DO IT

DOIT-Europe.Net

Entrepreneurial skills
for young social innovators
in an open digital world

DELIVERABLE 6.4
DOIT POLICY RECOMMENDATIONS

"DOIT – Entrepreneurial skills for young social innovators in an open digital world"
A HORIZON 2020 INNOVATION ACTION

Consortium: Salzburg Research Forschungsgesellschaft m.b.H. (AT, co-ordinator), Capital of Children (DK), eduCentrum (BE), European Social Entrepreneurship and Innovative Studies Institute (LT), Institut d'Arquitectura Avançada de Catalunya (ES), ZAVOD Kersnikova (SI), Lappeenranta University of Technology (FI), Mediale Pfade - Verein für Medienbildung (DE), Polyhedra – Designed to Create (RS), Stichting Waag Society (NL), University College Syd Denmark (DK), University of Zagreb, Faculty of Architecture (HR), YouthProAktiv (BE), Zentrum für Soziale Innovation (AT).

Webpage: http://DOIT-Europe.net
Duration: 10/2017-09/2020
Grant: H2020-770063 (Call H2020-SC6-CO-CREATION-2017)

Contact (coordinator):
Dr. Veronika Hornung-Prähauser, MAS
Salzburg Research Forschungsgesellschaft m.b.H.
e-mail: info@DOIT-Europe.net

Description of the Deliverable

Overview	Details
Authors	Max Kortlander, Stichting Waag Society, NL Pam de Sterke, Stichting Waag Society, NL Karien Vermeulen, Stichting Waag Society, NL Frank Vloet, Stichting Waag Society, NL
Reviewers	Guntram Geser, Salzburg Research, AT Margit Hofer, Zentrum für Soziale Innovation, AT Karina Svendsen, Syddansk Universitet, DK
Number of Deliverable	6.4
Title of Deliverable	DOIT Policy Recommendations
License	CC BY 4.0, see https://creativecommons.org/licenses/by/4.0/
Attribution	CC BY 4.0 DOIT, http://DOIT-Europe.net, H2020-770063
Dissemination Level	Public
Contractual delivery date	2020-03-30, moved to 2020-08-31
Actual delivery date	2020-08-31
To be cited as	Kortlander, Max; de Sterke, Pam; Vermeulen, Karien; Vloet, Frank (2020). DOIT Policy Recommendations, deliverable (6.4) of the Horizon 2020 project DOIT, EC grant agreement no 770063. Amsterdam: Stichting Waag Society.

Summary

This deliverable presents the final set of the DOIT policy recommendations. It builds on *Policy Briefing 3* (D6.8) and spells out in greater detail the implications regarding policy measures that should be taken to enable young learners to turn creative ideas into innovations that make our society more liveable and sustainable. The document first explains the research-based development of the policy recommendations. The main part presents the set of recommendations and their implications. In addition, a section provides directions for further research and development. The final conclusions summarise the measures required to enable educators and schools to facilitate the development of social innovation and the entrepreneurial skills of young learners.

Table of contents

List of abbreviations and terms

CC BY	Creative Commons Attribution license
MOOC	Massive Open Online Course
OER	Open Educational Resources
STEM	Science, Technology, Engineering, and Mathematics
STEAM	Science, Technology, Engineering, Arts, and Mathematics

1. Introduction

1.1 About DOIT

The DOIT project, a Horizon 2020 Innovation Action, recognises that fostering entrepreneurial mindsets, attitudes and skills in young people for innovative ventures should begin early in creative and collaborative settings. The project designed and trialled a practice-based approach for developing the digital, social and entrepreneurial competences of young people (6–16 years old) in makerspaces.

DOIT mobilised makerspaces (within schools and extracurricular programmes) to empower primary and secondary school pupils, as well as teachers and other facilitators, to develop innovative solutions for social and environmental issues. Such issues, perceived in the local context, encouraged young people in maker activities to acquire and apply creative and entrepreneurial competences.

