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Makerspaces in schools

Practical guidelines for school leaders and teachers

Case Study

Luxembourg's makerspaces including
Base 1 and Betzdorf

European
Schoolnet

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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, 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 national plan

The project, BEE Creative[1], is a collaboration between the formal and non-formal sectors in Luxembourg's national education system to create makerspaces. There are currently 27 makerspaces in secondary schools and five in primary schools or day care centres.

A team of five people have created guidelines on makerspaces for both sectors. There is a quality charter for makerspaces and the team visit the makerspaces to provide feedback and direct help to the spacekeepers, as the managers of the makerspaces are known, and their teams.

The National Youth Service (SNJ[2]) is contributing to the implementation of youth policy including educational projects such as BEE Creative. Its responsibilities are:

- Training and support for educational projects as animators and school mediators, including the BEE SECURE, BEE CREATIVE and Makerspace initiatives

- Management of three thematic pedagogical centres:

  ▶ Education for sustainable development, in Hollenfels in the west of Luxembourg.

  ▶ Sports discovery, in Lultzhausen by Upper Sûre Lake in the north of Luxembourg.

  ▶ Well-being and media education in Marienthal in the west of Luxembourg.

- Support for young people in their transition to working life.

- Quality development in working with children and young people.

Funding is provided by the institutions themselves. The Ministry of Education provides two non-teaching hours per week for a person to be able to run the infrastructure. This includes maintenance and developing continuous training for teachers.

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1   See bee-creative.lu or makerspace.lu for more information

2   Service National de la Jeunesse

Examples of makerspaces in Luxembourg

Two examples of makerspaces in Luxembourg are:

▶ Base 1, is located within Forum Geesseknäppchena, a resource centre for work with youth in Luxembourg City, and situated very near to three secondary schools. During school hours it is visited by primary and secondary classes and outside of school hours it is open to the general public. Base 1 is closely connected to the local community and people from nearby day care centres and youth centres attend workshops in the makerspace.

▶ A makerspace in the small town of Betzdorf in eastern Luxembourg, which is a collaboration between the primary school and the local Maison Relais day care centre for people with disabilities.

Base 1

Motivation and aims

Base 1 staff say their aim is "*to provide a boundary free environment for students where they can evolve their own project ideas in a creative manner*" and key objectives are:

▶ To create a non-traditional learning environment.

▶ To introduce makers to different mediums and develop their talents.

▶ To foster creativity.

▶ To provide a space for new ideas.

▶ To foster problem solving and teamwork.

Regarding services, the makerspace aims:

▶ To provide workshops at all levels, i.e. introductory, intermediate and professional.

▶ To provide students with opportunities to:

• Use new equipment and materials, e.g. 3D printers, laser cutters, soldering irons.

• To learn new skills, e.g. coding and design.

The implementation timeline

In 2010, Marc Teusch had the idea of bringing a "mentored hackerspace" to the Luxembourg schools. He was a co-founder of the national hackerspace[3] and wanted to bring a similar idea to schools as he was working in Luxembourg as a computer science teacher. After Marc gave a TEDx talk[4], entitled "Makerspaces - The Future of Education" in 2013[5], the idea was presented to SCRIPT, the Ministry of Education's coordination service for educational and technological research and innovation, and SNJ who were looking for new ideas at that time. Planning was very fast, as Marc had a lot of ideas already and it took only about a year to develop a national plan.

Developing a national deployment plan also took about a year, as there were already practical examples to learn from e.g. a makerspace in Ettelbruck Technical High School had been operational since the 2011/12 academic year.

The project to set up the Base 1 makerspace started in 2014 and full implementation took approximately three years.

Building and equipping the maker space

A large room was made available on the first floor of the existing building at Forum Geesseknäppchena and this was adapted to create the Base 1 makerspace.

When selecting equipment for the makerspace, the staff were informed and inspired by other makerspaces, maker fairs and published information. Some of the equipment was bought and some recycled materials were used.

