eCraft2Learn

Digital Fabrication and Maker Movement in Education

Making Computer – supported Artefacts from Scratch

Deliverable D3.2

Description of Use cases (M5)

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TABLE OF CONTENT

TABLE OF FIGURES

TABLE OF TABLES

EXECUTIVE SUMMARY

This report is the first one of a series of reports establishing different use cases. Thus, this report is divided into a first section that outlines the methodology on how different use cases are established and a second part that describes some first initial use cases. All use cases will go through a consolidation process. Further use cases will emerge during the lifetime of the project and existing use cases will be amplified by different methods.

1. INTRODUCTION

Deliverable 3.2 provides a first conceptual, methodological and practical framework for the eCraft2Learn project use cases. This first deliverable is based on initial desk research and work by WP3, WP4 and WP2. Thus, the first part brings the use cases in the context of these workpackages and outlines the methodologies for establishing use cases for eCraft2Learn technologies and processes.

Whereas deliverable D3.1 builds the pedagogical backbone, this deliverable puts its focus on possible application scenarios, integrating feedback from potential users. This document presents also the first version of the delineation of scenarios and use cases and will serve as a living document to be refined in an iterative way along the project from April 2017 (M4) till March 2018 (M15). The first co-created use cases describe use cases established via desk research and the expert knowledge of project partners, who provided initial insights into the usage of eCraft2Learn and possible outcomes.

Thus, the structure of this document reflects these two vital points - methodology and use cases - by outlining first the aims and objectives (section 2), the framework (section 3), followed by the methodology for creating the use cases (section 4), context screening (section 5) and the first three seeding use cases (section 6). Chapter 6 gives also an outlook for the next possible use cases to be delivered in month 10. Chapter 7 summarizes the findings.

The eCratf2Learn craft- and project-based learning methodology

The eCratf2Learn craft- and project-based learning methodology consists of five stages (Figure 1) aimed at learning through projects and producing a computer-supported artefact. Inquiry-based learning usually starts with students posing questions, problems or scenarios, and the process is supervised by a 'coach' (teacher acting as a coach). In inquiry learning approach, students identify study issues and formulate questions in order to develop their knowledge or solutions. This process is usually intrinsically argumentative whereby the students create questions and obtain supporting evidence to answer these questions. Project-based learning is based on the inquiry-based learning approach, but instead of building the arguments the students work around projects, which guide students' activities. We add the design thinking method as a hands-on counterpart in order to enhance maker activities and promote a producer view with the students. The five stages which are integrating project-based and design thinking methods are the following: 1) **ideation** through exploring the world outside the classroom, virtually or concretely and defining the problem, 2) **planning** and collecting the information for making the project plan, 3) **creation** of a computer-supported artefact using do-it-yourself technologies, 4) **programming** through using high-level programming language and 5) **sharing** and presenting what has been created and getting feedback from the professionals of the field.

The eCraft2Learn ecosystem deploys a craft- and project-based methodology. Via the web-based eCraft2Learn working platform, learners, teachers (coach, facilitator) and experts, are enabled to work collaboratively, open, playful and non-judgmental environment that supports learners' creativity. Learners are encouraged to walk around and collaborate freely with other students and to share ideas and solutions with peers and teachers.

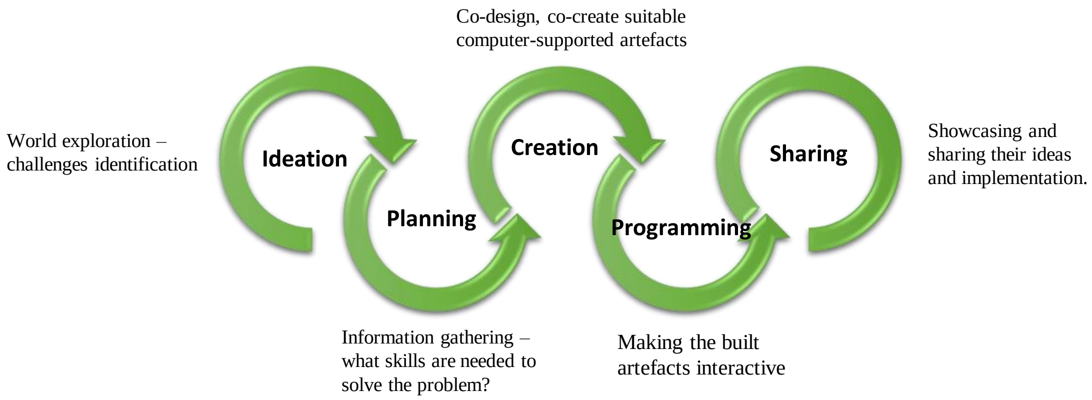

Figure 1: Five stages of craft- and project-based learning methodology

2. Aims and Objectives

With the rise of the maker movement (Anderson 2004), a new way of constructing interactive, digitally enhanced devices by young students, emphasizes learning by constructing not only mental models, but also personally meaningful artefacts. The new digital fabrication technologies, that are accessible to many, have gained importance for education and are entering into schools and spare time activities (Katterfeldt 2015).

In this environment which mixes the new maker movement, open innovation, pedagogy and technology, the gist of the idea behind the use cases is that they help to focus on the intended user of the eCraft2Learn services, rather than on the technical challenges of how to develop those tools and services. Thus, the likelihood that we develop tools and services that are actually useful for and usable by the target user increases.

Thus aim of this set of deliverables (two further versions in month 5 and 10) is also to reflect on the diversity of the end-users, captured in a combination of use cases, user stories and design claims, including – in the second and third version - the description of personas[1]. It puts its focus on possible application scenarios and integrating feedback from stakeholders.

As outlined in the DoA of eCraft2Learn, the use cases will be developed particularly for providing also insights into:

(1) Preparation, planning and logistics of - formal and informal - learning units,

(2) Orchestration of subsequent learning events and

(3) Impact (like empowerment of learners), especially in formal settings.

Thus, this deliverable takes the stakeholders of the project a step forward to outline on a more practical level the implications, needs and organizational necessities on the maker movement, the pedagogical perspective (ie. What learning model will be chosen? or How do we operationalize the open learning or the making?) as well as technical perspective (ie. Which tools shall we include in

[1] All concepts will be introduced with more detail in chapter 4.

the portal? How do we need to design the technical solutions in order to be user friendly?).

Guiding principle for the development is a participatory approach that will include teachers, learners, researchers as well as programmers. Participatory design aims to tightly align technical development with the needs of learners and teachers. This process starts with understanding the learning situations of the pilots as a whole and related implications for technology design in general (e.g. use conditions, appropriate terminology, required support and embedded guidance), creating some first use cases - D3.2 in month 5. It also forms the basis for discussion of the local development teams that will be established. The frequent exchange between end-users and developers, as well as the qualitative (interviews) and quantitative (questionnaire) data will further elaborate the use cases - D3.2. in month 10. Focus of D3.2/month 15 will be the usage of design instruments such as self-drawn mock-ups, photo diaries to capture learning processes and workshops to create a shared understanding of the needs.

It thus does not attempt to examine the detailed workings of individual cases, but instead to draw out from these the main elements which can be used to better understand the impacts they are having on the technical development and the pilots.

3. Design Framework: Conceptual models, practice and open innovation

3.1. Pedagogical Design and First Conceptualisations

The objective of this chapter is to firmly link the use case descriptions provided in this deliverable to the e-Craft learning methodology provided in deliverable 3.1. In a sense we can say that the pedagogical framework in D3.1 is domain-specific (theoretical approach) and here we approach the task-specific level (integrative approach).

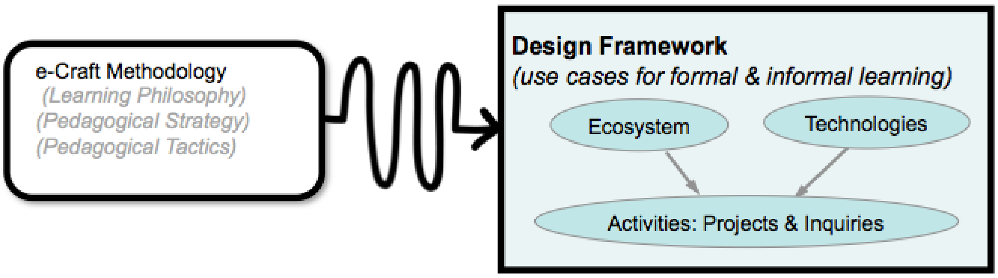

Figure 2: Methodology informs design framework

The figure above is based on Goodyear's (1999) generic overview of the relationship between pedagogy, the environment where learning is happening (i.e. the ecosystem) and technology. Goodyear argues that theory and implementations are closely intertwined, and that implementing a methodology or pedagogy is seldom a straightforward process. Rather it takes some reflection in order to figure out how to implement the principles of a methodology under the (often restraining) conditions of a particular school or maker space where the learning should be facilitated. This reflection is also represented by the iterative approach this deliverable is following as we start with candidate use cases which are then fine-tuned and tested under various conditions (small groups and workshops, classrooms or larger events in maker spaces).

