

**PART 2**

*Case Studies on Maker Education*





# Informal Learning in a Public Library Makerspace for Youth in the Netherlands

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## Abstract

Informal learning spaces create opportunities for children and youth to develop their talents and to experience new social roles. In recent years, several public libraries in the Netherlands have established makerspaces to empower youth by facilitating the development of their digital skills in conjunction with their creativity. The Amsterdam Public Library created a network of makerspaces (Maakplaats021) and provided training for the makerspace-coaches. These coaches – former librarians or other professionals – have a central role in the makerspace and fulfill several functions. This contribution describes informal learning of children in these makerspaces and distills critical features that enforce learning through the lens of children aged 8–12 and their makerspace-coaches.

## Keywords

public library makerspace – informal learning – empowerment – community involvement

## 1 Introduction

Over the past decades, many museums and libraries have created makerspaces where children can develop their creative, social and technological skills (Bevan et al., 2020; Escudé et al., 2020; Lin & Schunn, 2016). With trained staff facilitating and scaffolding these young makers' learning processes, these makerspaces have become regular learning environments in the 'educational playing field' (Gahagan & Galvert, 2020; Nagle, 2020; Slatter & Howard, 2013; Willett, 2018). The Amsterdam Public Library created a network of ten makerspaces (Maakplaats021) where children can attend school- and after-school programs. These makerspaces were established in various urban neighborhoods to reach

children from families with a lower socio-economic status. These children generally have little access to technology and creative resources at home, while schools in these communities often lack time and staff to focus on creativity and digital literacy.

In the first four years of the project Maakplaats021, the development of makerspaces was monitored through a formal research project examining what children and makerspace-coaches did and what they experienced during the school and afterschool programs in the library makerspace (Pijls, Van Eijck, & Kragten, 2020; Pijls, van Eijck, Kragten, & Bredeweg, 2022). In this contribution we present a new qualitative analysis of a portion of the data collected during this formal study (27 interviews with children and 12 interviews with makerspace-coaches), focusing on the characteristics of informal learning in the afterschool programs. We have selected typical passages of the interviews and use *thick description* to illustrate and explain learning in afterschool-programs in the makerspace and extract critical features of this learning environment. We also elaborate on the question what it takes from makerspace-coaches to support learning of the children. After a short general description of the project, we provide eight ‘vignettes’, i.e. snapshots that each highlight a particular aspect of the informal learning context. Five of these focus on the development of the children within the makerspaces and three on the professional development of the makerspace-coaches.

## 2 The Project Maakplaats021

Maakplaats021 was initiated by a consortium consisting of the Amsterdam Public Library and three partner organizations (Waag, the organization that started the first Fablab in Amsterdam in 2011; Pakhuis de Zwijger, an organization that focuses on community development; and the Amsterdam University of Applied Sciences, which performed the monitoring research). The project was funded by the municipality of Amsterdam. At ten library locations throughout the city, a makerspace was built, sequentially over a period of four years (2017–2020). Each makerspace contained the same basic equipment, consisting of two or three 3D-printers, a laser-cutter, a vinyl-cutter, fifteen laptops, glue guns, two sewing machines and pencils, paint, paper, etc. The library-makerspace offered after-school programs for tinkering, community development and computer programming (coding) for children between the ages of 8–12. The name Maakplaats021 (Dutch for Makerspace021) is derived from the concept of 21st century skills (OECD, 2021), which include digital literacy, collaboration, communication, citizenship, critical thinking and self-regulation.

All after-school Maakplaats<sup>o21</sup> activities took place on weekday-afternoons. Children could sign-up for free and the administration of the participants was carried out by the makerspace-coach. Each program admitted twelve to fifteen children, who were guided by two to three makerspace-coaches. A program consisted of ten weekly classes, often concluded with a closing presentation for parents in the last week. During school holidays, special activities were scheduled. The programs comprised digital fabrication and tinkering, designing, community-art, programming/coding, each often based on a theme.

When a new makerspace opened its doors, experienced maker-educators from other locations ‘ran’ the programs in the first months, coaching the library-makerspace-coaches in their new role. A training program for staff was developed, while additional staff training comprised of a yearly two-day-course, monthly meetings (‘maker morning’) and weekly ‘developing time’ as well as additional courses in pedagogy, maker education, digital fabrication, and design. Initially, maker educators of the partner-organizations developed the new programs, but gradually some of the makerspace-coaches created their own programs.

