Maketec: A Makerspace as a Third Place for Children

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Abstract
Makerspaces of various models are forming all around the world. We present a model and case study of the Maketec, a public drop-in makerspace for children, run by teens. The Maketec model is designed to promote making and socializing opportunities for girls and boys of ages 9-14. It is based on three underlying principles: (1) "Low Floor/Wide Walls": construction kits and digital fabrication technologies that allow kids to invent and create with no prior knowledge or expertise; (2) "Unstructured Learning": no formal instructors, teens serve as mentors for kids, and promote a culture of self-driven learning through projects; and (3) "A Makerspace as a Third Place": the Maketec is free and managed by kids for kids in an effort to form a unique community of young makers. We report on interviews with four recurring visitors, and discuss our insights around the three principles and the proposed model.

Author Keywords
Makerspace; Digital Fabrication; Playful Learning; Informal Learning; Collaborative Learning.

ACM Classification Keywords
K.3.1 [Computers and Education]: Computer Uses in Education – Collaborative learning

Oldenburg's hallmarks of a "Third place"

Ray Oldenburg, an urban sociologist suggested several properties that make a "Third Place". Among these are:

A. Entrance is free or inexpensive.
B. Highly accessible: within walking distance.
C. Frequent visitors.
D. Welcoming and comfortable atmosphere.

Introduction

The maker-movement is gaining popularity, with a growing number of Fab labs and other forms of makerspaces emerging around the globe [2]. Researchers and practitioners are designing tools and curricula to harness the potential of these spaces towards learning. Noteworthy are the lessons available in STEAM (Science, Technology, Engineering, Art and Math) which seem to cross gender, race and socio-economical borders [3, 4]. This endeavor of providing opportunities to gain 21st century literacy skills is essential, as it can allow people to take part in the digital revolution around them [6].

Given these educational benefits, we envision a future in which makerspaces are commonplace in communities as sandboxes are in kindergartens today. To make this vision a reality, models of feasible community makerspaces need to be articulated. In this paper we introduce the Maketec, a makerspace in a public library in Tel-Aviv, Israel. We designed the Maketec as "a Third Place" [8] for youth; promoting making and socializing opportunities. Our design is guided by three main principles:

1."Low Floor/Wide Walls"– building on Papert's Low Floor/High Ceiling [9] and Resnick's Wide Walls [11], we focus on construction kits that are easy to start with and do not require any prior technical knowledge (Low Floor), but at the same time ones that enable a variety of creations (Wide Walls).

2."Unstructured Learning" – we think visitors should be free to choose their projects and intrinsically engaged in making. Too much instruction can cause children to take the "back seat" and just follow steps, whereas too little instruction can deter them from even trying [12]. We try to strike the right balance. On one hand, by providing project examples with basic written instructions and the support of mentors that are always present in the Maketec. On the other hand, we encourage visitors to come up with their own projects and choose whether or not to use the mentors' help. We hope that promoting this kind of autonomy in learning will empower visitors in a unique way.

3."A Makerspace as a Third Place" – we envision the Maketec as a community center, allowing kids to socialize with other kids from surrounding areas (see side bar for explanation of the "Third Place" concept). The Third Place [8] is a location distinct from home or school where kids bring other members into the community and invest time and effort in helping them feel they are part of it. For this purpose, we decided that teenagers from local high schools will be the mentors. These teens live in the area, study in local schools, and are closer in age to the visitors, in contrast to university students or professional makers.

Related Work

The Maketec, a kids' drop-in makerspace in a public library, is our attempt to merge two makerspace approaches. Public drop-in makerspaces, where the general public can experience digital fabrication firsthand; and school makerspaces, usually led by librarians or teachers, where children of a given school engage in making and tinkering activities.

One example of a public drop-in makerspace is the ARS-Electronica Center fab lab in Linz Austria. It affords digital fabrication opportunities for people of all ages [10]. Visitors are invited to model designs and fabricate

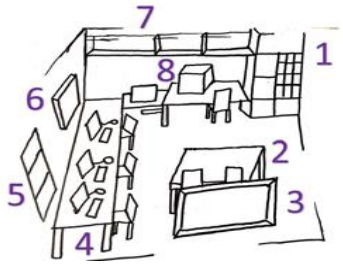

Figure 1. The Maketec space layout.