The above figure introduces two new concepts (beside the terms used in D3.1) which will be briefly conceptualised, so that their scope and implications for future development work becomes clear.

Ecosystem: Higher education goes beyond the acquisition of knowledge and is to “inspire and enable individuals to develop their capabilities to the highest potential levels throughout life, so that they grow intellectually, are well equipped for work, can contribute effectively to society and achieve personal fulfilment” (Ramsden, 1998). Taking on an ecosystem's perspective implies a look at the bigger picture of learning as a whole-person activity (Motschnig-Pitrik, Kabicher, Figl, & Santos, 2007). Elements of educational ecosystems include (Dillenbourg, 2008):

- Funding for learning materials and needed IT infrastructures;
- Redefining learning objectives in light of new competencies gaining importance (creativity, communication, (autonomous) problem solving, entrepreneurial spirit, ect.)
- Training for teachers;
- Remodelling the role of teachers;
- Redesigning (physical) learning spaces;
- Integrating physical learning materials (e.g. electronics or 3D-printed ones) with their software counterparts (e.g. simulations);
- Orchestrating the flow of learning (e.g. the interaction between explanation, practice, exploration etc - or the five steps model suggested in D3.1).

The list above doesn't claim to be comprehensive or complete in any sense. However, it should be clear that successful use cases need to consider (and discuss) more than the functionality of a tool and its intuitiveness when being used or installed. In most cases, eCraft2Learn technologies will enter existing ecosystems - with the exception of learning spaces created during the time of the project - here the ability to integrate our technologies with existing plans and objectives of teachers and learners may be as important for the successful adoption of technologies as the bells and whistles of the technology itself.

Technologies: Research concerning the influence of technologies such as radio, TV or computers abound and have a long history (Russell, 1999) and since traditional technologies persist (email, discussion forums, wikis), 'newer' technologies such as Raspberry Pies, Arduinos or 3D-printers need to find their niches or offer a strong value proposition without presenting too much of a burden in terms of purchasing, learning and maintaining the technology. Nonetheless, one lesson learned persists, since a plethora of factors influence learning, strong determinism needs to be abandoned and studies should emphasise the effects ‘with’ rather than ‘of’ technologies (Jonassen, Carr, & Yueh, 1998). A comprehensive description of available technologies can be found in Deliverable 4.1, hence in this section we limited the discussion to the meaning of technology for designing use cases. In fact, we can expect an increase in complexity as more and more technologies enter the classroom. This trend is partially addressed by the project's development of a unified user interface.

Learning activities: Learning can happen in innumerable ways. A frequent way to distinguish types of learning activities are content-specific learning activities on one side and engaging, learner-centred activities on the other side (Boud, 2006). The two types of activities are not mutually exclusive, however, they imply different approaches to teaching and guiding learners. Whereas the former favours an upfront design of processes, the latter requires a design that allows for variations of activities to emerge. Characteristic of the discussion around learning activities is the notion of 'ideal learning'. For example, scripts are frequently used to elicit certain actions that are conducive to successful learning (O’Donnell, 1999). Put differently, scripts are meant to increase the occurrence of pedagogically desirable activities and to decrease the amount of ‘unproductive’ interactions (ibid). Hence learning designs include specifications of an ideal process, prescribing what should be done, in what order and by whom, using what resources (Kobbe et al., 2007). However, whereas such a structured process is still viable for ***non-formal learning*** (learning that takes place through a structured program of instruction, but does not lead to the attainment of a formal qualification or award), it's less suitable for ***informal learning*** (learning not intentionally accessed by the learner, and thus is neither structured nor institutionalised) (Clayton & Smith, 2009).

We challenge the question on what elements do we need to find answers to in order to build valid and vivid scenarios to be used as a first initial idea generation for the target groups. Based on the elements from the ecosystem as well as the input of WP 2 and WP 3, we divided the questions in three pillars, namely the stakeholders, the environment as well as topics. The questions serve the purpose to give guidance to the different methodologies, although not all questions need to be addressed in all methodologies, due to the different settings of the methodologies (ie. P2/Q2 - support for students will be provided by Technopolis experts, thus this question is obsolete for the questionnaire of Technopolis).

3.2. Design Questions

Digital technology is radically changing the way people live and work. As a consequence, it is introducing the need for changes in the landscape of education and training. The goal to create an ecosystem that will allow users to build computer-supported artefacts in both formal and informal learning contexts requires the close view to today’s environment of learners. Today we understand that learning takes place outside as well as inside of classrooms. Technology enables us to learn on demand. Connecting virtually to, collaborating with, and learning from other individuals in real-time, independently from location is todays learning practice. Huge repositories of data, that can easily be filtered to exactly find the information needed, changed todays learning.

Although limited in terms of today's needed ecosystem, much research that has been done in the last decade of integrating ICT. The lessons learned from this research can serve as a starting point to formulate questions that could provide an orientation to create use cases. A key school factors that can be connected to school improvement approaches are the degree of ICT training (e.g. Galanouli, Murphy, & Gardner, 2004), ICT-related support (e.g. Lai & Pratt, 2004), and cooperation between-schools (e.g. Triggs & John, 2004). Baylor and Ritchie (2002) conclude that ICT training has an important influence on how well ICT is embraced in the classroom. This implies for the research design of D3.2 to include questions on the stakeholders' pre-knowledge, their abilities as well as their networks where they can find support or even training (other stakeholders). While ICT training is clearly useful, continuous support is an issue that concerns many teachers and facilitators to a larger extent. William et al. (2000) argue that mechanisms need to be put in place to ensure that teachers have adequate access to support, also in the organisational level. Dexter, Anderson, and Becker (1999) conclude that successful implementation depends upon goals shared by different actors and at different organisational levels. Setting clear goals and defining the means to realise these goals, is a crucial step towards actual integration (Bryderup & Kowalski, 2002). In addition, Kennewell et al. (2000) confirms that a good ICT plan should also comprise an assessment and evaluation approach. This fosters an iterative approach in planning and monitoring the integration.

Many studies have confirmed the barriers to the integration of technology in education and in particular in science education (e. g. Blanskat et al 2006; Gomes, 2005; Osborne & Hennessy, 2003) which lead to the conclusion that neglecting factors like individual preferences, pre-knowledge, planning of the activity and an adequate pedagogy can be pitfalls for integrating digital use in learning environments.

Considering all this experiences and items from the last decades of integrating technology in schools, as well as the learning environment (Fraser 2012, Bader 2000, Kremer 2005, Kremer and Sloane 2001) and ecosystems, we formulated guiding questions and structured them into four pillars.

3.2.1. Pillar one: Designing for Diverse User(s)

P1/Q1: Who are the users/stakeholders?

P1/Q2: What are the preferences of these users/stakeholders in technology, pedagogy and general interest?

P1/Q3: What (pre-)knowledge do the learners and the facilitator(s) or teacher(s) have? (i.e. coding skills, problem-solving skills, project working skills, collaborative skills, communication skills, presentation skills)

P1/Q4: What are their interests and hobbies they have?

P1/Q5: What is their aim/goal?

P1/Q6: What is their (youth) culture they are embedded (norms, values, practices)?

P1/Q7: How do they define their role(s)?

3.2.2. Pillar two: Designing Supportive Environments

P2/Q1: How long shall/can the activity take?

P2/Q2: Who can give support to the learners/teachers? (Other persons or organisations including e.g. trainings)

P2/Q3: How can 'traditional' pedagogy embed Maker movement and Open innovation?

P2/Q4: How does the environment in and outside school look like?

P2/Q5: What are the technical requirements?

P2/Q6: What are organizational requirements (ie. curriculum adaptation, whom to inform, …)

P2/Q7: How can we stimulate the production and sharing of knowledge?

P2/Q8: What material is available/ need to be organized?

P2/Q9: What are the organizational and technical limitations in schools (ie. is it allowed to install software on school PC's, is it necessary to be compatible with already used software)?

P2/Q10: Are there compatibility issues at school? If yes, which ones?

P2/Q11: Is project based learning possible or does it require integration in the curriculum?

P2/Q12: Are mobile applications appreciated and useful for the user group?

3.2.3. Pillar three: Designing Pedagogical Guidance

P3/Q1: What are the topics/projects that users would like to perform?

P3/Q2: Are these topics embedded in projects or curriculum? If yes, how?

P3/Q3: What are the learning objectives by students/teachers?

