Empowering Social Innovators through Collaborative and Experiential Learning

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***Abstract*—Educating social innovators in higher education is of great importance as many societal challenges exist. This study combines experiential learning with ICT tools to provide students with the needed competences and experiences to solve societal challenges. We employ this approach in an innovative course, named Experts in Teamwork (EiT), which follows the experiential learning cycle. The participants of this study are undergraduate students interested to learn how they can solve societal challenges. Specifically, 26 students with various background and nationalities participated. A collaborative platform was developed that supports teamwork and cooperation, as well as the social innovation process. The findings show that this approach can influence positively learning outcomes and increase students' engagement and motivation with both social innovation and the learning process. Also, students' creativity was increased leading to the development of better solutions. The overall outcomes contribute to theoretical and practical development, to allow educators to take appropriate measures to enhance students' learning experience and foster social innovation through ICT.**

Keywords—Social Innovation; Experiential Learning; Social Good; Higher Education; Engagement; Creativity

I. INTRODUCTION

Numerous problems exist in societies and various attempts are made to find and employ solutions, using all existing means, methods, and tools. Research has emphasized on technical and economic innovations, however further work is needed to address and solve existing societal problems and achieve social change [1]. Social innovation can help to understand and create social good and social change [2]. Social innovation is defined as: "*A novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals*" [2]. However, the question remains on how we can educate future social innovators [3], and foster creative problem solving using contemporary technologies. As Information Technology (IT) industries knowledge and ability to innovate relies in Information and Communication Technologies (ICT) skills [4, 5], using ICT tools can lead to the identification of innovative solutions addressing social challenges, fostering both innovation and entrepreneurship.

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Students' interest and motivation towards STEM subjects has been of great interest the past decade as the need for CS (Computer Science) and IT professionals increases rapidly. By 2020 half of STEM jobs will be in CS, and more than half will require significant CS skills and knowledge [6]. To this end, numerous studies have examined how to increase students' engagement and interest with ICT, as well as how to reduce dropouts from CS and IT studies [7-10]. Among the factors that may influence students' perceptions and behaviour are teaching environment and teaching quality, which refer to poor teaching, boring and big classes, and institutional commitment for high quality relation among students and faculty, as well as increased academic support to foster student performance. Such findings emphasize the need for further research in the area and suggest that employing learning approaches that are different from traditional ones may improve learning outcomes or students' performance and retention.

Educating social innovators is becoming increasingly prevalent in higher education, along with the need to develop improved and more effective pedagogical and learning approaches [3, 11]. Genuine education comes from experience, however not all experiences are genuinely or equally effective [12]. Experiential learning is an approach based on which students can learn through experience [13]. To this end, project-based learning has been employed for many years in education, engineering, CS, economics, and business [14, 15]. Employing experiential learning in STEM studies allows the students to work on meaningful hands-on-activities. Indeed, collaborative and teamwork project-based work brings together students with different backgrounds, helps them develop their IT skills using ICT tools to solve real-world challenges. Furthermore, this collaboration can be enhanced through the use of online platforms, which allow cross-cultural learning and team management, helping the students to learn and innovate together [16]

This study focuses on how learning outcomes in STEM may be improved through the use of ICT tools in order to educate learners on how to solve societal problems, towards becoming social innovators. Here, we aim to answer the following research question:

R.Q.: How contemporary learning environments can help to enhance experiential learning and educate the social innovators of the future?

To this end, we developed a collaborative platform that enables online teamwork and supports the social innovation process and employed an experiential learning approach to allow the students to work with real-life problems and find ICT enabled solutions. The findings show that an experience-based learning approach, combined with the use of a contemporary technologies, which fosters social innovation and is directly linked with students' project work, can help increase engagement, collaboration, and creativity. Improving these factors can have a positive influence on learning outcomes in STEM education and specifically on student retention in CS/IT studies.

II. Related Work and Research Overview

A. Experiential Learning

Experiential learning is an approach based on which learners learn best through experience [13], or in other words they learn by doing. Indeed, creating knowledge is a combination of both theory and experience, as "*learning is the process whereby knowledge is created through the transformation of experience*" [13]. Experiential learning is "*a sense making process of active engagement between the inner world of the person and the outer world of the environment"* [17] This approach is quite different from the traditional lecture-based teaching, which leads to students being rather passive regarding their engagement with the course. Instead, experiential learning fosters direct experiential encounters between the learners and the teacher, as well as among the learners themselves [18]. Yet, most of teaching in higher education is based on traditional lecture classes; as it usually requires less resources to educate the increasing number of students enrolling in higher educational institutions.

