

Makerspaces for Innovation in Teaching Practices



Giuseppe Alberghina

Abstract “MakIN Teach—MAKerspaces for INnovation in TEACHing practices” is a two-year project recently funded by the Erasmus + program. It aims to promote the exchange of good practices in the use of rapid prototyping techniques, tools and spaces in the fields of education and training. The project supports teachers/educators working with students/learners showing poor educational results in theoretical subjects (e.g., mathematics, biology, geography, history, language, communication etc.). The project will conduct three short-term joint staff training activities and one student learning event, which will provide teachers/educators and students/learners with practical experience in makerspaces/fab labs. The materials and ideas developed during these transnational activities will be collected into an interactive e-book containing information about rapid prototyping technology, as well as tools for innovating the educational system and integrating fab labs and makerspaces into traditional teaching practices. All the partners involved in this project will have the opportunity to be part of a fruitful and durable network of educational institutions and makerspaces/fab labs at local and European level.

Keywords Digital fabrication · Makerspaces · Fab labs · Education

1 Introduction

“MakIN Teach—MAKerspaces for INnovation in TEACHing practices” is a two-year project recently funded by the European Union’s Erasmus + program, part of Key Action 2: “Cooperation for innovation and the exchange of good practices” [1]. The project partners are AFP Patronato San Vincenzo (IT), I.E.S. Juan Ciudad Duarte (ES), Tallinn Polytechnic School (EE), Transit Projectes (ES) and Center for Creative Training Association (BG). All these organizations have the same mission of supporting students/learners on their path of growth, education and inclusion in

G. Alberghina (✉)

Associazione Formazione Professionale del Patronato San Vincenzo, Via Mauro Gavazzeni, 3,
24125 Bergamo, Italy

e-mail: giuseppe.alberghina@afppatronatosv.org

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today's society. Educational underachievement (especially in theoretical disciplines) and early school leaving are common problems for all project partners.

The objectives of this project stem from inquiries that teachers/educators in each organization have made at local level. The teachers/educators involved have found concerning rates of educational underachievement and early school leaving (the respective figures by country for these are: IT 22 and 27%, ES 20 and 19%, BG 40 and 13%, EE 12 and 11%). In addition, they have found this worrying situation to be linked to the teaching methods currently in use, which are often too static and not engaging enough for students/learners with educational difficulties. The teachers/educators realized that it is crucial to develop more captivating teaching methods, as well as learning environments that are closer to real life [2].

These results are consistent with the Digital Education Action Plan of the European Commission, which states that “education can benefit from opening classrooms, real-life experiences and projects, and from new learning tools, materials and open educational resources.” It claims that innovation in education systems can help improve learning outcomes and that “it is most effective and sustainable when embraced by well-trained teachers and embedded in clear teaching goals” [3]. Given this, the project partners believe that makerspaces and fab labs can support their teaching staff in this change [4].

2 Methodology

The project is inspired by the maker movement and fab lab ideas, and the closely related concepts of “experience learning” and “active learning.” As stated by Rivoltella [5]: “Experience learning is traditionally related to active learning. This means to make possible that students could be actors of their own learning. As Activism demonstrated, there is no chance for learning if teacher speaks all the time, thinking that education is only information giving. Learning is fostered if it is experienced, that is related with emotions and real-life situations. Classroom has to be re-designed as a lab: lessons become workshops into which problem-solving and collaborative learning are the main students' activities. Digital technologies and mobile devices can empower these activities making possible that every student could be able to produce its contents and share them with his/her colleagues.”

The methodology applied in “MakIN Teach” combines do-it-yourself (DIY) principles [6], typical of the maker movement and fab lab programs, with Activism theory and the related ideas of “experience learning” and “active learning.” By combining and implementing these concepts, the consortium aims to exchange good practices in the use of rapid prototyping techniques, tools and spaces in the fields of education and training. The project supports teachers/educators working with students/learners showing poor educational results in theoretical subjects (e.g., mathematics, biology, geography, history, language, communication etc.).

To optimize the exchange of expertise and experiences, the partners have planned three short-term joint staff training activities and one student learning event, which

will provide teachers/educators and students/learners with practical experience in makerspaces and fab labs. Each activity is hosted by a project partner and is organized in collaboration with a local makerspace/fab lab, either on or off the partner's premises. Makers will hold training sessions during part of the event, whereas the rest of the day will be used to develop innovative educational resources and define changes in teaching practices related to these resources.