1.2 DOIT research and development of policy recommendations

1.2.1 DOIT pilot actions

DOIT pilot actions are a series of workshops and other activities in which children learn, usually in small teams, through hands-on activities in makerspaces. The actions have been implemented in 11 regional pilots in 10 European countries (Austria, Belgium, Croatia, Denmark, Finland, Germany, the Netherlands, Serbia, Slovenia, Spain). They followed the DOIT learning programme for young people (6–16 years old) from the identification of local social and environmental issues to the public presentation of innovative solutions.

Actions took place in public maker spaces, schools, youth centres and other locations temporarily equipped with a makerspace. A variety of digital tools and physical materials was used for designing and prototyping innovative solutions. More than 1,000 young people participated in the activities, including primary and secondary school pupils from urban and rural areas, those with different social backgrounds, and those with a disability.

1.2.2 Evaluation

The results of the DOIT pilots were evaluated by analysing the effect of the application of the DOIT approach and learning programme regarding the development of attitudes and skills relevant for entrepreneurial and innovation activity among participants. The evaluation was based on qualitative and quantitative social science methods. These included: observation reports on learning dynamics and outcomes (e.g. innovative prototypes), interviews with students and facilitators, pre- and post-pilot creativity tests, and questionnaires (filled out by the students) on entrepreneurial attitudes and intentions.

The analysed results confirmed that the DOIT approach and learning programme, tried and tested in the pilot actions, yield positive results regarding attitudes and skills relevant for entrepreneurial and innovation activity. The results showed an increase in creativity and entrepreneurial attitudes such as self-efficacy. In the interviews, good results regarding soft skills (such as communication and collaboration in teamwork) were highlighted next to the creative maker skills. Teachers were impressed by the high motivation of the students. They observed that such actions are highly compatible with students' interests and promote their learning activities.

Discussions with experts in related fields of research and practice helped to validate the project insights and informed the development of the final set of policy recommendations. Expert meetings took place, for example, at the FAB15 global

conference of the FabLab Network (July 2019), the DOIT expert roundtable in Berlin (September 2019), and the Supporting Key Competences Development Conference in Brussels (November 2019).

1.2.3 Review of policies and research literature

The design of the DOIT pilot actions, interpretation of results, and final recommendations have been informed by a review of European policies on innovation in educational practices to promote digital and entrepreneurial skills as well as the research literature in related fields (e.g. entrepreneurship education, social innovation, maker tools and practices, learning in makerspaces). Important references are included below in the section Research Parameters.

1.2.4 Consolidated recommendations

Earlier recommendations by the DOIT consortium can be found in D6.6 Policy Briefings 1 and D6.7 Policy Briefings 2. These were delivered by the end of the first and second year of the project, respectively. The recommendations in Policy Briefings 1 built on the identified state-of-the-art practices in entrepreneurial education. Policy Briefings 2 derives from the additional results of the interim evaluation of the DOIT pilots, based on data collected in phase 1 of the two pilot phases. The recommendations detailed further in this document, regarding their empirical basis and implications, are from D6.8 Policy Briefings 3, which presents a synthesis of the previous briefings and final results of the project.

2. Research parameters and reference research and policy

The core aim of DOIT is to help young people develop innovation and entrepreneurial mindsets, attitudes, skills, and hands-on practices. To this end, DOIT researchers and practitioners:

- **Reviewed the research literature** in related fields, such as entrepreneurship education, social innovation, and maker practices while learning in makerspaces as a basis for the research design and interpretation of the results (selected reference literature is included below).

- **Designed a learning approach and programme** that uses makerspaces for early stage innovation and entrepreneurial education of primary and secondary school students (6 to 16 years old).

- **Implemented pilots** which trialled the learning approach and programme:
  - ○ in 10 European countries – Austria, Belgium, Croatia, Denmark, Finland, Germany, the Netherlands, Serbia, Slovenia, Spain;
  - ○ in which over 1,000 young people (6–16 years old) participated, including those with disabilities, those from urban and rural areas, and those from different social backgrounds,;
  - ○ in different settings, including public maker spaces or schools, youth centres, and other locations temporarily equipped with a makerspace;
  - ○ and used a variety of digital tools and physical materials for designing and prototyping innovative solutions.

