Social Innovation Training in Makerspaces with the new DOIT approach

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Abstract: Information and communication technologies, digital design and fabrication technologies are valued as driver for developing social innovations. This contribution addresses the question of how to stimulate social innovation skills in makerspace settings. The European H2020 project "DOIT-Entrepreneurial skills for young social innovators in an open digital world" investigates the yet "closed box" of how to coach a young person in his/her social innovation learning journey. The consortium is jointly developing the pedagogical concept, co-creation methods and specific training material for a programme that enables young learners and their facilitators to develop social innovation ideas, product- or service-prototypes or new social practises and projects in makerspace settings. The DOIT programme will be trialled and scientifically evaluated by more than 1000 learners in 12 European countries (2017-2020). The contribution describes the theoretical background; the conceptual elements of the DOIT programme and discusses open issues. We invite to join the DOIT network. Information: www.doit-europe.net.

Keywords: digital social innovation; social innovation process, makerspace; open innovation spaces for exploring technology, social construction of technology, maker pedagogy, constructionist learning, entrepreneurial self-efficacy, DIY artifacts;

1. Introduction

Social innovation is a powerful means to meet the social, economic, political and environmental challenges of the 21st century. Information and communication technologies (ICTS), digital design and fabrication technologies are valued as drivers for the generation of social innovations. This potential i recognized not only within the framework of the Europe 2020 strategy, but also worldwide (Misuraca et al. 2017; Howalt & Hochgerner 2017, p. 8). This goes hand in hand with the demand for a novel social entrepreneurship education, defined by the European Commission's Thematic Working Group on Entrepreneurship Education (2014) as education, which is "about learners developing the skills and mind-set to be able to turn creative ideas into entrepreneurial action." (p.8). While social innovation and early entrepreneurial education are regarded as crucial for overcoming social problems and generating social business and growth in Europe, there is a lack of scientifically grounded training concepts and methods in this field for young learners. The recent Eurydice study on entrepreneurship education at school in Europe (2017) reports that in "almost half of the European education systems, teacher training institutions have the autonomy to decide whether to include entrepreneurship education in their programmes, and if they decide to do so, they are free to determine how it should be delivered. Furthermore, the integration of entrepreneurship education into initial teacher training curricula is not subject to regulation in over one-third of the countries/regions". In other words, "more than half of the examined countries have very few and almost no teaching guidelines for entrepreneurship education. If there is one, they are more usually used at general upper secondary level and in school-based IVET than at lower levels of education" (European Commission/EACEA/Eurydice, 2017, p. 93-94; p. 14).

The current European political agenda for social innovation and digital transformation as driver for innovation offers the opportunity to develop and implement new strategies for a new European approach to early education for social innovation and entrepreneurship. This is a challenge that the European H2020 project "DOIT-Entrepreneurial skills for young social innovators in an open digital world" (www.doit-europe.net), coordinated by Salzburg Research, application-oriented research, innovation & technology organisation (RTO) in Austria, aims at. In a three years research and innovation action project, it investigates the yet "closed box" of how to train and coach a young person along his/her social innovation learning journey. The consortium, consisting of experts in social innovation, entrepreneurship education and practitioners in makerspaces and Fablabs from 10 countries (AT, BE, DE, DK, ES, FI, HR, NL, RS and SI) jointly designs the pedagogical DOIT approach in the first project year (2017-2018). It then tests different co-creation methods and develops specific training modules and materials for a programme that enables young learners and their facilitators to develop social innovation ideas, product or service prototypes or new social practices and projects in makerspaces. The DOIT programme and activities will be trialled and scientifically evaluated with more than 1,000 learners in 10 European countries (2018-2020).

This contribution addresses the question of *how to stimulate social innovation competences and skills in makerspace settings:* Firstly, we will describe the most relevant theoretical background backing the design of the DOIT approach. Secondly, we will present the conceptual framework, describe the different elements of the DOIT programme and discusses open issues. Thirdly, we will describe the planned steps and

introduce the European DOIT network. The project seeks partners interested in the project activities, such as the forthcoming European DOIT facilitator online course for social innovation by making and/ or on adapting and localising DOIT training material, produced with the Creative Commons License CC BY 4.0.

