Interactive Classroom
Working Group

Future
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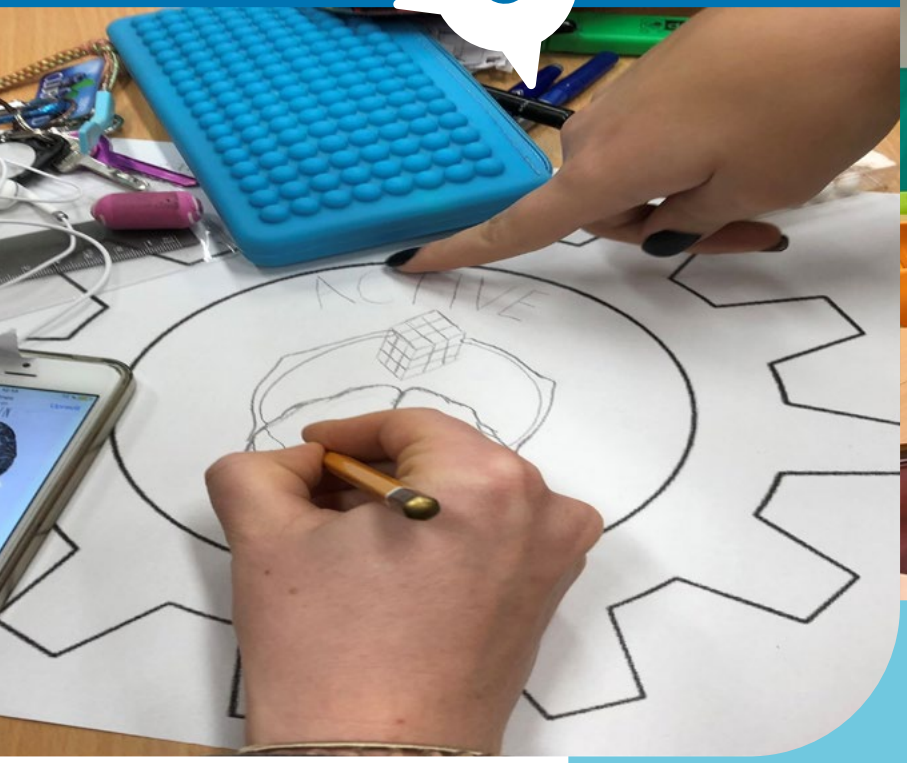
Makerspaces in schools

Practical guidelines for school leaders and teachers

Case Study

Dr. Edvard Benes, Praha – Čakovice,
Elementary School, Czech Republic



European Schoolnet

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Practical guidelines for school leaders and teachers

Case Study:

Dr. Edvard Benes, Praha – Čakovice, Elementary School, Czech Republic*

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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*

National context

Several Fab Labs for adults have recently been created in different cities of the Czech Republic (e.g. in Prague, Brno and Ostrava) as the initiatives of private companies or associations. Some cities or regions also support and fund activities similar to makerspaces, for example:

- The City of Plzeň established a centre, "Centrum robotiky", equipped with digital technology, robots and technical kits. This centre provides, free of charge:
  - training for teachers
  - devices (such as educational robots) for schools in the city
  - and extra-curricular activities for children for a fee.
- The South Moravia region, in collaboration with city of Brno, has established a mobile FabLab. This is a large van equipped with various technologies. Primary and secondary schools can order this mobile FabLab for a week. Trainers lead activities for children inside the van free of charge in the mornings and in the afternoons the van's services are available to the public for a fee.
- Schools in the city of Lanškroun can ask for free BBC micro:bits (programmable microcomputers with different sensors). This project is led by Micro:la foundation fund in collaboration with Lanškroun city and local companies.

Several Czech schools has recently opened/refurbished their makerspaces. From the initiative of Ministry of Industry and Trade, and in collaboration with Ministry of Education, Youth and Sports, there is also a pilot study on new subject "Technology" carried out in several Czech Elementary schools (the pilot has been launched in 2019/2020 school year).

