

Merging art and science in Canada: Identifying the current initiatives for adults in informal learning settings

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Overview

This is a preliminary study that investigated the current state of art and science initiatives in Canada. Specifically, these initiatives targeted adults in the informal learning environment. Since this research has not been previously conducted, a grounded theory approach was used to analyze 16 Canadian organizations that used art elements to communicate science. The results showed that there is support for art-science, although goals differ between traditional and non-traditional organizations. Both groups used a variety of content including material that is specialized (e.g. dissections), crafts and technology. Most participants were not aware of other Canadian art-science organizations, thus a list of groups has been included in this report (See Appendix). Few organizations used formal assessments, however consistent evaluative tools should be considered in order to accurately measure the effectiveness of art in science communication.

Background/Rationale

The importance of artistic expression in science engagement was previously discussed in a report documenting a two-day workshop on the evolving culture of science (Kaiser, Durant, Levenson & Wiehe, 2013). Participants (science communicators, educators, scientists) agreed that different forms of art were critical for integrating science into the broader culture. In the traditional learning environment, the inclusion of art in science, technology, engineering and mathematics or STEAM has been implemented to engage students to build stronger learning communities and to increase their interest in pursuing careers in the STEM field (Miller and Knezek, 2013). However, there are fewer reports (Curtis, Reid & Ballard, 2012; Robinson et al., 2014) of the use of artistic elements in communicating science to the general public. Many informal learning environments, such as science centres cater to children and youth with occasional adult focused initiatives. However, it is also important to prioritize the adult audience as they spend most of their life outside the formal learning environment (Stevens, n.d.) and therefore are in need of information outlets.

Research objective

This research project aims to identify the landscape of art and science initiatives in Canada. Specifically, what types of art-science informal learning environments initiatives exist and what type of art and science content is currently being implemented within the adult (18 years and over) informal learning environment? To answer this question, participants from informal learning settings including start-up companies, non-profit organizations, maker spaces, museums and science centres (if they used artistic approaches to communicate science) were interviewed. While art encompasses a range of forms including music, theatre and dance, this project focused on mainly visual and tactile (e.g. building and crafting) arts. Finally, this project concentrated on Canadian organizations only, primarily because there have been no comprehensive reports showcasing the types of art and science initiatives that can be found in this country.

Methods

To better understand the landscape of the current initiatives that are implemented, a grounded theory approach was applied/used. This is an inductive process which aims to generate theories strictly from the data, therefore the protocol could not be fully developed in advance and was heavily dependent on emerging patterns from the data (O'Leary, 2014). However, despite the limitations prior to implementation, parameters were set to maintain focus during the data collection. In summary, the methodology included: 1) setting preliminary criteria and forming interview questions, 2) collecting data through interviews and 3) transcribing and coding interview responses.

1) Preliminary criteria

These criteria were adapted from the strands of informal science learning as described by Bell et al. (2009). The learning environment was to foster: 1) an interesting experience which will motivate adults to learn more, 2) an understanding of science, 3) the opportunity to test and manipulate what has been learned, 4) a way to make the knowledge relevant to the participant. In addition, this research used a place-centered lens (Bell et al., 2009), which took into account the type of physical components used in the learning environment.

The aim of the semi-structured interview was to gather an overall picture of each organization by identifying their motivation for creating their group and/or programming, goals, content development approaches, types of evaluation and marketing strategy. Interviews spanned between 30-60 minutes long.

2) Data collection

The recruitment for this study used the following criteria to select organizations: 1) an artistic element (visual and/or tactile) is used to communicate science in an informal learning environment; 2) programs or initiatives that target the adult audience (18 years or

older); 3) programs or initiatives are facilitated routinely (no one-time initiatives); 4) organizations must be located or created in Canada. Organizations that met these criteria were sent an email requesting for their participation in the study. If they agreed, an in-person, Skype or phone interview was scheduled. Participants that were recruited were the most knowledgeable about the programming or initiatives of their organization. A total of 16 organizations were recruited for this study.

