STUDENTS´ ROLE IN DESIGN-IMPLEMENT EXPERIENCES – CASE: HEALTH INFORMATICS PROJECT

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ABSTRACT

Health Informatics has been one of the focus areas of Information Technology education in Turku University of Applied Sciences (TUAS) since 2009. Since the beginning of Health Informatics education in TUAS we have been implementing CDIO-based procedures and standards such as active learning and design-build experiences. Our education is strongly connected with the industry and many research and development activities have been carried out with the industry and our eHealth Technologies Research group. All our RDI activities are strongly connected with the degree programmes and learning is embedded into the RDI projects too. Our students learn, work and earn credits in these real-life design-implemented experiences. One recent example of such a project is "Tools for information and language technology for the utilisation of health information for patients and professionals" RDI project (TAILOR in brief) funded by Tekes (the Finnish Funding Agency for Innovation). In this project our eHealth Technologies Research Group´s Lab facilities and engineering students work together with healthcare professionals. Other research partner in this project is University of Turku. In addition, there are number of industry partners involved such as Lingsoft, Fujitsu, BCB Medical and Hospital District of South-West Finland. In this project our part is a demo version of a user interface for creating and using tailored patient instructions and medical data. Our engineering students have many different responsibilities in this project. They are working on the user interfaces, use cases, documentation, testing and many other tasks. The project is operated using Scrum methodology.
The students participating the project were interviewed and their experiences on desing-implement projects were studied. All interviewed students valued highly the experience on working in a real-life project. They recognized the important role of different stakeholders. They underlined the role of lecturers in supporting the project implementation. Furthermore, they identified the role of projects in understanding the content of the lectures. Finally, they all wished for more project activities.

KEYWORDS

Health Informatics, TAILOR project, Engineering education, Standards: 5, 6, 7, 8

INTRODUCTION

Turku University of Applied Sciences has been a CDIO collaborator since 2007. One of the very first programmes that started implementing CDIO approach was the Degree Programme in Information Technology. Since 2007 many elements of CDIO approach has been introduced into the degree programmes (Kontio, 2016). From the beginning the CDIO features such as design-implement experiences, real-life workspaces, intergrated learning experiences and active learning have had a strong role in our education. One typical way of connecting these elements into learning is to bring our RDI activities into learning. Our students learn, work and earn credits in these real-life design-implemented experiences. One recent example of such a project is "Tools for information and language technology for the utilization of health information for patients and professionals" RDI project (TAILOR in brief). The TAILOR project is a good example of hands-on learning where students are directly engaged in their own learning, and where students can learn from each other and interact with several groups. Learning in these project settings support several CDIO standards (Bennedsen et al. 2016).

Health Informatics is one of the focus areas in the Degree Programme in Information Technology in TUAS. This education started in 2009 after intensive planning together with the stakeholders (Kontio E et al. 2010). From the beginning this education has worked actively with the industry and other stakeholders. Majority of the studies in third and fourth year are embedded in real-life projects such as the TAILOR-project.

In this paper we will introduce the project in detail and describe the role of students in this design-build experience. The student experiences on working in a real-life project were studied and they are reported. In addition, we will report how we combined the emphasis on building products and implementing processes in real-world contexts giving students opportunities to make connections between the technical content they are learning and their professional and career interests.

TAILOR PROJECT

The TAILOR project started in autumn 2016 and is running until the end of year 2017. The project aims to create tools for tailoring patient documents, interactive patient instructions and medical information for patients and professionals. In addition, tools for analyzing health information related to heart illnesses and for tailoring information based on this are created during the project. Tools can be productized and developed for processing other health information as well.

The project's home base is in our eHealth Technologies Research Group´s Lab facilities where engineering and business information systems students work together with healthcare professionals. The University of Turku acts as other research partner in this project. . In addition, there are number of industry partners involved such as Lingsoft Inc., Fujitsu, BCB Medical Ltd, and Hospital District of South-West Finland. The project is funded by Tekes (the Finnish Funding Agency for Innovation) and partner companies.

The result of the TAILOR project is an information system which support the patient's self-care. The information system tailors the information on patient's illness, treatments, treatment instructions and medicine from different sources into understandable form for the

patient. The patient receives the information in electronic and/or printed form. The information helps the patient understand his/her illness, commit to the treatment and participate in the related decision-making.

