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MAKING IT WORK: MAKERSPACES, MAKER COMMUNITY AND HIGH SCHOOL PARTNERSHIPS

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Abstract

This study examines the benefits and challenges of creating partnerships between schools and their local maker community. Makerspaces are dedicated facilities for individuals to create products with specialised tools that vary greatly in different spaces. This paper focuses on makerspaces with technologies that facilitate fabrication. Based on interviews, we describe the benefits and challenges of makerspace-high school partnerships and the potential partnership between makerspace and technical schools. In high schools, makerspaces provide students with equipment to discover problems, explore ideas and gain self-confidence. In the community, makerspaces provide patrons with opportunities to develop making skills, collaborate, generate new economic activity, and build community. Despite having similar objectives, the needs of high school makerspaces and public makerspaces are vastly different. Hence, school-makerspace partnership attempts in Victoria, Australia have often been difficult to implement and more importantly, sustain.

Keywords: maker community, school partnerships, makerspaces, tech school

Making it Work: Maker Community and High School Partnerships

Over the last two decades, the Maker Movement has witnessed tremendous growth around the world. In Australia, this growth is evident in the appearances of makerspaces in local communities (Deloitte Australia, 2014), public libraries (Boyle et al., 2016), universities (Wong & Partridge, 2016) and schools (Education Services Australia, 2018). This is unsurprising, as researchers have identified plenty of benefits associated with makerspaces. Examples include helping individuals develop self-awareness (Fasso & Knight, 2020), offering new learning opportunities (Hsu et al., 2017), and fostering communities (Taylor et al., 2016). While most existing research has looked at how makerspaces support their users, few have examined how different makerspaces support each other. This provides the motivation for us to examine the supporting relationships between different makerspaces. In this study, we report thematically the benefits and challenges of partnerships between public makerspaces, high school makerspaces and technical schools in Victoria, Australia.

Background

This section briefly describes high and technical school makerspaces as their focus on the act of making situates them within the larger Maker Movement community. While these spaces operate differently, they have a common agenda of empowering users to learn through making.

Makerspaces are physical spaces where individuals gather to make. Whilst this broad term covers a range of spaces and activities, from pottery and music-making to jewellery workshop and men's shed, this paper focuses on makerspaces with fabrication activities such as wood working, product prototyping and electronics. Dougherty, recognized as the founder of the maker movement (Corcoran, 2015), popularized the term to represent "publicly-accessible places to design and create" (Cavalcanti, 2013). As there are no spatial criteria for a makerspace, the name is often used simply as a label (Blikstein, 2018). Hence, a more useful way of recognizing a makerspace is that its users adopt a maker mindset, which is, to engage in iterative experiential learning to turn abstract ideas into tangible outcomes (Dougherty, 2013).

It is this iterative experiential learning that makes makerspaces appealing to schools and educators. The making mindset and activities, coupled with a physical space and making equipment, becomes a "powerful context for learning" (Regalla, 2016, p. 257) for students and teachers. Built on the constructivist foundation of "learning by doing" (Dewey, 1986), making offers students opportunities to STEM-rich integrative curriculums (Bevan, 2017). Despite its promising contributions to students' learning experience, school administrators need to first overcome the challenge of maintaining such spaces in schools (Blikstein, 2018), before their students can reap the learning rewards.

Technical schools now have high-tech learning centres established by the Victorian government (Department of Education and Training Victoria, 2018). Students from neighbouring schools visit and

participate in education programmes as part of their learning curriculum. Such programmes offer students problem-based activities that are reflective of the local industry and students use the centre's equipment to explore and prototype solutions.

Through these making activities, students can experience the full extent of STEM education, using the toolsets, building the technical skillsets and developing growth mindsets.

Method

Aside from an online post (Time Out, 2016), there is no locally made online directory of makerspaces in Victoria, Australia. Hence, we referenced the directory of community makerspaces from Hackerspaces (Hackerspace, 2020), an international network that list makerspaces globally. We contacted all of them due to there being only a small sample size.

Six of the contacted eleven makerspaces responded and consented to an online semi-structured interview. Four of the six interviewees were makerspace founders, with the other two being a general manager and a committee member. Three of these makerspaces were volunteer-run and the other three were commercial organisations (refer to Table 1). All the makerspaces were founded between 2009 and 2019. Our questions focused on community needs, as described in the *Schools as Community Hubs Development Framework - Workshop 1 Emerging Themes & Insights* (Chandler & Cleveland, 2020). Specifically, we asked interviewees about their needs and offerings regarding equipment, space, and expertise.