Following an experiential learning style in the class and employing more interactive activities can increase students' engagement and positive feedback [19]. Engaging and motivating students in the class, such as through collaborative activities, is likely to have a positive influence in their performance, their overall satisfaction with the course, or the perceived benefits, thus leading to reduced dropout rates and increased enrollment [8-10, 19].

There are four basic stages in experiential learning, that are combined in an experiential learning cycle [13], to support the implementation of various activities, enabling the students to acquire a deeper understanding of a topic of interest. First, the experiential learner actively experiments with a concept and then reflects on that experience. Next, the learner should try to generalize what was experienced and apply this knowledge to another experiment. Figure 1 presents the experiential learning cycle developed by Kolb [13, 18]. Drawing on this cycle, different learning styles may be developed which are appropriate for students' different preferences, building on tradeoffs between feeling vs thinking and watching vs doing stages. The experiential learning cycle has some limitations, mainly due to stages that may overlap with each other. However, its benefits are strong in designing hands-on approaches [18], bridging the need to bring the students closer to real-life and complex environments, similar to those that they will experience after graduation [9].

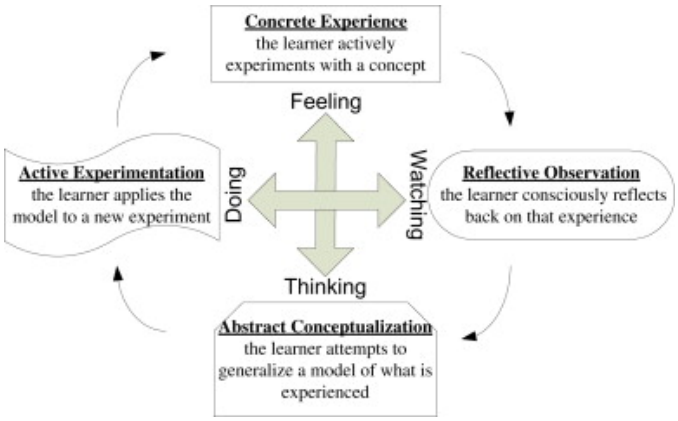

Fig. 1. Kolb's experiential learning cycle. Source: [18]

An innovative course, called *Experts in Teamwork* (EiT)[1], has been developed at the Norwegian University of Science and Technology (NTNU). EiT implements the experiential learning cycle to teach students how to work together while collaborating on a project. Although project-based courses are very common in higher education, EiT follows a rather different approach, as the students spend half of the course hours working on the project, and another half between learning how to collaborate and reflecting on their collaboration. Reflection is a critical part of the course, and one of the major factors that sets it apart from other project-based courses. Following Kolb's experiential learning cycle, the combination of the above is needed for successful learning outcome and increased student engagement

B. Experts in Teamwork (EiT)

Experts in Teamwork (EiT) is a MSc degree course in which students develop interdisciplinary teamwork skills. The course is compulsory for all students of master and professional study programs at NTNU. Students work in interdisciplinary teams and are asked to define a problem description and establish a project to solve this problem.

Fig. 2. A team of students at EiT. Source:NTNU/EiT[1]

By the end of the course, each group has to deliver a product report and a process report, counting 50% and 50% towards the grade, respectively. The product report must present and discuss the interdisciplinary solution developed by the group: a prototype or other technology artefact; and the scientific methods adopted. The process report must describe the team process, e.g., how the team cooperated, roles of different team members, whether there were any significant events during the process (e.g., conflicts, how these were

[1] Experts in Teamwork (EiT) - http://www.ntnu.edu/eit

solved), and how these can be related to group process theory [20]. At the time of writing (2017) EiT is taken by 3000 students divided in about 100 classes (also called villages) of 30 students each, who are composed into teams comprising of 5-6 students each.

Fig. 3. A village at EiT Source:NTNU/EiT[1]

Each village is supervised by a lecturer, who defines a fairly open-ended theme for that village. Each team may then invent their own project assignment, and set their own milestones, as long as they stay within the given thematic area and end up delivering the required reports. This openness of the assignment fosters students' creativity and a strong sense of ownership of the conceived project. Also, the open assignments make it easier for each team to define a project where every member can contribute their own expertise, regardless of which study program they come from. Hence, students are not assigned to villages at random, rather each student makes a prioritized application for 5 villages where the student believes that her background is relevant.