2. Theoretical background to the DOIT approach

Intensive literature review and discussions with stakeholders in this field made apparent that the key-issue with generating *digital social innovation* by young learner is to stimulate different intertwined competences and skills. Based on works from representatives from social innovation research, entrepreneurship education and business and innovation management consultancy we propose the following set of competences and skills, which are supportive while working on a social innovation project (see as representatives e.g. Lackéus 2015; NESTA 2017; Quinney 2015):

- Strong awareness and sensitivity about pressing needs from "users" being affected from social problems, paired with the belief of being able to do something about these (social/ societal awareness and entrepreneurial self-efficacy);

- The technical knowhow for exploring the functional innovation potential of digital design and fabrication technologies enabling new social products, services and/or collaborative practises (technological skills);

- Creativity and use of innovation development methods for fast ideation, testing, iterating and refining prototypes, and/or minimal viable products or services for social good and learning by doing (Design Thinking competences); and

- The ability to collaborate and form relationships and networks (scaling up an innovation project).

In the following, we discuss the theoretical considerations from different schools of thought and how they influence the fundamentals of the proposed DOIT approach.

2.1 Characteristics of social innovation and its specific management process

While the existing literature has clarified the differences between social and traditional innovations it is still unclear *what demand arise thereof for a truly social innovation education approach?* The Joint Research Center-led research team of the extensive European study on "ICT-enabled social innovation" discusses the difficulty in scientific discourse to differentiate between social, technological and organisational innovations and highlights the different boundaries and discussions in literature in depth (Misuraca et al., 2017, p. 33; Joint Research Center (edt.): ICT-Enabled Social Innovation: Evidence & Prospective). However, they point out that there is a joint understanding in the European Union to consider social innovation as: "new ideas, products, services *and models developed and implemented to meet social needs and create new social relationships or collaborations. In other words, social innovations are both good for society and enhance society's capacity to act"* (Murray et al., 2010; cited

in Misuraca et al., 2017, p. 33). Thereby they stress that this understanding of social innovation addresses "*the object, the aim and the process of social innovation, highlighting its social nature in*

- *1)implementing new ideas, services, production and organisational models to meet social needs,*

- *2) creating new social relationships as the objective of these factors and*

- *3) responding to social demand." (p. 33).*

In view of the "digital" dimension of social innovation, it is proposed to enlarge this definition by the role ICTs and digital technology play in this process. ICT-enabled or digital social innovation is thus considered as:

"*A new configuration or combination of social practices providing new or better answers to social protection system challenges and needs of individuals throughout their lives, which emerges from the innovative use of Information and Communication Technologies (ICTs) to establish new relationships or strengthen collaborations among stakeholders and foster open processes of co-creation and/or re-allocation of public value.*" (Misuraca et al., 2017, p. 21).

The table below summarises the different elements and conceptions of social innovations, whereas the "functionalist approach/weak social innovation" relates to the idea that "social innovation is an answer to social problems. Social innovation creates social services that meet demands to which neither the State nor the market has responded". This notion of social innovation seem to fit with the aim of enabling young persons to develop solutions really needed and work in open, collaborative processes for social good.

Table 1: Social innovation concept and elements. Source: Misuraca et al. 2017, p. 39f)

Conceptions of social innovation	Elements of social innovation
Functionalist/ weak social innovation	Need-driven/ outcome-oriented production
	Open process of co-creation/ collaborative innovation networks
Transformationalist/ Strong social innovation	Fundamental change in the relationships between stakeholders
	Public value allocation and/ or re-allocation

The "transformationalist approach/strong social innovation" mentioned in the table addresses the notion that "social innovation is a way of transforming institutions, contributing to institutionalising new practises, standards and rules founded on values inherent to solidarity and intended to work towards social and political transformation. Social innovation education for young persons are hardly apt to work towards transforming institutions or standards in the social sector. However, it is thinkable to aim at changing public decisions or stakeholder relations, such as by giving children their on saying and resources for action e.g. on how to design new city services for children in need.

What does a new educational programme for social innovation require with regard to the specific management process of social innovation? In innovation management research the common understanding is that the development of a new solution is best started in the form of a "project". An innovation project follows specific steps, which usually start with the identification of a problem or theme that should be improved in a yet not known way. Six phases are regarded as important for developing a new social service or practise (Murray et al., 2010, p. 11-13).