- **Evaluated the effect of the pilots**: The consortium agreed on an empirical and evaluative framework, pilot partners collected data and the Austrian partner Zentrum für Soziale Innovation analysed the outcomes. Our main research question was: Does the application of the DOIT approach and learning programme generate positive effects in attitudes and skills relevant for entrepreneurial and innovation activity? The research to answer this question was conducted using:
  - ○ Quantitative methods: pre- and post-pilot creativity tests and questionnaires on entrepreneurial attitudes and intentions; statistical analysis of the data.
  - ○ Qualitative methods: observation reports by pilot facilitators, interviews with participants (facilitators/teachers, young learners); content analysis of reports and interview protocols.
  - ○ Workshops with external experts in related fields of research and practice to validate research insights and derived recommendations.

- **Reviewed European policies** on innovation in educational practices to promote digital and entrepreneurial skills in order to take account of these policies and ensure the relevance of the related DOIT recommendations.

Reference research reports (selected)

- Eurydice (2016). Entrepreneurship Education at School in Europe. Education, Audiovisual and Culture Executive Agency, Brussels.
- Joint Research Centre, Vuorikari R., et al. (2019). Maker Spaces for Training and Education. Luxembourg: Publications Office of the European Union.

- Lackéus, M. (2015). Entrepreneurship in Education. What, Why, When, How. Paris: OECD/LEED Division.
- OECD & European Union (2019). The Missing Entrepreneurs 2019: Policies for Inclusive Entrepreneurship. Paris: OECD Publishing.

Reference policy documents

- Council of the European Union (2018). Council Recommendation of 22 May 2018 on key competences for lifelong learning. Official Journal of the European Union, C 189/01 (pp. 1-13), 4.6.2018.
- European Commission (2012). Communication: Rethinking Education. Investing in skills for better socio-economic outcomes. COM/2012/0669 final, Brussels, 20.11.2012.
- European Commission (2013). Communication: Opening up Education: Innovative teaching and learning for all through new Technologies and Open Educational Resources. COM/2013/0654 final, 25.9.2013.
- European Commission (2018). Communication: Digital Education Action Plan. COM(2018)22 final, Brussels, 17.1.2018.
- Joint Report of the Council and the Commission (2015) on the implementation of the strategic framework for European cooperation in education and training (ET 2020). New priorities for European cooperation in education and training (2015/C 417/04). Official Journal of the European Union, C 417/25-35, 15.12.2015.

3. Policy recommendations

The DOIT policy recommendations are structured in three groups under the following core recommendations:

1. Every young learner in Europe should have practice-based entrepreneurial learning experiences.
2. Schools should be supported to establish innovative learning ecosystems aimed at creative social innovation.
3. Teachers should be trained in maker education, entrepreneurial competences and social innovation.

3.1 Every young learner in Europe should have practice-based entrepreneurial learning experiences.

Practice-based entrepreneurial learning experiences like DOIT should be offered to every young learner in Europe. Europe needs more young people with entrepreneurial competences who are able to turn creative ideas into innovations that make our society more liveable and sustainable. The four recommendations below are concrete actions policymakers can take to make this possible.

3.1.1 Promote that maker education learning activities, with a focus on social and entrepreneurial mindsets and skills, become part of curricula in primary and secondary schools in Europe.

DOIT learning activities and creative spaces allow intrinsically motivated project-based learning, experimentation, trial and error, and cross-curricular and interdisciplinary collaboration. DOIT applies a maker education approach and addresses social and environmental issues, which young people encounter in their local environment and want to act upon. The DOIT evaluation has shown that these activities enable effective entrepreneurial learning experiences. It is important to promote maker education with a focus on social and entrepreneurial mindsets and skills. And, since developing an entrepreneurial mindset and skills requires regular training, it is important that these learning activities are structurally embedded in curricula.