P3/Q4: Are there any other topics or subjects evolving out of the original activity?

P3/Q5: Has the user developed variation(s) of his/her original plan?

P3/Q6: Is the activity itself and/or its outcome shared with anybody?

3.2.4. Pillar four: Designing Formative Evaluation

P4/Q1: How would you measure if an activity was successful?

P4/Q2: How would measure if the activity has failed?

P4/Q3: In what ways would you measure if students have reached their learning goal?

P4/Q4: Where do you see barriers or facilitators to .... <insert objective> ?

P4/Q5: How can the user's creativity be evaluated?

P4/Q6: How can the user's participation be evaluated?

These questions will be used to facilitate the construction of the use cases.

4. METHODOLOGY FOR DEVELOPING USE CASES

A challenge that we faced in writing the first user cases (month 4 and 5) was presented by the fact that the eCraft2Learn project is in many ways still at an early phase. Creating vivid use cases requires the participation and engagement of actual users, and much of this work is scheduled to take place in the months to come. A major component of the eCraft2Learn project concerns engaging end users. It is in the course of this time that we will be receiving a great deal more input and feedback from the stakeholders, much of which will result in revision or fine-tuning of current user cases and additions of new ones, stories which at this time we cannot yet anticipate. The first three use cases that are presented in this deliverable (section 6.1 - 6.3) are based on the experiences of several partners of the consortium and research evidence and feedback from facilitators. The use cases presented in this deliverable are intended, therefore, as base material for the subsequent project stages in which it will be further developed via engagement with end user and in close relationship to the agile development of tools that meet real-world needs of the stakeholders.

Following the description of possible methods to ensure the sound generation and development of use cases:

- case research;
- use cases, user stories and design claims;
- stakeholder interactions;
- personas.

4.1. CASE RESEARCH METHOD

Many well-known case study researchers such as Robert E. Stake (1995), Helen Simons (1980), and Robert K. Yin (1984) have written about case study research and suggested techniques for organizing and conducting the research successfully. Their work has been used to organize the first use cases that draw upon six proposed steps that should be used:

a) Determine and define the research questions
b) Select the sources and determine data gathering and analysis techniques
c) Prepare to collect the data
d) Collect data in the field
e) Evaluate and analyze the data
f) Prepare the report

In the process of developing the use cases/user stories and design claims, we will apply this structure also to the personas.

4.2. USE CASES, USER STORIES AND DESIGN CLAIMS

4.2.1. CASE SELECTION PROCESS

The conceptual framework of the methodology proposes a number of dimensions as deductive tools derived from three pillars: desk research and expert knowledge, qualitative and quantitative research and participatory design methods. Consequently, the production of use cases are guided in subsequent eCraft2Learn WPs in order to ensure that a range of different types are examined within the scope of the project and based on evidence from the literature, rather than this being an ad hoc random sampling decision. Random sampling would not be possible as we do not know what is the whole spectrum of all use cases, so cannot be sure we can sample across all possible occurrences.

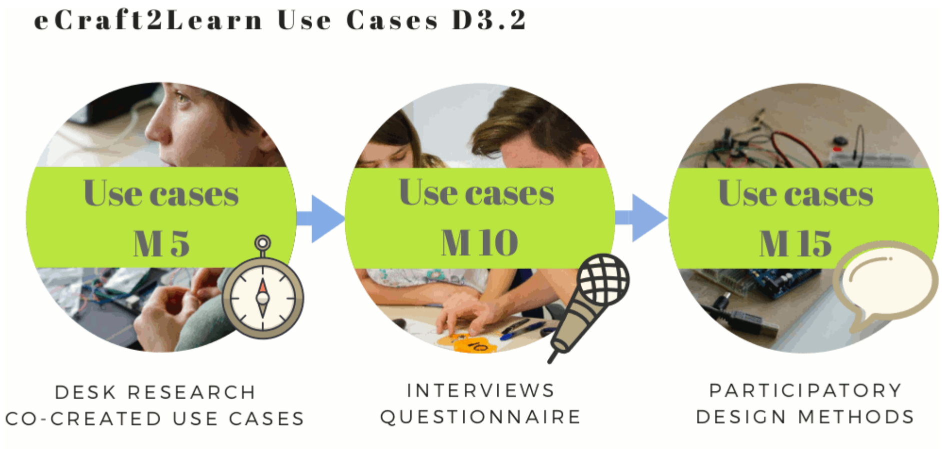

Figure 3: Stages of Use case reports

	Use case M5	Use case M5	Use case M5
Methodology Used	• Context screening / participatory research • Desk research	• Participatory workshop • Virtual exchange platform – participatory design • Interviews • Questionnaire	• Virtual exchange platform – participatory design • Participatory workshops

Table 1: Methodologies used in three phases

As outlined, the use cases will be established and evolved by a triple helix of methods, using interviews (qualitative), questionnaire (quantitative) and (co-creation) workshops (qualitative) data sets and subsequent participatory methods involving users.

4.2.2. Use case

Use cases excels at bringing us to an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research.

Use cases or scenarios describe what the user wants to do, what kind of goal she tries to accomplish (goal or task based scenario). Further information on the single steps he/she may be taking to fulfil a task is optional. In the context of software development, a user story consists of a sentence in the everyday language of the end user that captures what that user does or needs to do. It is the short, simple description of a feature told from the perspective of the person who desires the new capability. With this description, a development team can identify the user, an action and a request and it thereby serves as the basis for defining the functions which a software system must provide, and it facilitates requirements management.

Formal introduced by Ivar Jacobson (Addison-Wesley, 1992), use case analysis is an important and valuable requirement analysis technique that has been widely used in modern software engineering since its formal introduction by Ivar Jacobson in 1992. More recently, the concept has been developed further into a more general technique for requirements analysis and user interface design. Our use cases are aiming to identify, clarify, and organize requirements that a facilitator or learner is confronted with when interacting between a system in a particular environment and related to a particular goal.

In order to understand what is there to be varied in a use case, we need to describe the structure of a use case. One format described in Carroll (1996) includes

- Users' motivations
- Derived goals
- Design adopted (based on a design claim)
- Resulting experiences

4.2.3. User stories

A user story captures the 'who', 'what' and 'why' of a requirement in a simple, concise way, often limited in detail by what can be hand-written on a small paper notecard. It is usually necessary to give the user stories more body in the form of extra details or requirements that do not fit into the very concise format of the user story.

The quality of a user story can be determined by its adherence to the following criteria: independent, negotiable, valuable, estimable, small and testable. These criteria for a good user story were first formulated and given the acronym “INVEST” in 2003 by Bill Wake.

In his article Bill Wake describes the requirements that each criterion represents as follows:

- **I**ndependent: the user story should be self-contained, in a way that there is no inherent dependency on another user story.

- **N**egotiable: User stories, up until they are part of an iteration, can always be changed and rewritten.
- **V**aluable: A user story must deliver value to the end user.
- **E**stimate-able: You must always be able to estimate the size of a user story, i.e. what it will take to build the user story.
- **S**mall: User stories should not be so big as to become impossible to plan/task/prioritize with a certain level of certainty.
- **T**estable: The user story or its related description must provide the necessary information to make test development possible.

4.2.4. DESIGN CLAIMS

Design claims will have an essential input for the technical development of the eCraft2Learn system.

To describe a design claim, Carroll (1994) suggests the following format: *"IN <situation> <a feature> CAUSES <desirable psychological consequence> BUT MAY ALSO CAUSE <undesirable psychological consequence>"*. Stressing the inherently psychological nature of a design claim refers to the explanation component within the claim, as it is not the 'intention of the designer' that may cause the consequences, but underlying psychological probabilities. Hence design rationales are a means to go beyond the 'empirical testing and iterative design approach' most development projects are currently relying on.

4.3. TIMELINE FOR CREATING USE CASES

PERIOD 1 (M1 - M5):

The first use cases were established by a first context screening (chapter 5) by the consortium experts. In close collaboration with the partners, the first three use cases were developed (pl. see chapter 6). This development of the use cases has been guided by different discussions and activities around technical solutions for the pedagogical model (D3.1).

In preparation for the second period, a questionnaire was developed by Technopolis City of Athens to allow a broader insight into a broader than single interviews would allow.

The questions were selected in accordance to the three pillars, precisely collect data from the users themselves (pre-knowledge) and their interests (regular visitors), their preferred topics (content) as well as preferences towards the length of the activity (environment), which is - for the non-formal education of special interest.

The questionnaire was also designed to be very short thus the need to cover all topics with very selective questions was seen as a precondition for the distribution (pl. see Annex 1). A pre-test ensured the correctness and understandability of the questions (Given 2008, Kaplan 2004, Rasch 2006).