Next, we used snowballing (Goodman, 1961) and purposive sampling to recruit interviewees from the school sector. This approach was to ensure interviewees had previous engagement with public makerspaces and to represent a diverse sample of schools. Of the six interviewees, two were from

Table 1

Interviewees and their Context

Interviewee	Context
Interviewee #1	Volunteer-run makerspace
Interviewee #2	Volunteer-run makerspace
Interviewee #3	Volunteer-run makerspace
Interviewee #4	Commercial makerspace
Interviewee #5	Commercial makerspace
Interviewee #6	Commercial makerspace
Interviewee #7	Tech Schools
Interviewee #8	Tech Schools
Interviewee #9	Independent high school
Interviewee #10	Independent high school
Interviewee #11	Public high school
Interviewee #12	Public high school

technical schools, two from public secondary schools and two from independent secondary schools (see Table 1). The research team are makers and educators, bringing first-hand experience in makerspace and high school environments to this project. Our expertise aligned the interview scoping questions to probe the schools' needs and offerings from the maker community.

Findings

Despite sharing the same maker culture and situated within the broader Maker Movement community, public makerspaces still face challenges when trying to collaborate with high school makerspaces and tech schools. We summarise their community needs and offerings in Table 2 and elaborate below.

Can I use your equipment?

The makerspaces we focused on have sufficient equipment to satisfy their members' needs. The machines are either second-hand purchases, loaned by members, or purchased by the committee to satisfy the particular needs of their members. Based on the authors' experience, when makers are limited by making equipment, the makers find their way around the limitations and, in doing so, gain new making techniques.

While school makerspaces have equipment that is useful for makers, the restrictive conditions render these facilities unsustainable for regular use. For example, time restrictions that adhere to school schedules and staff availability do not always fit in with the needs of the makers. When asked about allowing makers to use school makerspace facilities, interviewee #12 said that operating their makerspace "would need some sort of coordinator. Effectively they [makers] would be paying for a product or a service". Though facilities are useful, they may not necessarily be suitable for makers. As interviewee #8 pointed out, "the equipment that students will use, like classroom technology, it's often quite different to the sort of maker technology".

Can I access your space?

While additional space can help accommodate more members, being able to access the space was more crucial than the space itself. Volunteer-run makerspaces are open when their volunteers are available. This often falls on weekday evenings or weekends. These operating hours must then coincide with the member's available time, for members to visit and use the makerspace. As interviewee #5 pointed out, "people in the community want to be able to come whenever, ideally, and not just limited to 'this-hour'."

While school makerspaces may have the floor space for the makers to use, their access times further restricts the already limited period when volunteers and makers are both free to work in the makerspace. As interviewee #11 said, "you got a very narrow window of maybe 2 hours, maybe 3 hours

tops between 5pm – 8pm where you might be able to get something done. Really the school is off limits at most other times." This is supported by interviewee #7, who said "For us it [technical school space] is used 6 hours, but it would be great to have it used 12 hours" but later added that "schools are very busy doing what they do".

For makers, working between their local makerspace and a school makerspace is unrealistic. As interviewee #5 pointed out, when working on projects, "you need dedicated space for that purpose. You can't just go set it up for a few hours and then pull it down. It's going to waste a lot of time".

Can I ask for your advice?

Public makerspaces do not pursue any specific demographics and thus attract people with various expertise. As interviewee #2 mentioned, the makerspaces are "more of a focal point for people with [different] kinds of skills or sort to share their knowledge". In fact, the school engagements discussed by the makerspace interviewees were mostly initiated when one of their members, either a high school or technical school teacher, saw an opportunity where the makers' knowledge could benefit their workplace. From the interviewees, the engagements included advising on planning of makerspaces, strategic

Table 2

Needs and offerings of public makerspaces, high school makerspaces and tech schools

		Needs	Have to offer
Makerspace	*Equipment*	1. advanced technologies 2. learning kits	1. experimental equipment
	Expertise	-	1. equipment expertise 2. making expertise 3. authentic expertise
	Space	1. more accessible space	-
High school makerspace	*Equipment*	-	1. learning kits
	Expertise	1. equipment expertise 2. making expertise 3. operational safety 4. authentic learning scenarios	1. teaching techniques 2. curriculum development
	Space		
Tech schools	*Equipment*	-	1. advanced technologies
	Expertise	1. authentic learning scenarios 2. curriculum development	1. equipment expertise 2. making expertise 3. operational safety
	Space	-	-

Note: This table captures the common needs and offerings of the different spaces. This may vary between spaces.

purchase of equipment and development of authentic curriculums.