3.1.2 Fund cross-curricular learning activities that allow for experimentation, trial and error, and collaborative learning by making.

As the evaluation of DOIT pilots has shown, maker activities foster creativity and self-efficacy and will, in the long run, support the development of social and entrepreneurial skills.

A cross-curricular approach which bridges technical, creative and social disciplines is needed for entrepreneurial learning. For example, using a STEAM approach (Science, Technology, Engineering, Arts and Mathematics) rather than just STEM (Science, Technology, Engineering and Mathematics) might allow for a more effective approach, providing more creative tools and attracting a diverse range of pupils.

Entrepreneurial programmes should allow room for experimentation, trial and error, collaborative learning, and learning by making. These provide valuable learning opportunities because students are challenged to analyse problems, take ownership of their individual learning process and, with support of the facilitator, grow their confidence. Room for experimentation, as well as trial and error in learning experiences, can be generated by changing the learning environment to help students to get out of the traditional school mindset. This can be established in schools by setting up a dedicated maker space, or the transformation of a traditional classroom by rearranging furniture for collaboration and having tools and materials for maker activities at hand.

3.1.3 Establish learning environments that promote active citizenship in order to foster creativity, self-efficacy and self-conception.

Maker spaces allow an approach of working with learners that fosters active citizenship and attitudes (such as self-efficacy and the awareness that one is part of a community) in the participants. Addressing social and environmental issues, which young people encounter in their local environment and want to act upon, will increase motivation and strengthen learning outcomes. This approach makes children aware of local issues and eager to develop creative solutions for the community. Promoting the spirit of the maker community (i.e. to reuse and up-cycle materials) also creates awareness around sustainable consumer habits and the need to avoid producing waste.

Maker activities develop their full potential through teamwork on both sides, children as well as facilitators. Maker education also benefits a lot from partnerships with external partners by bringing in expertise, knowledge and tools. Moreover, constructive feedback from practitioners such as designers, developers and entrepreneurs can inspire pupils and strengthen their motivation to create innovative solutions.

Pupils who collaborate on maker projects in teams acquire interpersonal skills that are highly relevant for future workers or entrepreneurs. Maker activities that are embedded in an autonomous working environment foster communication, empathy, creativity and problem solving. Students with disabilities or challenged students in particular might benefit since they can further develop – if sufficient freedom and space is provided – individual abilities and skills. Consequently, we also need to work towards more accessible maker spaces for students with disabilities.

3.1.4 Invest in activities that are accessible and explicitly commit to inclusivity and equity.

Public funding should only go to activities that have a low-threshold entry and explicitly commit to inclusivity and equity to ensure government funded activities are accessible to all children, regardless of gender, cultural background, socio-economic position, ability, or other differences.

Maker education should take the individuality of children into account. Maker activities that enable an adaptation according to children's abilities, pre-knowledge, preferences and social contexts should be fostered and supported. Children with disabilities deserve particular attention as they have various special needs. Such needs pose a challenge but also provide an opportunity for makerspaces regarding both inclusiveness and the development of innovative solutions for special needs (EBSCO 2017). The opportunity for the children to use makerspaces to develop such solutions themselves should be highlighted.

Regarding gender differences, research has shown that girls are more difficult to attract to maker settings where technologies are being used. This must be addressed with gender-sensitive measures in the communication, organisation and conduct of maker education. Such measures, for instance, include placing social questions before technical ones, promoting cooperation instead of competition, and involving female maker role models (Macdonald 2019; Schön et al., 2018 and 2020). Following the available guidance should be required by project funders and monitored.

3.2 Schools should be supported to establish innovative learning ecosystems aimed at creative social innovation.

Education has the potential to be the greatest enabler of preparing everyone for the future. However, However, this is not solely the responsibility of schools, communities also have a collective role to play in equipping young and lifelong learners to create meaningful futures. Innovative entrepreneurial education requires the integral cooperation of different

stakeholders at multiple levels. The following three recommendations highlight what support schools need to establish or become part of innovative learning ecosystems.

