveys consistently indicate that almost one-quarter of all students experience hurtful interactions with peers on a monthly or daily basis (e.g., Farrington & Tfofi, 2009). Research indicates that multifaceted approaches to reducing bullying in schools are more likely to succeed than single-component programs. This includes a school-wide component centered on awareness, monitoring, and assessment of bullying; a classroom component focused on building social and emotional skills, such as social problem solving and empathy (Ragozzino & O'Brien, 2009); and an intervention component for students who are frequent targets or perpetrators of bullying. Our focus for the makerspace was on the classroom component where we aimed to build not only awareness but also social and emotional skills such as problem solving, conflict management and empathy amongst the students. Each week we introduced discussions and activities centres on these themes. Activities promoted a peer-to-peer empowerment approach via students' making of specific items intended to raise awareness and promote positive messaging across the school (e.g., wearable tech, digital posters, infographics). Studies indicate that when children and youth receive messages from their peers and not

'authority figures' they relate more to the messages (Farrington & Tfoto, 2009). Therefore, peer programs can have statistically significant effects on attitudes, norms, knowledge, behaviors, and health and achievement outcomes (Advocates for Youth, 2015). One of the goals of peer-to-peer promotion of bullying prevention messages was to help foster students' sense of community and different ways they could see themselves as belonging in, and leaders of, a positive school community.

Previous attempts to address bullying have not met with much success at this particular school. Though signs are posted as visitors enter, noting that the school has a “zero-tolerance policy” for bullying, there are still incidents and the school has garnered a reputation as a school in which bullying occurs. The new administration at the school is committed to tackling the issues and identified an anti-bullying program intervention as a thematic priority in our partnership. They indicated that they wanted to reverse the negative associations with bullying at the school. The school itself is recognized as “high needs”, with significant populations of students who were considered “at-risk”, who came from troubled backgrounds and low SES households, who struggled with mental health and learning challenges, or who were labeled as poorly socially adapted. Giving children and youth opportunities to act as agents of change can be empowering (e.g., Morton & Montgomery, 2013), and can foster perceptions of self-efficacy, influence and control, and skills and prospects to effect change (Zimmerman, 2000). By introducing students to a makerspace environment, we hoped to help encourage empowerment, expression of voice, as well as the development of important social and emotional skills, such as conflict management and both social and digital problem solving.

## **Methodology**

Since this research focused on the transformation in teaching practices and student learning, an ethnographic case study approach was suitable. The researchers were immersed in the case, leading classroom activities and discussions, and thereby accumulated local knowledge.

## **Participants and Context**

This study involved five pre-service teacher candidates (three female and two male) and 21 grade six students from a nearby school, located in a “priority neighbourhood” (an area identified by the Region’s Health Department as a low income community that requires focus to build on health and well-being). The school is centrally located within an area identified as at “high risk” as determined by the Region’s Social Risk Index, which indicates that the area has the lowest average household income and lowest proportion of owner-occupied dwellings. In addition, the community has a very high number of lone parent families and a high reliance on government support payments. The unemployment rate is also high in proportion with the rest of the Region. According to the “Report Card on Ontario’s Elementary Schools 2015” (Cowley & Easton, 2015), our partner school was ranked in the bottom 3% over the past five years. Based on grade three and grade six provincial tests, the school received an overall rating of 4.8/10 in 2014 – a failing grade, though this increased from 3.7/10 in the previous year and from 0.8/10 in 2011.

One of our primary goals was to provide opportunities for students in low income areas with hands on experiences with digital technologies and DIY/Maker activities. Though most of our sessions took place in the school’s library, we also invited the students to our STEAM 3D Maker Lab at the Faculty of Education as a way to familiarize students with the idea of having a (future) place in the university. The students with whom we worked were primarily from families who had never gone on to post-secondary education.