The school

Dr. Edvard Benes Elementary School is a primary and lower secondary school located in the northern suburbs of the Czech Republic's capital city Prague. The school has 1,258 students and about 80 teachers. The students come from a variety of socio-economic backgrounds but the school is in a generally middle class location. The school has a very close relationship with the local community and the school's leaders believe it is important to continuously develop good local connections, including with local policy makers. The school cooperates with several local associations active in different fields, e.g. cooperation with seniors, promotion of folklore, etc.

Motivation and aims

During a European project, the headmaster, Martin Střelec, and the deputy headmistress, Petra Boháčková, had a chance to visit the European Schoolnet Future Classroom Lab in Brussels and were motivated to innovate in their school. The deputy headmistress recalls that *"The idea of having a flexible space, that supports collaborative learning and is equipped with technology, captivated us and we decided to set up a similar classroom in our school"*. Martin Střelec says *"I supported the use of digital technology in lessons and decided we could equip a Lab with various devices and gadgets"*.

The aim of the school management is to support new ways of teaching and learning by creating the right conditions in the school. Therefore, they encouraged teachers to participate in professional training opportunities in the Czech Republic and abroad,and participated in several national and European educational projects.

Martin Střelec emphasised that they did not want the new space, which can be considered to combine elements of a learning lab and a makerspace, to be used only by the IT teacher. On the contrary he says "*our aim is to open the space to all teachers in the school who are interested and for them to use it to support inquiry-based learning. This approach enables sharing of experiences and for knowledge and good practice to spread through the community of teachers*".

The implementation timeline

The Lab was opened in 2016 after approximately two years of planning and the school has increased the equipment available in it over the last three years when the availability of funding has enabled this.

Building and equipping the makerspace

An ordinary classroom inside the elementary school was refurbished three years ago to accommodate the makerspace. It is located next to the staffroom of the school deputy headmistress responsible for the management of the space and there is an interconnecting door. There is no direct access from outside the school.

The layout of the space, as designed by the school's management, enables collaborative team work and includes easy to move chairs and tables. The presentation area includes a blackboard and an interactive white board. There are lockable boxes for charging and storing tablets and other expensive devices (e.g. robots) as well as boxes to store other equipment. There is a green screen on wheels so that it can easily be moved to wherever it is needed.

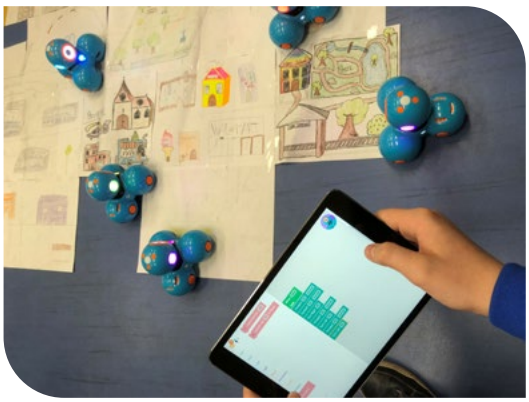
The makerspace is used for standard curriculum lessons by teachers of various different subjects and grades. Due to lack of space, the school decided to make the makerspace as mobile as possible, allowing the equipment to be used in different classrooms as well. It has mainly been primary school teachers who have taken advantage of this possibility. In the primary school each class has its own room, whereas secondary school classes change rooms during the day.

The equipment has been bought a bit at a time. Some equipment, such as iPads, were bought by the school before the makerspace was opened. The rest has been added later and is still being added to and updated when the budget allows. Petra Boháčková, in collaboration with the ICT coordinators, has selected the equipment that has been bought by school. They choose the equipment on the basis of knowledge gained at conferences and fairs and on the recommendations of other teachers, including active members of various teachers' professional communities such as Google Edu Group and eTwinning.

The approach of gradually increasing the equipment available probably makes it more likely that the equipment will be actively used during lessons. This is because teachers are able to get used to the equipment they have before more is introduced.

