

Smashing barriers to access STEAM

Leanne Gibson
Manurewa High School
Auckland
New Zealand
www.manurewa.school.nz
gbn@manurewa.school.nz

ABSTRACT

Young people in South Auckland who are predominantly Maaori or Pacifica from low-income families face tremendous barriers in accessing STEAM-based learning. The Maker Space at Manurewa High School, a public high school serving Years 9-13, has had a significant impact in addressing this access issue for learners. The most important lesson from our first year is that the Maker Space model has much to offer as we progress a transformation of our school in culturally responsive, student choice-based learning.

[Watch: "This is a wonderful place"](#)



2. DESCRIPTION

2.1 Description of your setting

We are a public high school of 2100 students ages 13-18 across Years 9-13. We are located in Manurewa, South Auckland. This is a region of New Zealand with some of the most challenging outcomes in education, health and household income. The community is ethnically diverse, with a large proportion of Maaori and Pacifica peoples, as well as Asian. We have very few students who are pakeha (white) / western. We are developing our school to improve outcomes for Maaori and Pacifica through culturally responsive pedagogy and curriculum.

2.2 Description of the educational experience

The Maker Space at Manurewa High School opened for learning in January 2018. Its genesis was the result of a successful joint funding application with The Southern Initiative (TSI), a council controlled organisation that is focused on the economic and social development of South Auckland. TSI engaged us in its vision to leverage the huge creative, entrepreneurial capability of the South Auckland region, through Maker culture. There was strong alignment with successful learning programmes being delivered in our school in Business, Science, Technology (construction, engineering and food), Performing and Creative Arts. A commonality of these programmes is a way of being, in Te Reo Maaori, we call it whaanaungatanga¹.

As part of our setup phase, in late 2017 we visited four different types of Maker Spaces to see how spaces are designed and equipped for different learners:

- A hack lab more aimed at adults
- A children's space in a library
- An after-school creative technology space
- An in-school space for the first two years of middle school. Our Ministry of Education can provide few examples of maker spaces in New Zealand schools currently.

While it was useful to visit these sites, the most valuable advice came from a TSI employee, Joel Umali, who had responsibility for creating access in communities to digital and maker skills. He brought with him a local entrepreneur, Keu Iorangi, who had experience in establishing creative technology spaces for youth in South Auckland and the Pacific Islands. Keu has been educated [in a school](#) that is an exemplar of culturally responsive education. His process is based on 1) establishing culture 2) building capacity and 3) creating opportunities. His expertise has been critical to our first year.

Another important first step was to participate in the Stanford FabLearn programme, Leading and Designing a Maker Space. As an administrator, the course introduced me to the pedagogical foundations of Making. I learned to adopt a scale mindset to the setup, which helped us to see the potential to have more than one Maker Space to serve a large, diverse school community. That helped us as the year progressed to resist the pressure from teachers who saw the space as a resource and wanted to be able to "get trained in using the equipment",

or “use it as a treat class”. It has given us time to develop our model for how we inhabit the space. In the future, as we embed the teaching and learning model, we can be more open about access. For now, we want to continue to build our student-focused processes.

We launched an after-school programme in April. The after-school programme ran weekly on Wednesdays, led by Keu Iorangi. A group of three teachers who had been part of the site visits stayed involved and we met on a monthly basis. We set up a project management system on Asana. A core group of 20 students established itself quickly and has continued to come regularly throughout the year. The engagement in the space was a result of Keu’s approach. I reflect more on this under “Culture”, section 3.2.

Throughout the year we also brought in students and staff who were not connected with the after-school programme. This included:

- A Year 9 Design Thinking workshop with a banking partner to give feedback on its Financial Literacy presentation. Being in the Maker Space, rather than a traditional classroom, inspired prototypes that featured empathy and technology. Among the prototype solutions students designed to improve the presentation was an App planned with some basic User Experience design.
- A STEAM project, “Matariki Maker”, facilitated by external experts. I reflect on this under “Connections with real life”, 3.2.
- Professional learning workshops for staff on Teacher Only Days.
- A project-based integrated curriculum project, “Buddy Bench”. (See section 3.2).
- Iteration of the All For One Locker Project, into a social enterprise, Film Making competition, and Community Problem Solving competition (see section 3.2).

A description of the educational experience:

- A digital fabrication space within a learning area known as the Pop-up Business Academy. This provides three spaces – a central space which has most of the tools; a container space which houses the CNC router; a space for breakout collaboration, which includes a kitchen to prepare food. Sharing food is an aspect of whanaungatanga ie a way of building the cultural bedrock.
- The primary use of the space in the first year has been to develop a leadership group of students through an after-school interest-based programme focusing on creative process.
- Emerging uses have been to serve a creative, entrepreneurial, problemsolving purpose and to support the shift to project-based learning that is coming for the whole school in 2020.
- Our space provides learners with hands-on activities and they learn through individual and team-based experiences, building non-cognitive skills and sparking enthusiasm about learning. Our tools include Sketch-up, Makey-makey, Lego, TinkerCAD, Scratch, Gogo boards, 3D printing, vinyl cutting, sewing, lasercutting and CNC routing.

