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# Makerspaces in schools



Practical guidelines for school  
leaders and teachers

## Case Study

Silberberg Primary School, Thayngen,  
Switzerland



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Practical guidelines for school leaders and teachers

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# 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, micro-controllers, 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](http://fcl.eun.org/guidelines)

## The School

Silberberg Primary School<sup>1</sup> is in the small town of Thayngen on the border between Switzerland and Germany and a 10 minute train ride from the town of Schaffhausen, the capital of the canton of Schaffhausen. The socio-economic background of students is lower middle class or middle class and there are very few students from immigrant families.

There are several school buildings in Thayngen. The Silberberg Schoolhouse was built in 2001 as a district schoolhouse in the west of the town. The school website describes it as "*bright and inviting*", "*a child-friendly environment with ideal learning conditions for students from 1<sup>st</sup> to the 6<sup>th</sup> grade*".

The school has very strong connections to the local community and there is close collaboration between the school and local authorities. Evidence of this is that "*the local community have financed a great school building and playground for the children*".



The school has no special curriculum focus other than being a primary school. However, the new Swiss German curriculum Lehrplan 21<sup>2</sup> is now being introduced. It places great emphasis on scientific investigation and introduces a new topic, Media and Informatics, from the first year of primary school.

1 School web site : <https://www.schule-thayngen.ch/> retrieved 5 May 2019.

2 <https://v-fe.lehrplan.ch/>

According to the Principal Lukas Weber, the makerspace project is unrelated to the curriculum changes but “*there are many curricular connections between the focus and philosophy of making and the competencies the Lehrplan 21 wishes to develop*”.

## Motivation and aims

Silberberg’s makerspace project<sup>3</sup> originated in a partnership between Thurgau’s School of Teacher Education<sup>4</sup> and St-Gallen’s school of management<sup>5</sup>. The partners developed a research proposal and were successful in obtaining funding:

- ▶ To set up and sustainably operate a makerspace in a pilot primary school where children will develop the 21<sup>st</sup> century skills of creativity, problem solving and collaboration as well as digital literacy through maker projects.
- ▶ To develop and test scenarios for effectiveness in practice with accompanying research to ensure that the findings can be used beyond the pilot school.



One of the conditions for obtaining funding was that the pilot school had to be located in the canton of Schaffhausen. The canton’s department of education looked for a school that would be interested in transforming its craft activities (or *werkunterricht*) room<sup>6</sup> into a makerspace and they selected Silberberg<sup>7</sup> based on the following criteria:

- ▶ Buy in from the teaching team.
- ▶ Availability of a teacher willing to take the lead as project manager.
- ▶ The usefulness of the project for the school, the students and the teachers.
- ▶ The teachers’ readiness to develop scenarios outside of the regular timetable.

Principal Lukas Weber is always keen to develop projects and is interested in technical challenges. He seized this project opportunity with one of the school’s teachers, Rebecca Meyer.

Lukas convinced colleagues to get involved and the local authorities to support the project by funding 20% of Rebecca’s time so that she could be the school’s makerspace manager or “Lead Lehrperson”.

The aims of the school’s makerspace are:

- ▶ To develop a makerspace compatible with the needs and goals of a primary school, to find ways to integrate making activities in everyday school life.
- ▶ To allow all students to be involved in making activities.
- ▶ To get all teachers involved in the space with their students.
- ▶ To develop a sustainable model so the makerspace can continue after the end of the pilot.
- ▶ To investigate, through observation, the effect of making activities on creativity, collaboration and digital literacy.

3 Ingold, S, Maurer, B. (2019). Von der Idee zum MakerSpace. Ein partizipatives Experiment an der Primarschule Thayngen. In: Ingold S., Maurer B., Trüby D. Ed. (2019). Chance MakerSpace. Making trifft auf Schule. München: kopaed. p. 191 - p. 217.

4 PH Thurgau Maker project: <https://mdz.phtg.ch/de/projekte/maker-space/>

5 [www.fhsg.ch/de/forschung-dienstleistungen/institute-zentren/institut-fuer-innovation-design-engineering/forschung/](http://www.fhsg.ch/de/forschung-dienstleistungen/institute-zentren/institut-fuer-innovation-design-engineering/forschung/)

6 In “*Werkunterricht*” students learn about making practical items, the manual processing of materials and the correct use of the corresponding tools as well as learning the basics of electronics.