These six stages are the following (p. 11ff): 1. Prompts, inspirations and diagnoses: True roots of a social problem are observed and clarified; 2. Proposals and ideas: Ideas are generated; 3. Prototyping and pilots: Ideas are tested in practice; 4. Sustaining: Idea becomes everyday practice; 5. Scaling and diffusion: Strategies support growing and spreading an innovation; and 6. Systemic change: Systematic change as ultimate goal of social innovation.

Compared with innovation management in other fields, the stage one ("*Prompts*") is very important in the field of social innovation. Its key objective is to understand the pressing needs of a person being affected from a societal or social problem. The innovation team should be formed in such a way that it can directly experience or observe the problem of the user. Therefore, with young learners it is best to work on problems to be observed in the neighbourhood or family and friends. This allows deep personal diving into the problem and increases the probability of generating practical ideas being ultimately accepted by the user and leading to change a social practice.

Conversely, the stage six ("*Systemic change*") is not necessarily important in business innovation management for becoming successful on a distinctive market. Systemic change would imply a change on a structural level, usually it is associated with initiating "social movements, business models, laws and regulations, data and infrastructures, and entirely new ways of thinking and doing" (Murray et al, 2010, p. 13). Although it is difficult even for a social innovation project to lead to a systemic change, findings from above make clear, that the distinct characteristics and management cycle of social innovation serve well as framework for a social innovation training.

As will be seen later on in the section about the elements of the DOIT programme, we have taken respect of the specific characteristics of social innovation and its management process.

2.2 Makerspaces and making pedagogy facilitating social innovation characteristics

Going back in history, innovation literature shows that "interventions for social development work best and endure longest when they build upon processes of citizen participation, open deliberation and sensitive community development" (Smith, 2017, p. 2). Nowadays, makerspaces[1] offer these democratic participation and cooperation

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[1] A makerspace is a physical location with is used as workshop with a variety of tools, including digital tools such as 3D printer or laser cutter, where people work on projects, network, and build. (EU project DOIT Deliverable 2.1)

possibilities and the chance to learn digital design, building personal artifacts and even use digital fabrication at very low entry barriers. They offer collaborative places for innovative forms of production and digital do-it-yourself work. They come in all shapes and sizes and can be found in many places throughout Europe.

Moreover, a makerspace offers the opportunity to get acquainted with other people working on similar projects or providing simply support (also, online via a strong external educational self-learning offer, e.g. the FabAcademy). For the purpose of social innovation education makerspaces can be regarded as physical open exploration rooms for innovation by means of technology and cooperation and support the elements needed for a successful social innovation process.

In pedagogical terms, the *makerspace learning setting* is methodological an open learning approach based on open accessible workshops, integrating peer tutoring and peer learning, where participating adults are involved as tutors and not teachers. Making as a *constructionist activit*y is a theoretically and historically founded principle for successful learning, coined as *"learning by making (doing)"* (Papert & Harel, 1991). It helps young and old experiment with innovation, develop an open mind, be creative, compute, and problem-solve, while considering the impact of their creations on society, ecology, and the environment. Construction as part of making can lead to various products and other concrete results, both tangible (machines, tools, 3D-printed parts, etc.) and digital (stop motion, apps, games, etc.). Compared to typical learning outcomes for students (e.g. rankings and grades), this can be a valuable experience that can be particularly important, but not only for underachievers. The greatest sense of achievement may come if making helps to solve problems in the real world and/or when teachers and parents are surprised by students' ideas, solutions and constructions. However, failure is also an inherent aspect of learning by doing and constructionism.

Maker education is a learning and teaching approach where a concrete or virtual product developed, constructed and/or done by oneself or in collaboration with others using not always, but eventually also, digital tools provided in a makerspace (Schön, Ebner & Kumar, 2014). Contrary to many STEM (Science, Technology, Engineering and Mathematics) activities, maker education is an open educational approach, including arts or social science (e.g. ethics, legal rights, participation), which fosters and allows creativity and the development of own solutions. Digital devices and the Internet as optional tools, not a requirement for social innovation Making is "(digital) do-it-yourself" (DIY). Making is an inspiring and creative way to use modern technologies and communication tools to support innovation with a potential business impact (Anderson, 2012). The Maker Movement fosters the creation development of new things (tangible or digital, often with an emphasis on Internet of Things), using new tools such as 3D printers in open spaces, workshops or labs (Anderson, 2012). DOIT's partners are active participants in the maker movement, with a strong connection with digital fabrication, and all skills that are involved in that.

