Project Deliverable

Entrepreneurial skills
for young social innovators
in an open digital world

DELIVERABLE 6.2
EVALUATION RESULTS PILOTS PHASE 1

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Description of the Deliverable

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Summary

Deliverable D 6.2 describes the DOIT evaluation procedure for piloting the DOIT action, from the construction and testing of the different evaluation instruments, to the compilation of the evaluation handbook for the practice partners and the collection of data at the different pilot sites. Since the deliverable is due before the conclusion of phase 1, a preliminary data analysis has been carried out for those pilots that were able to finalise at this stage. The full data analysis, both of phase 1 and phase 2, will be detailed in D6.9. Thus, this report follows a case study approach with an in depth analysis of the DOIT action in the pilot sites of ZSI, CoC and MEPF – Austria, Denmark and Germany. Based on the qualitative and quantitative analysis, first recommendations could be compiled that will help to adapt some of the procedures for upcoming DOIT actions in phase 1 as well as phase 2.

Content

List of abbreviations and terms

FI	facilitator interview

1. Introduction

The main objective of this deliverable is to describe the evaluation procedure for pilot phase 1 as well as first insights based on available data by the time of writing. Since the deliverable is due before the conclusion of pilot phase 1 not all data could be collated and analysed. Where possible we will detail first evaluation results based on the below formulated research questions.

The construction of the evaluation instruments was driven by theoretical considerations regarding the previously defined evaluation dimensions and built on co-design workshops with the practice partners, who contributed with their practical experience in working with children in maker activities. The study has a formative evaluation character (Bortz & Döring, 2006) with the aim to learn from the preliminary evaluation results and formulate suggestions for improving DOIT action phase 2. Recommendations are compiled in chapter 5.

The previous deliverable D6.1 comprised in detail the evaluation plan and the instruments. However, some of the instruments underwent changes resulting from co-design consultations with the practice partners as well as pre-tests. Therefore the evaluation procedure and instruments are described in chapter 2. The single instruments are to be found in the Annex. The theory behind constructing the different instruments and the evaluation plan has been spared in this deliverable as they are already presented in D6.1.

An underlying challenge in WP6 of the DOIT project and also of the overall evaluation design is the need to balance the uniqueness of each pilot with the requirements of a common evaluation base. Thus, already aiming for comparable conditions at the different pilot sites for several evaluation instruments, we took care of not to interfere too much with the pilot action design. For instance, while instructions for carrying out the questionnaire and the creativity test have been formulated in detail and in a standardised way and thus had to be followed as closely as possible by the different pilots (pre- and post-test), there is much more freedom of choice and less standardisation with others, as e.g. the feedback of participating children or the student interview setting. In the framework of first identification and preference setting for the pilot 1 phase of ZSI, we used a pre-workshop (15 May 2018 in Gröbming, AT) also to integrate and test several evaluation tools. After explaining to the children why we would like their help, they filled out the questionnaire as well as the creativity test and they willingly commented on the tools. As expected, the creativity test created no difficulties for the children. However, the designed questionnaire was revised and adapted.

To recall – as detailed in D6.1, in DOIT we do not propose a narrow, commercial definition of entrepreneurship education, but work on the basis of the more comprehensive definition provided by the EC thematic working group: “Entrepreneurship education is about learners developing the skills and mind-set to be able to turn creative ideas into entrepreneurial action. This is a key competence for all learners, supporting personal development, active citizenship, social inclusion and employability” (Eurydice, 2016). Thus, we put skills and attitudes such as creativity, planning or teamwork at the core of the definition. A first overview is provided by Lackéus (2015) who distinguishes between entrepreneurial attitudes:

self-confidence, self-efficacy, sense of initiative, ambiguity tolerance, perseverance; Entrepreneurial skills: creativity, planning, financial literacy, managing resources, managing uncertainty/risk, teamwork; and entrepreneurial knowledge: assessment of opportunities, identifying with the role of an entrepreneurs – self-reflection, how-to knowledge (accounting, finance, marketing and communications). This is also very much in line with the Entrepreneurship Framework (Bacigalupo, Kampylis, Punie, & Van den Brande, 2016), which puts 15 competences

such as self-awareness and self-efficacy, creativity, coping with ambiguity, uncertainty and risk at the core of their framework.

Finally, out of the previously discussed models we derived the following eight evaluation dimensions (c.f. D6.1 for definitions): creativity, self-efficacy, teamwork and collaboration skills, dealing with uncertainty, perseverance, empathy and knowing others’ needs, motivation and sense of initiative and planning and management skills.

Again, to recall (for more details please c.f. D6.1), the evaluation method is based on a mixed method approach, with quantitative and qualitative measures. For the quantitative measures, it follows a pre-post design, comparing the baseline data before and after the programme to measure the effects of the DOIT action on the participants.

Key questions to be addressed in the evaluation of phase 1 are the following:

1. Participants: Did the pilots reach the planned target numbers? Were at least 40 percent female participants? Did the pilots include participants as defined (disadvantaged children, children from rural areas, children with disabilities, etc.)? How was the attendance of the participants (drop-outs)?

2. Facilitators: What was the ratio of facilitators vs. participating children? Were there at least 40 percent female facilitators?

3. DOIT action methods: Which methods were rated well by the facilitators? What did participants like/dislike about the DOIT action?

4. Effect of DOIT action on participants: Did the DOIT action have an impact on participants in terms of entrepreneurial skills and attitudes?

The evaluation instruments have been developed after several design iterations to cover all the defined evaluation dimensions to answer the above formulated research questions (they will be described in more detail in the following chapter; the instruments are to be found in the Annex):

- Attendance sheet with demographic data
- Questionnaire for pre- and post-test
- Creativity test for pre- and post-test
- Workshop documentation
- Interview guideline with facilitators
- Interview guideline for students interviewing students
- Feedback by students

The following table gives an overview of the DOIT elements of any pilot and the respective evaluation dimension and instrument.

Table 1: DOIT elements and evaluation dimensions

EEE elements	Description of possible activities	How the activity could be supported	Evaluation dimension	Evaluation instrument
1. **Do it because you can** (Motivation)	Students get motivated by early successes or by envisioning the scope of their possibilities	Presenting/telling success stories that motivate, e.g. by peers	Self-efficacy, Motivation and sense of initiative	Questionnaire, Facilitator interview, Student interview
2. **Do what matters** (Co-design)	Students are asked to collect and select potential ideas for innovations, this includes methodologies and approaches to identify the true roots of a problem, e.g. talking with relevant stakeholders	Methods and Materials to detect true roots of a problem, Creativity tools	Sense of initiative, Creativity	Questionnaire, Creativity test, Facilitator interview, Student interview
3. **Do it together** (Co-creation)	Students will make the project a reality collaboratively – including more knowledgeable others (entrepreneurs, makers).	Planning methods Interdisciplinary group working	Creativity, sense of initiative, planning, managing resources, managing uncertainty/ risk/ teamwork	Facilitator interview, Student interview
4. **Start it now** (Iterate)	The development of projects is focusing on concrete prototypes and their continuous improvement.	Lean prototyping methods using different materials, understanding the decomposition of design challenges	Teamwork, creativity, managing resources	Facilitator interview, Student interview
5. **Do it better** (Reflection)	Within and after the development of the projects, students are asked to reflect their work and to get and give feedback for better (future) results.	Moderation skills; Reflection and feedback phase; sharing of failure experiences	Assessment of opportunities, managing resources	Facilitator interview, Student interview, Questionnaire
6. **Do more of it** (Scaling)	Depending on students' age, project results are brought to a bigger group of users.	Developing plans for scaling. Testing the robustness of a solution if replicated multiple times	Assessment of opportunities, financial literacy, managing resources, managing uncertainty/risk	Facilitator interview, Student interview
7. **Do inspire others** (Reaching out)	Students are asked to share their ideas and projects to a wider public	Public presentation and sharing of the idea and the (success) story	Planning and management skills	Facilitator interview, Student interview, Questionnaire

The following chapter 2 describes the data collection process and instruments.

2. Data collection process and instruments

To well prepare the practice partners for the evaluation tasks we compiled an evaluation handbook with checklists and practical information how to use the different instruments that guided through the different steps of the evaluation procedure. In regular calls with the practice partners we further made sure that all would be well prepared for carrying out the evaluation at the different pilot sites.

The following illustration gives an overview of the timeline of the different data collection instruments, what had to be prepared by the practice partners before the start of the pilot, when to use which instrument and when finally to transfer the data back to ZSI for data analysis.

Figure 1: Overview of evaluation process

As can be seen in the above overview, in the preparation phase practice partner needed to translate the consent form as well as some of the data collection instruments to the national languages, specifically the questionnaire and the students interview guidelines. To aim for the best level of accuracy, we recommended to apply forward and back translation (Cull et al., 2002). One of the team translates from English to the national language and another one in the team translates back from the national language to English. Then the two versions are compared and discrepancies are easily detected.

Also they were asked when designing the DOIT action to reserve sufficient time for collecting the data (45 minutes at the very beginning for the pre test and 45 minutes for the post-test towards the end of the DOIT action; additionally about 30 minutes for students interviewing other students).

At the beginning of the pilot, practice partners needed to collect the demographic data, assign IDs to the real names and do the pre- and post-test. Throughout the pilot, partners were asked to fill in the workshop documentation and to collect feedback by the participants. Towards the end of the pilot, the post-test was carried out as well as student interviews. After the conclusion of the pilot the data had to be transferred to ZSI. More details on the single instruments are given in the following sub-chapters.

2.1 Basic data and attendance sheet

An Excel spreadsheet was developed to be completed at the beginning of the pilot as well as throughout the DOIT action. It contains basic data of the participants (name, ID, gender, age, profession of mother, profession of father) as well as of the facilitators (age, gender). The practice partners were also instructed how to anonymise the data by deleting the first column containing the real names before transferring the data to ZSI.

Furthermore it contains a checklist for the evaluation instruments and the completion of consent forms by the guardians as well as an attendance list for participants and facilitators.

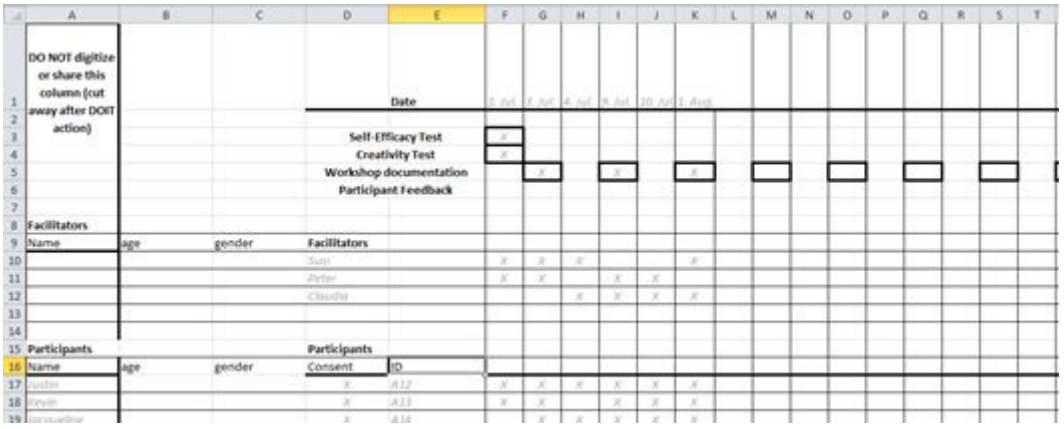

Figure 2: Spreadsheet with basic data

Further information to be filled concerns the reach of children (in school, outside school, less privileged background, special needs, rural area and advanced makers), the description of action (topic of DOIT action, venue of action, design considerations, used technologies, cooperation) and general considerations.

2.2 Creativity test

As described in D6.1, after scanning different creativity tests, we have opted for TSD-Z test (Urban & Jellen, 1995) as it combines several advantages (covers the age span, takes only 15 minutes, it is a culture-free test, which means that is measures in a fair manner). The TSD-Z is a drawing test that does not use language and therefore it can be used as it is in the different pilot sites without the need for translation. Only the detailed instruction needed to be translated.