On the other hand, the project creates solutions which support professionals in producing and utilizing high-quality patient documents and instructions for implementing medical care. When producing text, the expert can use their own language and expressions. The language tools created within the project translate the texts automatically into the language used by the patient. They can also be enriched with photos, graphics, videos and other additional information. The aim is thus not simplifying plain language but using the language as a rich tool for understanding communication without compromising the information content. Professionals are also supported by the diversification of information retrieval and visualization of the desired information (e.g. medication, pain, disorientation), which is enabled by the tools based on the analysis.

We are planning, developing and testing a user interface using for the utilization of the background information created in the project. The background implementation, which is based on analyzing the tools, can be utilized in several commercial applications. The result is information applications which support the patient's self-care and with the help of which information on his/her illness, treatments, treatment instructions and medicine from different sources is tailored in a form that's understandable for the patient. The patient receives the information in electronic and/or printed form, and if they wish, saved on their personal health record account. Once the planned analysis engine of the TAILOR project is built, there are several other commercial possibilities to use the analysis features.

STUDENT ROLES IN THE TAILOR PROJECT

Working with real customers makes the project work concrete as the teams need to negotiate with clients about deadlines, content and the quality of work. This environment also teaches students to work with uncertainty. (Alarcon et al. 2013.) The TAILOR development project used user-centric methods together with possibilities in innovation pedagogy. The TAILOR project used three phases of CDIO approach: Conceive, Design and Implement. A group of health informatics students started working on a TAILOR-project from September 2016. This work is being done within a Project management and processes in in healthcare environment course (15 ECTS) that students are taking part in. Course takes nearly entire academic year until end of April 2017. Student group's task in TAILOR-project is to define requirements for the user interface of the developed patient instructions creation tool and conduct usability analysis and tests for it. In effect student group is responsible for requirements and usability engineering of the interface.

In Figure 1. is a weekly schedule for student group. Two hours on Thursday morning are reserved for lectures where students receive information relating to theoretical background required for completing their tasks. Tuesdays and Fridays (marked with red circles) are reserved for project work. Students are responsible for managing their projects by themselves but they are reporting project status weekly to course management.

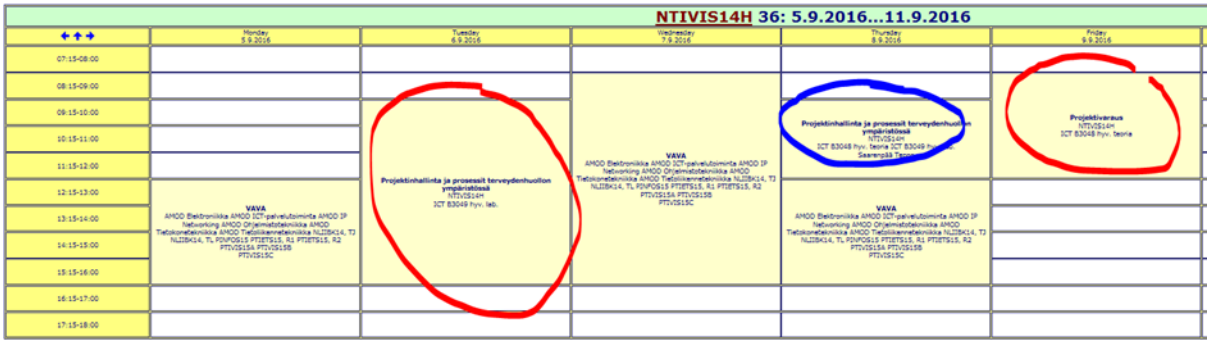

Figure 1. Weekly timetable for the health informatics students.

Development work is being done using agile methods in two week sprints. Student team has chosen to use Trello for project management and communications. In Figure 2. can be seen project timetable that group has designed and are committed to. Timetable and project plan has been approved by course and TAILOR-project representatives.

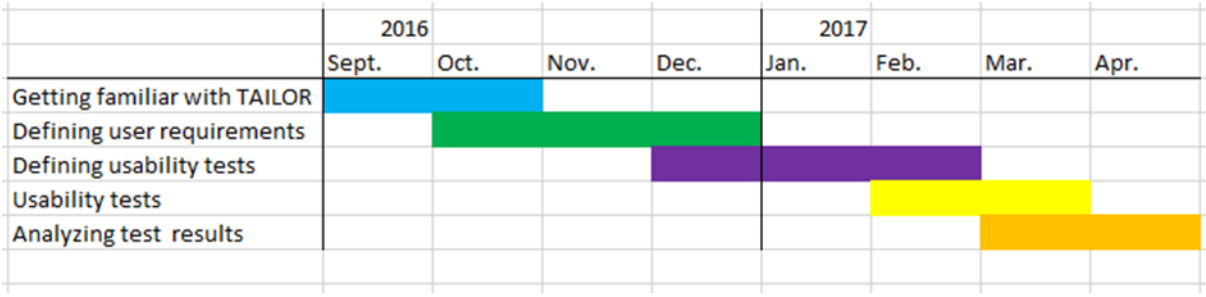

Figure 2. Student project schedule.