7 <https://www.makerspace-schule.ch/das-projekt/pilotschule/>

Lukas Weber “looks forward to many new possibilities made available through the new makerspace”. He believes the space offers the school “the opportunity to implement curriculum content from NMG (Nature, Humankind, Environment) or Media and Information Technology in a practical and active way. It should also be possible for the children to develop their own ideas and implement them in the makerspace.”.



## The implementation timeline

The original idea for the makerspace project occurred in 2016 and the project was launched in 2017. It took a year to plan, adapt the room, which was previously a Werkunterricht lab, and buy equipment.

Work with the students started in August 2018. After a few months, Rebecca has observed that the students are enthusiastic, but she feels the school will only be able to accurately assess the success of the project when students have been working on similar maker projects for a few years.

Currently the school is running the second year of the pilot. This includes an initial project week for all classes followed by the students in classes 4 to 6 having eight mornings in the space working on a project of their choice.

## Building and equipping the makerspace

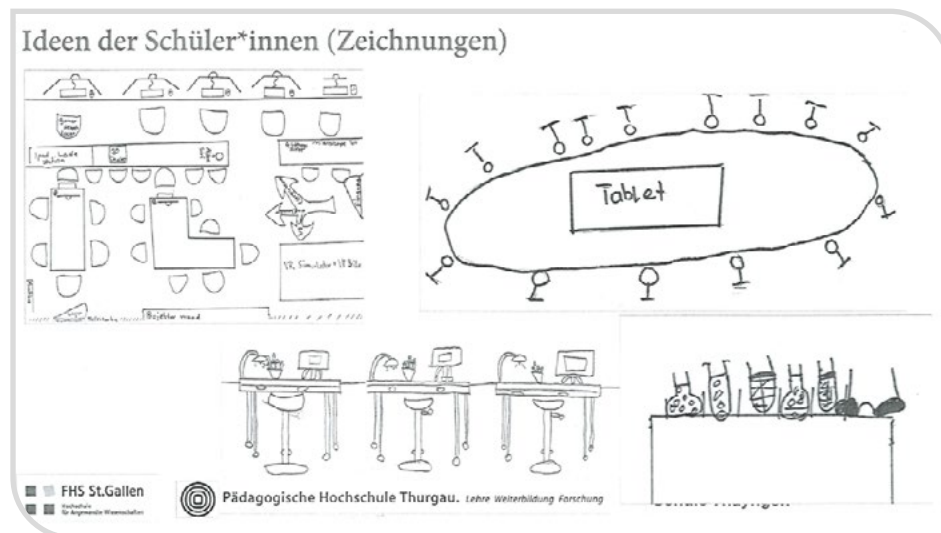
The three last years of primary school include mandatory Werken lessons (part of Swiss German curriculum). The makerspace was created by converting and expanding the existing Werkunterricht room. It is located in the school building with no direct entrance from outside of the school. There were always two rooms. One room is the size of a regular classroom (64 square metres) and there is an additional lab (25 square metres) for dust-sensitive equipment. The computers, tablets and flat screen are also stored in the dust free room, with all electronic components<sup>8</sup>.

<sup>8</sup> Ingold, Maurer, p. 205.



*Layout of the makerspace*

When the space was being transformed the students were asked what they would like the new space to look like and what kind of equipment they would like to have available.



*Student makerspace drawing*

Most of the necessary work to create the makerspace was carried out by the teachers and the project team during the summer holidays. The tasks they undertook included:

- ▶ Painting the room.
- ▶ Adding wheels to the tables so they can be moved around to make space for presentations.
- ▶ Adding a lower shelf under the tables so students can store their work in crates.
- ▶ Removing doors from the cupboards so students have direct access to materials they need.
- ▶ Removing the blackboard to install a whiteboard.
- ▶ Creating a presentation corner with spotlights and backgrounds.
- ▶ Installing the tools in such a way that students can access and operate them independently.

The school says there are three dimensions involved in a makerspace project, i.e. the space, the mindset of participants and the things the students use or do in the space.



*The three dimensions of the makerspace project*

Much of the equipment made available in the new makerspace was already in the school. Ideas were generated by the children in the project group and pragmatic decisions needed to be made according to the budget available. Parents were not initially consulted but the school say they now realise that parents can be very useful, especially when the staff support for a project is limited.

## Equipment and technologies

In addition to the equipment already available (e.g. for Werkunterricht lessons), the project team members could make suggestions for additional tools, often based on their experience with a particular piece of equipment or the versatility of a tool (e.g. Calliope programming cards). So far, Rebecca has not been able to attend maker fairs or conferences but she believes some members of the project team have done so.



