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Developing a Makerspace as a Vehicle for Partnership Building: The Role of Teacher Education Programs in Guiding Teachers, Librarians, and Communities

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Abstract

As schools consider new ways to enhance hands-on learning opportunities, many have focused on the emerging "Maker Movement." As a means to support this trend, the authors share how the College of Education at a state university in northern New Jersey designed and facilitated a Makers Day event to help teacher candidates, teachers, and librarians, to develop insights into the activities for their own community based makerspaces. This article first describes the impetus for carrying out such activities, followed by a literature review, a description of how the event was designed, and our future plans for building on these activities.

Keywords

Community, Making, Makerspaces, Makers Day, Maker Education, Maker Movement, Partnership

Cover Page Footnote

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Heejung An & Ellen Pozzi

Introduction

Making, tinkering, creating, designing, and engineering are all terms that have increased in popularity among P-12 school communities during recent years. These are all activities which have been encapsulated in the current Maker Movement. Overall, this movement is characterized "by people who engage in the construction, deconstruction, and reconstruction of physical artifacts, and who share both the process of making and their physical products with the broader community of makers" (Cohen, 2017, p.1). This movement draws upon pedagogies such as "constructivism, constructionism, inquiry, hands-on, and project-based learning and weaves in recent innovative methodologies like design thinking and effectuation" (Opperman, 2016, p.1). Teachers, librarians, and administrators have explored how they may adopt this concept into their curricula. Yet, research notes that many of these audiences are not prepared to adopt or embrace this new movement or how to initiate such activities in an effective manner (Oliver, 2016).

In order for the Maker Movement to have a meaningful impact on students, it is essential for teachers to be competent in the aforementioned issues. The authors assert that the emerging role that a college teacher preparation program plays is of the utmost importance. Such programs can offer insights and examples to surrounding communities, to which school teachers, administrators, librarians, staff members, parents, and children can be invited to participate in hands-on activities that can be held in their makerspaces. By doing this, teacher preparation programs and surrounding schools can interact regarding the maker movement, and understand and learn more about each other's needs.

This article illustrates how the authors designed a Makers Day event and describes the types of activities that were offered for teachers, teacher candidates, librarians, and parents and children from the community. Lessons learned after conducting the event are also provided.

Conceptual Framework

Pattern Language

The Makers Day event at our College of Education (COE) was built within the theoretical framework of pattern language development (Alexander, 1977; 1979), to understand how communities effectively exchange information. Alexander asserted that pattern language development is based on the historic action in which communities freely share information, with the intention of developing model procedures. He further noted that the process of sharing and then building on such new patterns has occurred for centuries, often through guilds of builders, masons, and other master / apprentice-based trade professions. Through the constant discussion of new techniques and procedures, guild members and other communities of learners have shared and thus improved upon the ways in which various tasks could be accomplished. These practices were not intended to increase profits, but were instead intended for the public good. In more recent times, pattern language development has been shared and built on by professional programmers, YouTube's Do It Yourself (DIY) communities, and now via the Maker Movement, as people from diverse backgrounds and skillsets come together in community-based settings to continually improve on the quality of different designs. This theory was relevant to our project in that we sought to develop our makerspace event as a vehicle for partnership building, and guiding teachers, librarians, and teacher candidates to develop the knowledge and structure to create their own makerspaces.

Origin and History of the Maker Movement

Wilczynski and Adrezin (2016) note that the "modern" Maker Movement has been associated with the development of open source computer languages, fabrication laboratories, the availability of how-to video tutorials on the internet, and the *Make* magazine (first published in 2005). Maker Faires, described as "part science fair, part county fair, and part something entirely new" broadened the reach of the maker movement (Maker Media, Inc., n.d.). Interest in makerspaces in schools followed the rise of the modern makerspace movement into more community spaces. President Obama boosted the visibility of the maker movement with the launch of his Educate to Innovate campaign. In 2009, he highlighted the value of making experiences saying, "I want us all to think about new and creative ways to engage young people in science and engineering, whether it's science festivals, robotics competitions, fairs that encourage young people to create and build and invent—to be makers of things, not just consumers of things" (Obama, 2009, para. 69).