During the period from April - August 2017, parents that visit Technopolis with their children will fill in the questionnaire. In addition, the questionnaire will be distributed during the Athens Science Festival (28 March 2017), which will also increase the number of completed questionnaires.

Obviously, the expected results relate to the targeted user groups (teachers, students and parents in Greece) and have restrictions when extending them to the entire population. Still, the findings will give indications and preferences that could serve well for further understanding of needs to address in the eCraft2Learn ecosystem.

The results will be thoroughly analysed in August and – together with the outcome of the interviews – presented to the consortium members. This quantitative information that will be gained will contribute to a firm basis for the next advanced use cases.

PERIOD 2 (M6 - M10):

Based on the initial questions of the three pillars, up to 5 interviews will be conducted during May and September 2017. These interviews will form the basis for further use cases as well as for some personas that will set an increased focus on the users and their needs, preferences and environment. Personas are a powerful tool for communicating the needs of different types of users and for prioritizing which users are the most important to target in the design of form and behaviour of a tool.

As a first step a selection of the most relevant questions will be done and (if appropriate) re-formulated, since not all of the questions from the pillar fit for (all) the interviewees. This will result in a semi-structured interview guideline that will be used by the partners to translate and perform the interviews with their selected interviewees (Flick, 2006 and Flick, Kardoff, & Steinke, 2005, Helfferich 2005).

After translation of the answers, ZSI will analyse the interviews and present the consortium the gained insights (proposed for the 2nd consortium meeting). As for now it is expected, that this analysis will be of high relevance for several WP's such as WP 2, WP 3 and WP 4 since these three workpackages give major direction to the concept of the eCraft2Learn system.

In addition, it will allow advancing the first three primal use cases. These advanced use cases will reflect increasingly the real-life scenarios for the eCraft2Learn system.

PERIOD 3 (M11 - M15):

As by the progress of the project it is expected that an increased number of learners and facilitators will share experiences and collaborate, supporting the development of the eCraft2Learn environment. Thus, the third phase will draw its use cases from materials of end-users that are engaged in the participatory design process. We will use design instruments like self-drawn mock-ups or photo diaries and will offer workshops and meetings as well as virtual tools for exchange and communication among users, technicians and educational scientists. This will support the technical development to increasingly adapt the eCraft2Learn environment to the specific learning experiences made.

4.4. DEVELOPER AND LEARNER INTERACTIONS: PARTICIPATORY DESIGN

Participatory design aims to tightly align technical development with the needs of learners and teachers. This process starts with a thorough analysis of learning situations as a whole and related implications for technology design in general, e.g. use conditions, appropriate terminology, required support and embedded guidance. As such, participatory design has two main components:

- the work of local development teams. The local development teams should include the expertise of teachers, learners, researchers as well as programmers.
- the updating of the projects consortium about milestones reached

According to the DoA, members of local development teams will be in close contact on a bi-weekly basis, however in practice development work will most likely be driven by development milestones so that local development teams are likely to need short but more frequent interactions. The same applies to the updating of the project consortium as a whole. Most discussions on technological directions are conducted with everyone in CC, in addition at certain points the state of development is captured in a summary page (Google Drive). Since partners are members of several workpages, not filtering communication too much at this early stage of the project seemed the most appropriate way.

However, at some point following up the different development streams around the most diverse technologies, crawling through emails becomes cumbersome. Hence in May 2017 we introduced Slack[2] , which is a platform developed to support the work of teams with easily to adapt structuring and notification mechanisms. It is still too early to judge whether this attempt will be successful or not. A huge benefit coming with Slack (see Figure below) is the preservation and transparency of past development decisions, which enables going back and referencing or changing past arguments.

[2] https://get.slack.help/hc/en-us

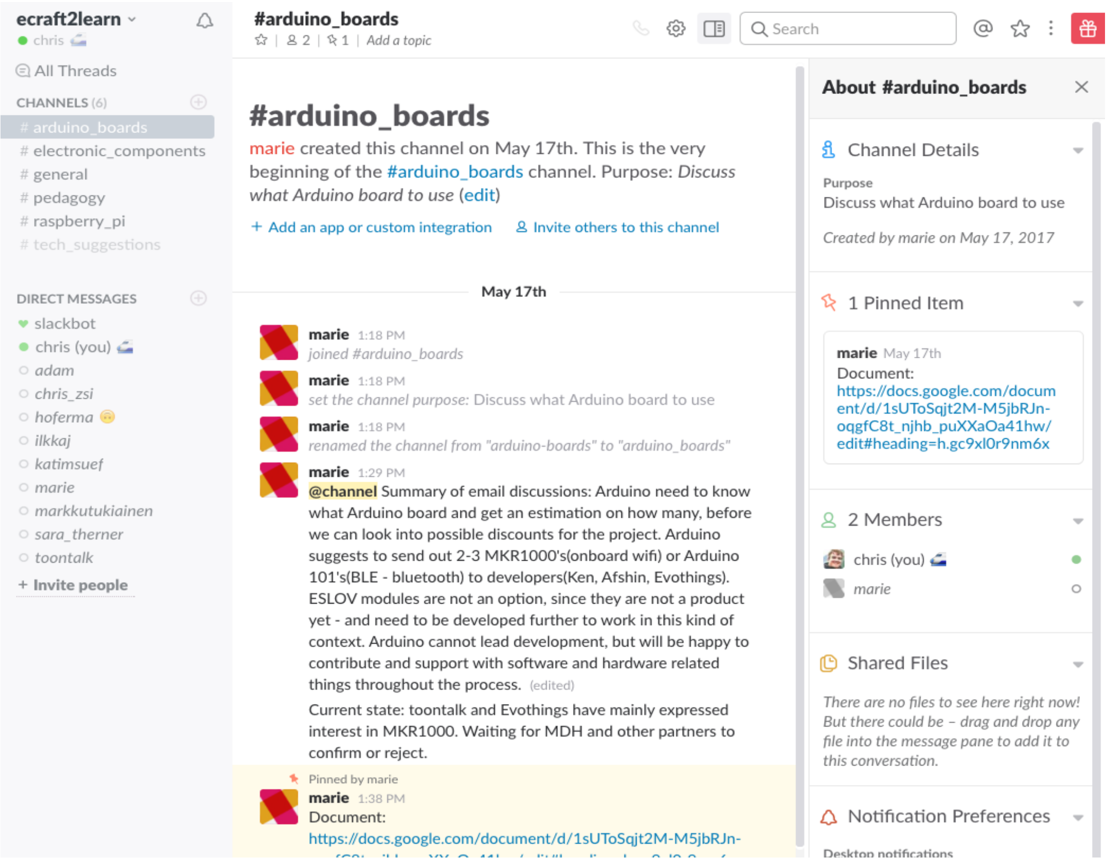

Figure 4: Screenshot of ecraft2learn.slack.com

4.5. Personas

We will develop the personas for this project around the basic facts of their person – such as gender, age and profession - the relevant behaviours they exhibit in their daily life and the needs they have in order to pursue certain goals related to the topics of the eCraft2Learn project.

Personas help to:

- Determine what a tool should do and how it should behave. Persona goals and needs provide the foundation for the design effort.
- Communicate with stakeholders and developers. Personas provide a common language for discussing design decisions and also help keep the design centred on the user at all times.
- Build consensus and commitment to the design. Because personas resemble real people they are easy to relate to. Having personas makes it easier to be certain that everyone is on the same page and is using the same language.
- Measure the design's effectiveness. Design choices can be tested on a persona, providing a powerful reality-check for designers trying to solve design problems. This allows design iteration to occur rapidly and inexpensively at the whiteboard. This results in a stronger overall design that can then be tested with real people.

An added positive effect of personas is that for everyone involved in designing and developing the tools it is easier to be interested in and committed to the solution when one has the feeling of creating something of benefit for an actual human being. Personas are user models that are represented as specific individuals. They are not real people but are based on observations of real people. They should be based on facts that have been well researched with regard to the potential users of a product. Despite their depiction as specific individuals, personas are archetypes, representing a certain type of user. They are, however, not stereotypes: personas should be typical and believable, but must not represent biases and assumptions that are not substantiated by factual data (Cooper, A., Reimann, R. and Cronin, D., 2007).

In this context personas bring issues of social and political consciousness to the forefront. In developing personas particular demographic characteristics must be chosen with care.

One of the most critical tasks in the modelling of personas is identifying user goals and expressing them succinctly. User goals serve as a lens through which designers must consider the functions of an innovation, tool or product. All humans have motivations that drive their behaviours; some are obvious, and many are subtle. It is critical that personas capture these motivations in the form of goals. The goals of the personas are shorthand notations for motivations that not only point at specific usage patterns but also provide a reason why those behaviours exist.