Equipment and technology

The makerspace equipment includes:



- Tablets (iPads)
- 3 x 3D printers
- Various sensors
- Green Screen (on wheels)
- Interactive panel
- Various construction sets
- Basic tools (e.g. screwdrivers)
- Sam Labs[1] STEAM and coding kits
- Programmable robots (Dash and dot[2], Ozobots[3], Bee-bots[4] etc.)

Funding and sustainability

The refurbishment of the room for the makerspace and the equipment in it has been paid for out of the normal school budget as no special funding or sponsorship was available.

The school participates in national and international projects which sometimes include funding for buying equipment. In future they plan to continue doing this and will apply for any grants that become available in order to update equipment.

1 https://samlabs.com/

2 https://www.makewonder.com/robots/

3 https://ozobot.com/

4 https://www.terrapinlogo.com/beebot.html

Organisation and management

The makerspace is managed by Petra Boháčková, who is also responsible for providing pedagogical support for teachers. As the school is quite large, there are two teachers who are ICT coordinators, and they help other teachers to effectively use the digital technologies.

Teachers can specify, before a new school year, if they want to conduct some of their lessons in the makerspace. These requests are used to draw up the schedule for the year but changes can be made if needed. Petra manages timetable changes and looks after the equipment, including charging tablets and installing software.

Networking beyond the school

The school's makerspace is not open to the local community, as it operates within classrooms during school hours and has no external door for access outside of school hours. Nor does the school currently regularly collaborate with other makerspaces or Fab Labs outside the school.

However, teachers from the school do attend educational events, including conferences, seminars, fairs and study visits in the Czech Republic and abroad in order to get inspiration and share good practice.

Petra Boháčková says *"We sometimes run seminars in the space for teachers from other Czech Republic schools and we would like to replace the room in the future so that it could be opened to the public during afternoons and weekends. Unfortunately, due to the demographic situation, we lack suitable space"*. She explained that this is due to a "population boom" in Prague's suburbs.

Training and support of teachers

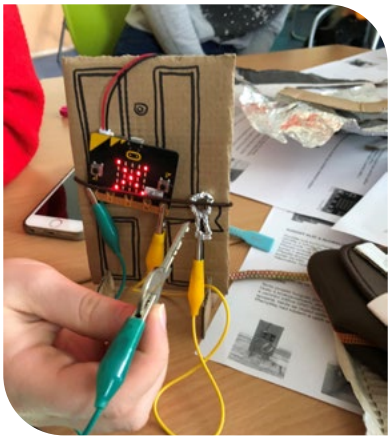
Some of the school's teachers have taken part in external educational experiences and CPD is organised within the school as well.

Teachers are encouraged to join an informal group focused on innovative teaching methods, which may or may not focus on makerspace activities. The group, which currently includes approximately 15 of the school's 80 teachers, meets once a month to exchange their ideas and good practice and to prepare training for each other.

There is also a school Moodle course that provides a dedicated virtual space for teachers to upload learning materials and short teaching scenarios, share teaching and learning tips and provide links to useful resources. The content is structured according to subjects and educational areas with several sections focussing on using digital technologies for teaching, e.g. tips on using Ozobot programmable robots in English or in Geography. Information and good practice is also shared during routine staff meetings.

Petra Boháčková's pedagogical support for teachers sometimes includes "tandem teaching" in which she helps another teacher to use various technology devices during their lesson. This involves working together with the teacher in advance to plan each lesson, including choosing the topic and the technology as well as preparing meaningful activities.

Teaching and Learning



Use of the makerspace by teachers is voluntary; Martin Střelec describes this as *"no one is forced, no one is denied"*.

Teachers who do use the makerspace have to adapt their teaching methods as the space is more suitable for collaboration and inquiry-based activities than for instruction-based teaching. Students are generally more active in the makerspace and the role of teacher is to be their guide or tutor.

In the makerspace students are not just relatively passive users of social networks and apps. They develop an awareness of how technology really works. For example, they learn to code, to use sensors or to construct objects using 3D printers.

Frequently students are more confident and competent in using digital technologies than some of their teachers. Petra Boháčková says "*this means a teacher can be in the situation where they ask their students for help and this can lead to a better relationship between teacher and students"*.