During the autumn term student group has familiarized themselves with TAILOR-project and more importantly environment where patient instruction creation tools is going to be used as well as current process how instructions are given at the moment in university hospital. Based on that group has written user requirements for the instruction tool interface. Group is also having regular meetings with instruction tool development team. Key users from the Turku University Hospital has been detected and contacted to and user-centric design methods are being used by the group to ensure that developed tool will support current care processes and usability goals are reached.

Spring term 2017 will be used for defining and conducting usability tests for instruction creation tool. This will be done in close co-operation with aforementioned key users. Test results will be analyzed and transformed into design input by the student group to be implemented into the developed tool.

THE RESEARCH

This research had two parts. First, an open-ended online questionnaire was used to collect data on students experiences and feedback about the project activity. After the analysis of the questionnaire, semi-structured face-to-face interviews were conducted. Semi-structured interview method is designed to ascertain subjective responses from persons regarding a particular situation or phenomenon they have experienced. It employs interview guide or schedule, and may be used when there is sufficient objective knowledge about an

experience, but the subjective knowledge is lacking (Merton & Kendall, 1946; Morse & Field, 1995). Semi-structured interviews are used when the researcher knows enough about the topic to be able to identify the domain and the main components of the topics but is unable to anticipate all the possible answers (Morse & Field, 1995). The more extensive the investigator's knowledge, the more precisely can the aspects to be covered in the interview be outlined in advance and the more significant questions may be posed (Kvale, 1996; Merton & Kendall, 1946).

In the first phase, the questionnaire was given to the students (n=10) working in the TAILOR project. The questionnaire had demographic questions and open-ended questions related to project working and learning experiences in design-build projects. The questionnaire had two main themes: 1) how project work supports learning and 2) how project work supports professional skills and professional growth. All students answered to this online questionnaire.

In the second phase, part of the students (n=6) were selected to the face-to-face interview. The interview questions were asked in the same way and in a systematic order from each of the students. However, the questions were semi-structured in that the interviewer was allowed freedom to diverge slightly from the script. The interviewer deepened and clarified the online questionnaire responses with the face-to-face interview.
The data was analyzed using content analysis. Content analysis is a research technique for systematically analysing written communication such as in this paper the questionnaire and interview data represents (Weber, 1990). It allows the researcher to analyze relatively unstructured data in view of the meanings, symbolic qualities, and expressive content (Krippendorff, 2012). In content analysis all answers are processed and interesting and relevant information is collected. Once all answers are processed major themes and categories are identified.

RESULTS

The purpose of this study was to identify the students experiences, challenges and feedback on working in real life design-build projects based on the questionnaire and students' interviews. The demographic information of the students participating the study are following:

- Average number of credits 147 ECTS, min 119 and max 192
- Age of the students varied from 22 to 25
- Six students had high school degree, three students had vocational school degree and one students had both.
- All students had earlier experiences on project based learning.

One major theme of the research focused on how project work supports learning. The responses of the students show interesting observations starting from a comment saying that *Working in real-life projects is always the best way to learn*. Students say that in practical projects they get a considerably better idea how things are made correctly. Students recognized that learning experiences in the projects support the topics learned in the lectures. They underline that the skills of the engineer are learned and deepened in the practice of the projects. They continue that learning of theory is more efficient through practice: *For example I have learned much more programming skills and more widely through the projects like on the courses of the programming.* Another example shows the power of real-life projects too: *A good example is documentation. When there is a purpose on the doing, it will be more sensible to make it; furthermore, the doing becomes purposeful and consistent.*

The second major theme of the research focused on how project work supports professional skills and professional growth. Students identified several effect of project work on their professional skills and professional growth. First, students accredit the contacts with the working life stakeholders and experiences how things are done in real life. They also valued the communication needed with the stakeholders: *these skills are priceless for today's engineer, because most of the engineering is done in projects and teams*. Besides communication skills they emphasized networking, presentations and management skills and methodicalness. Second, the project work gives students true experiences on working in various roles in a project. Students learn how projects are managed and what kind of procedures they have. Students stressed that successes in project work are very valuable, they improve students self-esteem and professional growth more than any lecture based courses. Finally, students underlined that their professional skills have improved – they not working with dummy exercises any more rather there are level of seriousness involved.