Definitions

Since "makerspaces" is still a relatively new term, we would like to provide several definitions. Dale Dougherty, founder of Make Magazine, notes that makerspaces "share some aspects of the shop class, home economics class, the art studio, and science labs. In effect, a makerspace is a physical mash-up of different places that allows makers and projects to integrate these different kinds of skills" (2013, p. 9). Davee, Regalla, and Change (2015) assert that "Makerspaces, as a more generic and inclusive term, has increasingly come to represent an extremely wide variety of creative endeavors, tools, demographics, and types of places where making happens" (p. 4). Wilczynski and Adrezin (2016) expand the definition to include not just the place where making happens, but also the people who use it and the activities done within the space. In this article, we position our event to support the definition used by Wilczynski and Adrezin (2016).

Educational Benefits of Makerspaces for P-12 Schools

In the literature, there have been few discussions regarding how the use of makerspaces can foster benefits in P-12 educational environments. By and large, it has been asserted that makerspaces can be used to spark creativity and encourage invention in many communities (White House, 2014). With the ultimate goal being creativity and innovation, this movement encourages tinkering and playing as part of the learning process. A vital part of the maker experience is providing opportunities for open-ended exploration, without boundaries. Peppler and Bender (2013) noted that allowing more time for young students to engage in open exploration and experimentation will generate innovative ideas. They also emphasized that makerspaces facilitate self-directed learning, allowing students to take control of their own learning through joint collaboration, problem solving, and sharing.

The makerspace phenomenon has also provided opportunities for students to apply their subject knowledge to undertake a design process resulting in the creation of artifacts for STEM or STEAM (Blackley, & Howell, 2015), to inspire students in the STEM fields, and to attract a more diverse population of students to consider educational and career pathways in STEM (Martin, & Panjwani, 2016). Besides the STEM subjects, "making" can also integrate language arts, social studies, and many other subject areas. For example, students can become motivated to participate in creative writing while doing coding activities with Scratch (Hah & An, 2017), turning their writings into interactive stories. Students can also learn social studies lessons in a makerspace, which can provide an immersed set of experiences (Barrow Media Center, 2017).

Our Program

Setting and Procedures

Our Makers Day was part of a state-wide event coordinated through the NJ Maker's Day organization (http://njmakersday.org). We registered the university as a host site to provide an impetus for teacher candidates and surrounding schools to explore the possibilities of incorporating Makerspace projects in their schools. We formed a committee to discuss what types of activities we wanted to provide and what capacities we had. After deciding which types of stations to set up, the committee contacted faculty members, librarians, and teacher candidates to find volunteers. We also heard from volunteers who wanted to offer particular activities. The dean of the College of Education (COE) also supported the event with refreshments and conference space, while several COE faculty donated materials. The event was free and targeted to the local school community and our own teacher candidates, school librarian candidates, and teachers. Ninety people attended the three hour event held on a Friday afternoon during the Spring, 2017.

Stations

There were four categories of stations: a) activities with technology, b) activities without technology, c) a creative corner, and d) a references and resources corner. At each station, there were tables featuring a tri-folder poster, which provided basic information about the associated activities. The participants could try the maker activity while conversing with the presenter. Figure 1 shows the configuration of the stations in the cafeteria of the COE building. Tables 1-3 detail what stations were offered and the materials that were used along with descriptions of the activities at each station. Figures 2-4 are photos taken on the day of the event.