As all activities in the makerspace are carried out during curriculum subject lessons, there is a direct link to the curriculum. Martin Střelec says *"we consider it important that the space, and the equipment, is used for different subjects including primary school subjects, language lessons and STEM subjects in lower-secondary school. Collaboration, computational thinking and digital literacy are transversal skills, so it is good to develop them within different subjects"*. The makerspace is currently used by approximately 15 teachers for subjects including English, Physics, Chemistry, Science and Health Education and Martin has commented that *"although not all teachers in our school use makerspace equipment, nor a student-led inquiry learning approach, the number that do is increasing"*.

Examples of activities undertaken with the makerspace equipment include:

- Primary school teachers use Bee-Bots to teach the basics of coding.
- Older students use other robots e.g. Dash and Dot, or learn how to code through Scootie Go![5].
- SAM Labs enable students to connect the physical and digital worlds as the kit includes different sensors with buzzers or lights that can be connected via the app with the other components to do different things.
- Green Screen is used to prepare short videos
- Ozobot robots and iPads are used in different subjects (English, Physics, Maths, ICT, the Arts).
- A 3D printer has been assembled by lower-secondary school students from a kit.

Added value and benefits

An added value of the makerspace is that the spatial layout is more suitable for inquiry-based learning and collaborative activities than the typical layout of a standard classroom, which is more suitable

5 https://scottiego.com/en/edu-scottiego/about-the-game/

for instruction-based teaching. In Dr. Edvard Benes school the spatial adjustment from classroom to makerspace takes only a few minutes as the furniture is light and easy to move. As all the equipment is stored in the room, there is also no risk of the teacher forgetting to take what is needed along to the lesson and storage of the equipment in one room facilitates easy management.

Another added value has been described as a "multiplier effect". Some teachers who have worked in the makerspace are starting to use some of the approaches learned in the makerspace in their usual classrooms.

Benefits of using the makerspace, observed by the makerspace manager, include:

- Students are more active learners and learning is more student-led, as they are encouraged to search information, to explore, to plan their work, to take responsibility for their tasks and to agree roles in team work.
- Students are more engaged and enjoy lessons more.
- Students are not only users of technological devices (e.g. iPads or 3D printers) but also learn how these gadgets work.
- Many competences, skills and mindsets are developed in the makerspace including:
  - Collaboration
  - Computational thinking
  - Inventiveness
  - Entrepreneurship
  - Following instruction manuals
  - Effectively and safely using different tools

The added value and benefits of the makerspace are also consistent with and enable key aims of the school. Martin Střelec says the school *"strives to prepare students for their future careers and for life in the 21st century; to educate students to be active citizens in a changing world where digital technology will play a bigger and bigger role and will influence different aspects of their lives. Students have to understand how technology works, but they also need to be pro-active, responsible, to have communication and collaboration skills"*.

Challenges

The main challenge identified by teachers is that preparation of lessons is probably more time consuming than in a standard classroom using traditional teaching methods. Others mentioned fear of failure and fear that the technology will not work properly.

The biggest challenge for school is the lack of space and the accessibility of the makerspace. The space is located inside the school with no direct access to the outdoors, so it cannot be opened to the public. The school would like to expand the makerspace but due to the high number of students it is not possible at the moment.

Future plans

In the future, the school would like to expand the makerspace (i.e. connect the space with the next classroom by demolishing the wall between them). This plan depends on the school's student intake as the number of students is still increasing and the school currently lacks space. Eventually the school's management would like to have one makerspace in each of the school's three buildings.

An aquaponics[6] centre is scheduled to be opened in 2020. This centre will be part of the school and students will use it during lessons. As the centre will be managed mainly online, students will have a chance to further develop their computational thinking. The school would like to buy Robotic Arms for use in the centre so that students could explore how industrial robots work.

6 Aquaponics is a combination of aquaculture, i.e. growing fish and other aquatic animals, and hydroponics, i.e. growing plants without soil.

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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