3. CONCLUSION

3.1 Results

For our students from Year 1:

- We have created a Maker Space that is a place of belonging, where students can share creativity, collaborate and grow in confidence with technology.
- We have a group of around 15 students, a balance of males and females from across the age range (13-17), who have maintained engagement in the space over the course of the year. They come in their own time. Although our family is small, the impact has been huge.
- Some of our students are comfortable to be described as quirky. The Maker Space is a connecting place for them.
- We are addressing the issue of growing the number of females engaged in technology.

For my objectives:

- It has been rewarding to have the feedback and endorsement of the deep learning by students observed by teachers, who are diverse in their philosophies about learning.
- We have created a space that embeds partnership with and for the community to support real-world learning projects.

Do differently:

- I would move slowly to add new pieces of equipment as we have mastered one. The lasercutter would be the first choice.

Broader impacts:

- I have included reflections on this below under 3.2.

3.2 Broader Value

No1 learning that I would share with Fablearn community: The importance of establishing the learning culture

As teachers and administrators, I don’t think the culture of the space was foremost in our minds at the start of the setup. We were occupied with the design, the equipment and how to use it. It was the involvement of our experts, Keu Iorangi and Joel Umali, who gave us this

necessary guidance. The focus on building the learning culture has been so important to the powerful impact the space has had in its first year. The culture has values of:

- Whanaungatanga¹
- Respect
- Collaboration and learning from each other
- Process not product

One example of the way we embedded culture was the Whaanau (Family) Portrait. Students drew self-caricatures. These were digitised, collated and output on the lasercutter. Everyone is recognisable. Piaget would recognise it as an object to think with. Capacity developed through this project included helping us to know and think about ourselves as a whaanau (family). It was also a “low floor” way to get into some of the “high ceiling” skills in Photoshop, RD Works, and lasercutting into a material.

Images: The Whaanau Portrait (left) and Social Enterprise (right)



Another significant hand-drawing, of a turtle, has become the first product in a social enterprise. The purpose is to help raise funds for the Maker Space and to support students travel to an international competition. The student who drew it is not the student who produced it. This collaborative, non-competitive culture has been a delightful, unanticipated feature of our space.

Another reflection about the value of whanaungatana is that we believe it has ensured we have equal number of males and females. Coding and Robotics classes in school are predominantly male. Girls are not drawn to them. The Fablearn programme provided some interesting research² on why this might be the case. In 2019, it would be interesting for us to test this.

Finally, we see culture as the key reason for engagement of a diverse range of students who come to the space in their own time, after school and in the holidays, to work together. When we suffered the tragic loss of one of our members late in the year, the Maker Space became the gathering place to grieve and support each other. This demonstrates how we are connected socially and emotionally, as well as digitally. At our heart we are a community. We advance ourselves as a community through the Maker Space. We think this is important to understanding how our Maker Space might be different to other schools and countries.

Key learning: Design

We purchased a CNC router and lasercutter as a package deal quite early on in our journey. The router was our first major piece of equipment to be delivered. We learned that it really wasn't a suitable startup piece. It didn't coexist with computers, because of the dust, even with proper extraction. We are in the process of fitting out shipping containers to extend our learning areas. We've moved the router into one of those containers. But now it's out of sight, out of mind, and not really feeling part of the space. Perhaps this can be described as a misstep or a failure. We think of it as a learning. We will fix this in 2019!

The lasercutter has been an awesome tool. Students are now confident at using it. It was really cool that one of our Engineering teachers asked one of our students, a girl, to make a sign for him. She had to learn how to adjust the base to allow for thicker material than we'd been using to date. She was really proud that she could do that.

Key learning: The value of connections with real life

Two projects that excite us from our first year were conceived and planned the previous year.

“All For One Locker Project” started as a Cross-Curricular Inquiry in 2017. Students went out into our neighbourhood and interviewed homeless people to understand their challenges. They learned that a pressing need was a safe place to store belongings during the day, so that they didn't get stolen. They came up with the idea of lockers. These were built and having enlisted the support of the Member of Parliament to get around bylaws, the lockers were installed nearby the town centre, and are being used as intended. The project could have ended there. Instead in 2018 it found new life in the Maker Space, continuing as an extra-curricular project done in students' own time. They have extended the project in a range of ways:

- A council in New Zealand has asked them to design a locker concept for its homeless people. They are prototyping new versions of the lockers on the 3D printer and lasercutter.
- Members of the group entered the project in a Community Problem Solving competition. It was chosen to compete at the Future Problem Solving Internationals in Boston in June, 2019.
- With their Maker skills, the group created a video story and entered it into a film competition. It was a national award winner.