The course runs in the Spring semester and has two different programs. First, the *"semester-based"*, in which the students meet once per week for a full day of work during a whole semester. Second, the "*intensive village"*, which lasts three consecutive weeks, where the students meet daily and work for the whole day. The intensive village aims to simulate the intensive and agile processes followed by companies and organizations when developing projects, thus preparing students for their life after graduation. Because both programs last 15 working days, the workload for each student is the same.

Although EiT resembles other project-based courses, the students are required to meet each assigned day, in a predefined room chosen by the supervisor, as they need to work both on the project as well as on the process. The students themselves need to develop a timeline for their projects, and make sure it is followed. At the meetings, shared problems are discussed to agree on actions to be taken. Some meetings are reserved for technical or team process presentations in accordance with a milestone plan that the students have worked out themselves at the beginning of the semester. By working in EiT, where each team member initially has different perspectives on the problem at hand, the students can develop attitudes that enable interdisciplinary teamwork. In solving a problem that challenges their area of expertise, they are trained in using their skills to contribute to the mutual problem-solving process. Through this process, the students are exposed to the challenge of interdisciplinary communication, learn to operate within an interdisciplinary environment, to understand the interaction between each member of the team, and how this interaction affects them. Since the students are familiar, from the beginning of the course, with the evaluation criteria, their outcome of each day is organized in such a way to meet these criteria at the end of the course.

Furthermore, as *reflection on experience* is a critical part of experiential learning, in the EiT course the supervisor and the teaching assistants also act as facilitators of this process. With reflection being a fundamental aspect in EiT, the facilitators receive a seminar before the beginning of the course on how facilitation should be performed. Briefly, facilitators' main duty is to observe the teams while at work and, when needed, to ask questions that *facilitate* the reflection process. Questions are formulated in a neutral manner, mainly as observations, which purpose is to inform the team about a specific situation. For example, during a discussion the facilitator may say "I noticed that student A is not actively participating in this discussion. What do you think about it? or "I noticed that students A and B take most of the decisions in this team. Would you like to talk about it?". Then it is up to the students to decide how to use this information. The students should use this information as input to foster discussion within the group, and are not supposed to reply to the facilitator. The purpose is to guide students into discussing in detail any issue that may arise in the group, or address problems observed during collaboration, which otherwise would otherwise remain unsolved. Also, facilitation aims to encourage students that usually prefer to remain silent or passive during discussions, to speak openly. Overall, facilitation is about improving reflection and discussion among the group, which by extension can lead to the identification and solution of problems.

To present students with real-life challenges, a village at EiT was created dealing with "ICT-enabled Social Innovation for Social Good". During this village, the students had to collaborate to identify and propose innovative solutions towards reaching the United Nations sustainable development goals[2]. Also, since collaborative platforms, including learning management systems (LMS), are able to increase users' engagement and co-creation of knowledge [21-23], a novel social creative intelligence platform was used to support both goals of the village by fostering social innovation through online collaboration

C. *Collaborative Platforms*

Collaborative learning and contemporary software tools can affect the learning and educational process [23]. Specifically, collaborative platforms can enable teamwork in virtual spaces. Their adoption in learning processes, allows cross-cultural learning and virtual team management, giving the students the opportunity both to learn and innovate together [16]. Collaborative platforms are increasingly becoming more popular among students as they allow free online collaboration

[2] United Nations Sustainable Development Goals - http://www.un.org/sustainabledevelopment/sustainable-development-goals/

and knowledge co-creation, even among students from different countries, time zones and cultures [24]. Through such platforms students exchange information, messages, videos, drafts of their work, etc. Online collaboration is also supported from various LMS (e.g., Blackboard or Moodle[3]), promoting active learning, teamwork as well as autonomous student work. Although students may have a positive attitude towards the contribution of such systems in their learning processes, they see them as complementary tools with high room for improvement [22]. Overall, regardless of how good LMS are, students often consult faculty members seeking support for their course [22], and a supportive learning environment is an important factor in predicting students perceptions about their degrees and their future intentions in completing their studies [10].

To this end, in the EiT village reported in this study students used a state of the art platform, which differs from existing ones as it supports online cooperation and teamwork, but also is directly connected with the scope of the students' project, that is finding innovative solutions for social good [25]. Indeed, this is a social creative intelligence platform, which allows online collaboration and offers specific tools to guide non-experts into defining innovative solutions and making prototypes towards the solution of real-life societal challenges.