5. Context screening

The purpose of the workshop session held during the kick-off meeting was to identify and problematize the current situation of learning within schools and organizations in order to provide insights on how to best implement the eCraft2Learn system. The first understanding of the use cases allowed for cross-fertilization and idea generation through shared knowledge and experiences of the consortium experts.

The strength of the approach consists in its ability to bring together different actors, their knowledge, and expertise and apply it to solve complex problems, or as in the case of eCraft2Learn, design use case scenarios. The participatory approach aims to tightly align the (technical) development with the needs of learners and teachers. As defined by Galvagno and Dalli (2004) co-creation is " … the joint, collaborative, concurrent, peer-like process of producing new value, both materially and symbolically."

This process started during the co-creation workshop of learning situations/use cases as a whole and related implications for pedagogy, technology, the ecosystem, design in general (e.g. use conditions, appropriate terminology, required support and embedded guidance) and organisation of eCraft2Learn applications. The workshop created a first common understanding on how eCraft2Learn will be used by the end-users.

Based on the four pillars of design questions, three expert teams from pedagogy, technology, the maker movement and the school engagement (three teams, each team 4-5 people), were given the task to design a use case scenario. In line with planned the small scale pilot of WP 5, three locational settings were determined in prior: one use case at a Greek school, one in a Finnish school and one non-formal educational setting in Greece.

The concrete task was to choose one of the settings and discuss and exchange following items:

- Describe the environment and the "project".
- Who are the stakeholders?
- What are their needs?
- Are there any drivers or barriers that would facilitate or hinder the implementation?

This workshop session revealed some first initial conditions for use cases that were developed further by the partners to the below presented use cases.

Initial use case: **Greek formal education**

Age group targeted	Existing situation: age 12+
Pre-knowledge of target group	Children using smart phones, although smart phone forbidden in schools, familiar to use touch screen; drag and drop skills, share photos, a.s.o. better familiar with smart phones than teachers. Greeks learn using computers at 13 and 14, continue till 15: processing spreadsheets, only some specialized schools learn programming (in technical schools).
Issue	Use of the tools is not connected with REAL live scenarios (rather abstract teaching); this is why low interest in some cases.
Other stakeholders	students, teachers, parents, policy makers, educational ministry and government.
Needs	Motivation (connection with real life scenarios), access to tools (more than PC labs), equipment Teachers need training, need continuous support, policy makers (need examples why they should support this), ministry (information to get convinced for change and improvement), government (awareness of multiple opportunities for new learning ecosystems for investments) in human capital (jobs for Greek citizens).
Barriers	Inexperienced not-trained teachers, existing structures (technical facilities, strict rigid curriculum that does not allow innovative teaching), misconceptions like ‚programming is hard / only for boys' (connected with real life scenarios); time constraints. Permissions from usual curriculum.

Drivers	Flexible curriculum, curiosity, role models of well-known scientists or examples, cool scenarios, awareness of opportunity these skills create new jobs (easier to enter the labour market). Alignment with curriculum goals (but this is difficult); motivation

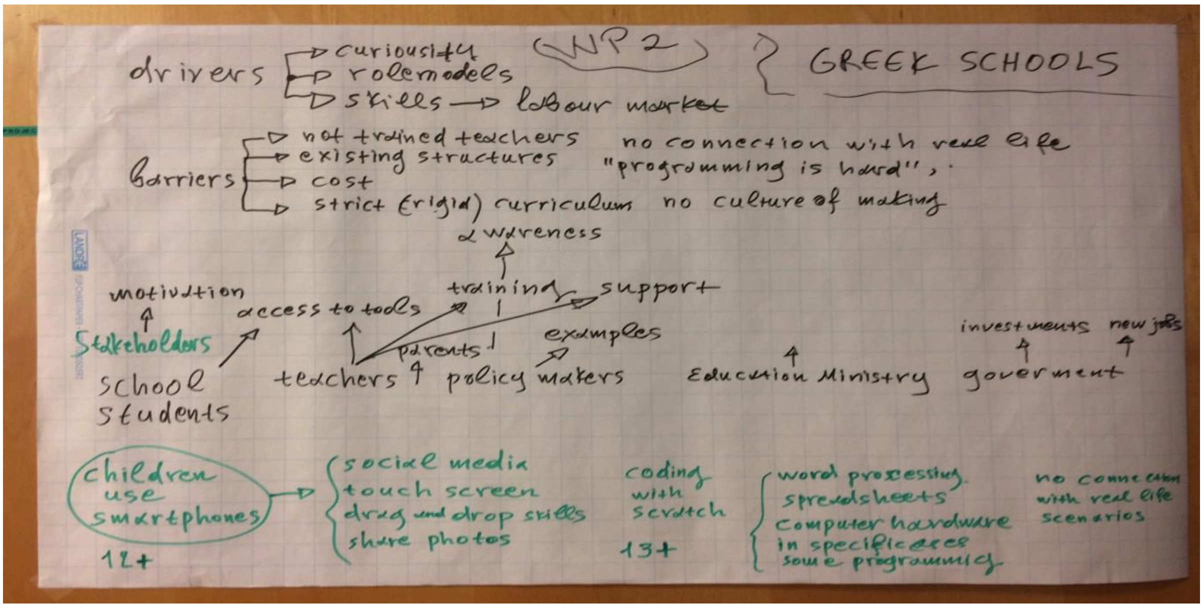

Figure 5: Greek use case school scenario

Initial use case: **Finnish formal education**

Targeted age group	Students 12+
Possible scenarios	Arduino: switching lights on/off, building car controlling it, Barbie robot, Biology 3-D printing
Other stakeholders	Students, teachers, parents (family coding clubs), champions (clubs), maker spaces, experts that one can ask
Needs	Involve teachers in planning, guidelines and recommendations, trained teachers, material (student), motivation (student), technology clubs, female dedicated projects (ie. Lilly pad), facility provision
Drivers and Barriers	Agreement/support from rectors, Convincing teachers, existing infrastructure (software), (money), involvement of family, informal scenarios, motivation, accessibility for special needs students.
Issues	Individually vs. collaboratively (how to give grades), involvement of maker