As expected, high schools and technical school interviewees flagged that there were many areas where the maker's expertise could benefit their workplace, both directly and indirectly. Directly, as interviewee #12 highlighted, "there is such a shortage of qualified technology teachers"; and indirectly, as interviewee #9 mentioned, where students "move outside the school environment to connect with industry experts [and] use their expertise in really powerful and meaningful ways".

While makers are open to helping one another, their efforts are finite. That is because most members have their full-time commitments and are using their leftover time to work on their projects. Makers use their makerspace to work on projects and learn from others during the process. Even when high school and technical school teachers join and participate in the makerspace, they cannot expect constant help from other experienced makers. After all, makers do not visit makerspaces to teach and guide others. As interviewee #5 said, "a lot of people are willing to share their expertise, but it's when it starts to become a drain on their personal time there's no way for them to get anything out [of the participation]".

Discussion

Despite the challenges listed above, all interviewees were still open to partnering with each other. For makerspaces, school partnerships can promote their community to a larger audience, attract new members to their communities, and bring in the much-needed funding through membership fees. For high schools and technical schools, makerspace partnerships can expose their students to real-world communities and contextualise their curriculums in authentic scenarios. The section below describes the opportunities technical schools can take to support their local makerspaces, and two conditions necessary for the partnership to be sustainable.

Tech School equipment, space and expertise

Despite being self-reliant, the makerspace interviewees were curious about the available equipment in technical schools. That is because technical schools house more advanced technologies that are often not viable for makerspaces to purchase. Being aware of these technologies may prove useful when a member's project requires a one-time use of an equipment not available in the makerspace. While school makerspaces need to prioritise their students, technical schools can respond to the maker community need as part of their objective to connect with their local industry. As interviewee #8 said, "we're developing our own makerspace … as another way for us to connect and interact with the local community". This may help local maker communities expand and accommodate more members. Finally, but unsurprisingly, we noticed that makers in makerspaces preferred working with technical schools because of their shared language. As interviewee #1 pointed out, "we mainly work with the technical

schools because they sort of understand us", and that "engage[ment] with that [high school] sort of level is completely different".

Short term v's long term

Volunteer-run makerspaces are cautious about committing long-term to work with schools. As interviewee #2 described, "we are completely volunteer run, so our availability is very haphazard". This is incompatible with the school's needs where, as interviewee #9 highlighted, "our [making] projects take a lot of time, and we still work within the restrictions of a timetable". However, most of the makerspaces had previous engaged with schools on short-term projects, such as showcase events and short learning courses, and continue to do so. As interviewee #1 said, "if it's one or two days or something, we could probably do that. But the longer period of time, it just becomes unmanageable for us because people are working full time and we would have to take people off work".

Reimbursement

While the makerspace interviewees were keen to help their neighbouring schools, the service rendered needs to be reimbursed. As interviewee #5 mentioned, "we don't want to be science teachers that aren't paid. We don't want to be technology teachers that aren't paid". Schools are aware of this too, as interviewee #9 mentioned, "obviously people are not going to give their time for free. And if you've got a niche capability you often struggle for money, and when they have an opportunity to make money, they will take it". This may become problematic for schools, as interviewee #12 mentioned, "They [external partners] need to be paid. You know, with all the good will in the world, they can't come down and spend a day or two with us". Even technical schools, established to form connections between industry and high schools, face a similar problem. Interviewee #7 mentioned, "we are funded to do a particular job" and that "anything we do outside of school hours requires us to look for additional funding sources."

Future works

For this paper, we reported only on the community needs and offerings affecting makerspace-school partnerships. From the interview data collected, additional findings indicated that smaller themes such as shared visions, funding models, and safety, also affected the viability of partnerships. Another research trajectory would be to explore how makerspace partnerships between schools can affect demographics such as age and gender in community groups.

To reveal the symbiotic relationship between schools and the maker community, other stakeholders within the maker landscape should be identified and examined, including makerspace coordinators in universities, public libraries, and museums. Discussions with the Department of Education and Training would also prove useful in order to further understand their vision for the role of making in the rapidly evolving STEM landscape and their action plan for providing making expertise to the schools.

While the interviewees identify as makerspaces, there were significant operational differences between them. This aligns with van Holm's (2014) perspective that makerspaces operate in different capacities, such as tinkerspaces, tech shops, and fablabs. Greater clarity on the different types of makerspaces can lead to stronger customisation of school partnership arrangements.