The research studies students experiences regarding the TAILOR project too. Overall the students were satisfied with the project activities and the actual project assignment. At the same time students said that working in the TAILOR project has been challenging but rewarding. The comments that students provided are consistent with the general statements presented above. Student underlined following issues:

- *Working in the TAILOR project gave provided a good viewpoint to the work in a project*
- *I learned through the practice more and it was nice to work as a part of the group*
- *The TAILOR project has been a good way to try in practice topics that we have learned in the Health informatics lectures.*
- *Working in a TAILOR project was very motivating*
- *The project assignment was interesting and the industry stakeholders were very cooperative*
- *It would be nice to have projects like this even more.*
- *Working in this project made us to be considered important when we participated in the meetings of the project and were able to work with the professionals of different fields.*

Out of the ten students only one provided a little unsatisfied comment: *I have experienced the working frustrated. The biggest part of the time will go in scrum sprint meetings where the necessary matters are checked at a slow pace. The project work itself has not been too hard, but somehow the meetings take more time than to the working. I myself would want to have more practical work and a little less discussion.*

At the end, students provided other comments regarding their studies and project based learning. Among the comments were views such as

- *There should be more projects*
- *Projects should be interesting*
- *More projects already in beginning of the studies*
- *Projects are definitely important to our professional growth.*
- *The support of the lecturers and staff is important to the students in project based learning.*

DISCUSSION

The aim of this paper was to describe the role of students in design-build experiences using one project as an example. The student experiences on working in a real-life project were studied and they were reported.
CDIO standard 5 rationalizes design-build experiences as follows for example :

- Iteration of design-implement experiences and increasing levels of design complexity reinforce students' understanding of the product, process, and system development process.
- Design-implement experiences also provide a solid foundation upon which to build deeper conceptual understanding of disciplinary skills.
- The emphasis on building products and implementing processes in real-world contexts gives students opportunities to make connections between the technical content they are learning and their professional and career interests.

In Health Informatics there are minimum two design-build experiences before students join our RDI-projects. TAILOR project was a good example of a project where the complexity increased and thus reinforces students understanding of the product development process. The results showed that project based learning deepens conceptual understanding of the professional skills and disciplinary skills. The results support the third rationale given above as well. Students clearly stated that they were able to make connections between the topics the learned in lectures and during the projects.

Our project based learning activities support the ideology of CDIO standard 7 too. With these projects we can help our students apply disciplinary knowledge to engineering practice and better prepare them to meet the demands of the engineering profession. Students responses confirm this obviously. Students recognized the important role of different stakeholders. In addition, they accredited the change to work with healthcare professionals. The one negative comment about project work shows that this students hasn't really understood the principles of project work yet.

Project work is also a form of active learning. Active learning helps to increase students' motivation to achieve program learning outcomes and form habits of lifelong learning. Certainly these elements were found in the students responses too. All interviewed students valued highly the experience on working in a real-life project.
The results of this research show that project based learning creates opportunities to students to make connections between the technical content they are learning and their professional and career interests.

All in all, the TAILOR project was a good example of design-build experiences and it carried out CDIO standards 5,6,7 and 8. In addition, this TAILOR project was also a good example of multiprofessional collaboration between engineering education and healthcare professionals. Furthermore, the TAILOR project agile development process plan-do-test-evaluate supported the project excellently.

The results of the present TAILOR project can be used in an information system which support the patient’s self-care and with the help of which information on his/her illness, treatments, treatment instructions and medicine from different sources is tailored in a form that’s understandable for the patient. However, the development work of the TAILOR solution is still needed dreadfully. In this paper the phases of development of the first TAILOR version were reported.

CONCLUSIONS

The results of this study show that design-build experiences provide valuable elements in engineering education. The key elements found in this research encourage programs to introduce project based learning into their programs. Using the words of the students we can conclude that

- Project work is a good way of learning
- Working with stakeholders is meaningful and valuable
- There should be more projects
- Projects support understanding of the lectures
- Working in real world design-build projects support professional skills.

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BIOGRAPHICAL INFORMATION

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