Furthermore, in "addition to aspects of divergent thinking, the TSD-Z also considers qualitative, creativity-relevant components (such as composition and solution form, unconventionality, willingness to take risks). Drawing skills do not play a significant role in the processing of the TSD-Z. On the test sheet, some special figural fragments are offered, which are intended to encourage further drawing in a free, undefined manner. The final graphic product is scored with points on the basis of 14 evaluation criteria, which at the same time represent the test construct" (D6.1, p. 39-40). As the test is strictly protected by copyright, which does not allow publishing the test, making copies or scans, the test itself is not included in the Annex like the other evaluation instruments. With paying a fee for the single copies of the test it could be used for the pilot evaluation.

The creativity test is a standardised psychological test, which comes with very detailed instructions that had to be followed very closely in order to create a comparable setting. It foresees, for instance, that every participant is equipped with a pencil or black felt (no eraser, ruler or coloured pencils) and the facilitator keeps track of the time

with a stop-watch since participants can win some extra points if the complete the drawing before 15 minutes (which is the maximum duration).

There are two parallel versions of the TSD-Z, Form A and Form B, which we used for the pre and post-test, at the beginning and at the end of the DOIT action respectively. Facilitators were asked to read out loud the (translated) instructions to the participants.

2.3 Questionnaire

As described in D6.1, self-confidence/self-efficacy are acknowledged as being key in pursuing own goals and ultimately support the development of entrepreneurial intentions and actions (Boyd & Vozikis, 1994). Although there are several standardised published scales available that measure self-confidence, self-efficacy or related constructs, such as FSKN (Deusinger, 1986), FKK (Krampen, 1991), PALS (Midgley et al., 2000), and some sub-scales of PFK (Seitz & Rausche, 2004), none was suitable as it was for our purposes. Even the Entrecomp framework (Bacigalupo, Kampylis, Punie, & Van den Brande, 2016), which developed scales for entrepreneurial education, covering also self-efficacy, would have matched only the older age group. Thus, the different available instruments did either not cover the age span or comprised incomprehensible items, especially for the younger children. For these reason, we have selected the most suitable items from different surveys and used them as basis for further development and as source for inspiration to develop our own scale instead. In working out the items, we have made sure, that the items were short, and formulated in simple English without double negations or double meanings. The resulting 15 items were meant to measure three different aspects of self-efficacy (also in line with the general dimensions of the DOIT pilot actions): self-concept of own capabilities (including perseverance), self-efficacy in relation to others and self-concept regarding problem-solving/situations of uncertainty. To these 15 questions we added one regarding the entrepreneurial intention.

After several iterations in strong collaboration with different practice partners and pre-tests with children, we chose a 5-point Likert scale as most suitable answer format. Several children were involved to test the questions of the different scales, during a first workshop 15 May 2018 that aimed to understand children's preferences and needs, the attention span, preferred way of working a.s.o. as well as to align the test. Explaining to the children why the evaluation is of importance and why we need their feedback, the children were filling out the questionnaire and creativity test and were very willing to comment on these tools. Children of different ages were asked to fill in the questionnaire. The pre-test served especially to understand, which answer format works best and if the questions are understood by children. They were asked after reading the question to rephrase the question, so we could note which questions had to be reformulated. With smaller children, whose reading comprehensions was not yet developed, we have tested whether the questions still work when they are read out loud. These pre-tests showed that visual scales (e.g. emoticons) and analogue scales did not work. With the visual scale children got confused whether they were asked to rate whether they liked the question or whether they should rate what applied to them. With the analogue scale, especially younger children, marked mostly the extremes and did not understand that they could nuance their answers. This is very much in line with research by Mellor and Moore (2013) who experimented with different answer formats in questionnaires designed for children.

Furthermore, in pre-tests with children it turned out that questions were easier to understand than statements and therefore the final version comprises only questions.

In the pre-tests, children were asked to rephrase how they understood the questions to check for the comprehensibility of the question. We furthermore observed how they answered the questions, their reaction to the questions, whether the answer format was intuitive enough and other occurring issues such as slipping a line. All the

observations led to several reformulations as well as re-designs. The English version was proofread by a native speaker, which led to some ultimate changes.

The questionnaire had to be translated into the national language and to be accurate and as close as possible to the original wording. An accuracy check of the translation recommended to the practice partners was to apply backwards translation. One of the team translates from English to the national language and another one in the team translates back from the national language to English. Then the two versions, the original version and the backwards translated version, to detect inconsistencies. The questionnaire was developed in two versions, as paper-pencil questionnaire and as an online survey (google form). Depending on the setting and the infrastructure, practice partners could choose the more suitable solution.

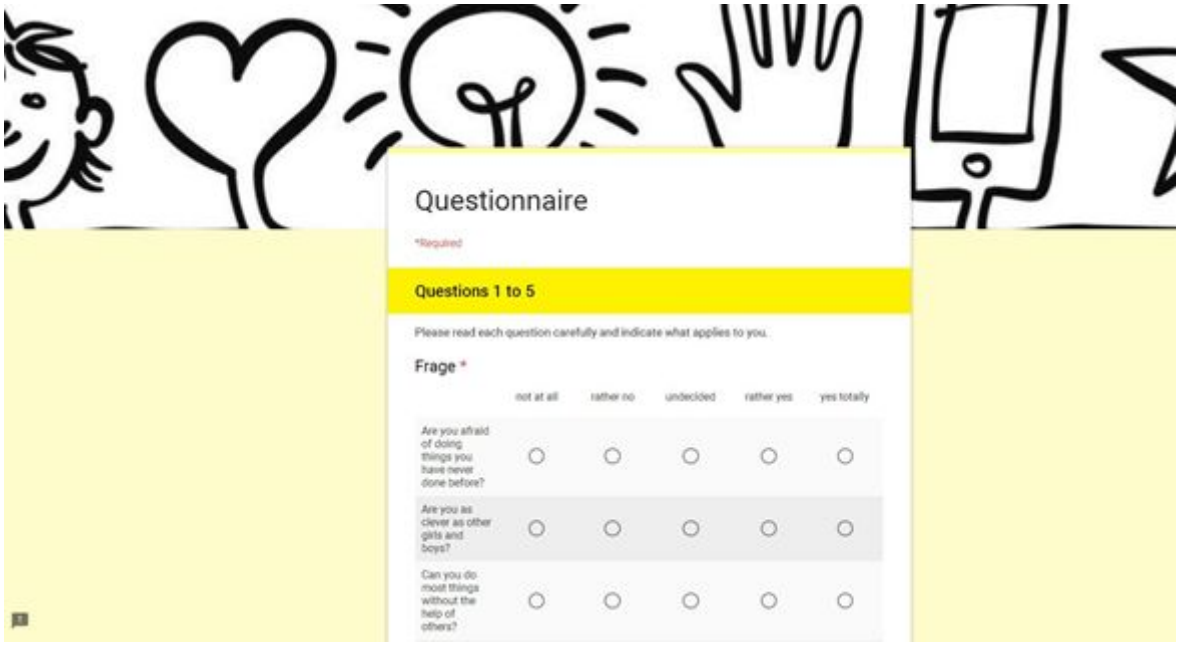

Figure 3: Screenshot of the online questionnaire

The questionnaire had to be completed two times, at the beginning and at the end of the DOIT action, for collecting data for the pre and post-test.

In the evaluation handbook, we again gave detailed recommendations how to instruct the participants. Besides explaining the purpose of the data collection, we recommended to making answering the questionnaire more motivating by working with incentives that eventually also served the purpose of the following DOIT actions (or could also be some other incentive). The idea was that students after completing the questionnaire were asked to grab something from a box of full of materials.

The instructions for the participants did not have to be read word by word but rather aimed at giving an idea how to introduce the questionnaire.

Instruction for students (our recommendation for younger participants was to have at least one assisting person for every three students in order to complete the questionnaire. With younger students the questions, one after the other, had to be read out loud by the facilitator who made sure that all students had signed their answer before reading out loud the next one. We expected that children aged 10 and above could read and answer on their own, once they had been instructed how to work on the questionnaire):

"Now I will give to you a short questionnaire. It consists of 16 questions. We would like to know how you think and feel about certain issues. I will read the questions out loud one after the other (only with children below the age of 10)*. After each question please make a cross at the right side next to the question. If you want to answer that the question is "totally true" for you make the cross here (show), if it is "rather yes" make a cross here (show them), if it is "undecided" mark here (etc. please make an example). There are no right or wrong answers in this exercise! After you have answered all questions I will ask you to grab something from one of these boxes. You can use the materials afterwards for* (XY depends on what you have in mind)*."*

If there are no further questions, distribute the questionnaire and let them work on it. Make sure they work on it independently!

After all students have completed the questionnaire ask them to hand it over to you and let them grab the incentive/ material.

Do you know what to do? Can we start?" (please answer upcoming questions)

And read out loud the questions one after the other with children below the age of 10.

"Let's start with question number 1: Are you afraid to do things you haven't done before..."

"Please make now a cross at the right side next to question number 1"

Etc.

2.4 Workshop documentation

The format of the workshop documentation was changed since the submission of D6.1. It was shortened dramatically to make the instrument more efficient.

The aim of the workshop documentation template is to document the DOIT action, stimulate reflection on the workshop's format, in order to learn from the own experience and to further improve the following workshops (in the sense of formative evaluation) and to distil the best workshop methods and tools, which could be fed into the online toolbox (task 2.2). Thus, the workshop documentation is an essential part of documenting and evaluating DOIT actions as well developing content for the toolboxes (WP2).

Practice partners were asked to invite the facilitators to immediately reflect after the workshops and to fill in the documentation in order to not forget important aspects. If there were multiple facilitators for a single workshop, the documentation was a good opportunity to reflect about the workshop as a team. However, we only asked for one evaluation per workshop. We asked to document at least half of the workshops and no less than three (see overview in Excel sheet).

2.5 Students interview

We highly encouraged participants to interview each other in order to empower students not only through the DOIT actions itself but also in their role as co-researcher. We recommended a minimum age of 10 years to carry out this task and identify with this role as co-researcher or reporter. We let it up to the practice partners to decide on the concrete setting taking into account the local condition: It could be also a pair of participants (or even more) doing the

interviews together (eventually assisted by a facilitator). In case in the group no student was willing to take over this role, also facilitators could do the interview instead of course.

The duration of the interviews should not take longer than 30 minutes. We imagined that the interviewing student(s) would go around from child to child and ask some of the questions (or from table to table and ask children who have been collaborating on a project). Depending on the group size it might be possible to capture the answers of all or only of some students (what is possible in half an hour).

The interviews had to be carried out towards the end of the pilot. Thus, the facilitator had to make sure that there was sufficient time allocated for the interviews either during the last workshop or right afterwards and to ask well before who would be willing to carry out the interviews.

Interviewers could be asked to imagine that they are co-researchers (or reporters for a local newspaper) who wanted to find out more about the project, what was going on, what students have learnt, what they have built etc.

The interviewing student(s) had to be briefed to take over the role as co-researcher (or reporter). Facilitators were asked to explain that the interviews were important to understand how DOIT has worked and how we could improve the workshops in the future and that therefore their assistance in this was crucial. The participants were equipped with the interview guideline (see Annex), a voice recorder, a mobile phone or a camera to record the audio of the interview and to take a picture of the prototype. The guideline did not have to be followed very strictly, it was emphasised that they were free to add more questions, which they were interested in.

The recorded interview was than transcribed and translated to English.

2.6 Facilitator interview

The interviews with the facilitators (2 per pilot country) have been carried out by ZSI and WAAG; thus the only responsibility of the pilot organisers was to put us in contact with two facilitators per pilot. The interview took place in English and via telephone, eyeson or Skype. Also the facilitators had to give their consent for recording the interview prior to the interview. The interview duration was about 30 minutes and was scheduled to take place towards the end of pilot or shortly after (-> consent form in Annex 7, see interview guideline in Annex).

2.7 Feedback by participants

To accommodate the needs of practice partners we omitted the original visual feedback scale that we had developed (see D6.1) but instead made suggestions how to collect the feedback by the participants and let it for the practice partners to decide how to do it. They were asked however to fill in a reporting template (see Annex) on the gathered feedback (which method they chose, the gathered feedback and what they would improve following workshop).

