Full STEAM Ahead: Creating informal teaching opportunities for pre-service teachers

Chris Campbell
The University of Queensland
Australia
chris.campbell@uq.edu.au

Abstract: This project involves creating informal community spaces for pre-service teachers to have an opportunity to teach either STEM or STEAM workshops with children. By giving pre-service teachers informal teaching experiences in these areas it will assist with the pre-service teachers gaining confidence in teaching in the STEM area. Pre-service teachers reported a gain in confidence by conducting the workshops which they were then able to build on or use in their final practicum. Pre-service teachers also reported greater confidence in teaching STEM or STEAM and the children involved in the workshops evidently had a good time. An unintended outcome was parental involvement in the workshops and the quality parent/child relationship building that was evident among many of the children.

Introduction

The STEAM Room project activates science-maths fluency in the community, shaped by the community's social, professional and commercial priorities, to innovate and enrich pre-service teacher education.

The STEAM Room is envisioned as a science, technology, engineering, arts and mathematics (STEAM) literacy and learning venture in a community setting. Through informal or 'pop-up' programs it aims to build wider science-maths fluency, appreciation and enjoyment. STEM education has been has been taught in schools for some time. STEAM, however, is a new term which incorporates the arts. The importance of improving science, technology, engineering and mathematics (STEM) skills is championed by science and industry leaders, to enrich student learning, workforce capacity and innovation for Australia's future. This is evident by the new Australian "National STEM School Education Strategy" which outlines the case for change and then goes on to suggest goals for all Australian students. These goals include suggesting that students gain a good foundation in STEM as well as ensuring that students are inspired in STEM so that they are able to complete more challenging STEM subjects when they are in their senior secondary years of study (Education Council, 2015). These goals will be achieved through increasing student engagement and participation in STEM, increasing teacher capacity for STEM, as well as supporting opportunities in STEM education and facilitating effective partnerships with business, industry and tertiary education providers.

By incorporating the arts, STEAM brings to the forefront the creativity inherent in STEM and enhances engagement opportunities for wider audiences, thus building on the "National STEM School Education Strategy". The STEAM Room project is designed to be fun and meaningful, aspiring to foster STEAM learning in our community as a vital part of this clever country. Creativity can improve STEM teaching practices with Henrikson (2014) suggesting that previous research suggests good scientists are creative and thus it is important to have creativity in STEM teaching practices. When adding the arts into the teaching of STEM a review of the literature suggests there is currently no consensus on that is actually entails (Moon & Kang, 2015). However Eger (2013) argues it is the arts and art integration although he does not go on to define this.

This project seeks to connect community members with diverse experts across STEAM through engaging with local community spaces and local activities that will be lively, informative and mutually beneficial for participants and presenters. From the universities' perspective, the project aims to enhance pre-service teachers' professional development so that they will be better at teaching science and maths in the classrooms. For STEM academics and industry, geeks and makers, it will also provide a new platform for sharing their insights and skills and for community engagement. For local business, council and community organisations, it will be a valuable

space for supporting educational innovation, vocational and professional development opportunities, and positive social interaction in the local community. Based on respectful consultation, the community's priorities will inform the shape of project development and events.

Aims:

- Connect maths and science pre-service teachers (and science students considering a teaching career), industry professionals and community beyond university or school programs
- Facilitate learning and sharing of STEAM resources and practices as a cross-institutional brokerage enterprise
- Enable meaningful and beneficial community engagement through an educational innovation space engaging with the community.

Specifically this project aims to give pre-service teachers the opportunity to engage with children from 7 to 15 years of age in community STEAM events outside of school. This paper will present the two workshops conducted by pre-service teachers and how the workshops were conducted in the community.

Methodology

The STEAM room at The Edge event was conducted on a Saturday with three workshops conducted. The Edge, which is part of the State Library Queensland has meeting rooms and classrooms which can be hired by the public for various purposes. Two of the workshops were conducted by pre-service teachers and one was a design thinking workshop by a professional. The pre-service teachers were given the opportunity to volunteer to conduct the workshops through their fourth year course *Teaching Technology and the Arts*. They were asked to complete an Expression of Interest outlining a workshop for children that would take between 1 and 2 hours to conduct. It was suggested that as the workshops were being taught out of school, on the weekend that it might be beneficial if the student workshops involved a topic where they could take a product home with them. Both the workshops conducted met this specification. The students who volunteered applied to conduct a workshop called Tower of Density and Can you Float a Boat? These workshops needed quite a bit of equipment but the pre-service teachers were informed they could conduct a workshop on any topic they wanted and that the equipment would be purchased. The pre-service teachers used iPads and a projector as the available educational technology to support the student workshops.

During the workshops pre-service teachers from another local university volunteered and assisted with these workshops. There were two volunteers for each session. As the workshops were conducted out of school, in the community, parents were allowed to attend and watch or assist their child(ren) in the activity. Although the workshops were full with 25 student registrations in each one, not all students turned up to this free activity which meant there were spaces. There were 12 students who attended the Tower of Density workshop and 16 students attended the Can you Float a Boat? workshop.

The Tower of Density workshop was presented by a 4th year pre-service teacher from The University of Queensland. This workshop went for one hour for children in grades five to seven. The Tower of Density workshop involved the kids using lots of everyday liquids, such as dishwashing liquid, glucose syrup, food colouring etc, to create their very own tower of density.