Makerspace-coaches were recruited from the library staff. Librarians with a passion for creativity and technology were schooled in digital fabrication. In addition, external staff, with experience in art, craft and technology was attracted. Ultimately, four of the twelve makerspace-coaches were current or former librarians. Whereas makerspace-coaches were scheduled to rotate the various locations, each makerspace had one coach who was in charge of that location only. This was particularly important for the maintenance of the equipment, tools and materials. Supplies were ordered centrally and distributed over the ten makerspaces by a ‘makerspace-producer’, hired by the public library.

In addition to cooperation within the project by the three partner organizations and library, the consortium also collaborated with various cultural foundations, museums and entrepreneurs in the city that offer art education and technology education. Student teachers assisted in the makerspaces, under supervision of the makerspace-coaches. The makerspaces also offered programs for school classes, again guided by the makerspace-coaches. All in all, the public library makerspaces have evolved into dynamic locations where children aged 8–12 come and visit school and afterschool programs, guided by maker-spaces coaches, whose professional development is arranged by the organization. In total, the Maakplaats<sup>o21</sup> registered 23,826 children visits in the after-school programs over its establishment period (2017–2020), with an approximate binary gender distribution of 50/50.

The following eight vignettes describe typical examples of learning in the public library makerspaces.

### 3 Developing Skills by Creating Creatures

On Tuesday afternoon, a group of nine children sit around their table, concentrated on their project. The atmosphere is calm and focused. Some of the children have been visiting the makerspace for three years already, while others are relatively new. Children mention that they came to know about the makerspace by friends, or their mother signed them up, as 'she saw the makerspace when she visited the library and she thought I would like it'. A subscription list for the next season-course with handwritten names is lying on the table. There are twelve places, and the list is almost full. There will likely be a waiting list, like there was before.

The children are proud of what they make and have made. A girl says:

I made so many things. Once I made a bag with hamsters on it. It was really a beautiful bag. I used it very often. I also made a gym bag, and we once made a forest of fairy tales. I was very proud of that, too.

Within these projects, the children learned to work with a laser-cutter and a sewing machine, Tinkercad software for the 3D-printer, Inkscape and a sticker cutter. The experienced children became very skilled over time.

He is the youngest child of the group. He can work with all that software and with the sewing machine very well. His mother likes that too.

One of the successful programs was 'Creating creatures', which involved designing your own animal, cutting the fabric with a laser-cutter, sewing it – first inside-out! – and finally designing small ornaments, such as eyes, with the 3D-printer. Figure 4.1 shows the cut fabric of a Pikachu.

The makerspace-coaches have designed programs with structured assignments. They say:

Children need this structure. We also teach them a lot of social skills, to help each other, to wash their hands and so on. The children love it; they want to prepare the drinks for the break. One week ago, we were sitting with the children, chatting a bit and I asked them 'Who feels happy now?' Many raised their hands. The atmosphere was so peaceful.

This vignette illustrates the makerspace as a fruitful training site for digital skills. Further typical characteristics of this informal learning environment are:

- The makerspace is accessible.
- Some children spend a lot of time in the makerspace, 100–250 hours.



FIGURE 4.1 Creating creatures: fabric cut with laser-cutter in the shape of Pikachu

- The children are motivated.
- Children develop technical skills and creativity.
- The makerspace is a space where children feel safe.
- The activities are structured but focused on individual development.

#### 4 I Learned So Many Things in the First Week

A child is visiting a makerspace that was recently built. On this particular afternoon he is the only visitor. He mentions very enthusiastically the many things he learned over the past few weeks.

I love making things. My mother heard from somebody else about this place,' he says. 'Here I work with my hands, and that is the difference between school and this place. And I use computers and a 3D printer, all very cool. At this moment I am working on a sticker with my name. Over the past three weeks we worked with all the equipment, and we learned how it worked: laser-cutter, vinyl-cutter. We used paper and pencil and Inkscape. Last week I worked together with another child, and we helped each other.

This vignette shows that although this child recently started in the makerspace, it already experienced that it learned a lot. The new technologies are fascinating and are distinctive from his experiences at school. Although children work on individual projects, helping each other comes naturally.

Another typical phenomenon of new makerspaces is that there are few visitors. In contrast to makerspaces that already existed for several years and often have a waiting list (see vignette #1), this place still must attract new visitors. This often goes by word of mouth or by people passing by, since these library makerspaces are often located near other shops and services.

## 5 Making a Robot to Help Grandma

It is Wednesday afternoon in the public library in the shopping center, and the makerspace is upstairs; a rectangular space with six large tables with stools. Today's activity is 'Codeteam', a ten-weeks program about coding and programming. Eight children are divided into groups of two or three. On their table a sheet of paper, with a map drawn on it. They are working with little cars and Micro:bit, which they program to make the cars follow the path.