In the sense of formative evaluation, collecting the feedback of the participants of how much they liked the workshop and what they have learnt is important. In other words, facilitators will need the information in order to improve the workshop design and to understand whether students appreciate the different elements of the workshop. Thus, not only the facilitators had to be asked to reflect after the workshop, but also the participants would be asked for their feedback on the workshop.

A proposed feedback method was the following: In the first workshop participants are asked to think about what they would like to learn/do. One facilitator writes down their ideas on a flip chart and in the last workshop asks them again whether they have accomplished what they wanted to learn/do. This can be done individually or as a group discussion.

Another idea would be to give each student four Lego bricks to visualise their answers to the self-defined learning goals. For instance, one brick per learning goal would mean ‘learnt a little’, and four bricks ‘learnt a lot’. The bricks of all students built together shows then the group result.

3. Data transfer and processing of data

All data that was sent to ZSI had to be anonymised. In case of scans (like for the Creativity Test), this meant to blacken the real name of the participant and write the ID on it instead if the participant had not already written the ID on the sheet. In case of the Excel-File that contained the attendance list and the Self-Efficacy results, the first column with the real names had to be deleted.

The evaluation handbook contained a detailed instruction how to transfer the data and a checklist in order to have the most complete data sets per pilot.

Overall, the data transfer worked well. To transfer the data to ZSI took sometimes longer than expected. Thus, we will work out a plan how to make the transfer more efficient. Also some data sets could not be used, either because the pre or the post-test was missing in some cases.

In regard to the creativity test, on one sheet the ID was missing, thus it was impossible to link the results to the participant’s data. Also the seating obviously had an influence on the creativity test. Some drawings were so similar that we suppose that the participant sat close to each other. Thus, we recommended the facilitators to seat the participants not to close to each other if the workshop space did allow for that.

The transfer of the questionnaire data worked well. Some questions needed to be recoded before the further processing since they are were formulated with opposed meaning. This was the case with the following questions: (Q1, Q7, Q9, Q14 and Q15). Please check the questions in Annex 8.1. Thus, the value ‘1’ (Also the sums of items 1 to 15 were built as a measure for overall self-efficacy. Q 16 is treated as separately as indicator for entrepreneurial attitude (“Do you want to become your own boss?”). Furthermore, the sub-scores were calculated based on five questions each. These sub-scores represent three different dimensions of self-efficacy:

- Self-efficacy in relation to others: Questions 2+6+7+10+14
- Self-concept of own capabilities: Questions 3+4+5+8+13
- Self-concept regarding problem solving/uncertainty: Questions 1+9+11+12+15

A confirmatory factor analysis will be carried out once the all data has been aggregated to understand if the proclaimed dimensions of self-efficacy can be verified based on the data.

The reliability of the questionnaire is quite satisfying with a Cronbach Alpha of 0,797. The reliability indicates the consistency of a questionnaire and represents one of the psychometrical standard quality criteria. Cronbach Alpha is based on the interrelatedness of the items.

The quantitative analysis of the creativity test, the questionnaire and the demographic data were carried out with SPSS quantitative analysis software. All the qualitative data (facilitator interviews, student interviews, workshop documentation, feedback report) was fed into the qualitative analysis software package MAXqDA. The collected material was subsequently analysed with qualitative analysis methods in an explorative and structuring way combining deductive and inductive coding approaches. After Mayring (Mayring, 2014), in content analysis

communication is analysed in a systematic manner, according to defined rules and theory driven with the aim to draw conclusions.

The coding system to develop allows for a systematic analysis of the data, while the rules for applying the codes have to be fixed in a coding plan with the purpose to increase reliability and validity across different researchers working with the same material. The theory driven approach has to be safeguarded in the development of the deductive codes. While there is a variety of techniques for interpretation available in qualitative research (c.f. Mayring, 2014, p. 63-64), classification and structuration are the most appropriate forms of interpretation for our cases. The aim here is to explore the data material according to the defined rules and categories (codes) and describe the transverse section in the data. In the coding process, the researcher goes through all the material and allocates text passages to the specific codes.

In the description of the results (see next chapter), in each case we will detail also the missing data.

4. Data Analysis and first results

Only the cases with complete data sets have been analysed, i.e.:

1. The ZSI pilot in Gröbming, Austria
2. The CoC pilot in Billund, Denmark
3. The MEPF pilot in Berlin, Germany

In the following we will answer the defined research questions per pilot, which were already concluded by the time of writing. An overall assessment of all collated data will be carried out in D6.9 together with the results of phase 2.

4.1 The ZSI pilot in Gröbming

The Austrian pilot (part 1 by ZSI) was the first one to take place (September 2018) and thus had furthermore the function of a test bed for the other pilots. First results and observations were shared with the other practice partners during the regular practice partner calls. The DOIT action lasted for four days in a row in the framework of a vacation programme for school kids, 4.5 hours every day in a rural region in Styria. The pilot took place in a rural area. The topic of the workshop was ‘water’ and ‘energy’ under the bigger scope of ‘environment and nature’.

The venue was a school, where a makerspace was installed for the action only. The technologies used comprised: Calliopes, LEDs, Internet, and computers and furthermore material of any kind: coloured papers, cardboard, Styrofoam, feathers, pens, coloured pens, etc.

The action took place in cooperation with three entrepreneurial organisations (who paid a visit at the end of the action during the final exhibition), the school where it took place, a fire department and the local community. Also two journalists came to visit the action and two articles were released in two regional newspapers.

4.1.1 Participants

In total 18 children participated in the DOIT action, resulting in a small deviation of two children as 20 were planned. Their age ranged between 6 and 11 years with an average age of 9.11 years, thus children from both age groups were present (14 belonged to the younger age group and four to the elder age group).

Table 2: ZSI participants' distribution by age

Age	Frequency	Percent
6	1	5,6
7	1	5,6
8	5	27,8
9	3	16,7
10	4	22,2
11	4	22,2
Sum	18	100

Of the 18 participants, 5 were female. Thus females were underrepresented in the DOIT action, constituting only about 28%. This was rather surprising to the facilitators (FI 1) as they had special attention to create gender-neutral invitations by specifically addressing both genders in the wording. As the first invitation resulted in only a few registration by females, the facilitator via social media tried to actively address girls, but unfortunately this initiative did not result in any more female registrations. During the workshop gender also played a certain role suc*h as in group building. Facilitator 2 also said that he applied a bit of positive discrimination during the DOIT action: "I was actually putting extra effort on this topic because in my field it's also a huge discussion, because technical domains are dominated by men and as well as the entrepreneurial domain (…) This is why I was putting extra effort when the girls were hanging out I was trying (…) to communicate, and then for the toothbrush robots I was helping the girls first (…) in the prototyping phase, my group was mostly boys, with just one girl. There I was trying to show her programming. (…) The last one was Valentina – like one girl, the oldest of the whole group, she was like 12, and she was already much more mature like most of the others – very calm and focused, so in the end I also let her do soldering. All the boys wanted to solder, but I wouldn't let them, but when this was necessary to do this at one point, I let her*" (FI 2).

Two children had a special needs condition: one child with limited fine motor skills and one child with dyslexia. However, the facilitators prior to the workshop neither knew about the conditions, nor did they observe any difficulties. The parents expressed their worries at some point that the children could not exercise everything that was needed in the workshop, but the contrary was the case, as the facilitator told in the interview (FI 1): *"The mother called me and wanted to know what children had to be capable of doing in order to participate, since her child had dyslexia but was really a great tinkerer. She thought that the workshop would be a great opportunity for him to show his talent, which was rarely the case at school. And this was absolutely the case".*

According to the facilitator 2, the 6-year old sometimes had troubles following but he was much supported by his sister who worked in the same group (FI 2). One of the children was described as an advanced maker by the facilitators. The attendance was continuous; there was no drop-out. One child missed on the first day and one child was sick on the third day.

4.1.2 Facilitators

There were four facilitators, two female and two male facilitators. The resulting ratio was 4.5 children per facilitator. According to the facilitator interview (FI 1) the ratio was not sufficient for this rather young age group. Also working with Calliope would have needed more time and assistance. Facilitator 1 also said in the interview that she had underestimated how important group dynamics can be and how they unfold. Although there were no conflicts, facilitators were concerned with the social aspect of the workshop, who would go along well with another child, who needed support, etc.

4.1.3 DOIT action

The workshop documentation shows that the most documented activities worked well, although there are also some indications for improvements. While the first ones are particularly relevant for the toolbox and eventually also for other practice partners to set up similar activities, the latter ones have to be improved to be successful in the next pilot phase or omitted altogether.

The following table shows which activities worked best (maximum points in rating of facilitators). In the last column the respective DOIT programme element(s) are listed.

Table 3: Best rated activities

	Activity	Material/Machines	Programme Element
1	Physical activities in a gamified environment	4 cards with different activities to be chosen by the children themselves	Motivation
2	Create an invitation letter for guardians for the last (public) workshop session	pieces of paper, packaging material, pipe cleaners, colourful pens, glitter stones, small pearls, toothpicks, old cans and bottles, old loo rolls	Motivation
3	Analogue Programming in Groups: Children needed to programme a „Nutella spreading robot" (while the robot was a person)	Nutella, packaged bread, butter, knife	Co-creation Iteration
4	Crafting Prototype (toothbrush monster)	toothbrush, battery box, batteries, motor, terminals, hot glue gun, pipe cleaners, LED, sticky eyes	Motivation Co-creation Iteration
5	Insights into Calliope programming	two laptops Calliopes	Iteration
6	Prepare presentation	paper, fotos showing process	Co-creation

In the interview, facilitator 1 described a big age difference in the concentration span of the children. Exercise 1

turned out to be particularly useful for the younger children but also for the older ones it was important to stand up in between and do a physical and at the same time fun exercise. This was mentioned also by the participants when collecting their feedback that they particularly enjoyed the additional physical exercises.

Exercise 5, working with the Calliope, worked well especially after exercise 3, analogue programming on the day before (FI 1). In the analogue programming exercise children had to "programme" another person acting as a robot which was supposed to spread Nutella on a piece of bread. The task here was to formulate very precise instructions to the robot. Another analogue programming exercise, which worked well, was the so called "bunny field". It was a field of 5-6 m long paper stripes with cut out holes, some filled with a carrot. Children needed to jump according to the instruction in style of a programme code given by another child, one field at a time. So children learnt in this exercise the seriality and if-then relations (FI 1).

No single activity was rated as not having worked at all but one activity did not work as well according to the facilitators:

Table 4: Least rated activities

	Activity	Material/Machines	Programme Element
1	Gathering Ideas for 'smart objects' and smartness in general	Children brought painted pictures with them 'smart house' represented by a turned around large box	Reflection

It was difficult for the children to identify 'smart objects' in their usual environments on their own without any further input. Thus, further input was needed to identify already known materials correctly. Also facilitator 2 was more critical towards the entrepreneurial activity, which consisted of working with a simplified business canvas. He argued that business canvases were developed for adults and that an exercise or a game that would specifically address children would be needed (FI 2).

The facilitators stated that they would change only smaller parts of the action and that they were rather satisfied with the DOIT action (data collection file).In the interviews, facilitators said that they would plan in more time for the coding work and to better prepare the exercise. Feedback by the participants was (besides that they liked the physical activity) that all of their expectations had been met. Also all participants expressed that they liked the workshops 'a lot'. The students were proud of their final prototypes and about their underlying ideas.

4.1.4 Effect of DOIT action on participants

Please note that for measuring creativity and self-efficacy we have two instruments, the interpretation of the effect on the other dimensions relies on qualitative data such as the facilitator interviews. To comply with the within-subject design of the study and to test for significant differences between the pre and post-test in the questionnaire and in the creativity test we applied a paired sampled t-test. One participant was excluded from the analysis as he was not present at the pre-test, resulting in a sample of n=17.

Self-efficacy

The paired sample t-test resulted in no significant differences between the pre and post-test as the following table shows. This means that children after the workshop showed more or less the same level of self-efficacy.