Equipment currently in the makerspace consists of:

3D Printing

- 4 x Ultimakers
- 3 x other 3D Printers (different models)
- 10 x Polaroid 3D pens

3D Printer

Robots

- 1 x Sphero BB-8
- 1 x Sphero Olli
- 2 x Wonder Workshop DASH
- Tablets for controlling and programming robots

Audio/Video/Music Workstation with Ableton Live

- Keystation 65 Keyboard Controller + PUSH Controller Microphone, Headphones, Headphone Splitter
- HDV Camera, Tablet Holder, Tripod

Digital workstation

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3   syn2cat.lu
4   https://www.ted.com/watch/tedx-talks
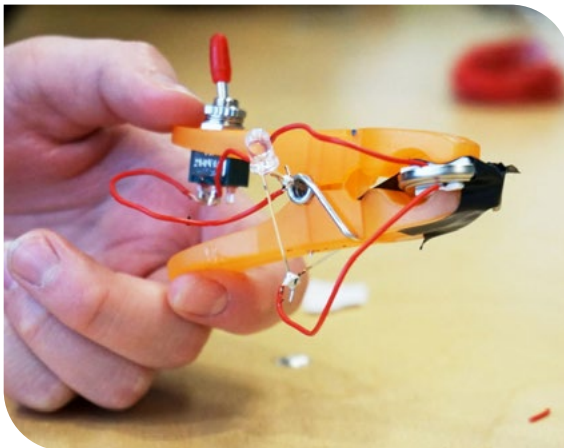5   https://www.youtube.com/watch?v=Ruo904vtQ8w

Computers

- 4 x desktop computers (2 Mac + 2 Windows)
- 3 x sets of 8 laptops
- 1 x A4 Colour Laser Printer/Scanner

Electronics

- Kniwwelino Classroom Kit
- Arduino Starter Kit DE
- Soldering Stations
- Battery tester
- Lamp with magnifying glass
- Multimeter

Laser Cutter

Electronics

Power Tools

- Cordless Drill
- Cordless screwdriver,
- Vacuum cleaner for Dust
- Thermo cutter
- Table saw
- Heat gun
- Laser cutter

Hand Tools

- Glue gun
- Ruler
- Hammer
- Allen keys
- Files
- Screwdriver sets
- Clamps
- Centre punches
- Measuring tape
- Hacksaw
- Vice
- Jigsaw
- Stapler
- Pliers

Textile Work

- 2 x sewing machines
- 1 x overlock sewing machine
- Foil Cutter
- Heat press

Health and Safety

In the makerspace posters inform users of the safety rules and there is a first aid kit. Also the makers and their parents have to sign a registration sheet where the safety rules are explained. The coaches are briefed about the safety rules and ensure that all makers adhere to them.

Cost and funding

Funding for the first six makerspaces, including Base 1, was provided by SCRIPT, SNJ and Luxembourg's National Research Fund (FNR). Now schools, and other institutions or organisations wishing to create a makerspace, have to provide funding from their own budgets or request special funding from the Ministry of Education.

The cost per makerspace varies between 5,000 and 25,000 euros, depending on the needs and requirements of the space. Then there is an annual cost of between 1,000 and 3,500 euros for expendable materials e.g. electronic components, 3D filament, etc.

BASE 1 cost approximately 40,000 euros for equipment (this excludes staff costs).

The organisers of the makerspace initiative say it is very important that every makerspace tries to provide materials for projects to students free of charge. This is to make it possible and sustainable for all students to participate. Access to the makerspaces is free on presentation of a valid student card.

Organisation and management

Base 1 makerspace is open to anyone aged between 8 and 30 years. It is open from Tuesday to Thursday from 12:30 to 18:30 and on Saturday from 9:00 to 16:00. Early requests to use the space indicated that these would be the most popular days. There are always two, out of a total of nine, coaches on duty to support the makers.

