INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
6 & 7 SEPTEMBER 2012, ARTESIS UNIVERSITY COLLEGE, ANTWERP, BELGIUM

PROJECT WORK ON WELLBEING IN MULTIDISCIPLINARY STUDENT TEAMS: A TRIPLE TESTIMONIAL ON EPS AT ARTESIS

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ABSTRACT
The European Project Semester (EPS) programme offers an educational framework to support students to practice problem-and project-based cross-disciplinary product innovation and research, in small multidisciplinary and international teams. To explore the potential and the restrictions of this international educational concept, in 2012 the Artesis University College became the first Belgian EPS provider to offer a multidisciplinary EPS programme in close collaboration with the following study programs: *product development, engineering, business studies, social work and teacher training*.
This paper reflects on the learning process for the teaching staff and the 16 students who have participated to the first edition. First, insights related to the preparation, initiation and overall implementation of this new multidisciplinary teaching approach and interdepartmental semester program are discussed. Second, we focus especially on one specific EPS project which addressed the development of *smart textile applications in health care*. Reflections and lessons learned are shared from the complementary perspective of the EPS study programme coordinator, the 'smart textile applications' team supervisor and an engineering student who participated in this project.

Keywords: Multidisciplinary teams, project and problem based learning, smart textile, healthcare

1 INTRODUCTION

Zarakian and Kusiak [1] emphasize the importance of multifunctional teams in product development. However, assembling a creative team to balance risk of failure with successful ideas takes a marriage of well-established fields to achieve the breakthrough [2].This paper wants to introduce the reader to the challenges and rewards of teaching students how to work in multidisciplinary teams for the first time in the context of a European Project Semester (EPS), a special semester program, consisting of project supportive courses and project work in teams, aimed at own students and international students from partner universities and university colleges.
EPS is organized by 11 providers all over Europe (www.europeanprojectsemester.eu). This specific programme offers an educational framework for students to practice cross-disciplinary product innovation and research in small teams of 3 till 5 students. Therefore, EPS uses a problem-and project-based learning approach to challenge students with various educational backgrounds from different European study programs to join their forces in an interdisciplinary project based on real life problems in close collaboration with industrial partners and research institutes for a period of five months. This special approach stimulates students to contribute with and apply their knowledge from their study field, while it triggers them simultaneously to develop their social and communicative skills during the different stages of the process of team collaboration [3] and during project related negotiations. This paper focuses on the specific case of one EPS team in particular: the team that worked on the project "Smart Textile Applications in Health Care".
Our paper is structured as follows: in the next section we describe the preparatory stage of the EPS, starting with our programme composition, the "smart textile" project proposal definition and the team member selection for this challenging project. Then we will proceed to present you a narrative of the project progress. In the discussion section we discuss the project results and pinpoint some of the challenges we encountered, based on the triangulation of the viewpoints and findings from three different perspectives, namely, the perspective of the EPS programme coordinator, the perspective of one ICT-engineering student and former team member of the "Smart Textile" project and the

perspective of the supervisor of this specific project team. We will conclude with a listing of the most interesting lessons learned during this EPS project elaboration from each of the three perspectives and formulate some strong arguments in favour of investing in multidisciplinary study programs under the heading of 'conclusions and future directions for multidisciplinary project work'.

2 THE EPS IMPLEMENTATION

2.1 Preparatory stage 1– the composition of the EPS programme

When we decided to implement the format of the European Project Semester for the first time, we had the challenging task to form a team of lecturers and supervisors comfortable with teaching students in English, committed to design adequate courses with the right content and level of difficulty and well prepared to coach multidisciplinary teams with students from very heterogeneous backgrounds. The project proposals, their supervision and the project supportive courses should not only address the cultural and linguistic differences between the students, but also the differences in mental models [4] due to the variety of study backgrounds of the team members.

We were in a favourable position as we were able to build on the experience and expertise of other faculties in Europe who had already implemented a similar program for several years at their department of engineering. On the one hand we could count on the teachers of two experienced EPS providers to teach courses of Teambuilding and Project management in the context of EPS during our first edition, and we received several EPS principles and assessment procedures which had been developed and redesigned over the years by these more experienced EPS providers, with whom we had the pleasure to discuss intensively their EPS experiences.

On the other hand, we have also gained useful insights from a focus group interview, guided by a semi-open question list on several EPS-related topics with six of our own students who had previously participated to the EPS programme of three EPS providers during their Erasmus period abroad.