D. Social Innovation

Social innovation draws from social theories and social practice, examining the interrelations among its actors, processes and cultural contexts in order to achieve social sustainability and change [26]. Social innovation includes different steps, which are defined as follows; *prompts*, *proposals and ideas*, *prototypes*, *sustaining*, *scaling* and *systemic change* [27, 28]. A social innovation process starts by the identification of a societal problem or challenge that act as prompts to spark innovation. Then it proceeds to idea generation through various methods. Based on these ideas, prototypes and pilots are created to test feasibility and acceptance. Further, ideas are improved to be sustainable in the long run, at this stage the ideas have been already transformed into companies or organizations. In scaling, the innovation needs to grow in various aspects, which might include spreading into a different or larger market. Finally, the goal of social innovation should be to create systemic change; a very complex process that involves multiple actors and elements, and it is expected to take a long time before it can be proven successful. Achieving systemic change means that a social innovation has managed to contest the social system that defines peoples' lives. It has influenced main beliefs, inherent in the system, that in turn led to the creation of new processes, routines, policies, laws and legislation.

III. Case Study: Learning Social Innovation Skills using Contemporary Technologies

A. Description and goals

During the spring semester of 2016-2017 we ran a EiT Village entitled "ICT-enabled Social Innovation for Social Good", during which participants followed a specific process which is based on the social innovation process as defined earlier [27, 29]. For this study, we focus on the first three steps of the process: prompts, proposals and ideas, and prototypes. In this perspective, the two main actors in the EiT village are the challenge owners and the students. The former present challenges, which are then to be solved by the students through innovative ideas. Different challenge owners were considered, based on their relationship with the goals of the study, as well as their intentions for active participation. Eventually, the Autism Association of Trondheim (Norway)[4] has been chosen to be the challenge owner. Five people from the autism association actively collaborated in all the phases of the village. They were asked to propose specific challenges related with the goals of this study. The proposed challenges were discussed between the researchers and the challenge owners, before being published on the website of the village.

The challenges needed to maintain a balance: on the one hand, not being too generic because that will not provide enough guidance in the process. On the other hand, they should not be too specific, so the students can maintain a degree of freedom and creativity when proposing and developing their ideas/solutions.

Furthermore, the challenge owners had to attract beneficiaries in the village. The beneficiaries are different stakeholders that may gain from the solutions developed. The goal is to engage collaboration between the different stakeholders (i.e., students, challenge owners, beneficiaries) through the platform, so the students can develop and evolve their ideas while using the help and feedback from challenge owners and beneficiaries.

The participants of this village are divided into groups comprising of 5 or 6 students. Once participants receive the challenges they start with ideation, that is to come up with ideas as possible solutions to the existing challenges. The platform allows the exchange of feedback among all three main stakeholders, fostering collaboration and teamwork.

Next, once the ideas have been defined in the platform, the challenge owners and the beneficiaries vote on the best ideas best on feasibility and relevance with the challenge. This process is complete in the first 5 days of the village, with the remaining 10 days left to develop prototypes of their ideas.

B. Procedures and participants

To recruit participants the village is advertised through a dedicated webpage that described its scope and main objectives. The website was advertised to NTNU students, at events related with social innovation and with EiT. In this way, we enrolled 26 participants. Table 1 presents the demographics of the sample.

The goal was to attract students from different backgrounds in order to create multidisciplinary and interdisciplinary teams. Indeed, students' background included Computer Science, Engineering, Architecture, Medicine, Political Science, Psychology and Childhood studies. The majority of the

[3] Blackboard Collaborative Learning Solutions – http//blackboard.com, Moodle Open-source Learning Platform – http://moodle.org

[4] Autism Association of Trondheim - https://autismeforeningen.no/sortrondelag/

students had STEM backgrounds, although students from other fields where included to foster multidisciplinarity in the groups and teach students how to collaborate effectively with people with different backgrounds.

TABLE I. DEMOGRAPHICS OF THE SAMPLE

	N	%
Gender		
Male	8	30.8
Female	18	69.2
Age		
22-23	11	42.4
24-25	7	26.9
26+	8	30.7
Reason for choosing this village		
Interest in the theme (Social Innovation through ICT)	19	73.1
Interest in testing a new platform	2	7.7
Other reasons	5	19.2

The village had a clear theme on using ICT tools for social innovation. Finally, as this was an international village, we were able to attract students with different nationalities, allowing us to create multi-cultural groups and foster cross-cultural collaboration, with the majority of the students (62%) being foreigners. In detail, 38% were from Norway; the rest came from Central, Eastern, and South Europe, as well as Asia and Africa.

The participants used a prototype of the platform that was used for the purposes of this study (Figure 4).