Benefits from co-creation and open innovation in makerspaces through co-creation of adults and children, and all materials and technology developed for the project will result from some forms of co-creation. Co-creation is one of the many terms used for a bottom-up, well-informed and iterative design process, where the end users and/or other stakeholders have a significant say in the development of products, methods or programmes. Co-creation can be linked to other well-known design terms like

participatory design, design thinking and co-design. In short, *co-creation is an open conversation through making.*

Summing up, the forthcoming *DOIT programme will focus on makerspace settings as an open environment with space, methods, tools and people stimulating creativity, innovation and entrepreneurship as well as intergenerational and interdisciplinary work.* We will focus on digital social innovation as this garners significant interest from children, and will lead to better support from educators and the public. A makerspace learning setting will typically (though not exclusively) focus on digital fabrication, where children are allowed to choose tools as well as other resources. Adults are tutors; children will co-design with peers as well as enjoy intergenerational and interdisciplinary work.

2.3 Target-group oriented entrepreneurial attitudes, skills and behaviour for young learners

The literature about early entrepreneurship shows a wide variety of approaches on how to motivate and train (future) entrepreneurial skills. Nevertheless, there is a lack of valid models of what skills children should develop in order to learn to think entrepreneurially and be active in the future. A very helpful overview was given by Lackéus (2015) to distinguish the goals of the current early entrepreneurship education:

One strand of early entrepreneurship literature, especially from the USA, focuses on the possibility to be the next youngest millionaire. To illustrate this area of early entrepreneurship education we just list some of the titles of such books: "The Lemonade Stand Millionaire: A Parents' Guide to Encouraging the Entrepreneurial Spirit in Your Kids" (Haynes, 2013) or "How to Let Your Parents Raise a Millionaire: A Kid-To-Kid View on How to Make Money, Make a Difference and Have Fun Doing Both!" (James & Coffey, 2012).

Lackéus also provides an overview of the wide variety of "early entrepreneurship education" and differences in the meaning and learning goals and approaches in the diverse European countries. He suggests the term "entrepreneurial education" for approaches that do not directly address children's competencies as the world's next youngest CEO, but for a broader approach focusing on children's skills and interests that give them the opportunity to shape the (future) world (see Table 2).

Table 2: Shifting pedagogical approaches and varying emphasis on theory over practice. Source: Lackéus, 2015, extract from Figure 1. (slightly adapted by Salzburg Research with social innovation skills)

Primary school	Secondary school	Higher education
Educating THROUGH entrepreneurship (skills, attitudes) Example: community outreach	Educating ABOUT & THROUGH entrepreneurship (knowledge, skills, attitudes)	Educating ABOUT, THROUGH & FOR entrepreneurship (knowledge) Example: elective

Example: mini companies	courses

Creativity and uncertainty

Engagement, self-efficacy	Failures, perseverance	Passion, identity, growth,

Observation skills, awareness of and/or concern about social problems and needs (specific for social innovation)

There are several ideas and models that describe which personal effects early entrepreneurship can have. These typically include competencies, attitudes, ambitions and skills. Most of the overviews are addressing adults (i.e. students in higher education), for example the EntreComp framework (Bacigalupo et al., 2016) or the overview of "critical competencies for social impact leader" provided by Kraemer (2016). Entrepreneurship education is also changing with regard to the age of the addressed target groups. Lackéus (2015) gives an overview of different concepts and shifting approaches over time. We build upon his suggestion to regard entrepreneurial learning as a process along the entire childhood and focus on developing different skills depending on the learner's age and personality (Table 3). While creativity and coping with uncertainty should be dealt with in one way or the other along the childhood, some other skills and competences relate to primary, secondary and higher education. With regard to learning outcomes in the field of social innovation, it is important to stress that the acquisition of observation skills and awareness.