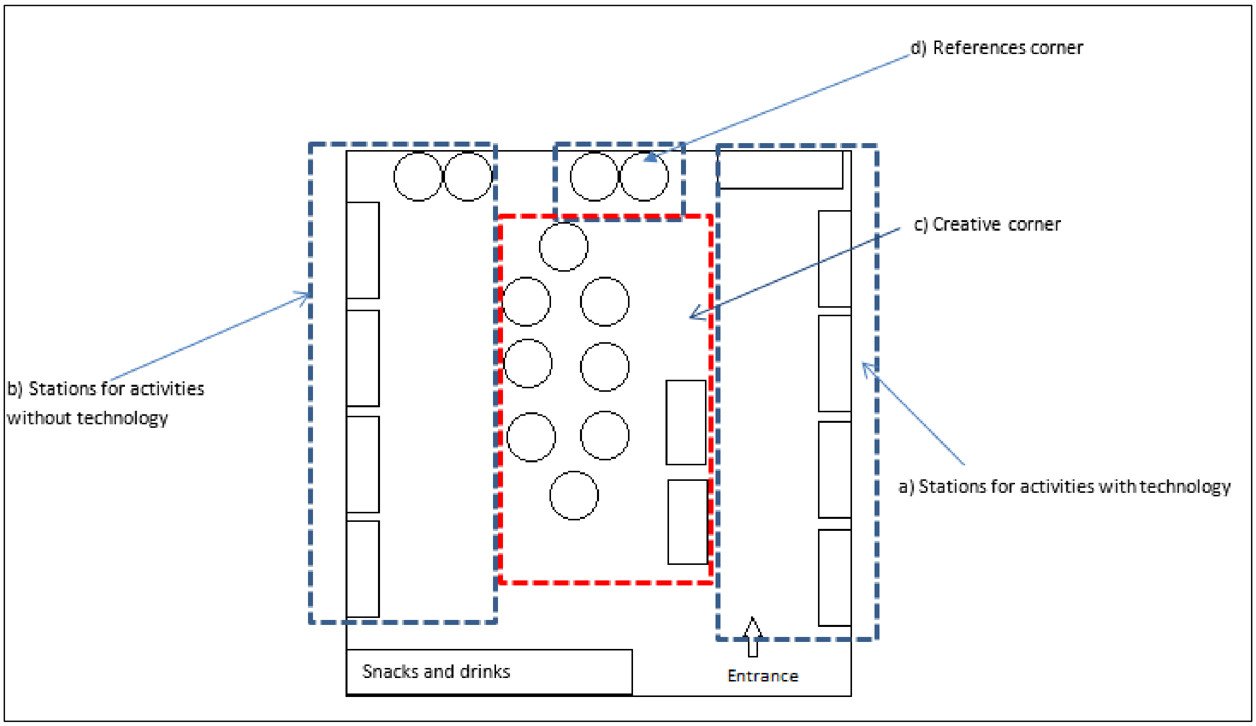

Figure 1. Station Set Up

One set of stations featured activities requiring technology. They included Educational Robotics, Video Recording and Editing, Video Game Making, Coding, a 3D Printer, and a Cricut Machine. Table 1 lists the materials at each station and a description of the activities. Children who accompanied their parents are shown interacting with the Lego WeDo 1 (Figure 2) and the Coding Station.

Table 1. *Stations with activities that use technology*

Name of the Station	**Materials Used**	**Description**
Educational Robotics	5 laptops (with Lego WeDo 1.0 program installed), and 5 Lego WeDo 1.0 kits	A tri-folder poster explained educational robotics, what types of robotic kits are appropriate for certain grade levels, and what benefits could be attained by the students. The presenter guided each audience member in an activity with Lego WeDo 1.0, for coding.
Video Recording and Editing	2 Laptops with Screencast-O-Matic program installed	A presenter demonstrated how to use the Screencast-O-Matic software and how to make enhancements to a recorded video using the editing tools.
Video Game Making	Bloxels; iPad	A poster explained what game, gamed-based learning, and gamification are, and how they can be used in the classroom for various audiences who stopped by this station. The presenter guided the audience in an activity with Bloxels on an iPad to create video games.
Coding	5 laptops (with *Hour of Code* program installed (http://www.code.org)	A poster prepared by the educational technology professor explained how the coding activity could be incorporated into school environments. The presenter guided each audience member in an activity with the *Hour of Code* program (see Figure 2).
3D Printer	Items created by the 3D printer were displayed (printer was not available onsite). These included a DNA model, scaled skull model, ionic bonding model, frog dissection kit, rubber band 3D car, Tessellation Escher Project, Add a Face to Mt. Rushmore project,	A poster had lesson plans for each of the items displayed and the presenter facilitated a discussion of how to use a 3D printer both with students (design and print rubber band car, then conduct experiments with the car) and as a resource for teachers to make unique items to enhance teaching (DNA model). Ideas and lesson plans from www.thingiverse.com were displayed.

	Stonehenge puzzle, and musical instruments	
Cricut Machine	Cricut Machine Paper Laptop	A presenter demonstrated uses and versatility of a computerized die cutting machine. There were samples of many projects that could be used for bulletin boards and displays.