Following Swadener (2010), we agree that the term “at-risk” has been overused and tends to suggest a deficit model, positioning these youth as “other” in “dominant education and policy discourses” (p. 8). While we recognize that the students we worked with in our study do, by the nature of their unfortunate circumstances, “inhabit the ‘margins’ of contemporary society and are systematically excluded from many of its benefits” (Swadener, 2010, p. 8), we choose to think of them as “at promise” for success, rather than “at risk” of failure (Swadener, 2010, p. 9). We also draw upon the work of Nel Noddings (2007) and Tom Cavanagh (2004) to explore how teacher candidates might work to address two education gaps simultaneously – achievement and discipline -- through culturally responsive pedagogy and a commitment to a “culture of care”.

Of the 21 grade six students in the class, 10 of them have Individual Education Plans (one for behaviour, two for a language impairment and seven for learning disabilities). There are also two integrated students from a treatment class who attended each session. The students had a range of experience with, and access to, technology and different digital tools both at home and in school from previous grades. The students’ digital literacy skills also ranged significantly. The preservice teacher candidates were in the second semester of a four semester initial teacher education program. Involvement of all participants in this study was voluntary.

### **Research Design and Process**

Through an integrated STEAM-based curriculum, with a thematic focus on bullying and making, the students explored ways to create awareness in their school about bullying and to make tangible and digital artefacts to this end. In doing this, our project was divided into two iterations. The first iteration consisted of eight sessions and focused primarily on understanding bullying, the various roles involved and the difference between positive and negative power. As we write this paper, we are currently involved in the second iteration and will only be reporting

on the first. In the first iteration, the preservice teachers collaborated on lesson plans with members of the research team. They then tailored the lessons based on weekly goals. Every week, the team worked with the grade 6 students in the school library, for 2.5 hours each session. The students, led by the pre-service teachers, engaged in a wide range of activities, including digital poster-making using PicCollage and the Pages App; digital infographic-making using Piktochart; creating wearable tech pieces (hats, t-shirts, bags) using Arduino LilyPad; button-making using WordSwag and a button press and photography/videography using the photo/video apps on the iPad Air. We did this to encourage the students' development of digital literacies skills. Most of the above mentioned programs and apps were accessed/used on iPad Airs that we loaned to the students at the beginning of the project, and which they used both during the project and at different times in their regular classrooms.

In order to begin the process of building community and cohesiveness in the group, and to get them thinking about the issues surrounding bullying and how we can agentively respond or address these issues through making, we began the first iteration identifying items such as: who are we as a group and what are our goals as a maker club? We also identified and discussed various bullying-like scenarios that have occurred in either their classroom or school that we could address through the club. The next few sessions focused on exploring the difference between positive and negative power; learning how to communicate through different digital and multimodal tools, such as learning about circuits and how they could be used to create real-world artefacts that spread a positive power message. In whole-class and small groups, students were taken through a variety of discussion-based, written-/research-based and kinesthetic activities that guided them toward an understanding of bullying and the makerspace tools. Sessions aimed

to be student-centred and inquiry-based, and were book-ended by warm-up and debrief activities to further encourage the development of a classroom community and critical reflection.

### **Data Sources**

Throughout the project, the researchers recorded detailed field notes, collected the preservice teachers' planning notes and reflections, still images/video recordings of their interactions with the students and classroom conversations. The researchers also engaged in informal discussions with the teacher candidates and teacher-librarian, of which noteworthy points, themes, ideas or feedback were recorded through text or voice recorder. We also conducted a set of open-ended interviews asking the preservice teachers to discuss what they learned about using maker pedagogies to address the theme of bullying with the students, and what they learned about working with these particular students. Thematic coding (Miles & Huberman, 1994) and cross-case analysis were used when examining the data sources. During the data analysis, we were particularly interested in what Bruner (1994) identifies as 'turning points,' looking for areas where the teacher candidates presented increased confidence or "aha moments" in their work with the participating youth. Results from this study contribute new knowledge in the areas of pre-service teacher development and digitally-enhanced learning environments, specifically related to maker pedagogies, for middle school learners.