Table 5: Paired sample t-Test questionnaire

Variable	Significance
Self-efficacy in relation to others	0.207
Self-concept of own capabilities	0.821
Self-Concept regarding problem solving/uncertainty	0.940
General Self-efficacy	0.753
Entrepreneurial identity	0.616

Although some tendency could be identified, e.g. the participants tended to have higher scores in entrepreneurial identity in the post-test, the results are not significant (Pre-test-score: 2.88; Post-test score: 3.06). Although the questionnaire does not show significant results, the facilitators observed how proud children were of what they were able to do, when they presented their prototypes during the final event to the invited people.

Creativity

Also in the creativity test the results in the post-test do not significantly differ from the scores in the pre-test.
Table 6: Paired sample t-Test creativity test

Variable	Significance
Raw Score	0.453
In relation to age group	0.850

Participants tended to get higher scores in the post-test in relation to their age group but again the differences are not significant (PR=41.71 at pre-test, PR=42,53 at post-test). Also we have to note limitations in interpreting the results of the second creativity test as children obviously sat to close to each other resulting in many very similar drawings. Also they rushed the exercise; almost no one needed more than two minutes to complete the test. However, also the resulting prototypes can be considered as a creative output (see section 4.1.5). In the interview the facilitators mentioned a couple of situations where creativity was needed. For instance, the participants were asked to create invitations for their parents for the final event and for doing so they got only upcycling materials. They were fist baffled by the request to create an invitation which was not paper based but it resulted in the most creative objects, a boat with the invitation on its sail, a schoolhouse, etc.

Teamwork and collaboration

As the facilitators said in the interview, they believed that teamwork was very important for the children, because they very much complemented each other. Also they showed a high level of tolerance, so no conflicts arouse. *"There was nobody who wanted to bring forward his or her idea on all accounts"* (FI 1). All groups were eager to work fast and some developed a division of labour, while it was still important to them the 'workload' was equally distributed and that they stayed within the groups. Facilitator 1 thought that the children have increased their social competence in the workshop since they all learnt to collaborate with children of different ages- from 6 to 11 years, which is quite an age difference. The group building was up to the children. There were several group building factors according to the facilitators. The girls preferred to build a group together. Just one girl worked in another group with her brother. Thus, main group building factors were gender, family relation and level of acquaintance. The facilitators helped organising the different roles within the group: *"example I would say "for this kind of thing you need a designer, like an architect, and then you need technical people, you need a programmer" and then I would observe how they took up their roles and this was like, there were some kids that were very into the technical stuff and they immediately took up the technical positions and jobs – they were responsible for cabling for example or positioning of the ventilator"* (FI 2).

Dealing with uncertainty

In developing the prototypes, the children worked autonomously, thus they did not follow a prescribed path and thus faced uncertainty at different points. The facilitators noted in the interview that the children experimented with different ways of doing things and adjusting their strategy accordingly. They gained the impression that participants enjoyed learning through trial and error a lot as facilitator 1 expressed: *"I think the approach of 'I do something and try it out' really empowered children. We have indeed communicated this message 'if something does not work, this is not at all a problem, then we try to find another way'"*. To create something with materials instead of merely writing ideas down on paper and combining materials to make something useful and not following a predefined path, had a great impact on the children, as facilitator 1 noted.

Perseverance

In relation to encountered roadblocks in the workshop, content wise there was one challenge, which was coding the Calliope, where children needed much support by the facilitators and where the otherwise used pedagogical approach to let them themselves explore and find out solutions and learn through trial and error did not work due to time restrictions. Otherwise the main challenge, according to the facilitators, was mainly of social nature. Facilitator 1 mentioned two children who on the first day would have some difficulties in integrating themselves in the group by showing off or doing something different. As the facilitators acknowledged the alternative way of realising a certain task, they started to enjoy the workshop a lot.

Facilitator 2 noted that most groups would just solve the problem on their own when they encountered a road block. For him group dynamics played a crucial role in this. However at the beginning when groups were not formed yet there was a situation where, confronted with a certain exercise – building a toothbrush robot -, some children did not really follow and *"just hang around"* and also would not ask for help yet (FI 2).

Regarding perseverance, facilitators noticed a big age difference. While the elder ones could keep their attention over a longer period, the younger ones were tired after a while. For this reason, the facilitators integrated rather spontaneously movement breaks. They had prepared some games where children had to jump around or run, often in combination with relevant workshop tasks, e.g. ask the children entrepreneurial questions and children had to run to a certain position to give their answers. As the attendance list shows, there was no drop out and continuous participation by all which further indicates a high level of perseverance.

Empathy and knowing others' needs

According to the facilitator interview (FI 1), the children could very well identify with the given topic of 'water' and 'energy'. They needed some orientation beforehand (FI 1, FI 2) but then their ideas and thoughts were just 'floating'. They could very well relate to big grand challenges such as the climate change, which was discussed, and they easily found problems they were concerned with and which stemmed from their own perceived reality.

Motivation and initiative

The motivation of the children was described by the facilitators (FI 1 and 2) as high, which resulted in a constant participation and no drop-outs. The child who was sick for a day wanted to come back as soon as possible and worried to have missed anything. Key for high motivation, according to the facilitators, was that the projects were about problems they were concerned with and that it was their ideas that were realised and turned into prototypes. Facilitator 1 formulated her observations as follows: *"'If I can choose my topic, which stems from my personal environment and I can create a solution by myself'…this really worked for the children. Creating and experiencing that the prototype works leads very soon to an experience of success. They saw: 'Ok, when I do that, I pour water in there and then the alarm goes off and the neon writing blinks', so they approached the problem and looked into it. They really enjoyed learning through trial and error".* According to facilitator 2, there were two factors positively influencing the level of motivation: *"Firstly the good timing – they had just returned to school from vacations, this was a good critical time point. Secondly, the exercises (…) were very rich exercises and the richness kept them very motivated throughout the process*" (FI 2).

Planning and management skills

According to the facilitators, the groups worked quite autonomously, thus they showed a great level of planning and management skills. They themselves decided, which materials were needed and planned on their own how to create the prototype – with the assistance of the facilitators (especially with coding the calliope). Some established a division of work to realise the prototype, e.g. they decided who would code the calliope and who would build the physical model.

Entrepreneurial identity

As mentioned above, the question in the questionnaire regarding the entrepreneurial identity showed a tendency towards being higher after the workshop, although the effects are not significant.

Also the consideration by the children when developing the different prototypes shows an understanding of entrepreneurial undertaking as they wanted to be innovative and invent something new that was not available on the market.

One exercise in the workshop was based on a simplified business canvas. Children did not have any difficulties in thinking neither about who they would collaborate with in order to fully develop the final product nor who would be the customers and what would be the goal of the product. However, they had little idea about the financial matters, how much the development would cost or what the product price could be. Facilitator 1 said that she had the impression that the DOIT action was successful in planting the entrepreneurial idea that children at the end were aware of the opportunity that inventions can be brought to the market and that they need to offer a unique selling proposition. Also facilitator 2 thought that eventually the experience might influence their decision making concerning their future careers. In the students' interview quite some expressed their wish to later become inventor or to work with computers or in a technical sector.

Other Skills

Additionally to the above listed dimensions, we have asked the facilitators in the interviews, what else they think, participants have learnt in the DOIT action.

Maker skills: According to facilitator 2, *"they learned how to build a system, that has a certain input and a certain trigger and a certain output, that has certain physical characteristics, certain aesthetic characteristics"* and to deal with systems with multiple functions. The analogue programming exercise taught them to think in *"different ways, or to think more rationally about a process"* (FI 2).

Presentation skills: Participants needed to prepare for the presentation at the final event and for a short video. They themselves thought of ways how to introduce themselves and the prototype. They talked to different people about the value of their inventions, which for facilitator 2 resembled really the entrepreneurial path: *"you meet the mayor of the city, you start collaborating and something happens, and this was I think very important"* (FI 2). He also believed that this created the highest impact in terms of entrepreneurial identity *"there they were proud, really showing something, it was like synergy was created"* (FI 2).

4.1.5 Prototypes as meaningful results

Lastly, also the resulting prototypes show the effects of the action. In total, 5 prototypes were developed, 4 bigger ones and a small one. The small one was an anti-theft device for chocolate; this was a side project as it didn't really matter with the given topic but since that group had some extra time they developed a second prototype.

One group developed a gas and smoke detecting system that would shut the door of the room where it is detected. The group showed an entrepreneurial spirit in their considerations as facilitator 1 noted: *"The children said: 'We do not want to build a smoke detector because this already exists. We want also that the door closes' as they knew that in case of fire all windows and doors have to be closed in order to keep the fire from spreading".* This clearly shows, that children thought about whether their invention would sell of if a similar device were already on the market.

Figure 4: Smoke detecting system

Another prototype was developed for cellar moisture alarm in case it was wet. The prototype was a model of the cellar with a washing machine. It even contained miniature clothes hanging on a clothesline. If the washing machine leaked, a ventilator would turn on and dry the walls.

Figure 5: Cellar moisture alarm

The third prototype was an alarm system for flooding of creeks. The real story behind was that the families spend time on the mountain pastures and that it happened quite often that creeks would flood, which was particularly a problem if this happened during the night. Facilitator 2 found this a particularly relevant invention: *"if you have such a system and you have 200-300 of these things that the kids built, then you can have real time high-precision tracking of flood. You can put on Danube from here to Dresden and in real-time track how the flood is coming and arriving to Vienna and in which is rising and have real-time data. I think this was already quite applicable to real life situations"* (FI 2).

Figure 6: Alarm system for flooding

The forth prototype was a ventilator system that would turn on a ventilator in case the temperature would rise to a certain degree. Interesting in this respect is the fact that the children were very aware that this is not a new invention since many rooms have air condition already. However, they stated that air condition might be not very healthy due to bacteria if not regularly maintained. Consequently they preferred a ventilator system, also because they saw the advantage that they could manipulate it in the way they wanted

Figure 7: Ventilator system

4.1.6 Impact on others

The DOIT action organised a final event where participants presented their prototype. Parents, the school director, the CEOs from the local electricity provider and a gas vendor, two firemen, two mayors, and a journalist were invited to the this event. As the facilitators noted the audience was really surprised by the innovativeness of the ideas and that it were actually the children to realise them (FI 1). The feedback was very positive as they acknowledged the usefulness of the prototypes that were solutions for real problems and discussed where they in fact could be needed. Especially the CEOs discussed with the children on possible further applications and adaptations, resulting in further ideas by the kids.

The school director asked to leave the prototypes in the school as she wanted the teachers to look at them and wanted to send them to a maker and Calliope training. She already had ordered Calliopes for one school class. She further asked if there was the possibility for another workshop or some smaller activities during the after school day care. The parents also gave very positive feedback and asked how they could further proceed in supporting their children with this approach and also buy a Calliope.

Two daily newspaper articles and one community magazine article were published on the DOIT pilot, which resulted in even more requests and cooperation (one cultural association and one social organisation) for organising similar workshops in the region.

Two prototypes were submitted at a national competition for water safety (Neptun-Wasserpreis 2019).

4.2 The CoC pilot in Billund

The DOIT action took place from 8th to 11th of October 2018 in the city of Billund with the duration of 16 hours in sum. In contrast to the other pilots, which involved smaller number of kids (18 and 28 children in the case of ZSI and MEPF respectively), the CoC pilot was huge in terms of numbers of participating children as well as facilitators (i.e. 135 children, 30 facilitators). Also it was special in the sense that the facilitators were themselves students, aged between 16 and 20, who had been trained two weeks before the pilot start to become facilitators. The venue of the pilot was two different schools in cooperation with a maker space with seven teachers and one maker supporting the pilot.

The focus of the pilot was ‘Nature and environment’. Technologies that were used comprised: Internet and computers for research, low-tech technologies such as Hot glue, scissors, etc. and high tech like smartphones for audio and video capturing and the game-based learning platform Kahoot!.

4.2.1 Participants

In total, there were 135 participants between 12 and 16 years. Thus, all belonged to the older age group and the number of participants was even higher than the planned number (100). The following table shows the age distribution. As can be seen most children were 13 or 14 years old.