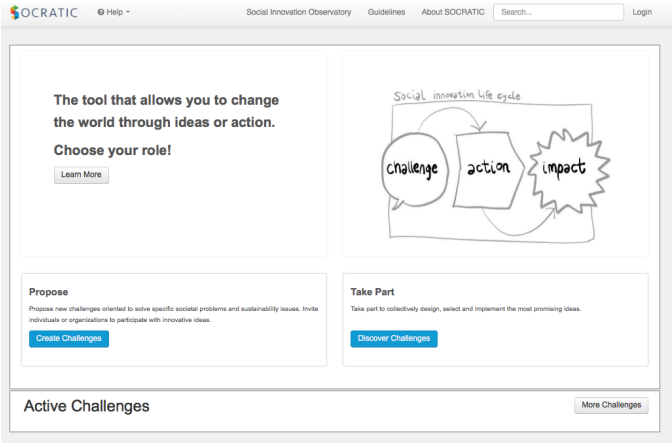

Fig. 4. Homepage of the developed platform

To define the challenges a template was given to the challenge owners. The template was developed as part of the predefined social innovation process, and it guided the users to provide the following information; title of the challenge, an elevator pitch (the challenge in one minute), the social challenge to be solved, the beneficiaries, the potential impact of solving the challenge, the UN sustainable development goal that this is linked with, the level of support that the challenge owner can offer, and how the ideas will be selected.

Briefly, the participants start with the title of the challenge and provide an elevator pitch to attract the audience. Next, the social challenge is described in detail, the beneficiaries and its potential impact. The challenge owners should decide with one of the UN sustainable development goals this challenge relates to. Finally, what level of support can be provided by them, and how the best ideas(solutions) will be chosen. The following challenges were defined using the template:

- Business ideas that take advantage of an autistic mind
- Promote vital information to stakeholders in the job market - job seekers, employers and employees
- Create solutions that help people affected by autism to better handle stress
- Fulfil the UN Convention for Persons with Disabilities

Next, the students had to define their ideas, as potential solutions to the challenges. To facilitate and guide this process a template was developed as part of the predefined social innovation process. The following basic information were asked to be provided for each idea: Title of the idea, an elevator pitch (the idea in one minute), the nature of the idea (product, service, policy, framework, training, other), the description of the idea, the beneficiaries. Also, it was optional to provide more information to better define the idea about the following: how the idea creates value for the beneficiaries, what is the impact to other stakeholders, what skills and resources are needed to implement the idea, an outline about the implementation plan, and a short description on why this user (i.e., challenge solver) is the right person to implement this idea

C. Data Collection

During the village, data about students' learning experiences during the course has been gathered through multiple strategies. Qualitative insights from semi-structured interviews and observations, which were complemented by quantitative data collected with questionnaires and log files. For the purpose of this paper, we focus on the qualitative data from the interviews, as they can provide rich insight into how the students worked in this course in order to develop social innovation skills and ICT solutions using contemporary technologies.

Towards this direction, each one of the village participants has been interviewed at the end of the course for about thirty minutes. The interview protocol included questions about idea generation (e.g., *How this platform and process helped you to find, refine and choose the idea?);* cooperation patterns both among students and with challenge owners (e.g., *Describe your flow of work within your group and with people outside of your group when using this platform and process);* challenges (e.g., *Did you encounter any challenges? Yes? Which one, with who and why?)*; and what third-party tools were used. All data collected from the interviews were anonymized. To avoid any bias from the students, the interviews have been performed by a person that is not involved in the course.

D. Data Analysis

For the qualitative analysis of collected data the guidelines by Strauss and Corbin [30] and Burns [31] are followed. We have focused our analysis on the search for patterns of actions that involved participants and elements of the predefined social innovation process and platform, especially in connection to

the goals for the course. Observations have also been used to spot and discover the process, intended as unexpected usage of the platform and pre-defined procedures supported by the method.

IV. RESEARCH FINDINGS

Students mention that the use of this platform helped them in defining ideas to solve the given social challenges, as they followed the social innovation process. Working on the challenges the students proposed numerous ideas, out of which five were selected to be implemented. Table 2 provides a summary of the five prototypes that were developed as part of this study.

TABLE II. THE FIVE PROTOTYPES

Name	Description
EMOTISCAN	An application for smart-glasses that work as a tool for recognizing emotions in facial expressions, to make social interaction less stressful for ASD people. A first pro
The Social Guidebook	An application that provides basic insight into everyday social interaction and expectations, as well as suggestions on how to interact within different situations and people.
ASPHIRE	An online platform where users can create private profiles. This profile can contain personality traits and strengths, and will function as a digital résumé. The purpose of this is to provide employers with a clear overview of a job seeker with ASD. The profiles will be closed to the public, but you can choose to share your profile with specific people, like employers.
Autism Inclusive Companies (AIC)	A service that provides specific criteria, that companies should fulfil to get the Autism Inclusive Company label.
The check-in application "Good-Work"	An application designed to reduce stress and help people struggling with social interactions.