3.2.1 Support schools to develop innovation capacity and to cooperate with local makerspaces, entrepreneurs and communities by increasing knowledge and skills for open schooling.

Entrepreneurial education aimed to generate creative solutions to social issues requires innovative learning ecosystems comprising the individual learners and facilitators; schools and other educational organisations; educational and social policy makers; and local stakeholders such as businesses, cultural institutions and youth organisations.

Schools need support (in the form of space, time and resources) to develop innovation capacity and to become an open school where teachers are enabled to facilitate an open, entrepreneurial learning environment as well as an engaging environment for learning in the neighbourhood that makes a vital contribution to the community. In DOIT activities, student projects meet real needs in the community outside school and draw upon local expertise. The DOIT evaluation shows that learning by tackling real world issues speaks to the imagination of pupils and teachers and motivates them to create meaningful solutions for their community and living environment.

3.2.2 Raise awareness of makerspaces as an infrastructure and environment for the practice-based development of digital, social and entrepreneurial skills of young people.

Makerspaces provide an effective learning environment for both inside and outside school learning with a focus on developing social innovation and entrepreneurial skills. DOIT pilots have demonstrated that learning in makerspaces is unique since it combines disciplines, deals with real world problems, is characterised by informal ways of interaction, and is often intrinsically motivated. The practice-based learning fosters the creative use of digital and other tools and materials, of teamwork, and of other social and entrepreneurial competences.

The existing evidence for innovative maker education and learning outcomes has been collated and showcased by DOIT in order to raise awareness of makerspaces as environments for social innovative and entrepreneurial learning. Both external makerspaces and makerspaces within some schools are already being used for innovative projects, and educators are enthusiastic about children's achievements. However, many schools and teachers are still not aware of such learning environments, despite their great potential for effective project-based and problem-solving learning. In order to raise awareness, the topic of makerspaces should have a prominent place on the agenda of educational institutions.

3.2.3 Expand the number of makerspaces in schools and cooperation on educational programmes with external makerspaces.

In schools around Europe, the development of makerspaces is at an early stage. There are pioneering schools in some countries, especially in the Nordic countries, and first pilot projects funded by ministries, municipalities, foundations and others. Some examples are FabLab@school.dk (2014-2017) in Denmark (Bødker et al., 2017), Makerskola (2015-2018) in Sweden (Eriksson et al., 2018), and Maker@Scuola (2014-2018) in Italy (Guasti & Rosa, 2017). These projects trialled maker activities and involved pupils and teachers from 30 up to 100 schools.

Setting up many fixed makerspaces in schools, training teachers, and fulfilling other requirements for embedding maker education in schools will necessitate considerable investments over several years. But hundreds of makerspaces already exist in Europe outside of schools. Many of these makerspaces already have an educational component which could be expanded and turned into regular programmes, an approach that would allow a faster adoption of maker activities by teachers and pupils.

Therefore, DOIT suggests that policy makers and agencies should support setting up more makerspaces in schools to explore and evaluate educational benefits as well as promote collaboration with existing external makerspaces on learning programmes for pupils and teachers. When employing this strategy, one must consider that the growing number of external makerspaces are mainly located in cities, while there is a lack of such creative spaces in rural areas. In such areas, therefore, it is particularly important to set up makerspaces in schools and to collaborate with partners who can provide expertise and tools.

3.3 Teachers need training in maker education, entrepreneurial competences and social innovation.

Facilitating practice-based entrepreneurial learning experiences requires specific skills from the teachers that are not usually covered in initial teacher training. It is important for policymakers who want to promote entrepreneurial education in Europe to recognise that both new and experienced teachers need additional training to build more capacity for entrepreneurial education. The four recommendations below result from the findings of the DOIT teacher training.