(1) Storage unit for kits, electronics, craft materials, books and magazines.
(2) Central workbench for individual and collaborative work.
(3) Floor-to-ceiling whiteboard for informal sketching and brainstorming.
(4) Desktop computers for 3D modelling and scratch programming.
(5) Gallery space for showcasing of physical objects.
(6) LCD monitor for inspiring projects and makers.
(7) Shelves for children's long term projects.
(8) Fabrication counter for 3D printers.

them using a variety of tools such as laser cutters and 3D printers. Support is provided by museum staff members, AEC students, and computer stations with instructions.

The Lamar makerspace in Flower Mound, Texas [7] is an example of a school makerspace. It uses technologies such as Makey Makey [5] and Scratch [11]. These tools provide the school's students an opportunity to prototype and experiment freely during opening hours. Structured workshops on specific skills like blogging are given on different days, by either the school librarian or by kids who take initiative.

The Maketec Model

We implemented the three guiding principles as follows: "Low Floor/Wide Walls" - we equipped the Maketec with carefully selected technological kits that offer entry-level experimentation in computation, tinkering and prototyping (See Figure 1). Hardware kits include Makey Makey [5] a simple electronics circuit board that offers unlimited ways to interact with a computer creatively, replacing the keyboard or the mouse. Little Bits [1] are modular electronic components that snap on magnetically to form interactive devices. For paper circuits such as Jie Qi's "Chibitronics Sketchbook" [13], we added craft supplies as well as LEDs and conductive materials. We chose software such as Scratch, a programming environment for kids [11] and freeware, 3D modelling programs due to their relative simplicity and the fact that they are available for kids to continue with at home.

"Unstructured Learning" and "A Makerspace as a Third Place" – we provided project examples as introduction to the different technologies (e.g., instructions of how to make a 3D printed keychain). Visitors are free to choose if they want to follow these project cards or create whatever they want. Our lab's undergraduate students and faculty trained seventeen 10th graders who chose to mentor in the makerspace for their 60 hours of social involvement, as required from high school students in Israel. None of the teens had prior experience with any of the aforementioned technologies or in instructing kids. The training included eight sessions of creating with the technologies using the instructional cards, and a discussion on the meaning of being a mentor for younger kids.

User Study

We conducted a small user study to evaluate the three guiding principles of the Maketec model in light of the visitors' experiences.

Participants

We conducted the study when the Makerspace had been open for 9 months and had been visited by 330 children. These came from 20 schools in Tel-Aviv and its suburbs. About a third of the children became recurring visitors, visiting 1-3 times a week. For the purpose of this report, we recruited four recurring visitors, two boys who heard about the Maketec at their school and two girls who are regular library visitors and decided to try the makerspace when they came to borrow books. All participants and their parents provided informed consent.

Procedure

One of the researchers conducted semi-structured interviews with the participants. These phone interviews lasted ten to fifteen minutes each. We then clustered excerpts to examine the visitors' experiences

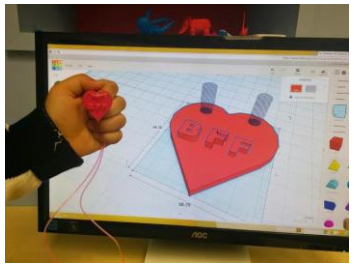

Figure 2. Anna's necklaces.

From Anna's interview:

A: "The first time I came I asked for help while making the keychain project. Then I made another thing by myself, I just worked on my own and asked the mentors to print my models. I recently made two half heart necklaces for me and my best friend, but everybody copied it and it annoyed me because I couldn't get back to my original work".

Q: "Had they saved your version and then made their own would it have been less annoying?"

A: "If they just asked it would have been less annoying, because then they would have given me credit".

in light of the Maketec's three guiding principles. Visitor names were changed to maintain anonymity.

Results

In this section we present the interview excerpts that we have associated with each of the model principles.

"Low Floor/Wide Walls": We clustered expressions pertaining to first and subsequent interactions with the technologies. All visitors stated they were able to use the technologies upon their first visit.

"When I come in I say hello to everyone, check if there's a new kit or Make magazine. If there are, I play around with the kit to figure it out or sit and read. On my fourth visit I made a device that high fives people who approach it by attaching a hand I cut out of cardboard and attaching it to Little Bits components". (Ron, M, 13)

Participants also talked about making personally meaningful creations.