Specifically, prototypes were developed for (1) an application that scans your face and identifies your emotions to help people with ASD to identify how others feel around them, (2) a social guidebook on how to increase social skills of people with Autistic Spectrum Disorders (ASD), (3) a platform that brings together people with ASD looking for a job and potential employers, (4) a service that evaluates companies based on how inclusive they are towards hiring people with ASD, and (5) an application that people with ASD may use at work to notify their colleagues under what circumstances they want to hold a conversation. Figure 5 presents an example from one the prototypes that were developed.

The students found the platform useful to scaffold the social innovation process (as defined in section III) providing affordances to both reflect and improve on their ideas and by supporting collaboration with the different stakeholders involved in the process. Yet technical and usability issue hindered the overall experience with the platform. Those issues were mainly due to the early stage technical development of the platform and expected to be fixed in future releases. Students also provided useful comment to improve the platform.

Next, we elaborate on the strengths and weaknesses of the platform, highlighting what elements supported or hindered students' ability to learn from their experience as social innovators.

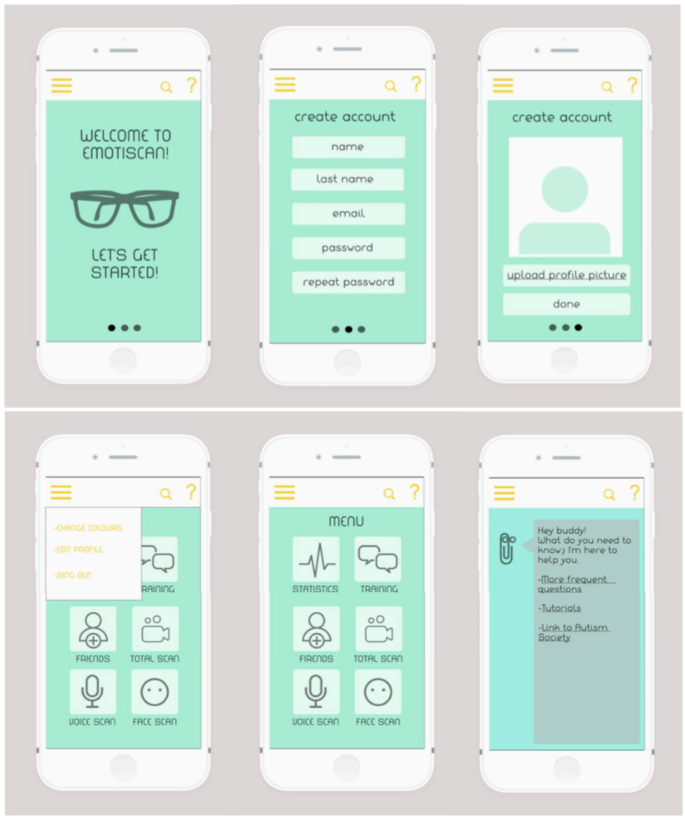

Fig. 5. Example of prototype developed by EiT students

1) Strengths

a) Guidance and Engagement

The platform acted as scaffolding for the social innovation process (Section III). By using the platform the students felt they were learning the underlying social innovation process: *"I think that when you use the platform, you are defining the way you are going to do the process…"* and *"the platforms really help so instead of just having ideas here and there and you should have compared-- the platform makes them more comparable because you have to fill in the same fields so never edit"*. We observed that this was especially connected to the idea template that the students had to fill in to register an idea in the platform. The structure of the template helped students to reflect on their own idea and come up with definition they would have thought without it.

Interesting enough, participants liked the lack of flexibility in the platform: *"The main characteristic that it is not very flexible. That is a good thing because it forces you to use a certain process."* Indeed, it is shown that adding constraints to the ideation process improves its outcomes in terms of creativity and number of ideas developed [32].

Unexpectedly, some group felt idea selection like a competition (and they liked it), which in turn increased their engagement with the platform and the course. They

recommended to make it more explicit. *"I think it was a competition. I do not know if the other groups took it as a competition. We were really triggered by it"* and *"We immediately wanted to win as a team"*.