Table 7: CoC participants' distribution by age

Age	Frequency	Percent
12	9	6,7
13	60	44,4
14	57	42,2
15	8	5,9
16	1	,7
Sum	135	100

The gender ratio was almost equal with slightly more females. Out of 135 participants, 71 (52,4%) were females and 64 (47,4%) males. Six children came from a less privileged background and 13 from a rural area.

The majority of the participants, 82,2%, attended on all days, 4,4% was present just on one day and the remaining 13,3% attended on two. Thus, the attendance was continuous in most cases.

4.2.2 Facilitators

In total, there were 30 facilitators aged between 16 and 20, most being 16 or 17 as the following overview shows. Also the number of facilitators was higher than planned (15-25 facilitators).

Table 8: CoC facilitators' distribution by age

Age	Frequency	Percentage
16	1	3,3
17	14	46,7
18	12	40,0
19	2	6,7
20	1	3,3
Total	30	100,0

Out of the 30 facilitators, about a third was females, i.e. 10 female and 20 male facilitators. The ratio of participants and facilitators was 4,5. All facilitators were continuously present with no drop-out.

4.2.3 DOIT action

The documentation of the workshops shows that most activities were rated well by the different facilitators. Of the overall 64 documented activities, none was rated with the value of 1 (i.e. has not worked at all). However, three activities did not work out too well (value=2) and 14 neutral (value=3), while the remaining majority of 47 received a value of at least 4.

The following table shows which activities worked best (maximum points in rating of facilitators). In the last column the respective DOIT programme element(s) are listed.

Table 9: Best rated activities

	Activity	Material/Machines	Programme Element
1	Making	Cardboard, glue gun, paper, thread, masking tape	Motivation Shared plan Co-operation Contact
2	Dodgeball	Ball and court	Shared plan Co-operation
3	Kahoot: with many different and random questions. Reward was a prize for the winners.	Either computer or phone	Shared plan Contact
4	Icebreaker Switch names		Motivation Co-operation
5	Presentations	Their models	Repeat Contact
6	Desk research: Insight into the subject	Computer	Shared plan
7	Product		Cooperation Creativity Making Shared plan
8	The students got a break. Our group + two teachers evaluated their performance and presentation.		Co-operation Evaluation
9	Evaluation of both days. A conversation about what worked and what did not. They received both praise and critique – the same did we. Stood in a circle and talked.		Motivation

Kahoot, an interactive learning tool, was used in several workshops and rated very positively. Also 'making' as activity was listed several times as best activity in the workshop documentation. The best rated activities comprise also some less typical ones such as Dodgeball and ice breakers, which show the importance to leave some space also for movement and ice breakers for starting the day.

In the following the least rated activities with a value of 2 are listed.

Table 10: Least rated activities

	Activity	Material/Machines	Programme Element
1	Brainstorming	Paper and pencil	Motivation Shared plan Co-operation
2	Icebreaker (talk about their day)		Motivation Reflection
3	Solving a prototype in teams of four	Wrapping materials, glue gun, micro-board, set of electronic sensors, multimeter	Repeat Reflection

Although some icebreakers were listed as most positive, the particular one is among the least rated activities. Talking about their days also does not constitute a typical icebreaker, which normally is a short and fun exercise that should motivate and activate people. Brainstorming exercises can be very boring if they are not well prepared and facilitated. Especially, when working with children, facilitators have to make sure that the brainstorming contains tangible and not too abstract concepts. Leading questions can help to steer the brainstorming activity.

The facilitators stated that they would change parts of the action although they also stated that they were very satisfied with the DOIT action in general (data collection file).

4.2.4 Effect of DOIT action on participants

Self-efficacy

N=117; missing data pre-test and post-test=18

The following table shows the significance levels of the performed samples t-test of pre and post-test scores. As can be seen the overall score, the general self-efficacy, differs significantly between pre and post-test. The other sub-dimensions of self-efficacy and the entrepreneurial identity do not differ significantly between pre and post-test.

Table 11: Paired sample t-Test questionnaire

Variable	Significance
Self-efficacy in relation to others	0.182
Self-concept of own capabilities	0.424
Self-Concept regarding problem solving/uncertainty	0.062
General Self-efficacy	0.029
Entrepreneurial identity	0.520

The General Self-efficacy is lower at the beginning of the DOIT action with an average score of 51,81 and slightly higher towards the end with the score of 52,67. Thus, the DOIT action has led to a measurable impact in terms of self-efficacy.

Students mentioned that they felt comfortable with the workshop and that they have learned that they can build something if they want to.

According to the facilitators students increased their self-esteem and self-confidence *"I think the were (very) tired but proud, because they did well"* (FI 3). This is also in line with the fact that the students identified themselves with the end-product, the prototype, to a high extend. The facilitator noted, that the usefulness of the prototype played an essential role. The older students (who were facilitating) had rather difficulties to understand the value of what they did, but could see the prototypes done by the younger kids.

Creativity

N=101; missing data Form A (pre test)=22; missing data Form B (post-test)=7

There are significant differences between the pre and the post-test in regards to creativity as the paired sample t-test shows (T=-7,005; df=100; sign=0,000). In other words, the DOIT analysis revealed a significant impact on the individual creativity of the participants. While the average (raw) score in the pre-test was 17,41, it was significantly higher at the end of the pilot with a score of 22,74.

According to the facilitators, the students *"...learned that it is good to be creative and I think they enjoyed that, not just theoretical all the time, but to be more creative ... be very focussed to make a project that could possibly be used in the real world"* (FI 4). Many students explicitly outlined in the feedback that they valued the fact that they were allowed to be creative. Creativity is mentioned several times in the connection of teamwork as well as to work with different facilitators in this workshop. According to the students' impression, the workshop setting had a positive impact on their creativity.

Teamwork and collaboration

As mentioned, the students claimed that they have learned how to work with others. Considering that the fostering of teamwork and collaboration was also set as one goal by the CoCs pilot, it is not surprising that this aim has been paid special attention to. For most students, working in teams worked well. However, facilitators also reported that some

students had issues to work in teams and needed more support to find their way on how to contribute to the group work (FI 4). This has to be seen in relation to both groups, the young students participating in the pilot, as well as the older students that were acting as facilitators: The CoC facilitators made clear that both groups had issues with the collaboration in teams. For the younger students it seemed to be difficult to collaborate due to the age, while for the older students –who were teaching the younger ones-, the twofold tasks of collaboration and the production of the prototypes were difficult to handle. Interesting in this respect is the observation of one facilitator that time pressure helped the older students to collaborate: *"…. they were under pressure and that pressure helped them work better together actually*" (FI 3).

Dealing with uncertainty

According to the facilitators (FI 3) it is difficult for some students to navigate in an uncertain and uncontrolled environment *"So for some students it was really difficult and some student also – this was normally the youngest students - to be in this room, where the rules were different than is normally in case in school. This was a different way of learning than they normally do – this made it more difficult for them to participate."* The fact that some students changed the working groups during the pilot increased the level of noise, which even made it more difficult for these children.

Consequently, facilitators need to understand what level of 'chaos' is advisable and can be still be handled by children, to give them sufficient freedom but also provide guidance. The right balance obviously depends on the participating students and their needs.

According to the facilitators, also the conflict between school and maker space is difficult for children to get over: *"Since students had some rules with their teachers at school, they had some difficulty breaking them, because the new rules were in conflict with the other ones. So I think it would be easier if one were to take them out in a different area, a different room."* (FI 3). Consequently the organisation of these workshops shall take carefully into account that the location and environment has (might have) an impact on the participants.

Perseverance

During the workshop, the students were sticking to the original plans, though some small changes and adaptations were done (FI 4). The students did not only set their goals, but even stayed within their set time frames *"I think they were pretty accurate in what they had planned and what they made and they were a bit like setting a goal for themselves: now you have to work in twenty minutes very concentrated and them you can have five minutes break."* (FI 4).

In terms of frustration and how it was handled by the students the facilitators could observe different reactions*: "… some of them were actually quite good in adjusting and tying over and going back and try once more, while others just needed help to get over that obstacle that didn't work and they just became frustrated. But I also think that they learned about each other, if they were watching someone else dealing with an obstacle or something like that and saw their frustration going away – it gave them more motivation to jump in and they had success with adjusting and finding other ways to get to their goal, it helped them."* (FI 3). Thus, working in a team had also the positive effect that students could observe and learn on how to manage frustration and finding other ways of handling roadblocks.

Empathy and knowing others' needs

In case of the CoC pilot, where older students acted as facilitator for younger ones, the workshop students mentioned that it was fun working with the older students from HHX, as *"... they could better relate to us and our thoughts. It makes it different and more fun than a normal day".* (CoC student feedback)

The dimension of relating to empathy and others' needs in the context of social challenges, the facilitators reported, that is was rather difficult for the students, since they were not familiar with social innovation. The pilot facilitators solved the problem by letting the student google and also giving them examples. This helped them a lot to find own issues they wanted to address. "*I think they are looking for finding solutions for their everyday lives*" (FI 3).

Motivation and initiative

Analysing the qualitative data, two aspects can be noted as highly influential on the motivation of the students. For once, many of them valued the 'different way of learning', meaning no usual school lectures, but learning that is done within a group of students and with facilitators that are also students as themselves (peer2peer). Thus, the different setting can be clearly identified as one motivational factor, even if some children were struggling with this different setting (pl. see chapter 'Dealing with uncertainty').

Secondly, the understanding that the own ideas and work has a real impact on somebody is a motivational driver for students - as regards for the younger students developing an idea and creating a prototype *"... but when they got the hang of it they were pretty motivated to make a product that could make a change for people."* (FI 4) - for the older students how much the given support was valued by the young students: *"In the beginning it was quite difficult for the older student to understand the process but when they were starting to see how much it gave them* (comment: the younger students), *they seemed quite motivated in trying to make this work. There was actually no one in that group that gave up – everyone managed to do it"* (FI 3). Consequently we can conclude that the awareness of (the possible) impact of an idea or prototype is highly motivating for students, independent on the age.

Entrepreneurial identity, Planning and management skills

Only few data could be retrieved in terms of entrepreneurial identity or planning and management skills. Still, several students commented in their feedback that they *"... have learned how to make a good product*" (CoC student) and that they *"...have learned social innovation and how to think outside the box" (*CoC student).

The facilitators relied on their own impression by commenting that the students liked to try and create things. They also belief, that they were able to give the students a new perspective on things and the environmental situation around the world (FI 4). "*I think, I hope they will take home that this is a way of changing things, that they can change things – they have the methods, they have the ideas, they have these strengths to change their everyday life if they want to"* (FI 3).

Other Skills

In addition to the listed dimensions, we noted that some students have also learned to steer their learning process themselves: *"I have learned that I learn better when I make the agenda myself*" (CoC student feedback).

4.2.5 Prototypes as meaningful result

Topics of the workshops comprised the following: Pollution in the city, How can we make the best cleaning system with the help of community? (workshop documentation) and resulted, for instance in, water filter systems. Impressions from the different workshops as can be seen in the following pictures.

Figure 8: CoC prototypes

4.2.6 Impact on others

As already described beforehand, the motivation of students was clearly raising once they have understood that they can create and develop solutions for real life. This is an important finding that already the awareness of a possible impact on somebody's life or environment of an idea or prototype is highly motivating for students.

Due to the peer-to-peer concept of the CoC pilot some impact was observed on the facilitation level: the older trained students that acted as facilitators for the young participants saw that their support had an impact on the young students in the way that they achieved better results: *"They made it possible for us to develop better and more creative ideas"* (CoC young student).

4.3 The MEPF pilot in Berlin

The DOIT action in Berlin took place on five consecutive days, from 29th of October until 2nd of November 2018, in a holiday week. Each day started with an 'open door' at 10 am where participants were already welcome and could do something on their own (like making notes in the diary that they received) and then the programme started at 11 am until 4pm, resulting in 25 contact hours (without the 'open door' hour). The DOIT action was called 'The future monster lab'. The didactic concept included confrontation with the future, the environment and sustainability. Through the maker actions the participants collected and processed used materials and got to know (digital) techniques and created their own 'future monster'. Technologies that were used in the action comprised the following: LED; Internet,

computers, sound modules, soldering and used engines. The action took place in cooperation with three other organisations involving three makers.