Figure 2. Educational Robotics with *Lego WeDo 1.0*

Some stations featured activities that did not require technology. While the maker movement has popularized the use of technology, including robotics and other activities featured in the stations above, the activities in this section provide a way to integrate hands on learning without the expense of technology. They included Quilting and Math, Insects Around Us and Gardening. Table 2 lists the materials available and a description of the activities at each station.

Table 2. *Stations with non-electronic activities*

Name of the station	Materials used	Description
Quilting and Math	Tangrams, Rulers, Geometric shapes, and Pencils Quilting books/patterns	The presenter demonstrated how geometric shapes come together and conducted hands-on experiences with tangrams to create a geometric design, similar to quilting.
Insects Around Us	Textile paper, glue, ribbon, yarn, water bottles, and various recyclable materials.	The presenter demonstrated how a maker activity is connected to teaching and learning science concepts. She cut out leaves and put glue drops to show larvae in the butterfly life cycle, and then layered water bottles using yarn to show the cocoon in the butterfly life cycle. Following this demonstration, participants did a hands-on activity for creating their own butterflies using any materials they liked. The presenter also provided the participants with information on the stages of the butterfly life cycle.
Gardening	Poster	A presenter shared a poster based on a garden project she developed with a local school and provided information on how the garden was incorporated into lesson plans at the school.

Dougherty’s (2013) definition of makerspaces above includes art spaces, so a Creative Corner with a Playful Inquiry for Young Minds Station, a Recycled Art Station and an Origami Station was included. Materials and descriptions of each station are in Table 3.

Table 3. *Creative Corner*

Name of the station	Materials	Description
Playful Inquiry for Young Minds	Building: Craft sticks (variety of sizes); Binder clips; Paper cups (variety of sizes); Clothespins; Wooden paint stirrers; Wooden cube building blocks (variety of sizes), and flat wooden yardsticks Documentation: white boards and markers	Participants were encouraged to create, construct, collaborate, and communicate with each other by using open-ended loose parts Some children drew what they were going to create before constructing it (e.g., skinny tower) (see Figure 3).
Recycled Art	Fiber drums, plastic containers, other industrial and commercial packaging materials, scrapbooking paper, and miscellaneous craft supplies.	The participants used fiber drums, plastic containers, and other industrial and commercial packaging materials and recycled them into containers for their personal use by covering them with other recycled materials such as beads, scrapbooking paper.
Origami	Origami papers, directions for creating a bird and a fortuneteller, construction paper with a V shape drawn on, glue, and markers	Two activities were provided. 1) modeling how origami activities can be incorporated into a science class. Each participant made a bird and placed his/her bird on a V shape on the blue big construction paper (see Figure 4). Information about why birds migrate in a V shape was shared. 2) Participants created a fortune teller origami for a game for the first day of school activities. After creating this, two participants played the game that they had created.

The Playful Inquiry Station engaged the children in attendance, as can be seen by the diagram of a "skinny tower" shown in Figure 3, and the concentration on the student's face in the same figure, as he works on creating his tower.

Figure 3. Creative Corner: The Playful Inquiry for Young Minds Station

The Recycled Art station was busy throughout the program. No instructions were provided, and individuals were free to create and take home their finished products. Of note was the interaction between the makers and the limited use of cell phones. The Origami Station featured art aligned with a lesson. Figure 4 depicts birds created at the Origami Station and set into their migratory pattern, and a finished fortune teller origami that could be used as a first day of school activity.

Figure 4. Origami Station

Resources such as books and articles were provided for further investigation into makerspaces. This included a handout with a link to the LibGuide (http://guides.wpunj.edu/makersday2017) and space for note taking.

Conclusion

During our Makerspace event, several phenomena occurred. First, the participants clearly understood the directions, specifications, dimensions, and capacity that they could handle in their school, rather than just improvising. They were also clear about the learning activities held in makerspaces, and that they didn’t have to utilize technology. They learned that activities held in a makerspace could be linked to many subject areas. Several participants later informed the authors that their schools created makerspaces immediately after this event, emulating and enhancing or modifying patterns that they learned. Additionally, presenters served as instructors and experts at their stations through apprenticeship and conversations. Participants observed and followed what the presenter modelled and asked the presenters questions, such as where to purchase devices, tools, and materials, and how to operate certain technologies. Lastly, some presenters provided contact information for further questions, and were invited to the attendees’ schools to inspire their students to create a new makerspace.