### **Findings**

Our focus here is the impact this partnership had on the teacher candidates and below, we share their perceptions of the success of the Full STEAM Ahead intervention. Not surprisingly, the primary challenge identified by the teacher candidates was building a trusting relationship with the students. Although many of the students in the class were on Individualized Educational Plans (IEPs) for various reasons, planning and facilitating inquiry-based lessons according to

individual student needs was not a major concern for them. The teacher candidates struggled to achieve a balance between maintaining high academic expectations and providing “too much” help to students, who gave up quickly in the beginning. Over the course of the intervention, the students became less reluctant to exploring new ideas and opportunities, and began to take more ownership over their learning. The most pressing issues for the teacher candidates were not related to curriculum content or technology use, but rather how they might support the students, help them gain confidence and provide them with an experience that might create a more positive disposition toward learning. To do this, they had to confront their preconceptions about “at-risk” youth. Re-thinking adolescence in general, and the notion of “at-risk youth” in particular, involved a reframing of adolescence/ts as a social construct (Lesko, 2012; Sarigianides, Lewis & Petrone, 2015).

### **Teacher Candidates’ Perceptions of Using Makerspace Pedagogies with this Group**

The teacher candidates saw both benefits and challenges in using maker pedagogies with the students. They all noted the power of inquiry-based learning, allowing students to explore a variety of technologies and giving them autonomy in choosing the tools they feel might be the best fit for what they wanted to make. Connected to this, the teacher candidates felt that this approach promoted creativity, because students were able to design their own tangible products based on the raw and digital materials available to them. Interestingly, the students struggled at first in the e-textiles segment of the project to design a wearable that promoted an anti-bullying message. It was not until we presented them with the array of materials available that they began to develop some concrete ideas and plans. Lindsay (all names are pseudonyms) observed that presenting the students with the raw materials (canvas tote bags, t-shirts, hats, gloves, bookmarks, wristbands) made the activity more “relevant to their age and interests” and acted as

a catalyst to “get them hands-on creating and making things”. All of the teacher candidates agreed that having students produce a tangible product engaged them in the activity of sewing circuits because “they [were] able to see their accomplishments” (Richard).

The teacher candidates also noted that the makerspace activities promoted collaboration and problem solving, two skills that were particularly important for this group of students. Bruce observed, “I can see that students are exploring, they're discussing, they're questioning each other, they're coming up with solutions, they're using all of those observation and exploration skills that are super important in today's education”. Lindsay noted that participating in this project helped her think about how to “combine curriculum expectations with makerspace activities” in order to make her lessons “much more engaging and enjoyable”.

Although they focused on the benefits of makerspace pedagogies, the teacher candidates did mention some of the challenges they witnessed during the project. The biggest challenge they identified dealt with managing the materials and technologies. Programs or apps we wanted to use on the iPads worked when tested at the University; however, when we tried to use the same apps at the school, the school district filters were often an impediment, either blocking us completely or requiring us to do demonstrations with a projector and school laptop. The teacher candidates learned very quickly that everything has to be tested at the school in advance; they also learned how to problem solve and find work-arounds. An added challenge was monitoring the progress of each student. Maker pedagogies promote individualized learning and students are encouraged to work at their own pace; however, logistically this was more difficult than it might be with regular meetings as we were only at the school once a week. At the beginning of each session, we introduced new activities and allowed students who had not completed the previous week's project some time to do so. As such, students were sometimes working on different tasks.

Keeping students on task was another challenge mentioned by the teacher candidates. Richard observed, “At times it was hard to keep the students motivated to do their work” and noted that when we did the e-textiles work, some of the students were frustrated by their “fine motor hindrances” (threading a needle, tying a knot in thread), which caused them to abandon their projects. He observed that some of the other teacher candidates were doing these tasks for the students to help them, but he suggested that it is “important for the teacher to plan projects with their interests in mind and to have alternatives for them” because he felt that “the student should have full control of making it themselves”. In a focus group session, the teacher candidates agreed that it would have been beneficial to scaffold the e-textiles session by having the students sew buttons onto a piece of fabric first. There was some debate about whether this is necessary if the principles of maker pedagogies include “just in time” teaching and learning by doing; however, in the end, they confirmed that they would build in more scaffolding when they worked with their own future students.