However, due to our choice to embrace more disciplines in our EPS programme, we implemented some alterations. Some of these alterations are also due to the fact that we are the only EPS provider who originated the EPS programme starting from the study programme of Product Development instead of starting from the department of engineering. Therefore we emphasise foremost the integrated approach of interdisciplinary product development in our EPS project proposals and supportive courses, next to the project- and problem based learning [5] tradition, which have always been the fundaments of our product development study program.

2.2 Preparatory stage 2 – defining the right EPS project proposal

Among our 8 EPS project proposals, one of the most popular ones, in terms of student applications, was the project on "Smart Textile Applications in Health Care". The goal of this project was to define innovative and inspiring product applications based on 'smart textiles' for a specific target group.

Intelligent or 'smart textiles' applications are being developed for about ten years now and worldwide over a hundred research projects have been accomplished in this field. The applications involve a mix of sensors and actuators, embedded in textiles with the capacity to sense the environment, to respond via an active control mechanism and to interact with the user. Several demonstrators and the first commercial applications indicate that this technology has a strong potential for valorisation.

One reason to choose this topic for our first EPS edition was our interest in and former experience with smart textiles. A similar project assignment, focussed on a technology driven ideation, had been conducted during the previous year as a design project in our regular students' master program of product development at Artesis University College in collaboration with the research group of textile engineering of the University of Ghent, a partner in 'Systex', a European network which stimulates the development of innovative applications and demonstrators for smart textiles. The assignment resulted in feasible and innovative applications in various domains. However, due to the lack of expertise in programming and electronics, no demonstrators or prototypes were realized by the design students.

This noted lack of ICT and electronic expertise was another reason to take this project one step further and to propose the topic of smart textiles as a project proposal within the EPS programme.

An intensive collaboration of industrial design with engineering was clearly called for in this type of project and equally a technology driven approach requiring an in depth analysis of the technical characteristics was needed in combination with an exploration of feasible applications in various

domains. Therefore it seemed a promising, fertile and exciting topic for multidisciplinary investigation and interdisciplinary collaboration.

2.3 The project process

To illustrate the project process, we will now describe the concrete project set up and process of our EPS student team for the particular EPS project about smart textiles.

As the team would have to explore both the technology and the user needs, to define various opportunities and to describe innovative product ideas in the field of smart textiles, we clearly needed a variety of different expertise. Therefore we selected the following undergraduate students: a Spanish industrial designer, a Spanish electrical engineering student, a Belgian product development student, a Belgian electronics-ICT engineer and an Austrian medical IT programmer. The project specific goal of this team was to create an innovative application in wearable electronics and ambient environments that would support health care, based on multidisciplinary research.

In order to explore the synergy between industrial design and engineering in the field of product innovation, our EPS project included an exploration and an ideation stage at the front end. A *technology driven* approach was to be merged with a *need driven* or *user centred* [6] approach to address both engineering and design competences and to stimulate cross fertilization between the disciplines.

After the first brain storming sessions the student team decided to focus on solutions to support 'wellbeing' for elderly users. This target group was chosen because of the recognized necessity to find solutions that enable longer independent living for the growing group of elderly and the identified potential of smart textiles to address the very relevant social, safety and health issues closely related to this specific demographic challenge which the Western societies are facing today. Thus, the need to incorporate and integrate new monitoring and control systems in clothing and furniture surely represented a wide range of opportunities for the target group as well as an intriguing starting point for the multidisciplinary EPS team.

As a first step towards exploration, user scenarios were suggested by the supervisor to define the user functions and the required interaction. Based on these scenarios a Product Data flow Diagram [7] was built to translate user requirements into technical requirements. This technique had been developed and evaluated to support the development of smart systems in the master curriculum of product development. The exercise proved useful, as it resulted in five proposals that were developed at a system level, before they were evaluated and one idea was definitely selected.

At this point in the project process, a list of interdisciplinary product specifications was completed, which allowed the team members to start on all underlying design tasks (software development, electronic design, product design, fashion design, GUI (Graphic User Interface) design and interaction design). This intensive stage resulted in a full description of the product concept and some technical simulations. The measuring system was built and tested and the communication protocol to link the sensors with an external device was made operational. Mock-ups and models of a suit and the interaction were simulated and tested with users. The effort of the team and the quality of the results were outstanding despite the problems that occurred during the design process, which we will amply discuss in our next session.

3 DISCUSSION OF THE PROJECT RESULTS AND THE IDENTIFIED CHALLENGES

3.1 The project result

The smart textile project resulted in the design and the verification of a smart textile suit to assist elderly in learning tai chi and remembering the moves by providing examples and feedback on a tablet device, as well as vibro-tactile and visual feedback on the clothing. Although the team members worked closely together as a team to realize an integrated product-service combination, the team decided to appoint specific end responsibility for different project features to specific team members, based on their principal discipline expertise. This section lists and illustrates the separate aspects of the final result and indicates the study background of the main contributor for each aspect.