'I can speak robot-ish: T. taught me', says one of the children.  
'Can you teach me that language too?' the other says.

Then they explain about the 'confetti-canon' they made last week: a robot that could move and throw confetti. Hence brightening up other people. A girl says:

I want to learn to work with things like robots and programming. I think it is important that a robot can move, can go somewhere. Catching things is also important: things like food or drinks, or the mouse of a computer. When elderly people are not able to walk or to grab things, the robot can do things for them. My great grandma, for instance, is alive but in the hospital. Sometimes she goes home. She lives nearby. I sometimes visit her with my mother and little brother. It is nice to see her. Then I can tell her what I did in the makerspace. That is nice to tell.

At the end of the afternoon, her mother, with her little brother drops in to pick her up. The mother tells how happy she is that her daughter can visit the makerspace. Her daughter says:

I don't know yet what I want to become when I grow up. Now, I like working with people, and with computers and programming, and I also like dancing and swimming.

This vignette shows that this girl enjoys programming and is very motivated to learn more. Her residence indicates that she is from a low-income family. She thinks about technology and programming as something to help other people, so as a social tool. It also shows that she is confident in learning and considers programming as equal to dancing or swimming. Furthermore, this child wants to share her pleasure in learning with her family. What she experiences in the makerspace affects her family directly.

## 6 Collaboration with the Local Outdoor Market

Thursday afternoon, the makerspace has a large window adjacent to the weekday market. On this afternoon, the atmosphere is restless. 'The children are a bit upset this afternoon, because of a violent incident that happened yesterday in the street', the makerspace-coach says. 'One of the kids knows one of the people involved and you can see that it bothers him'. Two children are sitting in the corner, playing with a 3D-pen, making a little 'dino'. 'We leave them quiet today; they usually collaborate well'.

Here, Makerspace021 directly collaborates with an established community program led by a local cultural foundation (The Beach). The makerspace-coach says:

I learn a lot from the maker educators from The Beach, who stimulate the children's autonomy and make them reflect on ideas, instead of taking an initial idea as a definite plan. Every week we look back: 'What did you do last week and where are you now?' Children made a neighborhood walk and photograph what they like and dislike. We also collaborate with market vendors, by recycling their packing material. This black plastic is used to pack fruit, now it became a fancy handbag.

Here, some of the clothes and accessories that the children made in the makerspace were sold on the local market as well. The open window of this makerspace symbolizes how it is connected to the urban neighborhood. Events in the community affect the children while the makerspace is a safe space where they can recover and connect with other children. They learn to reflect and to create. The cooperation with the local market vendors is a win-win situation for all: waste is cleaned up and the makerspace has free and interesting materials to work with. Children experience that they can contribute to the community by making and remaking.

## 7 Developing Confidence

A makerspace-coach talks about the way she coaches children in their personal development in the makerspace.

A child that was very shy when she came for the first time, started to blossom after a few times, her mother said. She gained confidence and started to express herself. This is a safe space for her. I think it is very important that children feel safe. Once they do, the rest will follow. Children learn to cooperate with others, also people that are new to them. Parents are very happy with this development.

The coach explains how she creates an open atmosphere.

They have so much fun here. That is important, I think. If they have questions, they can come to us. If they have complaints, they should tell us too. You must always remain open to criticism, really.

Children learn to overcome personal barriers and beliefs.

Often, children can do more than they think. In the end they say: I first thought I couldn't make it. Like last week, there was one child; he wanted to sit apart, to focus. Two weeks later, he joined the group and he wanted to show something. It appeared that he continued to create at home; he made a story in Scratch, an animation. We always work with freeware and a login, so he continued making at home and was proud of that.

Initially, many of the children that come to the makerspace are not used to learning through open tasks and the freedom to come up with ideas and multiple solutions instead of one correct answer.

I notice that children are insecure or lack self-confidence. They often ask me: 'Is this correct, did I do this well, do you like it? Then I ask them: 'What do YOU think of it? If you don't like it, you can make it better'. They are afraid to make mistakes, but programming is mostly about debugging, I tell them. And making is about repairing or remaking. Every child can do this and make it in its own way. Each at their own pace.

The makerspace-setting can be inviting for personal conversation, both during after-school programs and school visits.

This also works for school visits. Last week, at the end of the lesson, a child came to me: 'Can I give you a hug?' While they are involved in a project, they tell you about their lives. Sometimes only a little, sometimes even a little too much.

This vignette shows the opportunities for personal development in the makerspace. Programming and making require new approaches and new skills and these help children to gain confidence.