3.3.1 Recognise and support the changing role of the teacher and facilitate maker education.

A different mindset, attitude and skill set are required to facilitate maker education and entrepreneurial learning. Entrepreneurial education is 'leading by example'. Teachers need to be able to create a permissive learning environment that stimulates open-ended exploration, leaving room for failures as learning opportunities. In such an environment, experimentation is fostered and things to touch, to tinker and to build with are used in the learning process. This involves embedding maker activities into day-to-day teaching as an integration with (rather than an addition to) the existing curricula.

Building upon Seymour Papert's constructionism theory, DOIT recognises that learning cannot be delivered to the learner. Instead, learning occurs when a new experience connects to the learner's existing knowledge. And an effective way to create new experiences that connect to prior knowledge is to construct sharable things. In DOIT, the role of the facilitators is to *design learning experiences* and *to create the conditions for knowledge construction and invention*, rather than to provide ready-made knowledge. For this reason, one must make the shift from knowledge transfer to knowledge construction, and one must aim for a greater focus on the process, more open-ended learning and more hands-on making. Thus, using more physical materials, objects and new technologies is vital. Designing learning experiences and facilitating open-ended assignments requires training. Currently, teachers do not have the opportunity to be trained for this new educational approach.

Vital to the successful implementation of the DOIT approach is training facilitators and teachers to impart the spirit of making, which is grounded in: thinking outside of the box; losing fear of technology; experimenting and testing; failing and improving; encouraging youths to help each other (peer-to-peer support); prototype development; and entrepreneurship. The facilitator's understanding of their new role is essential. They must be supportive, but not resolve problems that occur in the making activities which pupils can solve themselves.

3.3.2 Fund the development of teacher training formats, peer learning, and social innovation projects with local communities.

DOIT strongly believes that every child deserves the chance to become an inventor. Inevitably, this implies that teachers, being learning inventors themselves, should know or learn how to enable this with effective methods and tools. According

to Sylvia Libow Martinez and Gary S. Stager, authors of *Invent to Learn,* it is impossible to teach 21 century learners if you have not learned in this century yourself (Martinez & Stager, 2013).

Teachers unfamiliar with maker education will need training on how to facilitate learning by making and the creative use of new (digital) technologies. DOIT has developed and trialled different teacher and facilitator models. In line with, for instance, the learner-centred approaches of Constructing Modern Knowledge and Waag's Teacher Maker Camp (see references), some core ingredients of these trainings are: time and space to learn and explore, taking the teacher-hat off and putting the learner-hat on again, a lot of tools and materials, and experienced facilitators.

It is strongly recommended to invest in training on a school or team level since a shared vision and collective pedagogy can promote more effective learning, particularly regarding cross-curricular projects and learning activities.

The sharing of existing and the development of additional transferable and scalable teacher training formats and materials should be encouraged via an online platform and Open Educational Resources (OER). Examples of such formats include the DOIT toolbox, handbooks and MOOCs. The maker spirit of open-source knowledge sharing should be adopted in order to build a shared body of knowledge, rather than reinventing the wheel. This requires active promotion of OER in educational institutions.

4. Reflections on further research and development

Throughout the project, DOIT partners made some observations that raised important questions which could not be fully addressed by the project but provide directions for further research and development. These questions concern pupils, teachers, schools, curriculum development, and assessment of learning outcomes.

The pupils

There is a need to stop the growing digital divide. There is also a need for inclusivity and equity in learning in general and in maker and entrepreneurial education specifically. In DOIT activities, we observed that children from less privileged backgrounds tend to show less self-confidence in their abilities, such as in creative work and in learning potential. To provide equal learning opportunities and truly value different backgrounds and ideas, more research on inclusivity and empowerment strategies for these groups, as well as children with disabilities, is necessary. Regarding gender differences, guidelines for gender-sensitive measures in maker education are already available, including the guidelines from DOIT (Schön et al., 2018 and 2020), and should be followed and monitored.

The teachers

In maker education and other practice-based learning, the role of the teacher changes from knowledge provider to learning facilitator. Furthermore, for learning with a focus on social innovation and entrepreneurial activities, teachers need expertise in such activities. Questions that arise regarding this shift away from traditional forms of teaching include: Does it require a new educational profession? Is there a need to rethink and redesign formal teacher training and professional development? Should schools ideally (be able to) have at least one teacher with expertise in social innovation and entrepreneurship among their staff?

