Future Classroom Lab

Makerspaces in schools

Practical guidelines for school leaders and teachers

Case Study

Baar Sekundarschule Sternmatt, Switzerland

European Schoolnet

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Baar Sekundarschule Sternmatt, Switzerland (cover, pp. 4, 5, 6, 7)

Introduction

Makerspaces, which are designed for hands-on, collaborative, creative work, are a fairly recent addition to some schools in Europe and worldwide. Students in school makerspaces can work with materials such as paper, cardboard, wood, metal, plastics, clay, fabrics, electronic components, microcontrollers, construction kits or programmable robots to create many different objects, and complete many different projects, using a variety of tools and machinery.

This case study is one of 15 developed from interviews with school leaders, teachers and other staff who have set up makerspaces in their schools. The schools are located in nine countries i.e. Austria, Belgium, The Czech Republic, Ireland, Italy, Luxembourg, Portugal, Switzerland, and Turkey.

The interviews were part of research carried out by European Schoolnet's Interactive Classroom Working Group and the schools' experiences, the lessons they have learned and the good practice they have developed, have informed the development of a publication "Guidelines on Makerspaces in Schools".

Find the full report and other case studies here: *fcl.eun.org/guidelines*

The School

Baar Sekundarschule Oberstufe Sternmatt is a lower secondary school in a small town in the canton of Zug with 234 students and 35 teachers. The school's catchment area is rather wealthy but only students planning to do an apprenticeship study at this school. Students who wish to attend university go to the local Grammar school. The school does not have a special curriculum focus and will have been using the new common Swiss German curriculum Lehrplan 21[1], which has come into effect for the 2019/20 school year. Teachers at Baar school have been receiving training for the new curriculum subjects Media and Computer Science. The teachers create their own yearly programme with all relevant materials.

The school has a strong connection with the local community and authorities. They fund the library and its programmes. Claudia Bücheli, a teacher, media librarian and ICT coordinator at the school, as well as a facilitator in the makerspace, works closely with the local librarian; they organise continuing education together and meet twice a year to discuss development strategy.

Baar school's makerspace is a local initiative originated by Claudia, who has previously successfully introduced innovative projects involving educational technologies. She says she has been able to do this due to her "*super school head and colleagues that support one another".*

Motivation and aims

In 2017, the local community were planning some rather extensive renovation work on the school's 30 year old building. This involved completely clearing the library and prompted consideration of using the space in a different way. Claudia wanted something new and positive for the students to come out of the rather unpleasant renovation process and when she attended a workshop in Zürich about makerspaces they caught her imagination. She was particularly inspired by the concept of recycling unwanted objects to make new things and started collecting scrap material in advance of setting up her school's own makerspace. The aims of the makerspace include:

▶ Allowing students to develop their own projects and creativity, with projects either initiated by the students or students developing project ideas suggested to them.

▶ Building bridges between different curriculum subjects.

▶ Increasing teachers' collaboration.

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1   https://lehrplan21.ch/

The implementation timeline

Following the seminar in Zurich, Claudia visited different makerspaces, including one in Winterthur's local town library and the Attraktor makerspace in Hamburg[2]. Claudia also started testing and buying various tools, exploring their uses and developing project ideas. She described this as "*a great time, when you don't quite know where you are going but can take the time to tinker*". Early small projects and workshops on tables in the library included making:

- ▶ Pixel Art posters.
- ▶ Thymio robots, with students making videos of their robotic projects.
- ▶ Electronics projects using the Calliope mini development board[3].

Funding was obtained via a successful bid to the Hasler Foundation[4] and within 6 weeks Claudia was able to propose the first planning workshop. Claudia believes that the funding bid, and seeking the necessary support from the school head, were successful due to a strategy she has previously adopted in order to obtain funding from the school budget for new initiatives. Her approach is to launch projects on a small scale and then talk about them and see if she can get support. She says "*if I were to ask for permission first I would go nowhere. I would never have been able to launch the makerspace if I had just submitted a proposal and waited for support*".

Once funding was in place, the necessary building renovation work was carried out, the makerspace was set up and it opened in October 2017.

Building and equipping the makerspace

The total size of the media library is approximately the same as three typical classrooms. Within this, the space dedicated to maker activities is probably that of one typical classroom. The space is inside the school building on the ground floor and the walls are made of glass so that everyone can see what is happening inside, which includes exhibits on or along the glass walls. Access is only possible from within the school and there is no external entrance.