## Health and Safety

Students have all the necessary equipment to work independently and safely in the makerspace, including special eye protection glasses and ear protectors. There are safe areas to work with saws, glue guns etc., and a fire extinguishing kit in case something catches fire.

During the project week, students are trained about safety regulations and discuss why they are in place. The rules are written down on the front door.

## Cost and funding

The research project, which includes the school makerspace pilot, was funded by the two initiating partner institutions plus a grant from the Jakob und Emma Windler-Stiftung Foundation. It is difficult to estimate the overall cost of the makerspace as the Werkunterricht room and equipment were already there.

## Sustainability

The foundation funded the research project for 2 years. This source of funding ran out at the end of the school year 2018-2019. In future, the equipment and running costs for the school's makerspace will be funded by the local authorities within the regular school budget. Moreover, the local authorities have agreed to pay Rebecca's maker salary (20% of her time) for one extra school year.

At present, the school is unsure how they will fund the 20% FTE support role in subsequent years. Without this funding, it seems unlikely the project can survive as it was conceived. There are options to develop the lab in connection with the new curriculum, which could help with funding. The teachers are being trained for the new curriculum, which also means additional skills being available for the makerspace, in particular for work involving programmable devices.

## Organisation and management

The Werkunterricht room, updated and stocked with new technical equipment and machines, functions as a makerspace every Wednesday morning. Teachers can also come to carry out their own projects any time the room is available.

As the makerspace is a special pilot project, and because timetable changes are relatively easy in a small school, it has been possible to take time out of the usual timetable for maker activities. Each class of students has one maker project week during the school year plus four blocks of four lessons working on their projects in the makerspace with Rebecca, the makerspace manager. In this role she collaborates with a large team of additional researchers from the two participating universities. The research project is investigating the learning, cooperation and development of digital skills that are achieved in this open space<sup>9</sup>.



<sup>9</sup> This is done by filming group discussions at the beginning and at the end of each session in which students are asked: How far along are you? What have you accomplished? What are your difficulties? What do you still want to accomplish?

The researchers also help the students with advice while they are working and sometimes film the students at work.

The team from the PH Thurgau are all keen makers and very enthusiastic about the project. Rebecca is also a keen maker and she says that for her role in the makerspace *“the most important quality is to be open to discover new things and ready to not have answers to all the questions students ask”*.

Regarding the maintenance of equipment, Rebecca looks after and maintains the media, electronic and computer components and the Werken teachers take care of the craft equipment.

## Networking beyond the school

Lukas and Rebecca visited other makerspaces before opening their own, for example a space in St-Gallen, but most of the education makerspaces are geared towards older students in professional education and are not really relevant for their primary school context. However, they welcome visitors and present the pilot in maker conferences when they have the opportunity to do so.

Initially networking beyond the school did not involve parents, but now the school is beginning to involve them by asking if any parents or grandparents are interested in helping out, in particular during projects weeks when you need more adults in the room. Several parents attended a parents' conference and volunteered to help. They were impressed by the equipment available and proud of the school's achievement.

During the project phase the makerspace was not open to the external community, including parents and other makers. However, the school is considering what it would take to open the space to other people. They would like the lab to be open on free afternoons for all of Thayngen's children. There are open questions around the number of supervisors to be present at all times and the financing of materials. Legally, it seems that if a school provides services to children who are not their students this is youth work, not education, and is therefore governed by a different legal framework.

## Training and support of teachers

Every other Wednesday afternoon, the project managers organise voluntary teacher training in the makerspace for those interested in developing the skills needed for the new Lehrplan 21 curriculum. The pedagogical support person was very involved in developing the training. The researchers from both universities and the teachers working in the lab have extensive maker competences and function as trainers.

There is a wide range of activities that teachers can choose to try out during training, depending upon their interests. The topics are related to both the makerspace and the new Media and Informatics curriculum and include Calliope programming, electric circuits, animations and film making. Some of these activities can be carried out in the classroom as well as in the makerspace. The fact that the project overlaps with so many priorities of the new curriculum explains why it has received such wide acceptance and most teachers attend the courses. However, if maker activities become embedded more into the curriculum rather than being a special project, there are concerns about the skills and amount of training other teachers will need.

There is no formal process for disseminating training to other teachers. However, a great deal of informal dissemination takes place face to face when staff meet in the teachers' room.

For Rebecca, who chose Werkunterricht as a specialisation in teacher training college, participating in the project has enabled her to learn a great deal through collaboration with the project team. She also says *“the kids know I don't have answers for every technical challenge, they have to find out some things for themselves or we figure things out together, or I look up answers for the next time”*.