4.3.1 Participants

In total there were 28 participants. Of these, five participants (17,9%) dropped out after the first day, the remaining 23 participants attended continuously. The children all belonged to the younger age group with an age range from 7 to 10 as can be seen in the overview below. The expected target number of participants was met as the planned number was 15 to 30 participants.

Table 12: MEPF participants' distribution by age

Age	Frequency	Percentage
7	2	7,1
8	10	35,7
9	12	42,9
10	4	14,3
Total	28	100,0

Around one third of the participants were females (9) and two thirds males (19).

In the interview the facilitator said that she could not well explain why the participation of the two genders was so uneven. The invitation had started before she was involved in the project. However, the invitation leaflet was not gender neutral as it was even more tailored towards girls as she found. It showed a figure in a purple dress. Sometimes parents of boys would call up and ask, what the exactly the DOIT action was about and what their boys would learn there as they seemed a bit confused by the leaflet. Before the first workshop the facilitators briefed themselves towards a gender-neutral language use and avoiding gender stereotypes in working with the children. Also they introduced a code of conduct with the participants in the first session, which they acknowledged. The code of conduct was about how to work with each other that all rules apply to all. The facilitator described their approach as follows: *"In general, we tried to treat them all the same and to support everybody irrespective of their gender"* (FI 5). Nevertheless, facilitator 6 observed some gender typical behaviour in the workshop: *"There were the typical problem between boys and girls. The girls create something, the boys come in and take over and the girls retract. I tried to create with the girls when the stronger voices boys were not there (yet). I was programming with one girl in the morning, the boys come in and want to take over. I tried to let the girl teach the boys. But it did not really work, because she did not quite understand how it worked and found it difficult to explain to the boys. So when the boys showed they understood what she interpreted as more than herself she said: "ok you do it" and left to play with her friend(s)"* (FI 6). The facilitator said however that in general in the workshop there was not a big gender division in the kind of task they would pursue. Also girls would code thanks to the sufficient coding stations available.

In the student feedback the comment of one participant was: *"The boys annoyed the girls a lot – the girls annoyed the boys a lot"*. This was reflected also by the fact that the participants tended to form groups with the same gender (see 4.3.4).

It is always a tough topic for us, or to do such workshops. We always have stations for programming, soldering. Usually boys go to programming stations and girls go to what is left. In this workshop it was more equal. The girls did go to programming stations now. We had enough stations and we managed that one of the team was allowed to go to the station.

One child came from a rural area. There were no children with special needs although the facilitators noted that for some children it was challenging to be concentrated in the group setting. One boy in particular, was able to concentrate very well when he was in an individual setting but in the moment he worked in the group he was easily distracted, and would flounder and clown around.

4.3.2 Facilitators

The pilot had overall five facilitators but only three of them were there all the time, two helped in the last two days, thus resulting in a children-facilitator ratio of 9,3 for the first day, 7,6 for the second and third day and 4,6 for the last two days. We can only assume that the low ratio at the beginning might have contributed to the comparable higher drop-out of children.

Also the facilitator found the ratio insufficient in the first few days: *"For the age and the size of the group we would have needed more facilitators"* (FI 5).

Nevertheless the students found the facilitators supportive and "very nice" (Students' feedback).

4.3.3 DOIT action

The workshop documentation shows that almost all documented activities worked quite well (score 4) and very well (score 5). Of the overall 27 documented workshop activities, 6 were rated with the maximum score of 5 and 21 with the score of 4 respectively; only one activity was rated with the average score of three. No activity was perceived as not having worked by the facilitators. The most positive ratings were given towards the end of the DOIT action. A possible reason for this could be that the number of facilitators was higher in the last couple of days resulting in lower facilitator participants' ratio and thus being able to better support individual participants or that by repetition of some activities they went on smoother such as the intro activity, which was similar on all days and worked extraordinary well on the last three days.

Unsurprisingly in the overall evaluation of the DOIT action, the facilitators stated that they would change smaller parts of the action and that they were very satisfied with the DOIT action (data collection file).

The following table shows which activities worked best (maximum points in rating of facilitators). In the last column the respective DOIT programme element(s) are listed.

Table 13: Best rated activities

	Activity	Material/Machines	Programme Element
1	Intro- open arrival – day 3	a) First Steps in Coding with the Tetrapix-LED Wall b) individual time with personal sketch books	Motivation
2	Intro - open arrival – day 4	(a) First Steps in Coding with the Tetrapix-LED Wall (b) individual time with personal sketch books (c) Monster construction	Motivation
3	Intro - open arrival – day 5	Monster construction	Motivation
4	Monster show		Motivation Reflect Scaling Reaching out
5	End of the workshop clean up + summ up how do you value the whole workshop ● what was satisfying? ● what was unsatisfying/ what stressed you? you did a great job!!	seating circle monster mascot (speaker ball/ "mic")	Motivation Reflect Scaling

In the facilitator interview FI 5 described in detail the open arrival format (activity 1, 2 and 3) that took place in a similar way every day. In the first hour of the day the doors of the workshop location were already open, so participants could drop in any time. Since the DOIT action was scheduled in a holiday week this had also practical reasons so that parents could bring their children in time before going to work. The hour was used by individual participants to write in their sketchbooks or to make a drawing. This turned out to be very valuable for motivation. Also individual hints and support were offered by the facilitators during this hour.

The DOIT action concluded with the 'monster show' (activity 4) and a final feedback round, summarising and cleaning up (activity 5). During the 'monster show' the participants presented their group work, i.e. the so called future monster that they had created collaboratively. It was designed like a market place with a stage. A moderator invited one team after another to present their monster. Each monster addressed an environmental question or a fear that the children felt necessary that should be dealt with. As the facilitator said in the interview she was very much impressed by how well the presentation went. Not only parents were invited but also other participants from the location around where other activities took place at the same time. Each group was well prepared for the presentation and did a great job.

Also the final exercise worked very well in the sense that the DOIT action was rounded up and that it helped to digest and reflect on the lessons learnt.

Table 14: Least rated activities

	Activity	**Material/Machines**	**Programme Element**
1	Electronic name badge	Textiles + conductive sewing thread Copper tape + Cardboard LEDs (double pin diodes) Lithium coin cell batteries	Motivation Co-design Co-Creation

Creating an electronic name badge was rated with the lowest score as it worked only fairly well. Again this might be due to the fact that the task took place on the first day when the participants- facilitator ratio was quite high. The task might not be all that self-explicable and require more support by the facilitators. In the students' feedback the DOIT action was rated positively. Having had 'great fun' was mentioned by one participant. One found that one particular task was not useful. It was a task that was used to help structuring the collaborative construction work (Scrum): *"this task list was not useful as we knew anyway what we had to build or wanted to build. Even without writing down"*. Another one said how much he or she loved the workshops since you had an entire day for building things, while at school they barely had two hours for a similar activity. In the student interviews, one said: *"It was great that we really created a monster robot"* and one expressed their surprise that they actually succeeded in finalising all monster although they expressed also some disappointment that not all features worked.

4.3.4 Effect of DOIT action on participants

Self-efficacy

N=23, missing data in post-test: 5 (drop-outs)

As the following table shows the General Self-efficacy score differs significantly between pre and post-test, while there are no significant differences in the sub-scores as well as in the item 16 on entrepreneurial identity.

Table 15: Paired sample t-Test questionnaire

Variable	Significance
Self-efficacy in relation to others	0.657
Self-concept of own capabilities	0.107
Self-Concept regarding problem solving/uncertainty	0.144
General Self-efficacy	**0.029**
Entrepreneurial identity	0.186

The average score in the pre-test is 54 and in the post-test 57,14 thus resulting in an increase in self-efficacy by almost three points.

Creativity

Unfortunately the creativity test could not be used for the analysis as there were only three complete data sets.

Teamwork and collaboration

Some children came with their friends, so they partially knew each other. This influenced also the group formation where children preferred to work with their friends and form a group together. The facilitators did not interfere with the group formation. The facilitator (FI 5) observed that one or two children did not find a group immediately and needed support by the facilitators to choose a group, whose monster ideas fit their preferences. The collaboration within the teams worked very well, although also frictions were reported by the facilitator and some participants. Sometimes a hierarchy with one leading participant would evolve within the teams. Other members were described then as less active (FI 5). They would say then at the end of the day in the reflection exercise that if the leading child was missing, they could not go ahead, because that person was the only one with good ideas. Thus in this case the group dynamics might not have been that ideal if the group was only productive when it was led within. Also the facilitator noted that not all groups were equally well organised. Some needed more support by the facilitators.

In the feedback exercise children expressed that they enjoyed being among friends but also to get new people. Others said that they liked only the own group.

Some frictions between the genders were observed by one participant but also within same-gender groups. The girls group for instance would discuss about orthography in their design plans. The facilitator said in this respect: *"You can see there what is priority in the school context"* (FI 5). Inner-group conflicts and the sometimes intense atmosphere showed, according to the facilitator *"how familiar the children felt with the group, the facilitator team, the room concept and the whole workshop setting"* (Feedback report). They also noted a constantly fair communication, which indicates that the code of conduct rules, the 'Monster lab rules', were intrinsically adopted by all.

Perseverance

The perseverance of the participants was quite high with some individual differences (see below motivation). According to the facilitators, their approach was to interfere as little as needed and they mentioned only a few occasions in the interview were this was necessary: *"Something broke right before their final presentation. The team panicked and children began to blame each other. In this situation on of us tried to help and calm them down by asking questions, how they could repair the monster and what they could do in order to still make the presentation a success"* (FI 5). In order to avoid too much frustration, facilitators needed to manage their expectations, as some were too ambitious when they wanted to built in too many features in the monster (FI 6).

Empathy and knowing others' needs

The facilitators introduced the topic of recycling and upcycling and ‚how the world will look like in future' by installing several stations with tablets and QR codes, which then showed videos on pollution and micro-plastics in the ocean and other threatening environmental changes. They received a sketch book and were advised to note down their ideas inspired by the information provided. The task worked very well in the sense that the children could well identify with the topic and explicate their fears resulting in 'monster' prototype (FI 5).

Motivation and initiative

The level of motivation of the participants varied between the children and depended also on the activity as the facilitator said (FI 5). In general the facilitator said that the motivation was rather high due to the fact that the workshops constituted a good balance between set structures and free choice. It was also positively influenced by the fact that many came with their friends. The open doors format in the morning where children would flock in one after the other and where they had some individual time to write and draw in the sketch book was particularly motivating according to the facilitator. After lunch they made sure to spend another half hour in the outside where children could run around. The facilitator however also reported of one activity that got almost destructive for some children and did not have a positive impact on the level of motivation: *"They were allowed to dismantle our scrap metal and technical equipment and sometimes this turned into uncontrollable destruction"* (FI 5).

Entrepreneurial identity

In the student interview a few mentioned jobs they wanted to do later that were creative and most self-employed such as architect, florist, crafting statues, fashion designer etc. However, it is highly interpretative to link these with the DOIT action.

In the questionnaire there are no significant differences between the pre and the post-test. The average score in the item on entrepreneurial attitude is somewhat lower towards the end of the DOIT action, although the difference is not significant and can thus not be interpreted as such (pre=3,87; post: 3,74).

Other Skills

When participants were asked by their peers during the interview what they had learnt during the DOIT action, they mentioned **maker skills** in the first place: building a robot (which they had never done before), soldering and programming sound and light modules, working with LEDs. One participant described how he or she learnt new things about soldering and how to be cautious with the hottest spots. Another one described overcoming the fear of getting bruises when soldering and how this turned into being proud of oneself that he or she actually succeeded and that after all it was fun. Also the facilitator mentioned improved technical skills in the interview: *"They have appropriated technology, have learnt to code and to solder, to dismantle things and to understand relations. They have opened up black boxes"* (FI 5). They have changed their attitude towards making things as FI 6 said in the interview: *""We can make stuff! We are makers, we don't need factories!" I don't mean they are fantastic makers now, but they get less fear of making things"* (FI 6).

Besides maker skills, the participants mentioned having learnt about **environmental** challenges such as plastic waste and developed ideas hot to protect the environment. According FI 6, the children liked to think about the future. Also they became aware of environmental problems we have to tackle.