Way forward

Challenges are high when forming partnerships between public makerspaces and high school makerspaces. This is due to different objectives, users and needs. However, technical schools are advantageously positioned between the two, as they have unique technologies, knowledgeable staff, and can provide the community with access to their space and share a common language in the maker community. From the interviews, we identified that with appropriate funding, technical schools have the potential to mediate between makers and high schools. This potential arrangement would benefit students by providing them access to expertise, ideas and role-models from their community. In return, makers could gain access to a wider range of equipment in their neighbouring schools and tech-schools.

Ethics Declaration

Ethics application RESID3007 was approved by the Swinburne's Human Research Ethics Committee (SUHREC) for this research. Informed consent was obtained from all individual participants involved in the study.

References

Bevan, B. (2017). *The promise and the promises of Making in science education.* Studies in Science Education, 53(1), 75–103. https://doi.org/10.1080/03057267.2016.1275380

Blikstein, P. (2018). *Maker Movement in Education: History and Prospects*. Handbook of Technology Education, 419–437.

Boyle, E., Collins, M., Kinsey, R., Noonan, C., & Pocock, A. (2016). *Making the case for creative spaces in Australian libraries*. The Australian Library Journal, 65(1), 30–40. https://doi.org/10.1080/00049670.2016.1125756

Cavalcanti, G. (2013, May 22). *Is it a Hackerspace, Makerspace, TechShop, or FabLab? | Make: Make: DIY Projects and Ideas for Makers.* https://makezine.com/2013/05/22/the-difference-between-hackerspaces-makerspaces-techshops-and-fablabs/

Chandler, P., & Cleveland, B. (2020). *Schools as Community Hubs Development Framework: Workshop 1 Emerging Themes & Insights*. Building Connections: Schools as Community Hubs. https://doi.org/10.26188/12730940

Corcoran, B. (2015, May 27). *Dale Dougherty, Father of the Maker Movement Talks About Breaking Rules, Erasers & Building a Learning Culture—EdSurge News*. EdSurge. https://www.edsurge.com/news/2015-05-27-dale-dougherty-father-of-the-maker-movement-talks-about-breaking-rules-erasers-building-a-learning-culture

Deloitte Australia. (2014). *The Australian Maker Movement*. https://www2.deloitte.com/content/dam/Deloitte/au/Documents/technology/deloitte-au-tech-maker-movement-290514.pdf

Department of Education and Training Victoria. (2018, October 24). *Establishing Tech Schools*. https://www.education.vic.gov.au:443/about/programs/learningdev/techschools/Pages/techschoolsestablish.aspx

Dewey, J. (1986). *Experience and Education*. The Educational Forum, 50(3), 241–252. https://doi.org/10.1080/00131728609335764

Dougherty, D. (2013). *The Maker Mindset.* In M. Honey & D. E. Kanter (Eds.), Design, Make, Play: Growing the Next Generation of STEM Innovators (pp. 7–11). Taylor & Francis Group.

Education Services Australia. (2018). *Maker spaces. Digital Technologies Hub*. http://www.digitaltechnologieshub.edu.au/teachers/topics/maker-spaces

Fasso, W., & Knight, B. A. (2020). *Identity development in school makerspaces: Intentional design*. International Journal of Technology and Design Education, 30(2), 275–294. https://doi.org/10.1007/s10798-019-09501-z

Goodman, L. A. (1961). *Snowball Sampling*. Annals of Mathematical Statistics, 32(1), 148–170. https://www.doi.org/10.1214/aoms/1177705148

Hackerspace. (2020, June 11). *Hackerspaces in Victoria*. https://wiki.hackerspaces.org/Victoria

Hsu, Y. C., Baldwin, S., & Ching, Y. H. (2017). *Learning through Making and Maker Education*. TechTrends, 61(6), 589–594. https://doi.org/10.1007/s11528-017-0172-6

Regalla, L. (2016). *Developing a Maker Mindset. In K. Peppler, E. Halverson, & Y. B. Kafai (Eds.), Makeology: Makerspaces as Learning Environments* (Vol. 1, pp. 257–273). Taylor & Francis Group. https://doi.org/10.4324/9781315726519-17

Taylor, N., Hurley, U., & Connolly, P. (2016). *Making community: The wider role of makerspaces in public life*. Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, 1415–1425.

Time Out. (2016). *A guide to Melbourne's maker-spaces.* Time Out Melbourne. https://www.timeout.com/melbourne/things-to-do/a-guide-to-melbournes-maker-spaces

Van Holm, E. J. (2014). *What are Makerspaces, Hackerspaces, and Fab Labs?* SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2548211

Wong, A., & Partridge, H. (2016). *Making as Learning: Makerspaces in Universities*. Australian Academic & Research Libraries, 47(3), 143–159. https://doi.org/10.1080/00048623.2016.1228163