science fairs

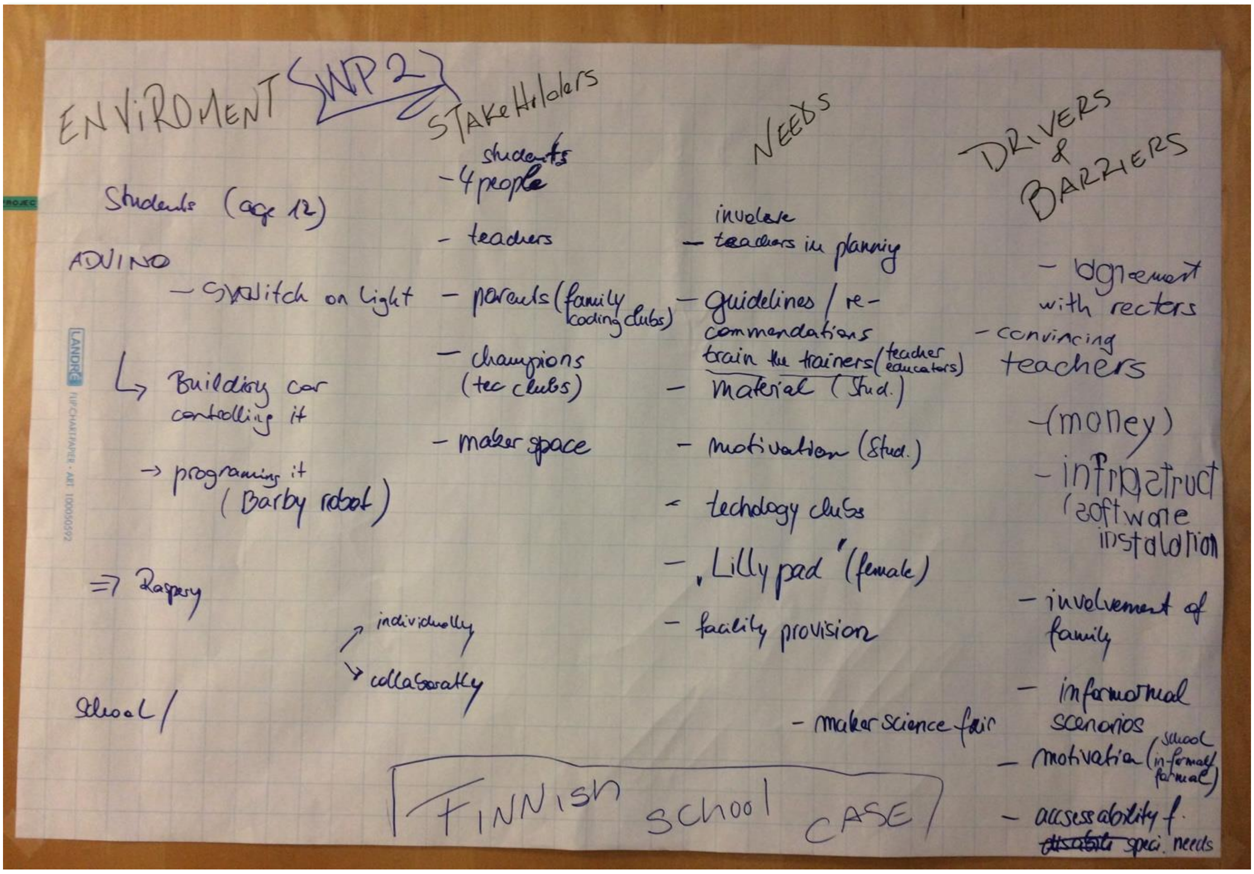

Figure 6: Finnish school use case scenario

Initial use case: **Greek non-formal education**

Learning environment and Pre-condition	Place have to be accessible, has to be inspiring (look), nice people, has to have components to make students motivation (how to motivate kids), Nice attitude, free time (alternative for playground).
Pre-knowledge	Very different levels of knowledge, abilities and interests
User groups	People should consist of educators, mentors and other peers and students, kids, something they can use (for good purpose)- connection to real life.
Issue	Parents (gate keepers), hard to engage typical parents (too technical, too difficult, ...), find another way to communicate (attractive).
Learning goal	What are the real goals of the project? Different way of learning: hands-on, collaboration, sharing, ... what are our priorities? Tools are needed, but not too many tools – being open to new innovative learning approaches

	Presenting something tangible eases the learning
Barriers	Problem: One-size fits all. Different interests, abilities; how do we accommodate that some do want to program, some do want to build, some are more into art.
Needs	Define roles; divide them by age, or by skills (what effects has that on the programming?), We need to narrow it down to make the project feasible. We need to know what it should not do. Creating the vision Transforming the role of teachers – he/she is not the expert!! Help teachers to change the role to facilitator.

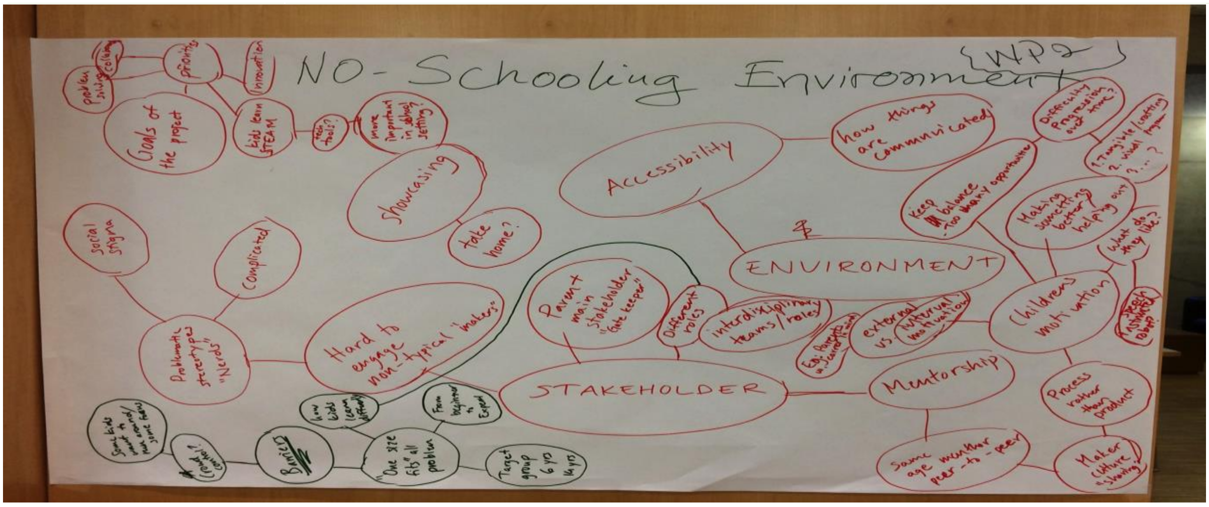

Figure 7 Greek non-formal use case scenario

By time, this initial group will be expanded by the formation of local development teams that will frequently exchange between end-users and developers. Once the pilot schools are selected the local development team will also include teachers, learners, researchers as well as programmers.

6. First use cases

Understanding the possible use, goals, topics and actors of the eCraft2Learn, use cases are an appropriate method to gain this insight. In order to ensure that the aspects that shall be considered (pillars) are addressed, a template has been created that serves the creation of different use cases (pl. see Annex 2). However, the intention of the template is not to restrict the use cases to a specific structure, but rather animate the writers to consider different questions and aspects. Thus, the use cases are written in a vivid and different way and structure, but contain major elements of each of the pillars.

6.1. Formal Education: DNA LESSON (Finnish school)

Name of use case	3D printing in Secondary school science class for Biology/DNA lesson
	USER – P1
*Age and Level	Susan, a Finnish secondary school science teacher, has a class of 20 fifteen-year-olds. Half of her class are female students.
*Primary Actor and main goal	She plans to teach DNA for the next week. She knows how to combine technology-driven hands-on projects with pedagogical concepts as she learned about in her professional development courses. The topic is difficult and the students are not motivated to study biology. However, the use of technology may be attractive especially to the boys, but having students working in groups in order to enhance social interaction might also be attractive to the girls. Moreover, allowing the students to discover the topic by themselves through a technological lens, being active, exploring and trying out, and producing interactive DNA models, the students learn more and become more interested in the topic. Teacher assigns the groups as she normally does in her classroom activities.
	CONTENT – P3

*Topic and Content	For the DNA lesson she decides to use 3D modelling, 3D printing, computer programming, and assembly instructions for electronic components and circuits. Her idea is to let the students build wireframe models of a DNA sequence. During the development of the project the students will be learning and applying knowledge from electronic components (e.g., Arduino) assembly, 3D modelling and printing, programming, collaborative skills and presentation skills. Susan is planning for the development of the project to take 2 weeks (3 times a week sessions 1.5 hours).
	ENVIRONMENT – P2
*Description of Environment and possible pre-conditions	Her school is pretty open for new ideas and projects, and there is a high trust in the teachers that the projects align with the curriculum. Still for security reasons, Susan needs to arrange the installation of the 3D modelling program with the IT coordinator from Happy Lab of the school. The school also has a designated space where the 3D printing machines are, alongside available electronic components such as Arduino, Raspberry Pis, resistors, breadboards, cables, and recycled materials (e.g., cardboard, clothes, pet bottles, etc.) for the students to use.
Preparatory work	Susan knows well the people from Happy Lab, and they set up the 3D printer for her. The people there explain her in detail how the 3D printer works and also how she could solve issues that might appear. She also organizing the necessary materials that the students

	would need for building their 3D model.
Other Stakeholders and their possible Interests	An IT teacher from the Happy Lab at school is happy to support Susan with any queries that she may have in setting up the project. She also offers support when needed during the working sessions.

*Description of Activity	During the first session, the activity starts through **ideation** and **planning**. A group of students, Paul, Kelly, and Julian begin to work on their project on the DNA model. Susan supports the students with the 3D printing of the model's pieces from the wireframe models they made since a number of questions appear. Also, during the **creation** of the model, there are a lot of errors to resolve at the beginning of the process to get the 3D model to print correctly. During the second session, they had to download drivers for the right 3D printer hardware model. However, once in a while, the printing process would fail, and they would have to discard the spoiled material and start the sequence again. User errors would also occur, such as miscalculations of scale between the software model and the printed result.The IT teacher offers assistance with the proper settings of the printer. Kelly and Julian wonder what will happen if they will modify the model shape. Kelly changes the parameter of the X and the group starts to see interesting results they will ask to the teacher Susan. During the third session, the students then assemble their pieces into a physical 3D model. The 3D-printed model give them a much different sense than the 3D computer images, because they could hold the model with their hands, rotate it directly, and combine their own model with other students' models. In the fourth session, Susan asks the students to to give "life" to their 3D models by **programming** in them some functionalities. Susan uses the guidebook included with the STEAM "packet" to explain different ways they could vivify their physical models with Arduinos. Each group selects a project and start to work on it. To design the circuits, students are facilitated by paper template circuits, and examples of codes which are ready to be used and modified easily.

	This activity takes two sessions to complete. For the presentation and **sharing** final session, Paul, Kelly, and Julian took turns explaining why they wanted to animate their physical models using LEDs in a particular way, and teaching their classmates how they did it. They then explain to the class how they programmed the Arduino for their project, e.g. how they solved the tricky part with creating a sequence to highlight repetitive structures, and how they overcome the 3D printing issues. This peer learning process continued with each group presentation. Susan now feels the students would be able to understand more about DNA than before. The following day, she asks each group to present their model to the rest of the class, to discuss what they learned about how molecules form the famous double-helix structure.