Table 3: Types of skills (competencies) for children 6-16 years addressed by DOIT's approach

DOIT addressed skills within a sentence	skill / competence
I see it! (I observe the need for a new solution to a social problem / am affected by a social problem)	social innovation awareness
I can do this!	(increased) self-efficacy and sense of own role to create social change
I want more of this!	(increased) entrepreneurial and social innovator's passion
I am a social innovator!	(increased) social innovator and entrepreneurial identity
I want to do good!	(increased) feel of the sense and passion of doing good for the society or contribute to global goals
I know how to cooperate!	(increased) communication and collaboration skills

As addressed above, the DOIT project is aware, that the addressed target skills are

slightly different according to the age range; therefore, the level and distribution of these skills might vary amongst the age groups. DOIT's approach might not directly build on this list of skills, but more on events and emotions that will lead to the development of the skills: Lackéus promotes such an insight into the 'black box of entrepreneurial learning' and describes a "conceptual example of how educational design triggers emotional events which in turn develop entrepreneurial competencies" (Lackéus, 2015, p. 21).

2.4 Conclusion and suggestion for the DOIT programme

Summing up the three theoretical pillars, we propose the following combination of action-based entrepreneurial education and the different stages of a social innovation management process (see Table 4):

Table 4: DOIT levels of action-based materials and activities using the classification scheme of action-based entrepreneurial education (ABEE) by Lackéus et al. (2015), and social innovation (SI) stages by Murray et al., 2010, p. 11-13, extended by DOIT

DOIT levels	Related levels of action-based entrepreneurial education (ABEE) / Social innovation (SI) stage	Realisation in DOIT
DOIT level 0	Level ABEE 0 - no action: e.g. lectures, study visits, literature study SI: Prompts, inspiration, diagnosis; problem identification	Approach and materials are presented and available in DOIT toolboxes, and DOIT success stories
DOIT level 1	Level ABEE 1 - creation: learners create artifacts, e.g. role play SI: Idea generation	Creating prototypes of concrete products in teams is core of the DOIT approach (DOIT action)
DOIT level 2	Level ABEE 2 - value creation: artifacts considered valuable by stakeholders outside the creators and teachers, e.g. co-creation with partners SI: Prototyping	
DOIT level 3	Level ABEE 3 - venture creation: learners are expected to organise the value creation in a venture SI: Pilots	Learners are expected to create the real applicable solutions within the DOIT actions
DOIT level 4	Level ABEE 4 - sustainable venture creation: aim that the venture keep on going after the end of education if it can be sustained SI: Sustainability	As far as possible within the DOIT actions and the DOIT competition
DOIT level 5	Level ABEE 5 (added by DOIT) - facilitating entrepreneurial education for children: possibility that older	As far as possible (as peer tutors, or as participants at DOIT facilitator trainings,

children might act as facilitators (or tutors) as well	they are open for older children as well)
SI (added by DOIT) - Educating others for SI	

We have proposed to combine the first four stages of social innovation with the four levels of action in entrepreneurial learning (see classification by Lackéus et al. (2015) and use this as a framework for the DOIT programme and toolbox. The above table builds upon Lackéus' classification of action-based entrepreneurial education, we added numbers to the levels and included level 5 as DOIT sees and engages children as (potential) facilitators as well, and social innovation stages.

3. Elements of the DOIT programme

Based upon the three pillars, we propose the following programme, which addresses seven steps in a learning journey of a young learner. DOIT will develop a set of materials for children and educators to support makerspace activities that directly enhance and foster entrepreneurial thinking as well as social innovation, intergenerational and multidisciplinary work (see Figure 1, Table 5).
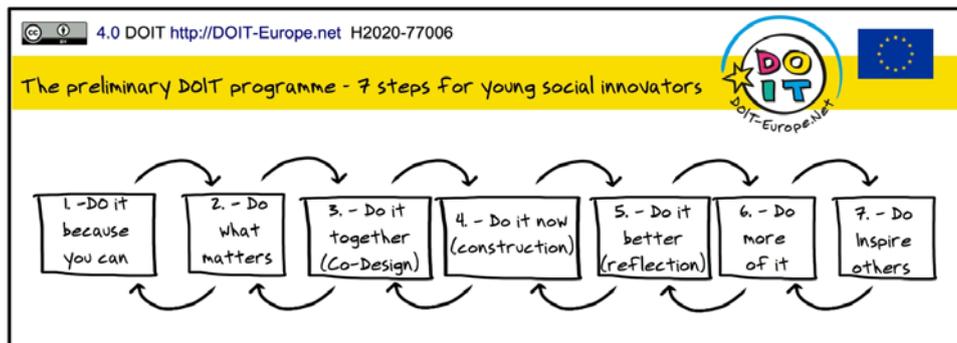