Anna, one of the children, reported asking for help for her first project, but that she made her second project independently (see Figure 2). Such reports suggest that the visitors were able to use the equipment early on, and to advance from seemingly trivial templates (e.g. a keychain) to personally meaningful objects. Anna's necklaces represent her attempt to design and produce personal objects for herself and a friend. Following her design, many visitors wanted to replicate and make their own versions of the necklaces. Anna found this irritating and would have preferred to somehow be credited for her originality. This issue of copyrights showcases the potential of makerspaces to not only teach new media literacy, but to also elicit questions of ethics.

"Unstructured Learning": we clustered quotes that addressed instructions, the visitors' perception of their mentors and how the Maketec compared to school or after school activities.

"There are no real instructions and it is very personal. You can work alone or with a partner, with guidance or independently." (Dan, M, 10)

"It is very different from school. At school the teachers and headmaster plan and run everything, here it's all freer." (Jenny, F, 10)

One user perceived the Maketec as comparable to extracurricular activities. "Very similar to afterschool classes, only you can come in whenever you want." (Anna, F, 9)

All four kids said that the mentors helped them or others in initiating project ideas and understanding things. Yet, one said he would like mentors to not only help but make their own projects.

"Some help while other don't do anything. They never interfere, just help, have fun and inspire. Without them many of the kids would not have what to do here." (Ron, M, 13)

"When I want to make something new, the mentors are always nice and show me new things and explain them to me. " (Jenny, F, 10)

Figure 3. A first visit.

A teen mentor (right) handing a tablet with an instructional card to a first time visitor (left) after she chose to make her own 3D printed cell phone case.

"If they make their own creations I can watch and learn from them. I don't usually need help and the teenagers are mainly there to help." (Dan, M, 10)

Reading into this cluster of quotes, we found that the visitors enjoyed the unstructured nature of the Maketec. It permitted them to visit whenever they pleased and to choose a project that interests them (See figure 3). However, one visitor perceived some mentors as more helpful than others and another expressed his desire to observe the mentors work on projects, and to serve as the mentor's apprentice. This calls for experimentation with the mentor's role.

"A Makerspace as a Third Place": we clustered quotes related to the space being operated by children and helping or inviting others. All visitors expressed a connection to the Maketec, claiming they felt part of it and wanted their friends to join them there.

"The instructors are really close to the kids' age which makes it easier to connect with the place, and when you are connected it is easier and more fun to come and create" (Ron, M, 13)

"I found something there which is beyond being at home or just any afterschool activity. Sometimes I come to teach and sometimes someone else teaches me. During the summer break the place was packed, and I was kind of a mentor myself, helping in between making." (Dan, M, 10)

"I spread the word around my school. One boy came and made a cell phone case and another girl made a hairbrush." (Anna, F, 9)

Discussion and Future Work

We presented a model and case study of a makerspace designed for children and operated by teens. We reported a small qualitative user study that provides an initial evaluation of our model. We interviewed four recurring visitors and clustered their quotes around the model's three design principles.

The "Low Floor/Wide Wall" principle was supported, as users were clearly able to use the technologies and make meaningful creations with relative ease. Whether "Unstructured Learning" was supported is less clear. The visitors appreciated the autonomy afforded by the space, and indicated it is different from their regular learning settings, yet some of their learning needs are not addressed by the teen mentors. Further experimentation is needed to identify the right balance between too much and too little instruction. One direction to explore is encouraging mentors to make more advanced creations themselves and have visitors observe and join in the process. The principle of "A makerspace as a Third Place" was supported, as visitors expressed relatedness with the Maketec, and showed a sense of social responsibility by introducing new members and welcoming them into the community.

We believe there is a strong need for research in this field. Makerspaces of various models are sprouting around the globe. Therefore, systematic research should investigate these models along relevant dimensions such as motivation, learning, and social aspects. We hope our work-in-progress will guide future research that will help fulfill the idea of makerspaces as Third Places for children and as environments for self-driven learning.

Future studies should (1) compare between different makerspace models to better understand the strengths and weaknesses of each, and (2) explore ways to harness the motivation children have, when empowered to lead their own learning.

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