3) Data analysis (coding)

Interviews were all recorded using the Audacity software and were transcribed manually. Emerging patterns within each theme were identified and sub-themes were created to quantify how many times they were mentioned by each organization. The coding process did not only take into account keywords, as this would have been limiting. Interviewees would often use examples and stories to voice a general idea and these ideas were placed into appropriate categories (See Table 1 for sample). Under the motivation category, interviewees would often use keywords such as "need" or "demand" which were eventually created a sub-category. However, the personal interest category was not created because interviewees stated "I have a personal interest in art and science". Instead, interviewees often provided evidence of their interest through anecdotes of their past experiences and interests which led them to where they are today.

Table 1. Sample of coding procedure.

Theme	Sub-theme	Examples
Motivation	Need (demand, initiatives missing)	"it started with a need in the science and art culture..."
	Want (attract new audience)	"we wanted to find different ways to attract that audience..."
	Personal interest/experiences	"I started my first makerspace in my garage 6 years ago for my kids and my friends, made a summer camp to tinker with technology...it was very popular and then after that we ran our first makerspace and that was really successful..."

Results

No statistical analysis was done due to the nature of the study. The following results are simply distributions according to sub-themes created and therefore values bare no statistical significance. Also, sub-themes were not mutually exclusive, as some organizations fit into more than one sub-theme.

Organizations were classified as either traditional informal learning environments (science centres) or non-traditional (non-profit organizations or small businesses). A total of 7 traditional and 9 non-traditional organizations were interviewed. The traditional group consisted of 5 science centres, 1 museum and 1 library. The non-traditional group consisted of 5 non-profits/charities and 4 small businesses.

Highlights

- Traditional organizations expressed the importance of engaging adults in science and emphasized on understanding and applying science
- Non-traditional organizations focused on interdisciplinary collaborations and making art and science accessible

Figure 1. The distribution of criteria based on framework from informal science learning
 A) Total number of organizations, B) Traditional vs. non-traditional

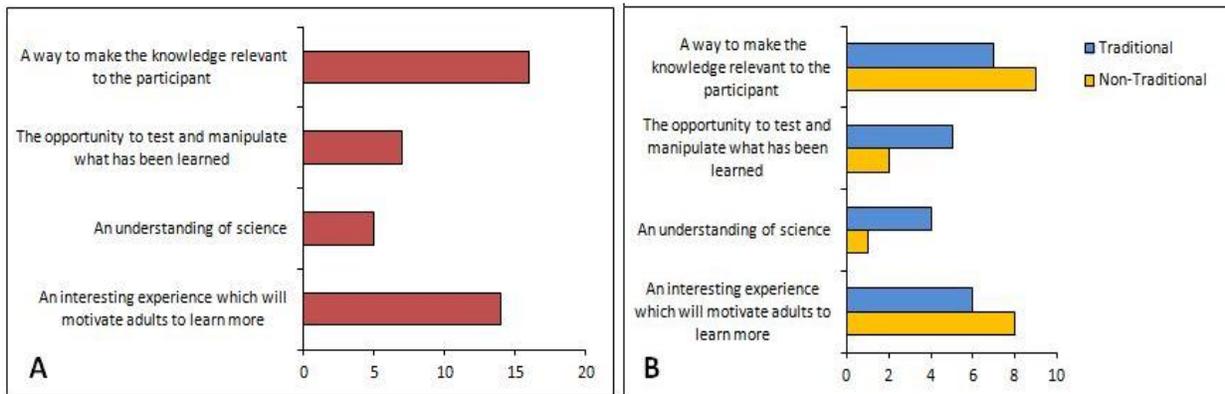
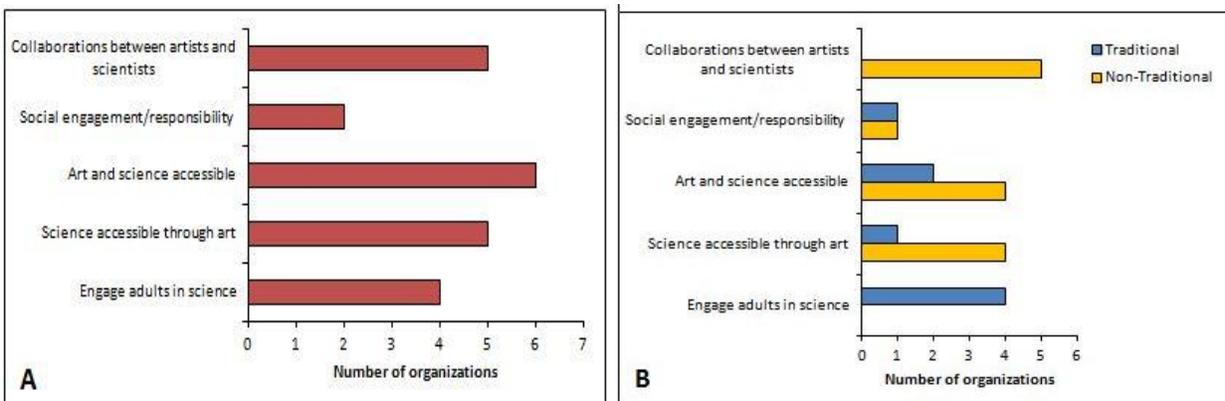