## Teaching and learning in the makerspace

Over the course of a school year, each student works on two maker projects. In their initial training week, students acquire the basic skills and competences needed to work in the makerspace which include, for example, Calliope programming, operating the CNC milling machine and using iMovie. They all make something from the explore-it.org project and learn about the health and safety regulations.



For their second project, students can choose from a large range of equipment and are free to use it to make anything they want, as long as they meet the minimal specifications defined by Rebecca (e.g. for the 6<sup>th</sup> class projects every object created had to contain a movement and a drive). The students organise their own work and make plans to complete their project/object, as well as a film about it, during their four blocks of four lessons in the makerspace.

Objects made so far by the students in the makerspace have included:

- ▶ Heart-shaped clocks.
- ▶ A round clock with a disco LED light and remote control.
- ▶ 3D printed masks with integrated LED lights.
- ▶ A TV remote control storage box with a red light to indicate when the remote is not in the box.

Rebecca has noticed that *“it is not necessarily the good students that end up doing well in this setting”* and that some students who excel in a traditional classroom can find the freedom of the makerspace a bit overwhelming. Planning and time management can be difficult skills to master. Rebecca observed that *“one of the students in the group wasted a lot of time in developing the concept for her project and then had to make her product during the last morning session available”*.

To date 15 to 20 teachers have been involved in the makerspace activities and numbers are expected to increase. Seven classes in the 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> years make scheduled use of the space but whenever it is available any teacher can use the space with their students. On Tuesdays, the gifted students have special activities in the makerspace. Students with special needs have also used the room to make animation movies. Teachers can reserve boxes of equipment to bring back to their individual classrooms on a wheeled cart.

The skills teachers need depends upon the kind of projects the students carry out. Currently the teacher training provided is focussed on a specific skill set that the teachers can then transfer by means of specific projects. Very flexible projects, in which students are entirely free to choose what they make with which equipment and materials, like the ones carried out in the pilot project, involve many different skills. Therefore, Rebecca does not expect all teachers to be able to lead such projects;

so she does this herself on Wednesday mornings. She believes very flexible projects are only possible as there is large group of people (two researchers and Rebecca's two interns) to support the students during the project phase. Also only half of each class, around 10 to 12 students, use the makerspace in each session.

In 2020 the project team is exploring ways of making "maker activities" more sustainable with fewer staff. The team is considering questions like:

- ▶ Should the project team and Rebecca prepare more guided activities?
- ▶ How can the school limit the choice of activities to something more manageable for teachers without stifling students' creativity?

The makerspace's research project is investigating how students learn in the space. Two former teachers are writing their MA thesis on the learning, collaboration and motivation of the students involved. However, it is not part of the formal project to consider what and how the teachers are learning.

## Benefits

The benefits of the makerspace observed by the school to-date include:

- ▶ Students are able to try out their own individual ideas.
- ▶ Students are finding out that failure is part of learning and that they can find ways around problems; this strengthens their self-esteem.
- ▶ Teachers and students can work together to find solutions and the new environment and tools help teachers to admit they do not know everything.
- ▶ Teachers can find out more about students they thought they knew. Less academically able students have more opportunities to demonstrate what they can do well. Conversely, some students who are very creative in class can find the unstructured approach in the makerspace rather daunting.



## Challenges

The school has previously been innovative on a small scale but the makerspace is an ambitious project, requiring significant teacher training and attracting a lot of media attention, which Lukas says has been a significant challenge.

In future there is also the challenge of maintaining adequate staffing to support the makerspace activities. To-date 20% of Rebecca's time has been dedicated to the makerspace. She also teaches her regular class on Monday, Tuesday, Thursday and Friday as well as taking part in many meetings, welcoming visitors and making presentations. The school has been fortunate to have To have such an enthusiastic teacher, willing and able to cope with this workload , but a long term solution must be found.

## Future plans

Funding is in place for the makerspace to continue for another year and the school is seeking funding to ensure it will continue beyond that point, preferably with the possibility of continuing some research into the impact of making on learning.

# Makerspaces in schools

The guidelines have been created by European Schoolnet and supported by members of its Interactive Classroom Working Group (ICWG). Eight Ministries of Education are involved (Belgium (Flanders), Czech Republic, Ireland, Italy, Luxembourg, Portugal, Switzerland, Turkey).

Read more at [fcl.eun.org/icwg](http://fcl.eun.org/icwg)



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