Course supervision and structure has also been deemed to increase creativity and engagement through the course *"I have to thank the learning assistants or the facilitators [cut] I don't view myself as a creative person. Through the exercises and through brainstorming within the team, I think we have much been quite creative"*.

b) Collaboration

Social innovation is a highly collaborative process. Also, collaboration has been linked to learning outcomes [21, 22, 24]. For these reasons supporting collaboration has been one of the primary design goals for the platform that was developed. Collaboration happened during the EiT course on three levels: between the students and the challenge owners, among the students working as a team, and between different teams.

Interaction with challenge owners

Interaction with challenge owners was done outside the platform (email/physical meetings), because commenting on challenges entered in the system was not implemented in the current platform release. Most of the groups stated that the communication has been good, both via email and in person. *"They are really good at responding when we make contact with them."*. Some groups found the challenge owners commenting on their ideas "intriguing", this pushed them to do better "*We got our feedback from at least three persons [challenge owners]. It was a constructive critiques or constructive thoughts, so they were helpful.*" Meanwhile some other participants suggested the challenge owners to prepare example ideas already in the platform before starting ideation. In summary, the interaction with the challenge owners had a big impact on the final ideas developed *"we tried to incorporate feedbacks from the beneficiaries and that really changed our prototype plot"*.

Intra-group patterns

Although intra-group collaboration was not explicitly enforced during the course, this happened naturally among groups. Notably, none of the interviewed students reported on conflicts among members. This could be motivated by two factors. First, because participants came from different disciplines they were able to easily divide the work by assigning specific tasks to specific skills *"I do nott think I have a specific role because we think we are all doing same role, the difference in between me and the others is that I come from more an artistic and creative branch so I am more into the design things and creativity things but then we always divide the work in equal weights."* And *"Besides our different backgrounds, I think we complement each other really well so I'm super happy with my group."*. It was easy for the groups to divide tasks among members *"each member of the group, or even two members of the group, are working in one task while the other is working in another. We can work in several tasks at the same time."*.

Second, most of the groups did not elect a leader, following a rather flat structure. Indeed, the students preferred not to have a leader but aimed to make democratic decisions by voting on every decision. Although the lack of leadership in a group can be seen as a weakness, in this case it seems to have facilitated cooperation among group member *"Yes, we assume it as a more flat structure, even though there is a person that has more communication abilities and that tends to contribute a little bit more than the others, but we assume it as a flat."*, *"We have a quite flat structure. We don't have any leaders. We all work together to find the solutions"* and *"We are all open to other people's ideas, there's room to be creative and some people are more creative than others, and then they're critical person [laughs] can throw away those ideas that are not so good"*. Interaction within the group has also been a trigger for creativity, as discussed later.

Inter-group patterns

Participant found ideas generated by other groups using the platform and the predefined social innovation process to be a source of inspiration and creativity: "It was easy to find inspiration in other ideas." "You might combine some ideas and make a completely new edit."

Further, to see ideas from other groups was perceived by the students as a trigger for reflection, a basic step in experiential learning [13, 18] In particular, this happened when the students found their own idea too similar to another one *"We saw that some of ours were quite similar to other people's"*. Interestingly, this was perceived by each student in completely different ways. For some, identifying their idea with another one was an issue: *"sometimes it was a problem because we saw that we had the same idea"* because they considered their idea not to be novel and worthy *"We decided to, okay fine, other people already thought about it so maybe it is not so new and innovative, so we throw away the ones that we don't like."*. On the contrary, someone else found this a positive attribute for an idea: *"to see that some of the groups had had some of the same ideas that we did, and it made us reassured that we were on the right track in a way."*

c) Creativity

Participants appreciated that overall, they went through a creative process. "I don't view myself as a creative person. Through the exercises and through brainstorming within the team, I think we have much been quite creative". As the challenges were formulated fairly open and broad, this encouraged creativity supported by the predefined social innovation process "The challenge in itself is quite open, so we were free to do whatever we wanted to do to solve one problem, and within the group we were all contributing".

Finally, we observed that the groups took into account tradeoffs between creativity and feasibility *"[during brainstorming] we're always trading this balance between feasible or just playing unrealistic"*, and felt the tension between diverging on ideas and converting on solutions via critical reflection *"in our group, we also tend to be critical which sometimes limits your creativity. So, if we would not have done that [being critical], we could have been a lot more creative"*.

2) Challenges

a) Usability issues

Participants reported that when using this platform their creative flow was often disrupted by system usability issues.