After the building renovation work had taken place, Claudia reorganised the space to create different media /maker areas including a computer area with tables for robotics programming and creation, an animation corner and a green screen area. The computers and most of the furniture needed were already available for library use but a sturdier table was added in the central area for students to work with nails, hot glue, etc. Other materials and equipment acquired for the students included paper, paints, cloth, Lego and Playmobile. The existing library furniture, including USM[5] modular shelves and tables, was very flexible. Claudia has augmented this with furniture she has brought in from her home, including sofas, armchairs and bean bags that she says "*the students love to read in*". Some additional furniture has been donated by parents.

2   https://blog.attraktor.org/

3   https://calliope.cc/en

4   The purpose of the Hasler Foundation is to promote information and communications technology (ICT) for the well-being and benefit of Switzerland as an intellectual and industrial centre.

5   https://www.usm.com/en-gb/commercial/products/

Claudia's aim has been to achieve an overall effect that is "lively and colourful" and to make the space very comfortable, "a home away from home" as she calls it. It is intended to be a place in which the students can feel "there is no pressure to produce or to finish something".

This homely aspect of the media library has, until recently, been enhanced by the presence of Claudia's dog which became the school dog. When she brought the dog in Claudia noticed that some younger students visited the media library just to be with the dog when they were upset and that teenagers also enjoyed the dog's company. She said Mambo was "a wonderful listener and reading coach". On Mambo's birthday students using the makerspace area celebrated by building a Makey Makey[6] piano and playing happy birthday for the dog.
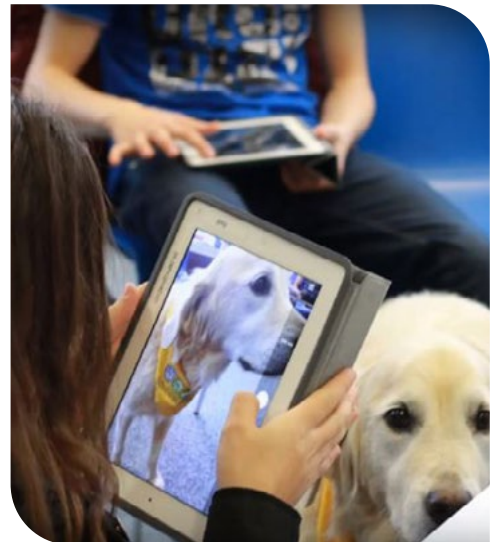
In order to select equipment and materials for the makerspace Claudia attends fairs and conferences and tests these for their potential for maker activities. She tries to obtain equipment and materials cheaply in order to ensure that there is a great variety of possible projects for the students to undertake. From the start she decided against the purchase of expensive 3D printers that would take up to much of the available budget. She wanted the freedom to explore a variety of projects. She also wanted to avoid a strong focus on informatics. All technology equipment is stored in the library area behind her desk for security as the library door is always open.

Equipment and technology

Equipment available in the makerspace includes:

- ▶ Hobby plotter
- ▶ A stop motion corner with iPads
- ▶ Green screens
- ▶ Hand lettering sets
- ▶ Oxocards
- ▶ Calliope Mini
- ▶ Makey-Makey
- ▶ Lego Mindstorms
- ▶ iPads
- ▶ Google Cardboard
- ▶ Sewing machine

Software related to the robots and devices, including Scratch and Swift Playgrounds, is installed on the lab's computers and laptops[7]. Claudia also has additional sets of equipment and materials that the teachers can borrow[8] for classroom activities e.g. robotic sets and books.

Available materials include scrap paper, glue and small objects such as shells and sparkles.

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6   https://makeymakey.com/

7   In 2020 all the schools' students will have their own computer thanks to a one-to-one initiative.

8   https://www.mediobaar.ch/angebote/ausleihe-informatikmaterial/

Cost and funding

Obtaining funding involved writing a grant proposal and submitting it to the Hasler Foundation, which at that time was providing funding to start educational projects around computational thinking. The proposal was successful and the school obtained a 5000 Swiss Francs grant (approximately 4,200 Euros). The only condition attached was that a project report must be submitted after 6 months.

Sustainability

No additional funding was available from the Hasler Foundation after it provided the initial 5000 Euros for the makerspace setup. On-going funding now comes from the school's library and informatics budgets. Also, due to the success of the makerspace, the school has allocated regular additional funding of 1000 Swiss francs (approximately 900 Euros) a year to renew equipment and develop the makerspace services.

Claudia says she can rely on the computer service for continued support. However, she has noticed that maker equipment has become much more expensive in recent years. Therefore, she is careful to seek similar products to those that are most well-known where they have very similar features or affordances and are more cost effective. An example in the area of educational robotics is the Oxo-Card single-board microcontroller which is attractive because the additional materials and activities are very good and the Swiss developer is really interested in collaborating with teachers and always ready to come to schools.