	EVALUATION – P4
Extensions	Paul, Kelly, and Julian explain how to highlight the different proteins that connected the DNA strands by assigning different coloured LEDs to each. They show that it was difficult to see that certain protein sequences were repeated. By lighting up the coloured LEDs, everyone could easily see the patterns. Protein sequences become even more evident when the LEDs associated with them flashed at the same time.
Failure and conditions	• Making sure that there is enough support available for all the learners/groups. ◦ Online communities should be introduced as a source of knowledge crawling ◦ The outcome of programming is not what is expected ◦ Sufficient material (technology) There is not enough time to complete the project due to the knowledge level of the students.

Success and condition	In just two weeks, Susan was able to foster student interest in DNA, while students learned how to use 3D models and printing, and how to program small circuits, including elementary programing statements such as sequences and loops. The students also gained experience in collaborating with each other, and in using software and hardware technology to realise ideas that began in their own imagination. Susan feels empowered by these tools, which facilitated the transformation of classroom roles and activities, and ultimately helped her achieve a progressive pedagogical approach in her classroom.
Barriers/ Facilitators	• The gender-based preferences – girls are more interested in social interactions • Every learner is making something personally relevant • Students with varied skills. • Using the mixed-gender groups (different interests of males and females) to support the peer learning. • Lack of previous experience of using different technologies. • creativity
Variations	

Table 2: Use case Finish school

6.2. Formal Education: Drum Machine (Greek school)

Name of use case	***Drum Machine***
	USER – P1
***Age and Level**	Nikos, has 10 students, who are around 16 years old.
***Primary Actor and main goal**	He is a substitute teacher in Greece, teaching for twelve years classes and has been asked to teach them about how sounds are produced by the modern music instruments.
	CONTENT – P3
***Topic and Content**	He starts by playing recordings of some instruments and explaining the various technologies that are used to make it. However, he notices that many of the students are getting bored. He asks: "Does anyone know how to make a drum machine?" The students laugh, joking about how they can download one from the app store with their mobile phones. They are expecting to be reprimanded, but they are instead surprised by Nikos' reply: "How about we all learn how to make a drum machine ourselves, without our mobiles?" The students are very intrigued and do not really believe this is possible, but they are willing to give it a chance.
	ENVIRONMENT – P2
***Description of Environment and possible Pre-conditions**	Nikos has brought with him an eCraft2Learn case, with 4 project kits. The kits contain electronic components and simple instructions how use the components and STEAM projects examples.

Preparatory work	Nikos knows well the kit, since he experimented himself with the tool some time ago.
Other Stakeholders and their possible Interests	Nikos asks some help from the computer teacher of the school, especially because he wants his students to have access to the computer lab for Arduino programming and information searching activities. The computer teacher of the school, who has little experience with Arduinos, finds the whole project very interesting and is offered to help by uploading the necessary web content, explaining the steps of this music project, to the school web site.

***Description of Activity**	He asks the students to form groups, and loans each group a kit.The students are interested, but some are worried this task might be too difficult for them, since they do not know about technology like Arduinos. He tells them not to worry, and asks them to take out a sheet of paper. “Your sheet of paper will become the buttons for your drum machine!” They think he must be joking, but they now feel very comfortable working on the project, since instead of a complicated circuit, they are focused on a piece of paper. He asks them to draw lines on the paper, dividing it up into “buttons”, in any arrangement they would like. He then asks them to take out of their project kits a few different coloured wires, and a handful of small sensors. They are instructed to connect each sensor to a different coloured wire, and to connect the free end of the wire to the series of pins on the Arduino board. Finally, he asks them to tape down each wire onto the piece of paper, so that there is one sensor in each square they’ve drawn. He also invites them to connect the small speaker from their kits into the Arduino’s audio output connector.
Failure and conditions	The students are following along, but they seem to be losing interest. Sensing this, Nikos decides to take an intermediary step.

Success and condition	There are also LEDs in the kit, and he asks them to connect the LEDs to wires, and the wires to the other set of pins on the Arduino board. He knows from a previous project that there is software pre-loaded onto the Arduinos that connects the input and output pins. He now invites the students to "play" the squares on the paper, which trigger the lights, and the students are immediately engaged, for a moment. They quickly tire of making lights flash, but they still want to know more about how the Arduino works. And they really want to make the drum machine that was promised to them!
Barriers/ Facilitators	
Extensions	At this point, Nikos tells them to plug the USB connector on their Arduinos into their classroom workstations, which have the Arduino coding environment on them. They load the software from the device onto their screens, and he explains to them what each line of code does, and what makes the LEDs light up. He then shows them how to add new lines of code that trigger a drum sound when the light is triggered. For the remaining time, the students play collaborative rhythms using drum sounds made by their paper and Arduino drum machines. Some of the students even get the idea that they can go back to the software and replace the drum sounds with sounds of their own voices. Now they are enjoying making music together, while having learned about music technology through an exploratory, hands-on approach.

Table 3 Use case Greek school

6.3. Non-formal Education: Robot Building Workshop (Greek School)

Name of use case	***'We-build-Robots'in Athens***
	USER – P1
Age and Level	Technopolis, a non-formal educational institution that fosters educational activities of new Technologies and STEAM. They would like to engage kids into some Robotics activities. Sofoklis, a facilitator from Technopolis likes the idea a lot and sets up a call for a workshop called 'We-build-Robots'. Sofoklis himself is very interested in technology and has built already robots for several years from many different materials. He and his colleagues are trained by an educational institution dedicated to enable people to hold STEAM workshops with kids. For this workshop, 20 students, aged 9-15, subscribed. Robotics is very popular amongst youngsters for the moment in Greece, thus it is not surprising for him that so many students subscribed. He expects that those that subscribed are very familiar with their mobiles including the different apps.
Primary Actor and main goal	From his previous experiences with students he knows that primarily the students are keen to play with "such a cool thing as robots" while their parents are happy to have some creative educational activities during the weekend for their kids.
	CONTENT – P3

Topic and Content	Sofoklis plans, to ask the students to assemble a robot, using lego pieces, blocks, rubbers etc. After that they shall use an Arduino kit, exploring different programs to make it work. The “classroom” is divided in pairs of 2 or 4 kids each, depending on the use of tablets or laptops. Sofoklis has decided that each group is working on the same project rather than each group taking over only a part of the project since he feels that the kids are more motivated if they are doing their own project from start till the very end. Also, all three objectives of familiarizing with crafts, the making and new technologies are tackled by all the students in that way.
	ENVIRONMENT – P2

Description of Environment and possible pre-conditions	The last times Sofoklis has performed the activity, each workshop usually took 6-8 hours divided in 2-hour sessions in subsequent Sundays. However, from the last evaluation Sofoklis received feedback from several parents, that they would prefer to have the kids there for 1, or 2 days so he decides to go for a 2 days workshop, 4 hours per day. The course takes place in a vibrant, colourful open space venue, inside a lab consisting of one large table and some supplementary smaller ones to accommodate the whole group. Usually, the students find the venue exciting due to its particular shape and layout. Sofoklis is not bound to any adaptation to a curriculum but there is a need for each workshop to be aligned with the strategic goals and educational program of Technopolis. Due to the fact that the workshops of Sofoklis is closely connected to STEAM, he is very much in line with the overall set goals. Sofoklis has full support also in terms of raising awareness and participation in his workshop. For once there is a media plan, set up each semester, for the upcoming workshops. Press releases and invitations are sent to schools and to a subset of a large contact database. Also, printed booklets are made available as well as announcements through different (social) media channels.
Preparatory work	For the workshop, Sofoklis needs an Arduino set and uses also Scratch and WeDo 2 for the programming. In case he needs other software, it is easy for him to install since there are no limitations of installation. He checks if the software is pre-installed and if the program runs also on the tablets. Also, Sofoklis buys the materials needed for the workshop.