Also, the participants found the functionalities provided by the platform to be limited, e.g. it was not possible to define group-wide ownership for the ideas entered in the platform allowing only the creator to edit *"The rest of the group couldn't edit ideas. It was only the one person who had uploaded the idea first [could] even though we were connected by the same group."*. Several participants found the user experience with the system frustrating. *"It was difficult to see the comments we got and it was difficult to see who liked our ideas. We tried to comment on other people's projects, but the technical difficulties made it a struggle"*. Yet participants managed to overcome the limitation of the platform using external tools, especially collaborative editing tools (e.g. Google Docs), and real-time communication tools (e.g. Facebook messenger, Slack).

Most of technical glitches also happened when there were many users logged in *"[The platform] didn't work properly when were like 30 people on the platform."*. Issues that will be fixed in future releases of the platform. Finally, some participants reported lack of workflow overview *"It didn't really have an overview of which task we were going to do and how we were going to do it."*

b) Time issues

Several participants report not having enough time to carry on the tasks at their best. When asked about cooperation with other team one answered, *"Not really because we are focused on working within the members of our group all the time, especially because we have a limited time, only three weeks, so it could be quite chaotic to try to cooperate with every member of the village". "We did not collaborate that much with the challenge owners, it's also due to the limited time we have…"*. Finally, there has been some misunderstanding between students and COs about expectation on what to deliver at the end of the course *"I think maybe expectations aren't the same because it feels like they want to have a full product. We've been only making prototypes and we have three weeks and we're going to write two huge reports at the same time. I think they might have some high expectations to what they will get out of it then."*

V. DISCUSSION AND CONCLUSIONS

This study proposes that experiential learning combined with ICT tools, can influence positively learning outcomes and increase students' engagement and motivation with both social innovation and the learning process. In detail, we present findings from a qualitative evaluation of an experience-based course that used a collaborative platform to solve societal challenges. The findings show that employing ICT tools in experiential learning provides students with the necessary guidance and can increase their engagement with the course. Also, it improves collaboration among members of a group, among different group, as well as between students and other stakeholders (i.e., challenge owners). Furthermore, the results show that through this process students' creativity was increased.

In detail, the findings verify the importance of experiential learning as a teaching approach, consistent with previous studies [18, 19], and extend them by highlighting the potential of including real life problems in project based courses. Also, this approach can help students of EiT, and of other similar courses, to develop IT skills and competences that are required by the industry, including problem solving, progress monitoring and communication, project management [9].

The design of this village, within the EiT course, which bridged learning with a research project, gave the opportunity to the students to work on real-life problems. Also, using a collaborative platform that was developed to support the learning process, as part of the course, and the social innovation process, as part of the research project, adds to the importance of using collaborative platforms in learning. Using the platform and receiving comments from challenge owners, increased students' engagement as it pushed them to work harder to improve their ideas. Also, it increased inspiration and creativity as the students were able to see what other teams were working on. Being able to compare with other teams helped students reflect upon their work, leading to increased engagement and motivation.

Furthermore, when these are aligned the students report that it led to better learning outcomes. In detail, the findings show that following the structured social innovation process, as it has been refined and extended for our study [28], helped the students to reflect on their ideas, improved the definition process, and increased their creativity. As the students were working with real-life problems looking for actual solutions, they also focused on developing feasible solutions, thus keeping a balance between creative and realistic ideas. Through critical reflection the students were able to transform ideas to genuine solutions.

Finally, this village managed to raise students' awareness on social innovation, a very important area on a global scale which needs further research [1, 33]. Also, during the course, the students became social innovators themselves as they worked on solving societal challenges of people with ASD. Most of the students chose this village due to its theme (Table 1). Further, using this platform made the students feel that they were learning the underlying social innovation process. This is critical as educating future social innovators in higher education is very important and should be combined with better and more effective learning approaches [3, 11]. Indeed, the findings show that combining experiential learning with ICT tools increased students' interest in social innovation, and offered them a hands-on experience in solving societal challenges. The findings add to the importance of collaborative environments and contemporary platforms in education [23].

As with any empirical study, the findings of this study have some limitations. This study follows a qualitative approach; thus, it may leave out contextual sensitivities while it focuses on meanings and experiences. As the study was conducted in a specific context the findings should be generalized with caution. Further, another important limitation is that the students used an early prototype of the platform, which led to

various usability problems. Despite these limitations, the findings generate valuable insights, which can be used in future courses.

In detail, it would be interesting and useful to follow a similar design approach in other villages of EiT, as well as other project-based courses, especially those working on social innovation and trying to address societal challenges. Also, as a next step of this ongoing study, we continue our research with mixed methods (both qualitative and quantitative) to have a better understanding of the students experience during this course. As our goal is to educate future social innovators who can take advantage of ICT tools, we plan to run similar village in the future and also use the platform in different contexts, in order to improve the learning experience of the students.

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