For this group of 21 students, most of whom do not own personal mobile devices, the iPads sometimes became distractions rather than learning tools. All of the teacher candidates observed that the students were taking selfies and playing with the photo booth feature and asking Siri questions. One teacher candidate noted that at the beginning he saw this as a “nuisance” but later realized that the questions they were asking Siri were often related to the task. For example, students who wanted to search for information but had difficulty with spelling could orally ask Siri to search for something they needed. Near the end of the project, students created posters with messages related to conflict resolution, problem-solving and anti-bullying using Pages, Vanilla Pen and/or WordSwag apps. We showed them how to airdrop the final posters to a central laptop for printing. Within minutes the students were airdropping photos of

themselves to everyone else in the class causing chaos for the teacher candidates who were trying to collect the posters. These are indeed some of the challenges of using iPads in the classroom; however, they also served as valuable learning experiences for the teacher candidates. They discovered very early on to capitalize on the students' interests in selfies, for example, by building the use of selfies into the lesson design. They asked students to take a selfie to represent how they felt about their learning at the end of a session and they suggested that students include selfies in their posters, buttons and other creations.

### **What Teacher Candidates Learned About Bullying and Bullying Prevention**

When reflecting on issues of bullying and bullying prevention, teacher candidates seemed to focus primarily on challenges they observed and experienced. The importance of students understanding what constitutes bullying, was raised. Lindsay felt that “before bullying can be discussed, students need to understand exactly what it means to be a bully and to be bullied”. Appreciating differences between bullying behaviour and other kinds of negative behaviours was important and took time for both teacher candidates and students. Lindsay pointed out that “issues surrounding bullying need to be addressed and discussed on a regular basis” and that “students often consider bullying to be physical, rather than mental or verbal.” Similarly, Bruce noted the importance of enforcing appropriate messages around bullying, though he acknowledged that students “know a lot, they’re well-informed”. Bruce observed that bullying was part of “the reality of the students that we’re working with” and that “it’s not beyond their area of thinking” though they seemed focused on “the bigger stuff” such as “aggression... violence... guns in schools”. One of the challenges noted by Bruce was in raising awareness that bullying also includes smaller, everyday events that are persistently acted out. In reflection, he commented: “I don’t think that they’re really truly grasping that the monotonous little pushing

and nitpicking” is “where it starts and then it evolves”. However, he was optimistic that over time, the connections would thicken as students were “right on that edge... of you know, really understanding how this... how this constant bickering really impacts them”.

The nature of bullying as a repeated offense was not necessarily well understood by students or teacher candidates, and teacher candidates in particular struggled to disentangle what might be considered bullying behaviour from the students from other kinds of acting out. For example, Richard observed a disconnect between lesson emphases on bullying prevention and students’ in-class behaviours. While he observed that “some good answers did come out” during discussion, he “did not notice a big change in how they [the students] treat each other and even the TCs”. Richard commented on students’ inattentiveness and ways of working that contrasted with his own expectations for student learning. He lamented that “there were times where they [the students] did not listen or include the TCs in their discussions and would ‘shun’ us out.” Richard seemed to have implicit expectations for how the students and teacher candidates should interact in a community of learners, some of which seemed to contradict his expectations for makerspace pedagogies. Whereas Richard felt that students “should have full control of making”, he also clearly felt a desire to be part of the learning and not be “shunned out”. For Richard, a potential conflict seems to exist between his desire to promote independence and student ownership and his desire to feel included in his role as an instructor.

Teacher candidates’ reflections highlighted some of the complexities of addressing issues of bullying and bullying prevention in our study in particular, but also in general. The recognition that students are “well-informed” about bullying via their lived experiences as well as the availability of information through media sources speaks to the challenge of consistent messaging. On a general level, students see and hear about bullying from sources both within

and outside of their school experiences, and these experiences can contribute to tacit understandings and expectations about bullying that may not align with intended learning goals. In our particular case, the challenge of reinforcing particular messages on a regular basis was further complicated by the fact that we were only with the students once a week. The content of lessons, the ways of interacting between instructors and students, and the makerspace pedagogies that were enacted in our visits were at times starkly different from what students were experiencing throughout their school week. Students were thus constantly adjusting between expectations and normative standards, not all of which were explicitly communicated to them.