The Can you Float a Boat workshop allowed for student engagement in design and technologies from grades three to seven. Students were asked to design and make a boat that will keep them safe in all conditions which included when carrying a load, when it rains and when the wind rises. This workshop used recycled garbage from a local reverse garbage center. Cheap items such as paddle pop sticks and straws were also purchased for the workshop. A group of two pre-service teachers conducted this workshop which went for one hour, although in reality actually went a little longer. This was due to the students designing their own boat and then making improvements on the boat after testing in water to ensure it met the required specifications.

The pre-service teachers who conducted the workshops were interviewed the week after the workshops. They were asked questions regarding their topic and its integration with the arts, how the workshops has helped them engage with STEM, as well as if it will help them with teaching STEM/STEAM in the future. They were also asked what the best parts of the workshop were and what could be improved as well as any suggestions or tips for

the program in the future. Observations and photos were also taken during the workshops with both ethics permission for the data collection being gained from the presenting pre-service teachers. Media releases for the photos being taken were sought from the pre-service teachers, other volunteers and parents. The interviews were analyzed for emerging themes.

Results

Results from the pre-service teachers' workshops are that they enjoyed conducting the workshops and felt that it gave them a boost in confidence going into their final practicum. Themes emerging from the interviews include students feeling more comfortable in teaching STEM going into their final university practicum and enjoyment in teaching students in an out of school setting. An unexpected theme included parental participation in the workshops, however no data was collected from either children or parents so this has not been explored in this paper.

The students who participated in the Tower of Density workshop appeared to enjoy using the everyday liquids to create their tower. The pre-service teacher who led the activity reported the kids had a great time with this and enjoyed some of the sticky everyday liquids such as dishwashing liquid, golden syrup, glucose syrup and others. Some kids said they would make another one when they got home. The pre-service teacher said this from the workshop:

> I think it was a great program for us as pre-service teachers to gain hands on experience without any pressure of being assessed and I had a lot of fun working and networking with like-minded people. I had a lot of fun working with students and other pre-service teachers.

Figure 1: Tower of Density activity underway with pre-service teachers and parents working with the children. The second image is student sharing and discussion.

In the final workshop of the day, Can you Float a Boat? the students were set a challenge of designing their own boat, with students persisting through lots of design modifications after testing their boat in water. The boats were varied in materials and size with much of the material coming from the Reverse Garbage centre located locally. The lead pre-service teacher commented that the activity was chosen as it was taught in the course Teaching Technology and the Arts which the pre-service teachers had undertaken in Semester 1, thus it had an art component and fit in with the STEAM theme. After the workshop the pre-service teacher leading the workshop stated it was "one opportunity [for teaching using STEAM] and I'll build on that bank now throughout teaching".

Figure 2. A student testing if his boat floats and discussing design improvements with the workshop leader.

The pre-service teachers all reported gaining confidence in teaching STEM. They felt this was particularly important as their final internship was to begin in two days. One pre-service teacher commented “I'd been out of the classroom for so long that I was starting to be like oh no, prac's a big thing. After STEAM I was like oh they're just kids, I'll be fine next week. It was a stepping stone”. All pre-service teachers reported that conducting the workshops assisted with them gaining a deeper understanding of how to teach STEM/STEAM in their classrooms in the future.

Suggestions for improvement include conducting the workshops at a less busy time of year for the pre-service teachers. Although it was a good confidence builder prior to the final practicum it was also a busy and uncertain time. Earlier in the year was suggested as being better than conducting the workshops in July. Another suggestion was that it would be good to have these extra curricula activities available each year in the future and to advertise them quite early so pre-service teachers could schedule them in.

One of the unexpected outcomes of the day was that parents often stayed in the room. Generally at first the parents were watching the group, and not engaging. However as the activities continued they often got involved. It was observed that the activities allowed for high quality time between parent and child. One pre-service teacher commented about one child and his father that they “could go home into the environment and prompt further exploration, like you know what happened in the bathtub at night or he might not have even thought to build a boat with his son”.

Conclusions

Literature suggests the importance of adding in the arts to STEM (Henriksen, 2014) as this may increase creativity in science in the later years. This project goes a small way to addressing the need to train teachers to being more comfortable in teaching STEAM. Although the activities described only contained a small educational technology focus this study has scope to have a greater educational technology focus in the future.

From this small case study it is evident providing opportunities for pre-service teachers to gain informal teaching opportunities assists with their confidence in teaching STEM and STEAM. One of the limitations of this study is the small scale nature of the data collection. Further reiterations will be conducted in the future.

References

Education Council. (2015). National STEM school education strategy. Available www.educationcouncil.edu.au

Eger, J. (2013). STEAM...Now! *The STEAM Journal, 1*(1), Article 8. doi: 10.5642/steam.201301.08

Henriksen, D. (2014). Full STEAM ahead: Creativity in excellent STEM teaching practices. *The STEAM Journal, 1*(2), Article 15. doi: 10.5642/steam.20140102.15 Available at: http://scholarship.claremont.edu/steam/vol1/iss2/15

Moon, S., & Kang, K. (2015). Trend of STEAM education-related domestic studies focusing on physics-related studies. *New Physics: Sae Mulli, 65*(12), 1199-1208. doi: 10.3938/NPSM.65.1199