The activities are thematically interrelated to create a coherent path of innovation in teaching practices, and provide an opportunity to develop educational resources that will be published in an interactive e-book. The planned activities are:

1. "FabLab/Makerspace 101—modelling of teaching artefacts" held at Fablab Bergamo (IT);
2. "How to create teaching artefacts by using rapid prototyping tools and machines" held at MakerConvent in Barcelona (ES);
3. "Turning the FabLab and Makerspace into the new classroom" held at Tallinn Polytechnic Institute (EE) and the first student learning activity.

However, these transnational training/learning activities are not an end in themselves. They are the starting point for building a fruitful and durable network of educational institutions and makerspaces/fab labs at local and European level. Indeed, in just a few years, rapid prototyping technology will be affordable for most schools, and vocational education and training (VET) centers and institutions [7]. By implementing the project activities, collaborating with the associated partners (fab labs/makerspaces or educational institutions) and using the project results, the consortium's goal is to plan ahead proactively and to acquire the elements, information, expertise and tools to exploit this technology and promote change in traditional teaching practices and spaces.

3 Objectives

Even though rapid prototyping technology is becoming more and more popular, educational institutions are still in the early stage of adopting it, and teachers and educators need training to use it. "MakIN Teach" aims to foster innovation in teaching practices by training teachers/educators (from VET centers and general schools) to use and adapt rapid prototyping techniques and tools to develop learner-centered approaches, problem-solving learning, participative learning and learning-by-doing.

For this, the project "MakIN Teach" has the following operational objectives:

- to gather best practices and develop a set of modern teaching insights for publication in an interactive e-book containing tutorial video-clips, pictures, texts, exercises, artifact designs and information about rapid prototyping machines and tools, with a view to innovating the educational system and integrating fab labs/makerspaces into traditional teaching practices;

- to provide elements, information and expertise for re-evaluating current and traditional educational environments, especially classrooms used for general subjects, and adapting them into a more engaging, unstructured, laboratory-style, less static setting;
- to open up classrooms by building networks between educational institutions and fab labs/makerspaces at European and local level.

4 Expected Results and Impact

Organizations, teachers, educators and makers working with students/learners who underachieve in predominantly theoretical subjects (mathematics, biology, geography, history, language, communication etc.) will be involved with the aim of improving their teaching practices. The training and learning activities and the interactive e-book developed by the participants and the staff of the partner organizations will have an impact on the teaching practices, tools and spaces of the project's target groups, that is:

- education and VET providers;
- education and training professionals, particularly teachers, trainers, guidance counselors;
- experts, specialists, and professionals involved in the maker movement and fab labs;
- associations of schools/VET centers.

A positive impact is predicted for the final beneficiaries, who are learners with poor school results in predominantly theoretical subjects, and early school leavers. First, they will benefit from being involved in an inspiring, transnational experience. They will also get the indirect benefit of the training their teachers/educators will receive, which should result in improved, more experiential methods. Lastly, they will benefit from new teaching material (the interactive e-book and its parts) validated in a European context, as well as having access to the network of education/training institutions and fab labs/makerspaces (locally and transnationally) created during the project. These innovations will help them strengthen their competences and employability. The long-term social impact will be greater opportunities for social inclusion.

From a European perspective, the project will enable education/training providers in other countries to benefit from its results and materials, which include open educational resources and deliverables licensed Creative Commons 3.0. Finally, the networks built during the project will be able to implement new materials, offer new services (e.g., seminars, CPD courses etc.) and reach new users. In professional terms, the project will provide important continuing education and professional development opportunities for teachers/educators.

At least 35 teachers and educators and at least 12 students/learners will take part in the transnational training/learning activities. Local team activities will involve at least 100 teachers and educators and at least 90 students/learners with poor school results.

5 Monitoring and Evaluation

The target groups and activities we have discussed will be involved in a multi-level assessment process, in which the training/learning activities are evaluated according to the following criteria (Kirkpatrick Model):

- **Reaction:** on the last day of each training/learning activity, the participants complete a satisfaction questionnaire;
- **Learning:** after each training/learning activity, the participants attend a co-evaluation of the acquired knowledge and skills;
- **Behavior:** the coordinators perform a pre- and post-event evaluation of the participants' behavior;
- **Results:** the coordinators check the teachers/educators' ability to use the fab lab/makerspace tools and spaces in their teaching practices.

At the same time, the educational resources and the interactive e-book features will be evaluated according to these criteria:

- **Functionality:** the quality of being suited to serve a purpose and meet stated or implied needs.
- **Usability:** a set of attributes that have a bearing on the effort needed for use (learnability, operability, attractiveness, satisfaction).
- **Efficiency:** the relationship between the tool's performance when it is used and the amount of time and other resources needed to use it.
- **Portability:** the ability of the tool to be adopted in different learning environments or with users with different needs/capabilities.

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