Open space of Base 1

There are two spacekeepers who manage the makerspace. One of them is responsible for the concept of the makerspace, the budget, the team, the workshops, etc. The other spacekeeper is responsible for the technology and materials. Maintenance is carried out by the spacekeepers, following training sessions for the specific tools to be maintained.

External freelance coaches are used to motivate students by providing interesting workshops, giving demonstrations and organising hands-on activities. The activities include coding and electronics and other creative activities such as music workshops. The external coaches also act as mentors when questions arise or trigger research when asked questions like "what could I do?".

Training and support of teachers

Regular training is organised for the coaches in order that they are familiar with all activities and equipment offered in the makerspace.

When teachers were recruited to act as coaches there were no specific skills necessary, except for a general interest in making. Teachers with knowledge of their own subjects, e.g. electric engineering, computer science, mathematics, languages, etc, were recruited and mentored to provide them with the basic knowledge to operate in the makerspace. The spacekeepers found that most of the teachers already had most of the skillset they needed as a result of their previous teaching experience and ideas.

Training sessions for other teachers are organised by IFEN, a national training provider for teachers and educators. Workshops that are related to specific curriculum topics provide teachers with ideas about alternative ways to engage their students in learning. Initially demonstrating some activities in the teacher's usual environment can help to remove their fear of the unknown makerspace.

OpenSpace[6] sessions are organised to introduce makerspaces and their use to other schools.

Teaching and Learning

The Makerspace pursues the educational goals set out in Luxembourg's Education Framework (the Bildungsrahmenplan).

The process of an activity is planned in advance by the spacekeeper and is organised together with the coaches, who are the experts in the different topics and who lead the activity. Teamwork and communication are important skills for staff working in the makerspace, as is collaborative problem solving.

Typical activities taking place in the makerspace include: coding, logo design, use of wearable technologies, programming, music activities, electronics and photography.

There are regular coaches' meetings to exchange experiences and ideas and the coaches take turns organising training courses for each other. The coaches also share information about users of the makerspace, their projects, problems encountered and solutions found, by writing short reports in a log book.

Added value and benefits

The spacekeepers at Base 1 identified an added value of makerspaces as the fact that they have no hierarchy and that this means "everyone learns from everyone, there are no clear roles of teacher or student as in classrooms".

It was also considered valuable that people can come with ideas and create solutions and they can also approach topics in physics, mathematics and other subjects in a practical way.

A strong benefit of makerspaces is the opportunities they provide for sharing knowledge. The use of OpenSpace workshops was identified as a good way of extending these opportunities.

Challenges

An initial challenge for Base 1 was recruiting two coaches for each day the makerspace is open. Space keepers also identified the challenge of finding ways to spread information about the opportunities offered by the makerspace in order to attract new visitors.

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6   https://www.openspaceproject.com/

The Betzdorf Makerspace

The school

Betzdorf Primary School is situated in the small town of Betzdorf in the canton of Grevenmacher. The school has approximately 300 students and about 30 teachers. The students are from different socio-economic backgrounds, but most of their families could be described as middle class. Property is expensive in Betzdorf, and most of the students' parents have completed higher education.

Motivation, aims and timeline

In January 2017 SNJ started a pilot project in five primary schools across the country. The local community encouraged Betzdorf Primary School to take part in this project. In May 2017 the school committee, together with the local Maison Relais day care centre, agreed that they would collaborate to create and operate a makerspace.

The aims of the makerspace are:

▶ To enable students to learn about technology in a playful way.

▶ To facilitate inquiry learning by encouraging "tinkering".

▶ To encourage teachers to learn and discover new knowledge together with their students.

Detailed planning of the makerspace started In August 2017 and in the September it officially opened.

Building and equipping the maker space

Initially the makerspace was set up in an existing space inside the school, an unused room was found and adapted. Then, in September 2018, the makerspace moved into the newly built Maison Relais building, which is located beside the school. Maison Relais is operated by Caritas Youth and Families Luxembourg and the town of Betzdorf.