Regarding on-going management of the makerspace, both the project and day to day operation of the space rely upon Claudia's energy and dedication; it is unclear who would take over if she left the school.

Organisation and management

The library is open all week. The maker offer is available on Monday after school and on Wednesday afternoons (when there are no lessons), but the equipment and maker corners can be accessed at all times. There are also teacher training workshops in the makerspace. The space works as a general area of the media library for the rest of the time.

Claudia is the manager of the makerspace and the media library in which it is located. She chooses the equipment and materials, organises workshops and trains the teachers. She also installs and maintains tools with the help of the school's IT team.

There is no external maker collaborating with or supporting the school, but Claudia sometimes invites former students who excel in specific areas to run workshops for her students. For example, two boys who were passionate about animation films ran a workshop and two other volunteers came in on a Saturday to help with a 3D printer workshop. Currently the makerspace is not open outside of school hours and is not open to the outside community. However, Claudia is considering offering activities at the weekend when she says "teenagers are often bored" and she tries to adapt to students' needs and requests.

Networking beyond the school

Claudia collaborates with other libraries but to-date has not collaborated with outside Fab labs or makerspaces. She visits the fab lab in Zug, but they have a very different offer. She has also talked to the team in Winterthur's lab about how they operate and what they offer. Currently Claudia says she collaborates more with teacher training colleges than with city fab labs.

Training and support of teachers

There is currently no formal training for teachers specifically in the use of the makerspace. This is something Claudia may develop in future in addition to the workshops she runs - which are open to teachers. On the other hand, Claudia is collaborating with two other teacher trainers on training for the new curriculum in Media and Informatics, which teachers throughout Switzerland are being trained to teach.

Claudia has trained as an ICT coordinator, a Media and Computer Science mentor and a school librarian, but she has not received specific training in making. She says she "*has always been interested in making things*" and "*is used to working with technology, trying new things out, tinkering with tools, etc.*".

Baar school has a dedicated team of IT specialists which provide support for the IT equipment in the media library and the makerspace. They carry out all updates and can help whenever there is a problem or when additional WiFi is needed. The IT team is very supportive of the idea of operating a makerspace and very helpful to Claudia even when this means additional work for themselves.

Teaching and learning in the makerspace

Currently teachers at Baar school mostly visit the makerspace for their own continuing education or when they want to borrow sets of robots, etc. for use in their classrooms. Teachers using the makerspace independently with their classes will be developed in the future when the new curriculum is implemented. In order to promote the use of the makerspace directly to teachers, Claudia delivers to her colleagues' letter boxes copies of the monthly leaflet she produces announcing planned activities and project possibilities.

Small groups of students use the makerspace independently on Monday and Wednesday afternoons to work on projects[9]. On these afternoons Claudia puts all the equipment and materials that are needed on carts (former Chemistry lab carts) which students then wheel to the area of the media library where they will be working. Additional equipment is available on demand. A popular activity with students is the development of "book trailers", for example[10], and Claudia has established a website to promote these projects[11] in which students read a book and then use the media library equipment to make a short video about it.

9   Examples of project ideas promoted to students: https://www.mediobaar.ch/makerspace-1/aktuelles-makerangebot/vergangene-angebote/

10   https://www.youtube.com/watch?v=MX3tIJyn6Lw

11   https://www.buchtrailer-bibliothek.ch/buchtrailer/

Some of the activities developed and successfully used in the makerspace have strong connections with the curriculum. However, integration of all makerspace activities into the curriculum is not an aim of the school's makerspace initiative. This is because it is seen as a good thing for students to have opportunities to work in a different context outside the pressures of the curriculum but with links to it. Media projects in particular have strong links with language teaching.

Claudia has tips for teachers about teaching and learning in a makerspace; she says:

▶ Just making equipment and materials available is not enough. Activities should not be as guided as in regular lessons, but students need well organised information about how to start.

▶ Teachers do not need to know everything about a tool before introducing students to it. It is important to know the first steps very well and to solve initial difficulties otherwise students can become discouraged. However, for the more advanced features of tools and more complex uses of them, teachers and students can learn together. This may include searching the Internet for information and solutions in a competitive mode, i.e. "let see who finds the answer first?".

▶ Projects can be initiated by students in response to an event or situation, e.g. students celebrated the school dog's birthday by building a Makey Makey[12] piano to play happy birthday.

▶ Students exploring independently will sometimes discover limitations in tools they planned to use and need to change their plans but this is part of the project-based learning process.

▶ New tools become available all the time, so it is worth continuing to spend some time researching and testing tools. Sometimes a school may buy, or plan to buy, a device and then discover something similar which is more appropriate for their students or more cost effective.