Furthermore, the facilitator (FI 5) was very much impressed by the **presentation skills** of the participants at the final 'Monster show'. She described herself as feeling very proud of the children and what they had achieved and observed also how proud they were and that they obviously had much fun.

4.3.4 Prototypes as meaningful result

The five prototypes that were developed during the MEPF pilot were robots/monsters that represented a fear concerning environmental threats or that were meant to address a specific environmental challenge: *"The monsters do not necessarily solve the problem, but helped the children deal with the global problem (...) The combination of a topic and to do something with it makes a click in their brain. They took it home, talked about it. I think the main way the children connected to the problems was giving them this input to start talking about it"* (FI 6).

The process started with a rough plan visualised on a flipchart that the each group developed. According to the facilitator, this did not work all too well (FI 5). Only after posing leading questions (e.g. How shall the monster look like? What shall it address?) the participants were able to sketch the plans. The next step on the following day was to come to a more detailed plan. However, some of their initial ideas turned out to be too comprehensive in order to be realised in the remaining time of the DOIT action. Again leading questions would help to come to a more concrete and realisable plan that was visualised on another flipchart. These questions were: Which three core features should the monster have (e.g. light, motors, sound etc.)? Which three characteristics? The realisation of the plan was then structured with a canvas board (Scrum). Sticky notes were placed on the wall under different columns: what has to be done? What are we currently doing? Sticky notes were moved from one column reflecting the progress of the project. The participants themselves structured the working process and the facilitators only interfered as much as needed but offered support throughout.

They facilitators installed different stations equipped with different tools, which were each supervised by a facilitator, so that participants would not hurt themselves when soldering for instance. When the monster was finalised the facilitators took a picture as take-away for the participants as it was a group work and thus could not be brought home. Also some parts of the monster had to be removed because they would be needed in future DOIT actions.

Examples of final prototypes are the following:

The Monster called 'Big Bobby' was developed to filter micro-plastic in the ocean. For this, they equipped the monster with a shower hose. The monster was supposed to swim and furthermore I a light chain and a sound module was installed. The sound module would play what they had recorded ("I remove micro-plastic from the sea"). One of the team coded the light chain on the computer so that the LEDs would show a pattern. This didn't work at first (Student interviews).

Another one was to protect animals if their natural habitats are destroyed. The group soldered a lot and built in lights. One girl was very much afraid of soldering but when she finally did she was very proud. The facilitator reported that her mother came the next day telling her how much fun it had been and how proud the girl was. The monster was meant to light up when a hedgehog would cross the street in order to protect him by being harmed by a passing car. Also it would scare away hunters and protect animals from animal experiments (Student interview). Furthermore, the monster had blinking eyes and a mouth that could say what had been recorded on the built-in sound module ("I save animals").

The third monster was meant to collect garbage from the street and it had the shape of a car. It was the only monster, according to the facilitator (FI 5) that was somewhat close to a real product in the market sense.

One monster was developed by a group of participants who seemed quite destructive with one exercise where they had to dismantle technical equipment. So the facilitator was very much impressed by their creativity, which led to a monster full of details (FI 5). It had arms out of bottles and strings that could be torn, it had a calculator and a sound

module built in, which would say the result out loud. What the monster was about the facilitator however could not recall.

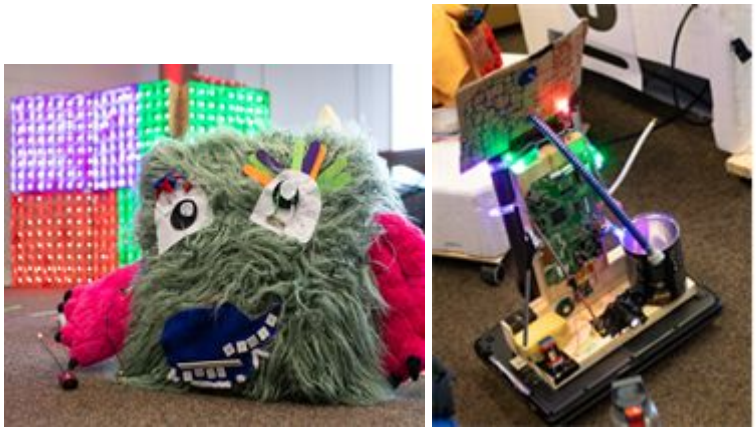

Figure 9: MEPF artefacts

5. Conclusions and Recommendations

In this chapter we will summarise and answer the research questions as defined in chapter 1, which formed also the structure of the pilot subchapters as described in detail above. The reader should bear in mind however that the following answers to the research questions are based on preliminary findings. Nevertheless the analysis of the first three pilots is very valuable to distil first lessons learnt and to gather recommendations for improving the following pilot actions.

The **first** research question relates to the **participants**. In the three pilot sites, the actual participant number outperformed the planned number as described in D4.1. Only in the ZSI pilot there was a small deviation of two children. In relation to the gender ratio among participants we can say that there is balance overall as 47% are females. Thus, the goal of including at least 40% females has been reached. However, it has only been the case as in the CoC pilot there were more females, which compensated for the fewer females who attended the ZSI and MEPF workshops. The key explanation for the fact that there were fewer in the two pilot sites of MEPF and ZSI, and more females in the CoC pilot, might be the different setting. While in school-setting, females are not particularly difficult to involve, it is obviously much harder in out-of-school settings to attract female participants, although both practice partners paid particular attention to address females specifically. Also the goal to include children with different skills and background has been met so far as six children come from a less privileged background, two have a special needs condition, 32 come from a rural area and one was named an advanced maker. The drop-out rate ranged between 0 (ZSI) and around 18% (MEPF). A probable reason for the higher drop-out rate in the latter one might be caused by the high participants-facilitator ratio at the beginning of the MEPF pilot. The constant participation in school-settings such as in the CoC pilot, is obviously due to the fact that school attendance is compulsory. Overall leaving aside the drop-outs, the participation was continuous in all pilots.

The **second** research question concerns the **facilitators.** As the analysis shows, the ratio of children per facilitator was 4,5 in both ZSI's and CoC's pilots, and ranged between 9,3 on the first day and 4,6 on the last day of the MEPF action. We can only hypothesise that the higher ratio of children per facilitator at the beginning in the MEPF pilot might have contributed to the drop-out of participants. Especially the younger children group even needs more support by the facilitators compared to the older ones. This was also the impression of the ZSI facilitators who

recommended in the interviews to have a lower ratio than 4,5 with the younger cohort. Some tasks are richer than others and require more support and thus the facilitator ratio has to be taken into account when designing the action (see recommendations). Another goal in respect to the facilitators, was to have at least 40% female facilitators, which was almost met with a percentage of 37,5 female facilitators. Looking at the specifics of the three pilots, the ratio was exactly met in the ZSI pilot, MEPF had even 60% female facilitators, while the CoC pilot had only 33,3%.

In average facilitators were 20 years old, ranging from 16 to 44 years, while most of the younger facilitators were active in the CoC pilot, which had a special focus on training teenagers to become facilitators themselves (peer2peer learning).

The **third** research question addresses the DOIT actions and which elements worked particularly well and which didn't. The idea is that the best rated activities might be inspirational for other practice partners to eventually incorporate these in their own workshops. The second aim is to further describe them in more detail for the DOIT toolbox in synergy with WP 2. In general most DOIT activities were rated positively and for almost every DOIT element at least one activity received the highest scores (Motivation, Shared plan, Co-operation, Repeat, Reflection, and Contact). The only DOIT element with no corresponding positive (and also no negative rated) activity was Measurement (Do more of it). The best rated activities comprise also rather atypical maker activities such as icebreakers or physical movement and games. This shows again that is important in the design of the workshop to incorporate sufficient space and time for participants to do something else in between working on the maker project. This is crucial especially for the younger kids whose attention span is limited but also the older kids enjoyed motivating games in between where they could move around. Also the more typical maker activities received high scores by the facilitators and in the student feedbacks these were often recalled as very positive. For preparing participants to code analogue programming exercised turned out to work very well. The presentation part where participants prepared to show their prototype to a bigger audience was also rated in most cases as very positive experience.

The more challenging DOIT activities comprised activities where participants should link own ideas to the overall topic, which showed that the topic has to be well introduced and prepared and broken down to the participants' context. Also brainstorming exercises can be quite boring if they are too abstract and if they comprise only the typical 'adult' materials such as paper and pencils.

Fourthly, the research question regarding the effect of the DOIT action on the participants can clearly be answered with the compiled data in relation to the quantitatively assessed dimensions, i.e. creativity and self-efficacy. There is a significant difference in the overall self-efficacy between the pre- and the post-test. Towards the end of the pilot, the average score is significantly higher than the initial score at the beginning of the pilot. Thus, the overall self-efficacy among the participants has increased. This finding is surprising given that the DOIT action itself comprises only 15-25 hours of 'intervention' and given that other studies came to contrasting findings. A study with college students in the Netherlands (Oosterbeek, Van Praag, & Ijsselstein, 2010), which installed a mini-company, resulted in negative scores in respect to entrepreneurial intentions. There are, however, no significant differences on the two subscales "Self-efficacy in relation to others" and "Self-concept of the own capabilities" but yet significant differences on the subscale "Self-concept regarding problem solving and dealing with uncertainty". Thus, we could speculate that the DOIT action has put participants in situation where they learnt to deal with uncertainties and were they perceived themselves better equipped to solve problems after their participation in the DOIT action.

There is also a clear indication that participants' creativity is addressed in the DOIT action. In the creativity test, they had significantly higher scores at the end compared to the scores at the beginning. In average, they improved by more than 5 (raw) points, from an average of 17,13 to an average of 22,53. This is also a very interesting finding given that other studies on entrepreneurial education lacked to prove an effect on personal qualities, namely creativity and self-efficacy as Rizza and Varum (2011) show in their meta-analysis of 40 studies on entrepreneurship education.

This meta-study however is limited to high school pupils. Another study with primary school pupils in the Netherlands (Rosendahl Huber, Sloof, & Van Praag, 2014) yields similar results as our study does. In this 5 days lasting field experiment with primary school pupils significant effects were found on the non-cognitive entrepreneurial skills but not effects on cognitive skills and eventually a negative effect on the entrepreneurial intention. As in our study the participants increased their self-efficacy and creativity among other non-cognitive skills.

Participant as well as facilitators agreed that the DOIT action fostered the creative development of ideas.

Complementing the quantitative data, the interviews and feedback forms support the statistical findings and enrich with further insights.

Although only two pilots could be used for the analysis for creativity, the facilitator as well as the students’ feedback confirmed a high level of creativity that was enabled during the workshops. According to the facilitator, creativity requires other dimensions like the ‘right’ environment or location, a fitting workshop setting, the usage of different materials and frames that allow freedom but also decrease uncertainty.

Also the group work in teams turned out to work well for most of the students. Facilitators from all three pilots reported in the interviews that some kids need more support than others. However, at the end the students found ways on how to develop ideas and finalise the prototypes together. Interesting in this respect is the observation of one facilitator that a certain time pressure helped the students to collaborate better.

As reported by the facilitators, using different materials or dealing with situations that are unknown challenges kids and can foster creativity. On the other hand some kids have difficulties to adjust to such a new environment. Consequently it is advised to carefully select environment, material, methods a.s.o. A balance between known and unknown elements is advisable to open up for creativity, but give sufficient guidance for children that need a more secure environment.

The perseverance of the participants was quite high - with some individual differences. This is also the case for the dimension motivation. However, open workshop formats as well as the relation to real life problems are particularly motivating for students.

All pilots facilitators reported, that they needed to introduce well the topics with different methods (ie. questions, videos, Google search, ...) so that the children could identify with the topic and start developing their creative ideas. Thus some first input is clearly needed to understand other ones’ needs and issues. It is recommended to plan this introduction very carefully to allow the students to get quickly into the topic and find adequate issues and problems they would like to work on.

Several facilitators had the impression that the DOIT action was successful in planting the entrepreneurial idea and that eventually the experience might influence their decision-making concerning their future careers. Given the fact that these pilots were done with fairly young children, the entrepreneurship thought might be more difficult to implement than with older students since they have no pre-knowledge of markets or production. Thus, it is recommended for the second pilot phase to set one highlight on methods and exercises that target entrepreneurship, especially for young children.