The size of the room in which the makerspace is now located is about 50 square metres. It consists of three areas:

▶ An area for technology, with a white board.

▶ An area for general or universal activities with more tables.

▶ An area for artisanal activities (especially woodworking).

Equipment for the makerspace was selected in consultation with everyone who was involved within the school and Maison Relais.

Equipment and technology

- Equipment in the makerspace includes:
- 3 x desktop computers
- Laser Printer
- Some tablets
- Wood drill
- Wood saw
- MakeDo cardboard construction kit
- Lego WeDo
- mBots
- Maker materials
- e.g. LED's, wires, batteries, wood

Health and Safety

When the spacekeepers received training the coaches briefed them on health and safety rules. The spacekeepers pay attention when students and teachers are using the space to ensure these rules are applied.

Cost and funding

The local community and the government, via the SNJ, funded a 3 year project to establish the school's makerspace. This funding included paying for a coach and teachers attended SNJ training courses.

Some of the equipment in the makerspace was purchased using the school's budget. The local community and the Luxembourg Red Cross, who work with Maison Relais, also pay for materials. The school and the day care centre both investigate possible new equipment and they work together to decide on priorities and purchases.

The total cost of setting up the makerspace was approximately 5,000 Euros.

Organisation and management

During school hours all the school's teachers have access to the makerspace. Teacher Daniel Weyrich, who is the spacekeeper during school hours, leads weekly sessions, on Wednesdays, with different classes. Steve Kremer, from Maison Relais is the spacekeeper outside of school hours when children from Maison Relais can use the makerspace for two hours each day from Monday to Friday.

The two spacekeepers cooperate and share ideas and good practice. Steve Kremer helps with organising activities in the makerspace within school hours every two weeks and Daniel Weyrich works inside Maison Relais during the school's lunch time.

Training and support of teachers

During the initial project phase, 2017- 2019, training related to maintaining and implementing different tools was offered by the SNJ. Further informal training has been provided by other spacekeepers and all the educators share experiences and ideas in the staff meetings.

Teaching and Learning

Every class comes into the makerspace with their teacher at least once a week. Daniel organises the activities and supports the teacher. When they have used the makerspace with Daniel at least once and feel confident, teachers can use the space by themselves with their students. To help

them, Daniel provides materials and "ready-to-use" activities so that even teachers with no previous experience of making can lead class activities on their own.

Most activities are linked to the Science curriculum, or to Geography. Some other teachers can find it difficult to link use of the makerspace to the curriculum. Activities often include electric circuits, coding and constructing objects and the pedagogical approach is problem-oriented learning.

Added value and benefits

Teachers at the school, and educators at the Maison Relais centre, say they have found that children:

- ▶ Are more motivated to learn when they have to really try to solve problems.
- ▶ Work in teams better in the makerspace.

Also children learn that:

- ▶ There is not always only one solution.
- ▶ Sometimes you have to try and fail when learning by doing.

The teachers saw added value in having a separate makerspace away from the normal classrooms as, in that space, teachers and students know where to find everything and do not need to move the tables, chairs and other objects. The teachers also commented that for primary school students it is something special to go to another room as they usually stay in their home classroom.

Challenges

For the school spacekeeper the main challenge was the amount of planning he needs to do outside of school time. Daniel commented that he is allocated "two school hours for preparation and being in front of a class, but this time is not enough". For the other teachers, Daniel describes the main challenge as "they have to get rid of the fear of all the technical equipment".

Sustainability and future plans

To-date the makerspace has been created and operated within a special project. In 2020 plans for use and development of the makerspace will be included in the school's development plan. Every school creates a development plan which determines the goals and focus of the school for a period of three years. A longer term aim is to open the makerspace outside of school hours for community use and for children who do not attend Maison Relais.

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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