Experiences in DOIT demonstrated that teachers understand the need for change, appreciate the great effects it has for many pupils as well as see a whole new perspective for their professional work. But they also recognise the existing constraints of schools (e.g. the formal curriculum plan) to implement maker activities.

The schools

Schools should become the centre of an innovative learning ecosystem, a learning hub in their local neighbourhood and community that promotes innovation and entrepreneurial activities to address social and environmental issues. A promising route to support this might be dedicated research on 'open schooling' and a 'whole school approach', projects that assist developing learning ecosystems based on cooperation between schools, makerspaces, and other stakeholders of the community.

The curriculum

In traditional curricula, maker education will tend to be squeezed into short-term projects separated from the regular educational programme. The rationale for this unfavourable approach is that, due to the requirements set by the formal curricula, schools cannot afford to do it in a different way. However, maker activities do not necessarily call for additional teaching hours because they can be connected with STEAM learning, which engages pupils through addressing social and environmental issues. Furthermore, cross-curriculum learning is already required in the programmes of many educational systems and maker activities provide an excellent approach for learning across several disciplines. But to gain the full

benefits of maker activities, they should be integrated into school life in ways that provide room for the free exploration of social and environmental issues, teamwork, and creative problem-solving.

Assessment

Within traditional curricula, maker education poses an issue because the outcomes of maker activities can hardly be evaluated with written assignments and oral examinations. Therefore, new approaches to enable assessment such as peer review (Flores, 2014), maker portfolios (explored in Maker Ed's Open Portfolio Project, 2013-2017) and others (Bergner et al., 2019) have been suggested. These approaches need to be trialled and evaluated in practice in order to equip teachers with proven and accepted assessment methods.

5. Conclusion

If we want to develop the social innovation and entrepreneurial skills of young learners in an open digital world, changes in formal education and support of informal learning spaces are necessary. The DOIT recommendations do not imply a radical change, but a shift of focus that opens up space for the integration of new modes of learning and skills development.

The type of learning experiences required for entrepreneurial learning are practice-based and hands-on, enable pupils to relate to social and environmental themes, and allow experimentation and working in teams. Schools should be supported to implement a makerspace or collaborate with external ones because makerspaces as learning environments stimulate innovative and entrepreneurial learning. Teachers in Europe need training in maker education, so that the students in Europe become able to turn creative ideas into innovations that make our society more liveable and sustainable.

We need to:

1. Promote that maker education learning activities, with a focus on social and entrepreneurial mindsets and skills, become part of curricula in primary and secondary schools in Europe.
2. Fund cross-curricular learning activities that allow for experimentation, trial and error and collaborative learning by making.
3. Establish learning environments that promote active citizenship in order to foster creativity, self-efficacy and self-conception.
4. Invest in activities that are accessible and explicitly commit to inclusivity and equity.
5. Support schools to develop innovation capacity and to cooperate with local makerspaces, entrepreneurs and communities by increasing knowledge and skills for open schooling.
6. Raise awareness of makerspaces as an infrastructure and environment for the practice-based development of digital, social and entrepreneurial skills in young people.
7. Expand the number of makerspaces in schools and cooperation on educational programmes with external makerspaces.
8. Recognise and support the changing role of the teacher and facilitate maker education.
9. Fund the development of teacher training formats, peer learning, and social innovation projects with local communities.

6. References

Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G. (2016). EntreComp: The Entrepreneurship Competence Framework. Luxembourg: Publication Office of the European Union, http://doi.org/10.2791/593884

Bergner Y., Abramovich S., Worsley M., & Chen O. (2019). What are the learning and assessment objectives in educational Fab Labs and Makerspaces? In: Proceedings of FabLearn 2019, 42–49, https://doi.org/10.1145/3311890.3311896

Bødker, S., Dindler, C., & Iversen, O. S. (2017). Tying the knots: Participatory infrastructuring at work. In: Computer Supported Cooperative Work, 26(1-2), 245-273; https://www.researchgate.net/publication/313728502

Constructing Modern Knowledge, http://cmkpress.com

Council of the European Union (2018). Council Recommendation of 22 May 2018 on key competences for lifelong learning. Official Journal of the European Union, C 189/01, 4.6.2018, pp. 1-13.