The product developer was responsible for the suit design, which involved research on ergonomics, usability, integration of electronics and user interfaces, while the industrial designer worked mainly on

the interface part as shown in Figure 1 and also made the layout for the project reports and presentations. To become familiar with the tai chi moves and philosophy, both designers had also joined several tai chi classes, together with the medical programmer.

Figure 1. Concept design of the smart textile suit (left), design of the user interface and interaction principles for the tablet (right)

The medical programmer was appointed as the responsible for the protocol for communication between the tablet and the suit, which he designed especially for low power consumption, while the electronics engineer was appointed as the responsible for the design and simulation of a power system with a battery and a charger for the suit, which are shown in Figure 2a and 2b.

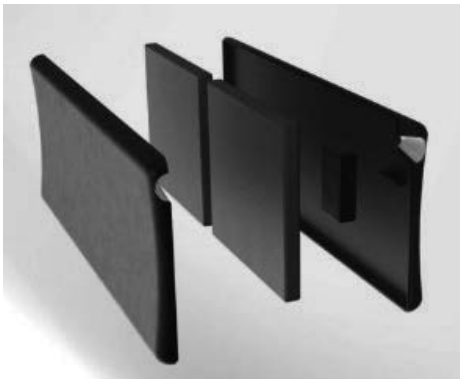

Figure 2a. Battery design

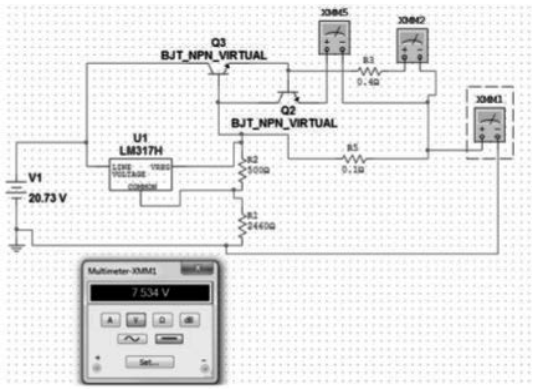

Figure 2b. Charger simulation

Prototypes for verification and proof-of-concept for the motion sensing and feedback were made by the electronics-ICT- engineer.

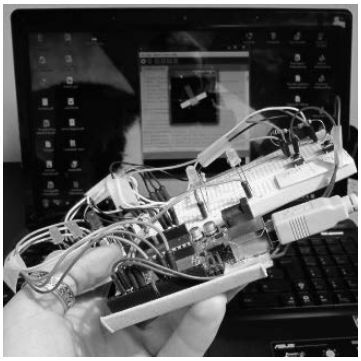

Figure 3a. Proof-of-concept prototype

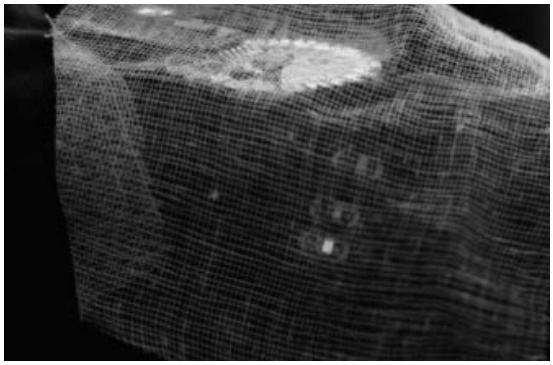

Figure 3b. Showcase prototype

3.2 The challenges inherent to working with a multidisciplinary team

One challenge we faced was the necessity to raise the awareness of the similarities and differences of perspective and project approach between the team members and between the project supervisors and lecturers of different backgrounds. The "smart textiles" supervisor, specialised in design, testified that his ambition to engage the engineering students in the early stage of the design process with a focus on defining new applications resulted into resistance. The students with an engineering background did not seem familiar with goal seeking activities and had difficulties to cope with the many uncertainties and variables which are typical during these activities. They rather preferred an explicit design brief and were more eager to start with the execution of *well specified* requirements for electronic design and programming, which were the input and deliverables they were used to in their own regular study programs. This resistance to broad exploration became even more visible to the supervisor when the engineering students were invited to contribute to the ideation stage. Although the proposed approach was driven by user insights and by new technologies, the engineers did not warm up naturally to the role of innovator at this stage. Spotting opportunities, reflecting on users insights and imagining various user scenarios were initially regarded by them as a designer's ability and therefore a designer's task. Engineers also seemed less familiar with explorative creative and lateral thinking, resulting in many discussions with the supervisor, between the team members and in the abortion of various product proposals.