▶ Making regular suggestions for new projects that students may wish to get involved in helps to keep them interested in the makerspace.

▶ When you share information about makerspace projects, tools being used and students' achievements, via a website or by writing a blog, the students are pleased and people both inside and outside the school will want to contact or visit you to learn more and share ideas.

▶ Spread the word about what is going on in the makerspace. Claudia uses an Instagram account as well as the school's website and a blog, distributes her monthly leaflet to all 17 classes and finds the glass wall helpful as students can see what is happening in the makerspace.

▶ If you can, attend conferences and workshops to get ideas for developing activities in your space.

▶ It is important to have all the available tools and artefacts easily available in the makerspace to encourage student creativity and project-based learning.

▶ Many teacher training colleges have developed resources that schools can base activities on.

▶ The ethos of the makerspace closely corresponds to the pedagogy and methodologies that underly the new curriculum being introduced in Switzerland. The Lehrplan 21 emphasises learning through exploration, problem solving, creativity and focussing on learning processes more than learning outcomes. Claudia has observed that "*there are many activities foreseen in the new Media, informatics and STEAM curriculum which will be difficult to set up in a regular classroom setting.*".

Activities that take place in Baar school's makerspace have included:

▶ Programming a Thymio robot[13]

▶ Stop motion animation films using Playmobile figures[14]

▶ Calliope scissors piano[15]

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12   https://makeymakey.com/
13   https://www.youtube.com/watch?v=pOIILSXdCP0&list=PL8FJXWCxRvapzX4iHkIRXMlqMZe7wczuF&index=1
14   https://www.youtube.com/watch?v=d4P6pM9adwg&list=PL8FJXWCxRvapzX4iHkIRXMlqMZe7wczuF&index=2
15   https://www.youtube.com/watch?v=1SJAm2EHnRI&list=PL8FJXWCxRvapzX4iHkIRXMlqMZe7wczuF&index=4

- ▶ Mixed CGI and student actor film using green screen[16]
- ▶ Building and programming a robot with Lego Mindstorms EV3
- ▶ Manual lettering, not dependent upon digital technologies, which can be combined with photography or animation.

Added value and benefits

Key benefits of Baar school's makerspace include the opportunities provided for students to use different technologies, develop new skills and acquire knowledge. Also in the makerspace students can take time to carry out creative projects that would be difficult to schedule into the time frame of normal 50 minute lessons.

Claudia has also identified a key added value in the makerspace's ability to be a "third place" of the kind described by sociologist Ray Oldenburg[17]. He described places in which people build a sense of community and that bridges the gap between the 'first' and 'second' social environments, i.e. home and the workplace. Claudia believes that offering students the opportunity to work on projects that are different from the usual school projects, and enabling teenagers to "*develop a personal relationship with a place of learning*", are important benefits of the makerspace. She also notices that they love being there.

Having a dedicated makerspace, instead of carrying out making activities in a traditional classroom as part of mandatory curriculum activities, has a number of benefits which Claudia has identified as:

- ▶ Students can carry out projects at their own pace *"without the pressure of having to finish their project when the bell rings".*
- ▶ "*Students have more time for tinkering and exploring, they can come and go, there is no pressure to have a beautiful object at the end, and they can leave after 30 minutes if they want to*".
- ▶ Students are free to develop skills according to what they find motivating, assisted by the fact that makerspace activities are not compulsory, have no set time frame and do not demand that they develop a strictly defined set of skills.

An additional benefit, specific to a makerspace located in a library, is that students "*sometimes pick up books they would not usually look at"* and, therefore, learn something new or develop a new interest.

Challenges

A significant challenge is balancing the desire to provide open access and to encourage creativity against the need to look after expensive equipment. As the library door is always open, makerspace equipment is stored in cupboards behind Claudia's desk but this limits accessibility. A future challenge will be preparing for and implementing a process whereby teachers can use the makerspace with their classes by themselves.

Future plans

The future plan is to continue to develop makerspace activities within the budget available for the library. With the new media and computer science curriculum, there should be many options for closer connections between the makerspace and the curriculum.

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16   https://www.youtube.com/watch?v=z8J2MorZNHc&list=PL8FJXWCxRvapzX4iHkIRXMIqMZe7wczuF&index=5

17   Oldenburg, Ray (1989), "The Great Good Place: Cafes, Coffee Shops, Community Centers, Beauty Parlors, General Stores, Bars, Hangouts, and How They Get You Through the Day"

The case study complements the European Schoolnet's publication "Makerspaces in schools / Practical guidelines for school leaders and teachers" (2020).

Find the full report and other case studies here: **fcl.eun.org/guidelines**

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