## 8 'Thinking in 3D Is... Mind-Blowing'

One of the librarians who was involved in the setup of the very first makerspace had to master a lot of new skills. At that time, all makerspace-coaches had to learn from scratch to work with the software and the machines. This makerspace-coach makes clear what it meant to then to learn a new skill.

Thinking in 3D is what everybody must learn, the children too. It doesn't matter what age you have, when you do that for the first time, your brain must get used to it. It takes a few weeks, and then you know how to think. That is what we teach them here. To broaden your mind.

She explains that many of the new skills she coaches she had to learn by doing herself.

When I still worked in the library, I got time to work on my own in the makerspace. From now and then I asked my colleague for help. But you had to discover everything for yourself. I learned everything while I was here [in the makerspace] from morning to night. I had to dive in and discover how it works. We practiced and practiced and practiced.

This vignette shows that for future makerspace-coaches without a background in technology or programming, the new skills can be fascinating but require many hours of practice.

## 9 The First Time I Had to Present for a Group

Some of the makerspace-coaches do have a background in designing and technology, but not in education. They must learn how to manage a group, like this makerspace-coach tells.

During the summer program, there were moments that I thought: there is too much noise, now I have to set stricter rules. I find that difficult. The first time I had to present for a group, I felt so shy. Because I also think 'just make fun'. It all went well. But there is a rule that children are not allowed to run in the makerspace. I want to learn how to address children if they do not behave.

The struggles and concerns of this makerspace-coach are comparable to those of beginning teachers. Since the groups of children are smaller and the setting less restrained than at school, the situation is less urgent, but makerspace-coaches must develop these leadership skills too. This makerspace-coach experiences that she could learn from a teacher-training student, who did an internship in the makerspace.

Last month, a student teacher came to help us weekly. She is interested in the makerspace and must learn to work with the equipment. But she helped me too, pedagogically she is more skilled than me.

## 10 Hands Off That Keyboard

One of the new makerspace-coaches is a photographer. When asked about his main learning objectives, he talks about the pedagogy of inquiry-based learning.

In the first place, of course, I had to learn to handle the equipment. And we had to learn to coach the children and to keep order within a group of children and to know the right moment to intervene. I had to learn to hold back. It is so easy to take over and push the button yourself on a computer. Instead, we have now learned to use words and stimulate the children to learn, to provide more distant instruction so that children can find out for themselves. Corona has helped to normalize keeping distance too... [laugh].

The coach mentions that in the end he learns through practice and from and with colleagues.

I learned a lot from colleagues, you are left to dive in at the deep water after two days of technical training. How to cope with children is something that you learn through practice.

## 11 Critical Features of Informal Makerspaces

1. The makerspace provides opportunities for children to learn and to get acquainted with creativity and technology. Altogether, children can spend a lot of time in the makerspace. By visiting the makerspace weekly, they develop technological skills and creativity. Even a few visits to the makerspace can impress and motivate children and give them the feeling that they learned a lot.
2. After-school programs in the makerspace attract intrinsically motivated children and the activities stimulate their motivation.
3. The personal guidance in the makerspace enables children to overcome anxiety and to experience those times of frustration are allowed in the process of making. Children gain confidence over time.
4. The makerspace is embedded in the community. The physical embedding of the makerspace in a public library and near other public spaces or shops attracts children from local communities. It also allows parents to easily contact the program.
5. Makerspace-coaches need continuous professional development. They wear many hats in the makerspace (expert in technology and creativity, coach, developer of new learning materials, organizer). Especially the pedagogical role requires proper training and coaching.
6. Cooperation with local organizations and institutions and universities stimulates the development of makerspace-coaches. Maker educators from cultural organizations bring in expertise, while teacher students from universities can assist in makerspaces too.

## 12 Conclusions and Discussion

After-school programs in a public library makerspace fulfill an important role in the development of talents and to motivate children. There are requirements to fulfill in order to realize this rich learning environment. It takes time to reach children in the community and set up the makerspace. After-school makerspaces put high demands on staff, which needs to reserve time and require training and support. A makerspace-coach is a jack-of-all-trades who coordinates several roles (Pijls, van Eijck, Kragten, & Bredeweg, 2022). For the realization of training and support, collaboration with (local) organizations and universities is very important. The after-school context is an interesting learning space for teacher-students too.

It is challenging to keep children connected to the makerspace when they grow older. This seems especially important for stimulating children who are interested in technology and programming. Another challenge is to keep this service free of cost for children. One way to ensure continued participation may be by establishing a peer-tutor system, where older youth with experience in the makerspace can tutor the younger children (Sheridan, Clark & Williams, 2013).

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