It became evident that by providing this event to the surrounding schools and our teacher candidates, we, as a community, strengthened our interactions and partnerships between the college and surrounding schools, where our teacher candidates are often placed for their practicum experiences and student teaching. Schools surrounding our college are interested in the Maker Movement, however, they have not had an opportunity to actually see and experiment with technology and other materials, or to participate in an activity by using such materials. We created a makerspace for educators to explore and design their own. As Wilczynski and Adrezin

(2016) emphasized in their definition of makerspaces, it is necessary to include the people who use them and the activities done within the space. We developed a community for this endeavor and developed appropriate activities while strengthening the partnership between our College of Education and the surrounding P-12 schools. As Hira el al. (2014) noted, in order to enable a movement to enrich the school-day curriculum and bridge formal and informal learning contexts, educators need to have an understanding of the technologies, management issues, and maker pedagogies involved. We envision doing this event every year, tailoring the curriculum to specific participant needs and providing inspiration and assistance to our surrounding partner schools.

References

Alexander, C. (1977). *A pattern language: Towns, buildings, construction*. New York: Oxford University Press.

Alexander, C. (1979). *Timeless way of building.* New York: Oxford University Press.

Barrow Media Center (2017). *Weaving together social studies and makerspace.* Retrieved from https://expectmiraculous.com/2017/01/04/weaving-together-social-studies-and-makerspace/

Blackley, S., & Howell, J. (2015). A STEM narrative: 15 years in the making. *Australian Journal of Teacher Education*, *40*(7), 102-112.

Cohen, J. (2017). Maker principles and technologies in teacher education: A national survey. *Journal of Technology and Teacher Education*, *25*(1), 5-30.

Davee, S., Regalla, L. & Chang, S. (2015). Makerspaces: Highlights of select literature. *Maker Ed.* Retrieved from http://makered.org/wp-content/uploads/2015/08/Makerspace-Lit-Review-5B.pdf.

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). New York, NY: Routledge.

Hah, Y. & An, H. (2017). Supporting the development of elementary students' creative writing for coding in the Scratch environment. In P. Resta & S. Smith (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2017* (pp. 1073-1080). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Hira, A., Joslyn, C. H., & Hynes, M. M. (2014). *Classroom makerspaces: Identifying the opportunities and challenges.* Paper presented at the Frontiers in Education Conference, Madrid, Spain.

Maker Media, Inc. (n.d.) *Maker Faire: A bit of history.* Retrieved from http://makerfaire.com/makerfairehistory/

Martin, D., & Panjwani, A. (2016). *Make: Start making!: A guide to engaging in maker activities.* Maker Media, Inc. San Francisco, California.

Obama, B. (2009). *Remarks by the President at National Academy of Sciences meeting* [Press release]. Washington, DC: White House Office of the Press Secretary. Retrieved from https://obamawhitehouse.archives.gov/the-press-office/remarks-president-national-academy-sciences-annual-meeting .

Oliver, K.M. (2016). Professional development considerations for Makerspace leaders, part one: addressing:"what?" and "why?" *TechTrends, 60*(2), 160-166.

Opperman, A. (2016). Maker education: The STEAM playground, *The STEAM Journal*, *2(*2), Article 4, Retrieved from http://scholarship.claremont.edu/steam/vol2/iss2/4

Peppler, K., & Bender, S. (2013). Maker movement spreads innovation one project at a time. *Phi Delta Kappan, 95*(3), 22-27.

White House (2014). *President Obama to host first-ever White House Maker Faire.* Retrieved from https://obamawhitehouse.archives.gov/the-press-office/2014/06/18/fact-sheet-president-obama-host-first-ever-white-house-maker-faire

Wilczynski, V., & Adrezin, R. (2016). Higher education makerspaces and engineering education. *Proceedings of the ASME 2016 IMECE.* November 11-17, 2016, Phoenix, Arizona, USA Retrieved from https://static1.squarespace.com/static/55833fc0e4b07d6bd2063c9e/t/581a2847b3db2be38a44aab0/1478109256719/IMECE2016-68048.pdf