Description of Activity	Sofoklis starts off at the very first Sunday explaining the 20 students some basic understanding of terms such as "voltage", "current", "motor", and "sensors". He asked the students to determine what their robot should do. With the given materials, one group decides to build a wheeled robot, that will act as a 'wheeled butler' carrying things in a small box. The students should determine the route of the robot towards a specific location by writing commands for moving forward, backward, left or right respectively. Sofoklis is summarizing with the students what materials they would need for their, driving' dustbin. The students are following a step-by-step printed direction. Although Sofoklis sees that they are sometimes struggling, he lets the students solve their issues themselves. Encouraging them to think creatively requires sometimes quite some patients from him, but he makes them also stop at various points and check together their robot from time to help ensure they have configured things properly before moving on to next steps. Thus, while constructing the students repeatedly try it out in the room. During that process, they realize that their initial programming in Arduino is leading the robot in the wrong directions. They re-program their device again and again until they are satisfied and personalize by adding eyes on it. At the end of the workshop they present their 'butler' in front the other students, using it to carry some candy bar paper to the bin.
Other Stakeholders and their possible Interests	
	EVALUATION – P4

Success and condition	At the end of the 2 days' workshop, all the groups were able to finalize their robots. Sofoklis had the impression that students had fun and joy by creating their own robots. Some even asked if they could to do more and come again for creating an even more advanced robot.
Failure and conditions	Only one student was not able to take part in the finalization of his robot since he had to leave earlier at the last day. Unfortunately, his robot never worked and the student left fairly unhappy.
Barriers/ **Facilitators**	At the end Sofoklis ask the students if they have other ideas for workshops and what they would find interesting. He experienced, that the interest and curiosity of students as well as parents is limited because they are just not used to/ not familiarised with makers and the option they would have. Thus, they don't really know what to wish for. However, after this workshop, he was able to collect many different creative ideas from the students in all kind of areas not only technology, but also including art and other sciences.
Extensions	Sofoklis discusses with the students how the butler robot could reach the target more easily. They suggest to modify the algorithm of the robot in order to intercept remote commands via a Bluetooth interface.

Variations	Students are asked to propose different applications for their robot. So, they suggest to cover it with a shell made of colour paper in order to look like a ladybug. So, its route to the target becomes more amusing. The girls that are following the lessons find this alteration from butler to ladybug very artistic and pleasant.

Table 4: Use case non-formal Greek school

6.4. Basic Building Blocks for Use Cases

At this stage the use cases presented in the three previous sections should not be seen as complete implementation guides (to be covered by D3.4 - Teacher Trainings - and D4.5 - User Manuals -). However, WP4 discusses multiple options for programming environments and hardware components which are then grouped into families of solutions linked with specific steps of the pedagogical model presented in D3.1. These solutions will include:

- on the hardware side: sensors, actuators, computers on a chip, micro controllers and 3d-printers and
- on the software side: 3d-modeling software, access to AI cloud services, web-based or local programming languages.

The above selection is not meant to be exhaustive but helps to illustrate how existing use cases can be specified with the help of these building blocks selected, evaluated and, where necessary, adapted in WP4.

7. Conclusion and Outlook

The present document has been outlined the methodology of the use cases and presented the first three cases. In the next weeks and months after submission of this deliverables, the user cases will be further advanced by interviews, further input from partners and the analysis of the questionnaire. However, it is expected that also additional use cases will follow, depending on the concrete ideas and needs of the users identified and the technologies that will be selected by the technical partners (M10). Further, personas will be deviated from the interviews performed. They will allow increased insights into concrete needs of users and consequently influence also the advancement and adaptation of the eCraft2Learn environment.

The present document has been drafted in parallel with the development of the eCraft2Learn technical platform (D4.1) but has vivid exchange of the initial use cases. This established working procedure will be followed further in the next week. The advanced use cases will be integrated in a highly iterative process of agile development: especially during the third period (M10-M15), where we increasingly seek for interaction with the users and their inputs for further adaptation.

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9. ANNEX

9.1. ANNEX 1 - USE CASE TEMPLATE

Date	Author	Description of change
17 March 17	Hofer, m.	Initial draft – aligned with revised Pillars
25 March 17	Voigt, c	Feedback to initial version
30 March 17	Hofer, m.	revision

Template:

Name of use case	*<give your use case a name>*	comments
	USER – P1	
Age and Level	*<indicate the age level of you user and the level of knowledge>*	**P1/Q1: Who are the stakeholders?** **P1/Q3: What (pre-)knowledge do the learners and the facilitators (teachers) have?**

Primary Actor and main goal	*Pl. Describe the user (ie. student age xy, teacher)*	**P1/Q4: What are their interests and hobbies they have?** **P1/Q2: What are the preferences of these stakeholders in technology, pedagogy and general interest?** **P1/Q6: What is their youth culture they are embedded (norms, values, practices)?** **P1/Q5: What is their aim/goal?** **P1/Q7: How do they define their role(s)?**
	CONTENT – P3	
Topic and Content	*<indicate the content of the use case>*	**P3/Q1: What is the topics/projects that users would like to perform?** **P3/Q2: Are these topics embedded in projects? If yes, how?** **P3/Q3: What are the learning objectives by students/teachers?** **P3/Q4: Are there any other topics or subjects evolving out of the original activity?**
	ENVIRONMENT – P2	

Description of Environment and possible pre-conditions	*< describe Environment which must be true before this Use Case can be executed, i.e. school, non-formal environment, teamwork, afternoon work, project of school ... >*	P2/Q1: How long shall/can the activity take? P2/Q3: How can 'traditional' pedagogy embed Maker movement and Open innovation? P2/Q7: How can we stimulate the production and sharing of knowledge? P2/Q9: What are the organizational and technical limitations in schools (i.e. is it allowed to install software on school PC's, is it necessary to be compatible with already used software)? P2/Q10: Are there compatibility issues at school? If yes, which ones? P2/Q11: Is project based learning possible or does it require integration in the curriculum? P2/Q12: Are mobile applications appreciated and useful for the user group? P2/Q4: How does the environment in and outside school look like? P2/Q6: What are organizational requirements (ie. curriculum adaptation, whom to inform, ...)

Preparatory work	*<is there any preparatory work to be done; if so, which ones>*	**P2/Q8: What materials and technology is available/ or need to be organized?** **P2/Q5: What are the technical requirements? And which technology and tools are used?**
Description of Activity	*< describe the activity the user is doing, including the used technologies and tools used>*	
Other Stakeholders and their possible Interests	*<List the various stakeholder who may not directly interact in the use case but which might have an interest in the outcome of the use case. Identifying stakeholders and interests often helps in discovering hidden requirements which are not readily apparent or mentioned directly >*	**P2/Q2: Who can give support to the learners/teachers?** ***P3/Q6: Is the activity itself and/or its outcome shared with anybody?***
	EVALUATION – P4	
Success and condition	*<Is the use case successfully implemented? If so, what were the success criteria?>*	
Failure and conditions	*<Describe any possible failure and the explanation for it>*	*Has the use case failed? If so, describe why?*

Barriers/ Facilitators	*<Describe any possible other barriers or facilitators for your use case>*	
Extensions	*<Enter possible Extensions of the described use case and their steps*	*e.g. a student has an idea on how to proceed further or improving further>* **P3/Q4: Are there any other topics or subjects evolving out of the original activity?**
Variations	*<Describe possible other variations of the use case>*	**P3/Q5: Has the user developed variation(s) of his/her original plan?**

9.2. ANNEX 2 - QUESTIONNAIRE TECHNOPOLIS

Educational Workshops for Children by the Industrial Gas Museum and INNOVATHENS!

Please let us know what you think of our Educational Workshops and help us to improve our services!

*Please if you accompany more than one child, fill in the form once for each.

It will only take a minute!

*Required

1. **How old is you child?** *

   Mark only one oval.

   - 4-5 years old
   - 6-8 years old
   - 9-12 years old
   - 12-15 years old

2. **Which of the following topics do you find more interesting?**

   Mark only one oval.

   - Experiments/ Physics/ Chemistry
   - Technology
   - The Arts
   - Constructions
   - Other: ____________________

3. **Which is the preferable duration of a workshop for you and/or your children?**

   Mark only one oval.

   - 2- 3 hours
   - Two days for 2-3 hours per day
   - More than two days
   - Other: ____________________

4. **How are you being informed of our educational programs?**

   Mark only one oval.

   - Facebook
   - INNOVATHENS Newsletter
   - Technopolis Newsletter
   - INNOVATHENS Webpage
   - Technopolis Webpage
   - Publications- Editorials (digital or printed)
   - From Friends/ Word of mouth
   - Other: ____________________

5. **Have you ever visited Technopolis in the past?**
Mark only one oval.

- Yes
- No
- Other: ____________

6. **Have you ever visited the Industrial Gus Museum and/or INNOVATHENS in the past?**
Mark only one oval.

- Only the Industrial Gus Museum
- Only INNOVATHENS
- Both
- Neither
- Other: ____________

7. **How familiar are you with the New Technologies?**
Mark only one oval.

	1	2	3	4	5	6	7	
Not much	◯	◯	◯	◯	◯	◯	◯	A lot

8. **How familiar is your child with the New Technologies?**
Mark only one oval.

	1	2	3	4	5	6	7	
Not much	◯	◯	◯	◯	◯	◯	◯	A lot