Figure 2. The distribution of organizations' goals
 A) Total number of organizations, B) Traditional vs. non-traditional



- Type of content was divided into three types: specialized materials (non-technological), crafts/conventional art mediums and technology

Table 2. Specific examples of content material under each sub-theme (sample)

Specialized materials (non-technology)	Crafts / Conventional art mediums	Technology
<ul style="list-style-type: none"> • Octopus dissection • Making whisky stones • Molecular gastronomy • Use of dead insects in art • Portable blacksmith forge 	<ul style="list-style-type: none"> • Knitting • T-shirt silk screening • Using recycled material to build creations • Photography • Painting on canvas 	<ul style="list-style-type: none"> • Arduino • Building robots • Use of scientific data/code to construct a visual • Virtual reality • Use of medical equipment (e.g. electromyography)

- The use of the above content types were used equally in both traditional and non-traditional organizations
- Set criteria (usually reflective of their goals), external partnerships and discussion within team were the most popular approaches to developing content

Figure 3. Distribution of content material
A) Total number of organizations, B) Traditional vs. non-traditional

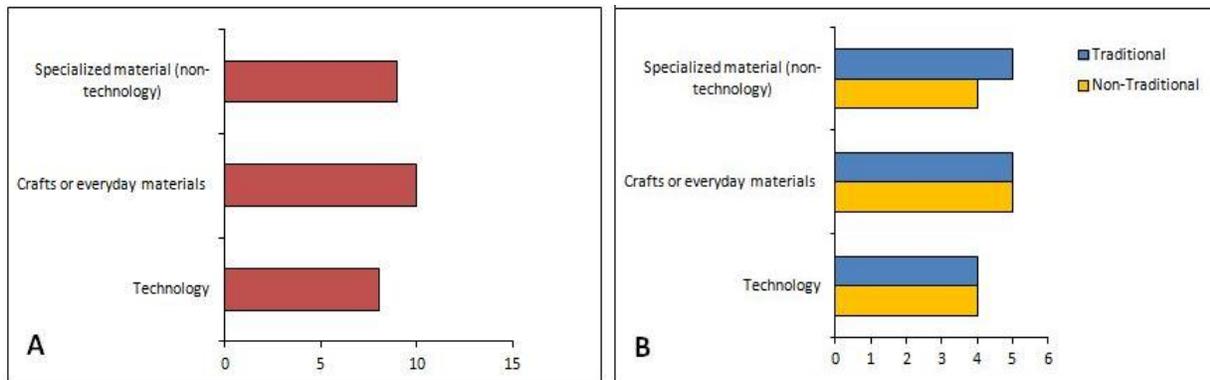
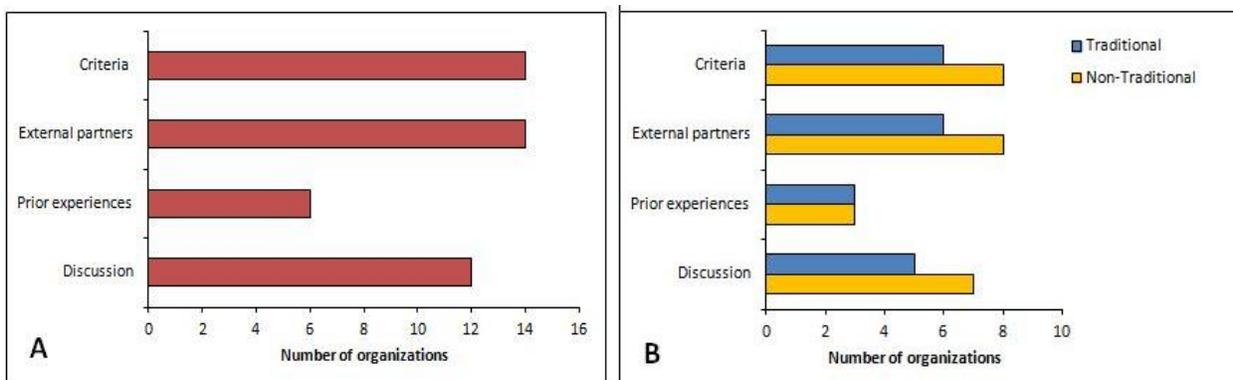
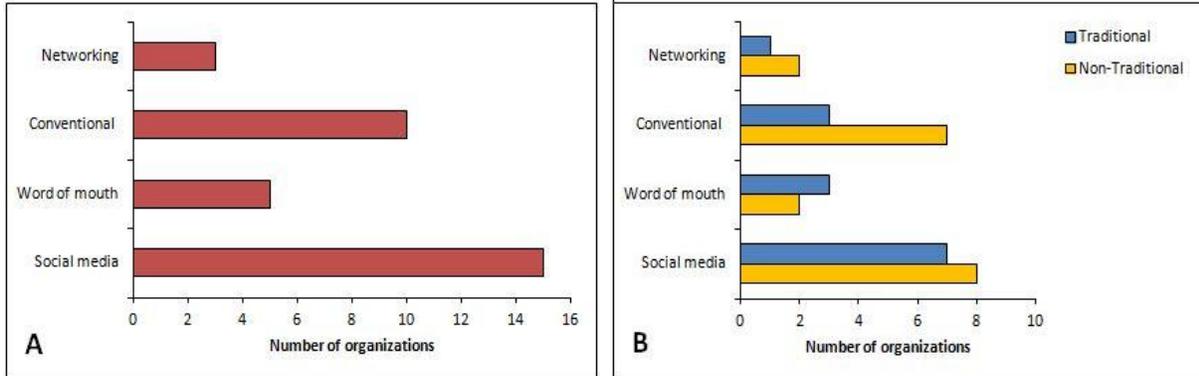


Figure 4. Distribution of approaches to content development
A) Total number of organizations, B) Traditional vs. non-traditional



- Social media platforms were mostly used to promote initiatives

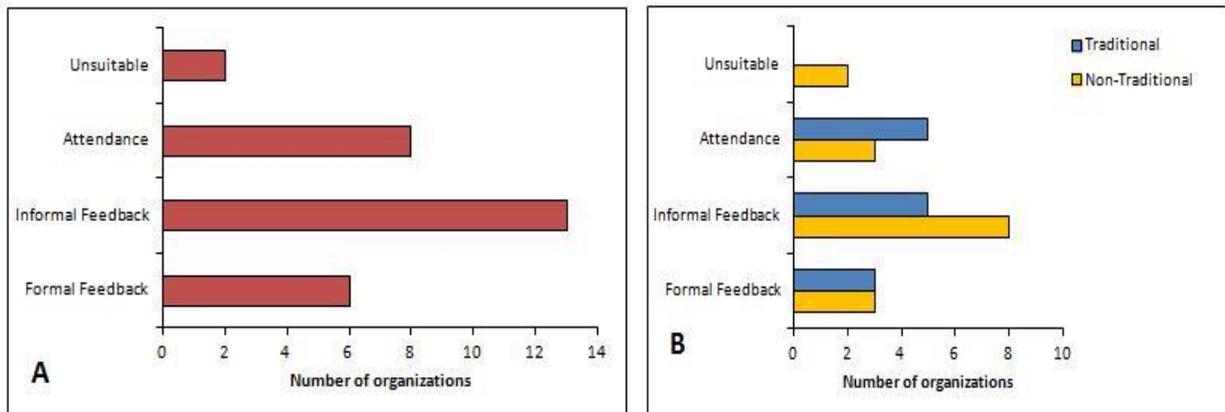
Figure 5. The distribution of marketing strategies used
 A) Total number of organizations, B) Traditional vs. non-traditional