Next to the mentioned findings other skills like specific knowledge on topics (like programming, nature issues,...), maker skills, presentation skills and understanding of individual learning styles were gained by the students.

As a result of the above described preliminary findings, first recommendations have been compiled in order to undertake formative evaluation and thus to improve the ongoing pilots in phase 1 and to eventually adapt the

workshop as well as the evaluation design and procedures for the phase 2 pilots. The recommendations have been clustered around the following topics: participants, facilitators, DOIT action and evaluation.

Participants

- Female participants are more difficult to attract in out-of-school settings. It is important to particularly address them in order to reach them. This can be achieved through specific invitation channels that reach girls more easily. Also how the invitation is designed (in terms of language and pictures used) can have an impact on the gender ratio.
- Gender sensitive language is important also throughout the workshops. It would be good to reflect and brief the facilitators before the first workshop (as some pilots already did).
- It makes a difference if an activity is performed in the framework of the school environment, or if it is held in another (out-of school) facility since some guidelines or agreements might contradict with the usual day-to-day school environment. Some students find this confusing and is difficult to handle for them.
- Understanding that the own ideas can have a real impact to somebody is a high motivational factor for students.

Facilitators

- The younger the age group the more facilitators are needed. For 6 and 7 year old children the recommendation is to have one facilitator for three children each.
- Also some exercises need more support e.g. coding exercises if there is no pre-knowledge in the group. This has to be taken into account when designing the workshop.
- Lacking support by facilitators caused by a high participants-facilitator ratio might lead to drop-outs early in the DOIT action.
- The group dynamics among participants and socio-emotional component plays an important role in the group formation and interaction of the participants as well as the division of tasks in the different groups. Facilitators need to be attentive to these components and mitigate in case it is needed so that all participants feel welcome and that there is a good balance between dominant and less dominant children for instance. Reflection exercises among the facilitators help to sharpen their observation skills and to prepare facilitators for remedy.
- The group formation can be demanding, especially if some participants know each other and others don’t. It is up to the facilitators to react very sensitively and to steer the group formation and eventually have gender mixed groups (or not) or have siblings work together (or not). It highly depends on the situation what is more advisable.
- In order to further support fair communication and collaboration between the participants it is recommendable to discuss code of conduct rules at the very beginning.
- Pilot actions should be carried out by at least 40% female facilitators. This is particularly important as it is known from gender studies how important female role models are.
- Especially with younger children it is advisable to have a fixed facilitator per group who can more closely support each team and so there would be a constant person of reference.
- Facilitators need to have the right understanding of the ‘maker’ activity in terms of letting the students decide what to create and how to proceed. The facilitator needs to support the children by asking the right questions and give advices but should not direct the children in one or other direction. It is essential to make the facilitator aware of this issue and possibly give good training on this issue.

- Find and integrate tools and methods that allow (especially young participants) to integrate the entrepreneurship thought better.

DOIT action

- Preparation is key (this was repeated several times)! There needs to be a balance between good preparation of the workshops and adapting on the fly and being prepared for the unexpected. However a good planning allows a certain degree of flexibility in the first place.
- Also all facilitators ideally are trained in all exercise (e.g. all know how to code in a coding exercise).
- Sometimes it was difficult for the children to link own ideas for prototyping with the overall topic of the workshop. Thus, the introduction to the topic has to be well prepared and prompts have to be given at various occasions.
- Leading questions such as what shall the prototype address, which problem shall it solve and for whom can steer participants towards very concrete ideas.
- Exercises that are directly addressing the entrepreneurial spirit and undertaking were lacking according to some facilitators. The ones that were available such as an adapted and simplified version of the business canvas did not seem suitable for the children, especially the younger age group. A more playful and fun approach would be needed e.g. role playing.
- Some prototypes seem a bit far away from representing an (socio) entrepreneurial artefact. When planning the DOIT action it should be kept in mind what the ultimate goal of the workshops are and participants have to be supported in reaching their aims.
- Exercises that allow participants to dismantle technical equipment can turn into destructive behaviour. These exercises therefore have to be well accompanied by facilitators.
- The students need support in the timing. Most of the students need clear guidance and limitations for tasks; in some cases time pressure is even supportive for collaboration.

Evaluation

- Attendance sheet: We ask for the gender of the participants and facilitators but have not yet introduced a third option, which was criticised by practice partners. We will introduce a third option (diverse) in the next pilot phase.
- Attendance sheet: We will omit the parents' job information since it was difficult for the practice partner to get accurate information. Most children did not exactly know what their parents did.
- Attendance sheet: We will include the duration of the workshop on each day (not only the dates) in order to calculate the attended hours per individual.
- Creativity test: We will produce a checklist to administer the creativity test since some things tend to be forgotten (do not sit participants too close to each other as they copy from their neighbours, ask participants for a title of the drawing, note down the time taken, no other tools besides a pencil or black felt should be available – e.g. no rubber, no ruler, the correct ID on the drawing is important)
- Self-efficacy questionnaire: For phase 2, we will re-formulate some of the questions in order to use a gender neutral language e.g. 'other children' instead of 'other girls and boys'. We will critically go over all items again in order to understand where items can be improved to further enhance reading comprehension especially among the younger children.
- Student interview: Students interviewing other students need support by the facilitators (especially the younger children). In general we recommend that interviewers should at least be ten years old. Before doing the interview a briefing is necessary in order for them to really fulfil the role of a co-researcher and to

produce meaningful data e.g. what is the aim of the interview? Why do researchers do interviews? How to do an interview? How to record the interview?

- Overall we have noted that the transfer of data after completing the pilot takes longer than expected. For pilot phase 2 we need to make some adaptations in order to make the evaluation more efficient.
- It is important to make the facilitators understand the importance of the evaluation, not only for the project but also as feedback for their own performance.
- Some activities might have additional potential for feedback and evaluation. These activities should be pointed out and possibly evaluated in addition by the organisation.

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APPENDIX

A Questionnaire

Name

Date

Workshop

Location

Please read each question carefully and indicate what applies to you.

	Question	not at all	rather no	undecided	rather yes	yes totally
		--	-	0	+	++
1	Are you afraid to doing things you have never done before?	O	O	O	O	O
2	Are you as clever as other girls and boys?	O	O	O	O	O
3	Can you do most things without the help of others?	O	O	O	O	O
4	Do you know which things you can do well?	O	O	O	O	O
5	Can you do a task even if it is hard?	O	O	O	O	O
6	Can you do as much as other girls and boys?	O	O	O	O	O
7	Do other children know more than you?	O	O	O	O	O
8	Can you do most things as long as you do not give up?	O	O	O	O	O
9	Are you afraid of doing tricky things?	O	O	O	O	O
10	Do you often succeed better than others?	O	O	O	O	O

	Question	not at all	rather no	undecided	rather yes	yes totally
		--	-	0	+	++
11	Can you figure out new things even if they are very tricky?	O	O	O	O	O
12	Do you prefer trying new things to things you are used to?	O	O	O	O	O
13	Can you learn new things that are shown to you?	O	O	O	O	O
14	Do other girls and boys often have better ideas than you?	O	O	O	O	O
15	Do you prefer not to learn many new things?	O	O	O	O	O
16	Do you want to become your own boss?	O	O	O	O	O

THANK YOU!!!

B Workshop documentation

Workshop data

Date: _____

Duration: _____

Location: _____

The aim of this documentation template is to document the DOIT action, stimulate reflection on the workshop's format, in order to learn from the own experience and to further improve the following workshops. Thus, the workshop documentation is an essential part of documenting and evaluating DOIT Actions.

Please reflect immediately after the workshop and fill in the documentation in order to not forget important aspects. If there are multiple facilitators for a single workshop, this could be a good opportunity to reflect about the workshop as a team. However, we only need one evaluation per workshop.
We understand that this can be a lot of work, if you have 10 or 15 workshops so we would like to ask you to ***document at least half of your workshops and at least 3 workshops*** *(e.g. in case you have only three workshops) (see also excel sheet).*

Workshop action

Have a quick look at the following table, with five columns:

- **Duration** - how long did the activity take
- **Activity** - some core things / meaningful examples
- **DOIT Element** - choose those elements that fit best, especially if you could provide concrete examples (e.g. how exactly was reflection encouraged). Following a short reminder of all 6 DOIT elements:

  A. Motivation (Do it because you can)
  B. Co-design (Do what matters)
  C. Co-Creation (Do it together)
  D. Iterate (Start it now)
  E. Reflection (Do it better)
  F. Scaling (Do more of it)
  G. Reaching out (Do inspire others)
- **Materials & Machines** - ... things you used ,
- **Self-Rating** (what worked / what didn't)

Also, if you fill in the table, more important things come to mind first - it's OK to put things down in any order you like. There is no need to order them chronologically. In the table you find two examples to illustrate what to do.

Duration	**Activity**	**DOIT Element**	**Material/Machines**	**Self-Rating 1 to 5** (1= has not worked at all to 5=has worked very well)
1 hr	Formulating a social innovation challenge	(B) Co-design (C)Co-creation	Post-its	1 – 2 – **3** – 4 – 5
4 hrs	Prototyping one solution as a team of 4	(D) Iterate (E) Reflect	Packaging materials Hot Glue-Gun Microboard - Calliope Set of electronic sensors Multimeter	1 – **2** – 3 – 4 – 5
				1 – 2 – 3 – 4 – 5
				1 – 2 – 3 – 4 – 5
				1 – 2 – 3 – 4 – 5
				1 – 2 – 3 – 4 – 5

Thank you very much for filling in the documentation!

C Reporting of Students’ feedback

The aim of this documentation template is to document the workshop feedback by participating students. It needs to be filled after the last workshop of the DOIT action.

Date: _____

Pilot location: _____

Please briefly describe how you have collected the students’ feedback (min 50 words)

Please describe the gathered feedback. *(e.g. How did students like the workshops? What did students say, what they have learnt?) (min 50 words)*

Please describe how you have dealt with the feedback*. E.g. in what way have you changed the set-up following the gathered feedback?* If you have collected the feedback only at the end, what would you change the next time?

D Facilitator interview guideline

Date:_____

Pilot country:_____

Interviewer:_____

Interviewee:_____

Before starting the interview please check whether consent form has been signed!

Please follow the interview guidelines. Adaptations of questions are welcome if the suit the evaluation purpose of the interview.

- Introducing interviewee and interviewer
- Short explanation: Aim of interview and information about anonymity, duration of interview

1. Was it easy or difficult for students to identify social challenges? What role did the awareness of social problems play? (Awareness of others' problems)
2. Please describe the top two resulting artefacts (prototypes) of the DOIT actions! (Please send also some pictures of these prototypes)
3. Please describe a scenario where these prototypes could be used!
4. Please think of one of these prototypes. What was the process to realise the prototype?
5. How would you describe the motivation of students over the course of the DOIT action? (Motivation)
6. What do you think did the students learn/take home?
7. How would you describe the teamwork among the students in the pilot? *E.g. students worked collaboratively, worked in isolation…(*Teamwork)
8. Which roadblocks did students encounter and how did they deal with them? How would you describe the perseverance (=sticking to the tasks) of the students? (Perseverance)
9. Did you observe any challenges that made it difficult for some students to participate *e.g. language barriers, disability, had to leave earlier, etc.*
10. How did you support the reach of girls? Was this successful?
11. (Additional questions in relation to evaluation criteria mentioned in the pilot description template.)
12. Is there anything else you would like to share?

- Debriefing

E Student interview guideline

Date:_____

Pilot country:_____

Interviewer:_____

Interviewee (ID):_____

Note: We would love to encourage students to interview other students (above the age of 10). Please equip interviewing students with this interview guideline, a voice recorder or mobile phone to record the interview and to take pictures of the prototypes and brief them how to do an interview.

The interview guideline for students is structured as follows and does not need to be strictly followed:

1. Please tell me your name and how old you are.
2. What did you build/do in the DOIT workshop? (+take a picture of what was built)
3. How does it work?
4. How did you build it?
5. Which new things did you learn?
6. What kind of work would you like to do as an adult? Why?
7. Is there anything else you would like to share?

- Thank you very much! Goodbye

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