### **What Teacher Candidates Learned About Working with At-Risk Youth**

That which really stood out for teacher candidates when reflecting on their experiences with at-risk youth was the importance of relationship-building via listening. Lindsay observed that “students require support in many different areas”, a sentiment which was echoed by Richard who commented that “there will always be students that come into your classroom with some sort of baggage.” For both teacher candidates, it was important to cultivate a “safe environment’ (Richard) where students “felt as ease” and “felt they could discuss their home life with us” (Lindsay). An essential part of cultivating such an environment was a willingness to listen, which teacher candidates noted might not always be available: “often students just need someone who can listen to them” (Lindsay) and “sometimes they just need that one person that will listen to them” (Richard). Actively listening to students’ concerns afforded Lindsay opportunities to encourage “students to reflect on the situations as a group so it turned into a learning experience for them”. Richard noted the personal reward associated with developing connections with students through listening: “knowing that I made that much of an impact in such a small time... keeps me going and loving to work with at-risk youth.”

For many of the teacher candidates, this was a first experience working with at-risk youth and it broadened their awareness of “working with different kinds of students, different types of learners” (Bruce). It was eye-opening for Richard that at-risk youth were “so close to home”, and he noted that “when we think about poorer families or families that are not well off, we do not think of [our neighbourhood]”. Appreciating the variety of learners in a class, and how “every single one of these individuals is different” (Bruce) impacted how some of the teacher candidates tried to forge relationships with the students, though for the most part they saw the students as “no different than any of [their] practicum students” (Bruce). A tension arose between Bruce’s recognition of the students as “a high-needs group” with different needs and a desire to apply “a universal kind of approach”. While Bruce acknowledged that “of course you have to adjust” and that “there is (*sic*) underlying things, and there’s history or whatever” he nevertheless felt that “it’s very similar in the overall management of how I would manage them”. As mentioned previously, teacher candidates were not overly concerned with meeting students IEPs and it is possible that this contributed to the perspective that “how and what you want the students to get out of it [the learning] should be the same” (Bruce). Underlying these tensions was a belief of Bruce’s that it was important for all students to experience the “important skills of today’s education” which are available through a makerspace environment and which are accessible even to struggling or disadvantaged students: “Am I able to pull these individuals in the same way I’ve been able to pull my practicum group? No. This has been a lot more challenging... Do things happen as quickly? No. Do they happen? Yes.”

### **Conclusion**

This study points to the importance of providing preservice teacher candidates with additional opportunities to work with students who need extra support. These kinds of school/university partnerships provide win/win situations for teacher candidates, classroom teachers, students and the larger school community. The localized nature of this program, which focused on a class of high needs students in a targeted intervention program, enabled us to couple community outreach with deep learning for both preservice teachers and the students.

## References

- Advocates for youth (2015). Peer programs: Looking at the evidence of effectiveness, a literature review. Retrieved from <http://www.advocatesforyouth.org/publications/publications-a-z/1856-peer-programs-looking-at-the-evidence-of-effectiveness-a-literature-review>
- Bruner, J. (1994). 'Life as narrative', in A.H. Dyson, C. Genishi (eds). *The Need for Story: Cultural Diversity in Classroom and Community*, Urbana, IL: NCTE.
- Buechley, L., Eisenberg, M., Catchen, J., & Crockett, A. (2008). The LilyPad Arduino: using computational textiles to investigate engagement, aesthetics, and diversity in computer science education. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, 423–432.
- Buechley, L. & Perner-Wilson, H. (2012). Crafting technology: Reimagining the processes, materials, and cultures of electronics. *ACM TOCHI* 19(3).
- Cavanagh, T. (2004). Creating a Culture of Care in Schools Using Restorative Practices. Paper presented at *New Frontiers in Restorative Justice: Advancing Theory and Practice*, Centre for Justice and Peace Development, Massey University at Albany, New Zealand.
- Cowley, P. & Easton, S. (2015). Report Card on Ontario's Elementary Schools 2015. Fraser Institute. Available at: <https://www.fraserinstitute.org/studies/fraser-institute-report-card-spotlights-fastest-improving-elementary-schools-ontario>
- Farrington, D. P., & Ttofi, M. M. (2009). School-based programs to reduce bullying and victimization. *Campbell Systematic Reviews*, 6.
- Groff, J. E. (2013). Expanding “our frames” of mind for education and the arts. *Harvard Educational Review*, 83(1), 15-39.