Networking - attended conferences/events; **Conventional** - email newsletters, posters, website; **Word of mouth** - participants passed on message through friends/family; **Social media** - Facebook, Twitter

- Most organizations used informal evaluation for feedback on their initiatives

Figure 6. The distribution of types of evaluation conducted
 A) Total number of organizations. B) Traditional vs. non-traditional organizations.



Unsuitable - participants questioned the efficacy of evaluation; **Attendance** - participants measured success by number of attendees; **Informal feedback** - direct conversations with audience; **Formal feedback** - evaluations that were recorded

Discussion

Traditional vs. Non-Traditional organizations

Traditional organizations such as science centres, listed many types of activities with science focused activities (which sometimes used art) with the end goal of engaging adults in science. On the other hand, non-traditional organizations expressed emphasis on finding a way to connect with the audience by creating an interesting experience using art and science. Perhaps one reason why traditional organizations emphasized the science is due to their apparent status as an educational facility, while non-traditional organizations are not necessarily viewed the same way and are still establishing their role or identity in the community.

While both groups were open to using a variety of creative content and took advantage of social media to promote their initiatives, traditional organizations typically had more resources to accommodate larger audiences and more activities. Both relied on partnerships with local businesses to support their initiatives, although three non-traditional organizations voiced a concern on the limited funds to support art and science initiatives which can restrict the types of programming done. Previously, the Natural Sciences and Engineering Research Council (NSERC) partnered with the Canada Council for the Arts to provide a grant with the intention to promote collaboration between scientists and artists, however it was discontinued after 2012 (NSERC/Canada Council for the Arts New Media Initiative, 2014). With an upcoming review on federal support for fundamental science in Canada (Government of Canada, 2016), perhaps funding for more interdisciplinary collaborations will be considered.

Evaluation

Evaluating the efficacy of art and science initiatives was initially a part of a focus in this research, however it became clear early on that formal evaluation was rarely completed. However, the question of evaluation was still asked to investigate current practices. For those organizations that did not complete formal evaluations, a lack of time, resources or knowledge of a reliable framework were seen as obstacles. Despite this, four organizations voiced a want to implement formal evaluation in the future. A recent review by Lesen, Rogan and Blum (2016) demonstrated that art is becoming widely adopted for science communication upon reviewing 200 projects in the US and recommended establishing more assessments and metrics to measure the effectiveness of arts based science communication. While evaluative tools in this area are still being developed and tested, organizations who want to do some form of recorded evaluation should explore alternative ways to obtain metrics including surveys through [surveymonkey.com](https://www.surveymonkey.com), Google Forms or through social media platforms. Organizations should consider their goals and define how their organization fits into the art-science realm in their evaluation/reports. While informal feedback seems to suffice for now, formal evaluations may prove to be important not only for the growth of the organization but also for funding purposes.

Limitations and Future directions

A larger sample size is always ideal, however due to the time constraints of this study, there were organizations that could not be included in this study. Thus, the patterns that emerged from this research may not be consistent with a larger sample. The methodology was also one sided in the sense that only representatives from each organization were interviewed. To gain a more comprehensive view in the future, participants that took part in the initiatives should have been interviewed or at least surveyed.

There is also an opportunity for social media to engage adults who are often limited by other commitments. These online platforms could provide faster accessibility to digital media and discussions on the intersect of art and science. In a case study focused on adult learning, social media interaction helped improve participants' application and analytical skills following six weeks of intentional use for informal learning purposes (Lee and Sing, 2013). Thus, it would be interesting to investigate the role of social media campaigns and digital art on science engagement for adults.