Taking these differences in expectations into consideration and anticipating on them while planning the project proves to be crucial for the successful formulation and execution of a multidisciplinary project proposal. Thus the supervisor believes that narrowing the scope of future projects, defining a clear starting point and limiting the complexity of and the time spent on ideation, will optimize the collaboration.

The participating ICT-electronics student sheds a complementary light on this issue. He subscribes to the supervisor's observation that an engineering student is used to search solutions for clearly defined problems and that it certainly takes some time to make the mental switch in order to engage in a broader exploration of project possibilities and use scenarios. However, he also suggests that another powerful blocking factor is at play here, which we certainly cannot ignore, namely the mutual vague but powerful "*prefab* stereotypical images" which the students from different study backgrounds have already firmly formed beforehand about the other disciplines. In depth knowledge gathering at the start of the different disciplines involved and insights of what can be expected from the various grades and specializations is therefore crucial for supervisors and students to manage and plan the project.

In alignments with the supervisor's and engineering student's findings, the EPS programme coordinator opted to establish an additional project process progress check during the project: in the second edition of the EPS after one month and a half a project contract with a clear outline of the project, the overall project objectives for the team and the responsibilities of each team member has to be completed and signed by all the team members, the team supervisor and the discipline experts. Additionally, during the team building and project management sessions of the next edition, more attention has been paid on discussing with the students their previous project approaches and the needed project approaches to apply in a multidisciplinary project setting.

4 CONCLUSIONS AND FUTURE DIRECTIONS FOR MULTIDISCIPLINARY PROJECT WORK

The supervisor and the EPS coordinator learned that, working with students of different disciplines asked for a more intense interdisciplinary guidance by several discipline experts right from the very start in addition to the team supervisor, to guide, instruct and evaluate the learning progress of all team members from different disciplines than the supervisor.

Where we chose in the first edition to give the students a list of discipline experts, whom they could meet upon appointment whenever they needed their expertise and who would evaluate the team's midterm and final project reports and presentations, we opted to indicate specific discipline experts for each team in the second edition and we take the lead to organize frequent meetings between these experts and the students from week two till the end of the semester.

The advantages of the introduction of these team specific discipline experts are twofold. First, besides acquiring all the competences involved in working on a challenging real life problem in an international and multidisciplinary team, the professional development of each team member in his or her own discipline is now more closely and more regularly monitored.

Second, we invite future project supervisors to operate as discipline experts for at least one EPS semester, to become familiar with the EPS learning concept, to obtain a better insight into the kind of project challenges which can be handled by the team and to get a realistic estimate of which project outcomes to expect when developing their own EPS project proposal for the next edition.
The engineering students taught us that it was important to invest more time and effort in the introduction of a user centred approach to make them familiar with the skills and tools. From that perspective, the supervisor learned that elderly were a too complex users group to gain insights from. Defining a target group that is closer to the students' world and mindset - thus allowing students to better understand user insights and user requirements - is more accessible and therefore suggested.
The supervisor also learned that the selection of certain technology had a strong impact on the synergy between the disciplines. The option to start from "smart textiles" limited the possibilities to set up experiments to explore the opportunities. Because the technology is still in a research phase and because components are not available, a practical approach is not feasible. We believe that hands-on exploration has great potential to bring design and engineering competences together and stimulate the ideation for both disciplines.
Despite the problems that occur and the optimizations that are needed to improve this interdisciplinary concept, we conclude that working with EPS teams, including engineering, design and other disciplines, delivers an outstanding learning experience for both students and teachers, leads to a richer knowledge integration from different fields and interesting results and builds strong interdepartmental connections which stimulate more collaboration, also beyond the EPS programme.
We recognize that the intensive collaboration with other disciplines requires a high level of flexibility of the participants, challenges settled dominant views [8] and may require students, teachers and administrative offices alike to leave their comfort zone, which is, although sometimes unsettling, at the same time essential to grow and stay motivated on a professional and a personal level. We also believe that the students' participation to EPS will be seen as a real asset on their cv and will have taught them some valuable lifelong learning competences for their professional life. Our beliefs in the benefits of this EPS program are confirmed by the growing numbers of students, study programs and companies [9] who want to become involved in EPS projects.
As a concluding remark, we would like to use a quote of one of our actual EPS students, which summarizes this paper very well and which reminds us why and for whom we have started the European Project Semester adventure in the first place, when he told his home international office and us that:" I wouldn't go for less than an EPS".

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