The second project is “Buddy Bench”. This was a cross-curricular collaboration between our Technology (Construction) and Business learning areas. The bench was promoted to surrounding primary schools as a way to develop inclusion. A student in need of a buddy could

sit on the bench, and that would be a signal to another student to join him / her. The Business students pre-sold four benches. These were built by Construction students and then painted creatively in the Maker Space. The project has now spun off into a social enterprise. The students have been in the Maker Space in the school holidays collaborating and planning, to be ready when the new school year begins. In the Maker Space, these young entrepreneurs have been introduced to Lean Canvas and Design Thinking in a “just in time” way. They also have access to creative technologies to help them code their own website, and develop a professional brand toolkit. The teachers have been available in a coaching capacity, to provide guidance when the students have been open to learning about these processes. Without the Maker Space, students would not have been able to leverage Buddy Bench in this way ie it has spanned as a project from one school year to the next and provided access to the tools the students needed outside of normal school operations.

A third, effective project came through our partnership with TSI. They engaged community role models, The Roots Creative Entrepreneurs, along with Meshed IT, to deliver a Maker Space curriculum. The project brought to life Matariki, an important time in the Maaori calendar which signals the start of the New Year. Students learned about the seven stars in the Matariki constellation and the legend that describes the qualities of the stars as a Mother and her six daughters. The students chose a star that was meaningful to them. They then had to hand draw the key messages. They were supported by seven undergraduate Architecture students. Their designs were digitised and lasercut on 7 x 2m high acrylic panels. LED lighting connected the seven panels. A couple of students less engaged in the drawing tasks found a strong connection working with the electronics. As well as developing a range of skills, the project provided new knowledge in a culturally significant way. In addition, the learning was powerful through connections with real life:

- 1) The opportunity to learn with people in the community who are working in social change as architects, and electronics designers.
- 2) The creation has been installed in a civic building and has become a permanent, public display of their learning.

“Matariki Maker” was also an opportunity for teachers to explore their practice, and understand how the fabrication tools can be integrated into a culturally responsive curriculum project.

Watch Videos: Matariki Maker curriculum project (turn off Mute)

<p><u>Video 1 - making</u></p> 	<p><u>Video 2 – final output</u></p> 
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From these three examples we describe an “organic curriculum” that offers “flexible purposing”³, as Dewey would say. It is a model that can serve the whole school, or at least those parts in need of a new approach.

Importance of the Maker Space to learning:

Young people in South Auckland who are predominantly Maaori or Pacifica face tremendous barriers in accessing STEAM-based learning (we add an A for arts). Research such as the World Internet Project shows that access to digital technologies and technical know-how are significant hurdles that Decile 1-3⁴ schools face. One impact of this is evident in workforce participation. A Te Puni Kokiri study reveals that less than 5% of the ICT workforce is Maaori or Pacifica and this can be traced back to lack of exposure and support in STEAM and discovery type learning. International literature says that maker spaces are successful in increasing access to technology, improving science and engineering skills and enhancing confidence to use innovative tools. These findings are bolstered by the New Zealand Tech Industry study saying that Decile 1-3 schools agree that the integration of technologies is improving learning outcomes of students.

The Maker Space has begun to grow students and staff who are confident to pick up and use new tools and technologies. We also support an evolving model of teaching that is strongly relational, and cross-curricular.

Our Maker Space inspires a passion for STEAM through making approaches, and nurtures that by working with learners through deep exploratory learning methods. It increases their confidence to use maker tools, enhances their entrepreneurial and problem-solving skills and their creativity. In this regard, it is also preparing them to navigate the Future of Work.

The space is a new and exciting environment for the development of the five key competencies of the NZ Curriculum: Thinking / Relating to others / Using language, symbols, and texts / Managing self / Participating and contributing.

Dewey⁵ says: “There is very little place in the traditional schoolroom for the child to work. The workshop, the laboratory, the materials, the tools with which the child may construct, create, and actively inquire, and even the requisite space, have been for the most part lacking.” The Maker Space at Manurewa High School has become that space.

3.3 Relevance to Theme

This is relevant to the social theme in the service of transformative potential for people in our society who do not have equity in education, health and household income. It creates access to technologies that otherwise they would not have, and contributes to knowledge and competency development in culturally responsive ways that are desirable for the students involved. We are not saying that Product Making is for everyone. But the model is powerful and provides an example to educators seeking to improve school as a place of learning.

4. BIOS

Leanne Gibson is an administrator of the Maker Space at Manurewa High School, located in Auckland, New Zealand. Her role focuses on providing opportunities and resources that support the development of the school's first Maker Space as a place for creativity, collaboration, and community connection.

5. REFERENCES

[1] Whaanaungatanga in Maaori culture is a way of being that is developed through shared experiences and working together that creates a sense of belonging. The derivative, Whaanau, includes direct family, extended family, and ancestral family. It also extends to others to whom one develops a close familial, friendship or reciprocal relationship.

[2] Epistemological Pluralism and the Revaluation of the Concrete, Sherry Turkle and Seymour Papert

[3] Towards a Flexible Curriculum - John Dewey's Theory of Experience and Learning, Joop W. A. Berding

[4] Decile is a way of describing the demographics of a school. Low decile schools, deciles 1-3, serve families with low incomes or who have been on long-term welfare dependency (more than five years). Approximately one third of students at Manurewa High School (over 600 students) come from families who have lived long-term in welfare dependency.

[5] The School and Society and The Child and The Curriculum, John Dewey.