Conclusions

There is support for art and science initiatives in Canada, but non-traditional organizations will likely lead the way in its growth due to their art-science focus compared to traditional organizations. It is also evident that Canadian organizations do not commit to consistent evaluation and rely mostly on informal feedback to shape their initiatives. However, efforts should be made to evaluate because there is a lack of literature in this area, which is arguably the limiting factor for incorporating art in science as well as resources to fund such initiatives. Consistent evaluation may therefore be the key to building a strong infrastructure for art-science in Canada as well as other parts of the world.

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Appendix: Profiles of Canadian art-science organizations

Art the Science | artthescience.com
Kingston, ON

A creative technology agency that works with students, principal investigators, faculties, academic establishments and conference organizers to foster broader public engagement in scientific research. Art the Science also runs an online gallery (Polyfield Online Gallery) curated by co-founder, Julia Krolik and a blog which features interviews with sci-artists, artworks/exhibitions and spaces that promote sci-art around the world.

Action Potential Lab | www.actionpotentiallab.ca
Toronto, ON

The Action Potential Lab is dedicated to merging science and art through classes, workshops, birthday parties, lecture series and community outreach programs. It targets people of all ages (mainly children) and encourages people to look at the world with different perspectives by combining these two fields together.

ArtSci Salon | www.artscisalon.com
Toronto, ON

ArtSci Salon is dedicated to fostering a dialogue between artists, scientists and other professionals at the intersection of art, science and technology. Monthly (or bi-monthly) events are held to discuss, present and debate ideas at the intersection of these disciplines.

Beakerhead | beakerhead.com
Calgary, AB

Beakerhead is a "smash up of science, art and engineering" aimed at opening the doors to these three disciplines in order to inspire and engage the general public. The main festival is held each year in September with creative exhibits and workshops set up throughout Calgary. In addition, monthly workshops featuring a "Beakerhead" type person (e.g. maker, creative, scientist) are held to engage the general public outside the main festival time.

CommNatural | commnatural.com
Quebec City, QC (*moved to US)

Bethann G. Merkle (photographer, illustrator and science writer) started her own science communication consulting business, Comm Natural with the goal of helping scientists and

non-profits communicate their research with their peers and the general public. She has a blog where she provides neat tips and opportunities for people on sketching science. In addition, she runs workshops in Canada and the United States, with a range of audiences from university students and professors to the general public on how to understand science (particularly biology and ecology) through sketching.

Curiosity Collider | www.curiositycollider.org
Vancouver, BC

Curiosity Collider encourages interdisciplinary collaborations that capture human curiosity. They look for ways to use art, culture and technology to communicate the relevance of science by working with innovators of all disciplines. A variety of creative events are held in partnership with local organizations to communicate science.

Make Fashion | www.makefashion.ca
Calgary, AB

Make Fashion pairs fashion designers and artists with engineers and tech enthusiasts to produce innovative tech garments. Creations inspired by the merge between fashion and electronics are showcased at the runway gala in Calgary. They also host public-access workshops, innovative theater and molecular gastronomy events.

Nascent Art Science Collective | www.nascentartscience.org
Kingston/Toronto, ON

The Nascent Art Science collective is an international collaboration of artists and scientist who explore the interface between social hardship, technological advances and health. They disseminate scientific concepts within the medical sciences through public exhibits and events.

STEAMLabs | steamlabs.ca
Toronto, ON

This is a non-profit makerspace that has programs for both children and adults. Everyone is encouraged to come together to access high tech tools to learn and to create their own projects. In particular, it provides courses for beginners who want to learn a bit of everything and also provides workshops for educators who may want to use particular concepts in their classes.

Subtle Technologies | subtletechnologies.com
Toronto, ON

Subtle Technologies hosts an annual festival incorporating a diverse range of topics on art, science and technology. They have also created a public forum of makers and thinkers and fosters interdisciplinary collaborations.

Visual Voice Gallery | www.visualvoicegallery.com
Montreal, QC

Visual Voice Gallery fosters the connection between art and science and features exhibits at the intersection of these two disciplines. The gallery also hosts public lectures and workshops aimed to stimulate curiosity, inspire, spark discussion and promote the appreciation for the natural world.