EBSCO (2017): Makerspaces: Hands-on Learning for Students of All Abilities. EBSCOpost, Library Resources, 30 August 2017, https://www.ebsco.com/blog/article/makerspaces-hands-on-learning-for-students-of-all-abilities

Eriksson, E. et al. (2018). Makerspace in school - considerations from a large-scale national testbed. In: International Journal of Child-Computer Interaction, 16, 9-15.

European Commission (2012). Communication: Rethinking Education. Investing in skills for better socio-economic outcomes. COM/2012/0669 final, Brussels, 20.11.2012.

European Commission (2013). Communication: Opening up Education: Innovative teaching and learning for all through new Technologies and Open Educational Resources. COM/2013/0654 final, 25.9.2013.

European Commission (2018). Communication: Digital Education Action Plan. COM(2018)22 final, Brussels, 17.1.2018.

Eurydice (2016). Entrepreneurship Education at School in Europe. Education, Audiovisual and Culture Executive Agency, Brussels, http://doi.org/10.2797/301610

Flores, C. (2014). The Role of Peer Assessment in a Maker Classroom. In: FabLearnFellows weblog, 28 April 2014, http://fablearn.stanford.edu/fellows/blog/role-peer-assessment-maker-classroom

Guasti, L. & Rosa, A. (2017). Maker@scuola - Stampanti 3D nella scuola dell'infanzia [Maker@scuola - 3D printers in the nursery school]. Assopil Editore Firenze, http://www.indire.it/wp-content/uploads/2017/09/Libro-Maker-a-Scuola_2017.pdf

Joint Report of the Council and the Commission (2015) on the implementation of the strategic framework for European cooperation in education and training (ET 2020). New priorities for European cooperation in education and training (2015/C 417/04). Official Journal of the European Union, C 417/25-35, 15.12.2015.

Joint Research Centre, Vuorikari R., et al. (2019). Maker Spaces for Training and Education. Luxembourg: Publications Office of the European Union, http://dx.doi.org/10.2760/946996

Lackéus, M. (2015). Entrepreneurship in Education. What, Why, When, How. Paris: OECD, LEED Division, https://www.oecd.org/cfe/leed/BGP_Entrepreneurship-in-Education.pdf

Martinez, S. Libow & Stager, G.S. (2013). Invent To Learn: Making, Tinkering, and Engineering in the Classroom. Constructing Modern Knowledge Press

Macdonald, A. (2019). A gender-balanced approach. Hints & tips for organisers of Fab Labs. Phablabs 4.0, https://www.steinbeis-europa.de/files/gender_booklet_reduced.pdf

Maker Ed: Open Portfolio Project, 2013-2017, https://makered.org/opp/publications/

OECD & European Union (2019). The Missing Entrepreneurs 2019: Policies for Inclusive Entrepreneurship. Paris: OECD Publishing, https://doi.org/10.1787/3ed84801-en

Schön S., Rosenova M., Ebner M. & Grandl M. (2018). How to support girls' participation at projects in makerspace settings. Poster presented at Edurobotics 2018, Rome, https://www.researchgate.net/publication/328175572

Schön S., Rosenova M., Ebner M. & Grandl M. (2020). How to support girls' participation at projects in makerspace settings. Overview on current recommendations, pp. 193-196, in: Moro M., Alimisis D. & Iocchi L. (eds.), Educational Robotics in the Context of the Maker Movement. Edurobotics 2018. Cham: Springer (AISC 946); https://www.researchgate.net/publication/338164755

Waag (2018): What is a teacher maker camp?, https://waag.org/en/article/what-teacher-maker-camp