Figure 1: Overview of the DOIT programme

The DOIT programme is the framework for all materials and activities within the DOIT project, especially the planned activities with children and youth. Within DOIT these activities are called DOIT actions, which are a multi-day-event or a series of regular, but shorter events within a makerspace setting. Every DOIT action starts with a co-design workshop where (potential) participants (children as well as facilitators) co-design the future DOIT action, for example deciding on potential partners, involving stakeholders, more refined topics (for example an event focusing on "quality and accessibility of local playgrounds") or the decision to pitch specific ideas after a first workshop. Each DOIT action relates closely to the field of social innovation and to the field of maker education. Each pilot partner engages its target group with a socially relevant and relatable topic, and uses making as a means to discuss and research this topic, come up with alternatives, collaborate with people and to be creative in thinking

about possible solutions. DOIT actions lead to several ideas and prototypes (DOIT projects) for social innovation within the addressed topics (see Table 5).

Table 5: Overview of the DOIT programme and methodologies

DOIT programme part	Methodologies within the DOIT action (6-10 and 11-16 years)
1. Do it because you can	Co-Design of the DOIT action: Planning and preparing the DOIT action together with children and entrepreneurs as an essential part of a DOIT action
2. Do what matters	Collecting ideas for social innovations (What is the challenge? Where is a need? What can I do?)
3. Do it together (Co-Design)	- Selection of ideas - Building a team - At the end: Wrap-up of the DOIT action on how to move on with the ideas and to evaluate the DOIT action itself
4. Do it now (construction)	- First prototyping of ideas, presentation and reflections, iterative approach - Instructions for new approaches and technologies (e.g. coding)
5. Do it better (reflection, feedback, failing forward)	Reflection and feedback phase; sharing of failure experiences,
6. Do more of it (finding support, first business plan modelling)	Developing plans for: - Realisation of the product idea or prototype - presentation and marketing plan
7. Do inspire others	Public presentation and sharing of the idea and the (success) story

Although DOIT's facilitators' trainings will developed in a later stage of the project, we already described their skills, also using existing sources (see Table 6), see the table below.

Table 6: DOIT's preliminary list of types of skills that facilitators should have or develop as DOIT facilitators, using a list of entrepreneurial competencies provided by Lackèus (OECD 2015, p. 8-point 4 to 6).

DOIT addressed skills	Short description facilitators skills
Believe in it	Make the learning for social innovation relevant to your learners.
Be a maker	Primacy of doing concrete artefacts, products and usage of (digital) tools.
Co-design	Support co-design of activities and collaboration within teams.
Use creativity	Retain creativity inherent in young minds.
Build and develop	Learn and evolve, educating educators and managing expectations.
Assess to assist	Evaluate the learning through context and engagement, not merely norms.

4. Discussion and next steps: evaluated pilot phase and establishment of the DOIT ambassador network

In the first year of the European project the DOIT consortium, coordinated by Salzburg Research, application-oriented research, innovation & technology organisation (RTO) in Austria, is currently developing the DOIT programme and materials together with children, experienced making facilitators, social innovation and entrepreneurship experts and runs the first pilot training activities in 10 European countries (start in autumn 2018). The consortium is also working on developing a scientifically sound evaluation framework measuring the impact of the programme on the children´s learning journey about social innovation in makerspace settings. Despite the methodological difficulty in measuring these multi-layered and intertwined competences and skills as proposed by the DOIT approach, we aim at providing first results after the first and second pilot round in mid-2019.

DOIT aims to enlarge its professional network for stimulating digital social entrepreneurship and innovation within young learners and invite to take part in other DOIT activities (e.g. a MOOC-course for facilitators in social innovation training) or testing the DOIT platform. We are specifically interested in other best practises and social innovation lab-experiences in order to better adopt the DOIT results in different countries and regions.

The interested readers can learn the most recent project news and results on the official website: www.doit-europe.net.

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