- Halverson, E. & Sheridan, K. (2014). The maker movement in education. *Harvard Educational Review*, 84(4), 495-504.
- Hughes, J. & Morrison, L. (2014). At the intersection of critical digital literacies, YAL and literature circles. *ALAN Review*, 42(1), 35-43.
- Johnson, L., Adams Becker, S., Estrada, V., and Freeman, A. (2015). *NMC Horizon Report: 2015 K-12 Edition*. Austin, Texas: The New Media Consortium.
- Kafai, Y., Lee, E., Searle, K., Fields, D., Kaplan, E., & Lui, D. (2014). A crafts-oriented approach to computing in high school: Introducing computational concepts, practices, and perspectives with electronic textiles. *ACM TOCE 14*, 1.
- Kuznetsov, S. & Paulos, E. (2010). Rise of the expert amateur: DIY projects, communities, and cultures. In *Proc. of NordiCHI*. ACM, 295–304.
- Lesko, N. (2012). *Act Your Age! A Cultural Construction of Adolescence*. 2<sup>nd</sup> ed. New York: Routledge.
- Martinez, S.L. (2013). *Invent To Learn: Making, Tinkering, And Engineering In The Classroom*. New York: Gary S. Stager.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded source book* (2nd ed.). Newbury Park, CA: Sage.
- Morton, M. H. & Montgomery, P. (2013). Youth Empowerment Programs for Improving Adolescents' Self-Efficacy and Self-Esteem: A Systematic Review. *Research on Social Work Practice*, 23 (22) DOI: 10.1177/1049731512459967
- Nansel, T. R., Haynie, D. L., & Simons-Morton, B. G. (2007). The association of bullying and victimization with middle school adjustment. In J. E. Zins, M. J. Elias, & C. A. Maher (Eds.), *Bullying, victimization, and peer harassment* (pp. 49-65). Haworth Press.

Noddings, N. (2007). *When school reform goes wrong*. New York, NY: Teachers College Press.

Papert, S. & Harel, I. (1991). Situating constructionism. *Constructionism* 36, 1–11.

Qiu, K., Buechley, L., Baafi, E., & Dubow, W. (2013). A curriculum for teaching computer science through computational textiles. In *Proc. of IDC*. ACM, 20–27.

Ragozzino, K. & O'Brien, M (2009). *Social and Emotional Learning and Bullying Prevention*.

Sarigianides, S., Lewis, M. & Petrone, R. (2015). How Re-thinking Adolescence Helps Re-imagine the Teaching of English. *English Journal*, 104(3), 13-18.

Swadener, B. (2010). "At Risk" or "At Promise"? From Deficit Constructions of the "Other Childhood" to Possibilities for Authentic Alliances with Children and Families, *International Critical Childhood Policy Studies*, 3(1), 7-29.

Tanenbaum, J. G., Williams, A. M., Desjardins, A., & Tanenbaum, K. (2013). Democratizing technology: pleasure, utility and expressiveness in DIY and maker practice. In *Proc. of the SIGCHI*. ACM, 2603–2612.

Zimmerman, M. (2000). Empowerment theory: Psychological, organizational and community levels of analysis. In J. Rappaport, & E. Seidman (Eds.), *Handbook of community psychology* (pp. 49-64). New York, NY: Kluwer Academic/Plenum Publishers.

Zins, J. E., Elias, M. J., & Maher, C.A. (Eds.). (2007). *Bullying, victimization, and peer harassment*. New York: Haworth Press.