DESIGN-BUILD EXPERIENCES – ICU GAME CAPSTONE PROJECT

Elina Kontio, Riitta-Liisa Lakanmaa

Faculty of Business, ICT and Chemical Engineering,
Turku University of Applied Sciences, Turku, Finland

Faculty of Health and Wellbeing,
Turku University of Applied Sciences, Turku, Finland

ABSTRACT

A capstone innovation project has a central role in the third study year of the curriculum of Degree programme in Information and Communication Technology at Turku University of Applied Sciences (TUAS) in Finland. The Capstone innovation project is one of our implementation examples of CDIO Standard 5 (Design-Implement Experiences). In this paper we focus on describing one of these innovation projects called ICU game. The project assignment came from another faculty of TUAS (Faculty of Health and Wellbeing). Their partners in this project were Intensive Care Unit (ICU) of the Turku University Hospital and Faculty of Nursing Science at Turku University. The intensive care unit employs a large number of nurses. Work in an ICU requires specific expertise. This expertise can be achieved partly through working in an ICU and partly in training sessions. The idea of the ICU game was to develop a tool/a serious game for nursing education to support learning these ICU specific skills and knowledge. The aim of the project was to develop a serious game prototype simulating and teaching intensive care unit operations. The game development project used user-centric methods together with possibilities in simulation and virtual pedagogy. The capstone innovation project used three phases of CDIO – Conceive, Design and Implement. The project team started conceiving the needs, the specific environment of ICU and possible other tools in the market. After the conceive phase a prototype was designed and implemented in a cyclic process.

KEYWORDS

Capstone, Innovation project, Game development, Intensive Care Unit, Education game, CDIO, Standards: 5, 8

INTRODUCTION

The Capstone innovation project implements thinking known as the Lean Startup philosophy, which includes testing the ideas on real customers as early as possible. Through this kind of thinking and activity, the students learn to take the users into account and build working solutions which the customers are also ready to pay for. (Crawley et al 2014.) The capstone innovation project has a central role in the third study year of the curriculum of Degree Programme in Information and Communication Technology at Turku University of Applied

Sciences (TUAS) in Finland. This project is a 15 ECTS module combining students from the Degree Programmes in Electronics, Information and Communication Technology, Business Administration and Library and Information Services in a multidisciplinary way. In addition, Capstone unites working life with studies in a realistic and concrete way, thus benefiting both the students and the customer companies. The Capstone innovation project is one of our implementation examples of CDIO Standard 5 (Design-Implement Experiences). All innovation projects are real projects raising from the needs of the partner organizations. In this paper we focus on describing one of these innovation projects called ICU game. The project assignment came from another faculty of TUAS (Faculty of Health and Wellbeing). Their partners in this project were Intensive Care Unit (ICU) of the Turku University Hospital and Faculty of Nursing Science at Turku University. The intensive care unit employs a large number of nurses. Work in an ICU requires specific expertise. This expertise can be achieved partly through working in an ICU and partly in training sessions. The idea of the ICU game was to develop a tool/a serious game for nursing education to support learning these ICU specific skills and knowledge.

Critical care/intensive care is in interest of large number of nursing students (39%). However, only minority of nursing students (14%) have the possibility during nursing education to practice at intensive care unit (ICU unit) because places for nursing students are too few. Critical care nursing is an own specialty in nursing field and requires specific competence of nurses. At this moment critical care nursing courses' amount of ECTS credits vary between 0 – 5 in Finland. Also there are not any post graduate specialist nursing educations in Finland for this need. The growing need for special education at the basic nursing education level is evident. (Cf. Lakanmaa 2012).

Young new nursing students seek innovative new effective learning methods. Also the need of digitalization and the decreased number of amount of theory and class room teaching play an important role and create pressure for nursing lecturers to seek new approaches for learning. One solution can be serious games. In health care, and more precisely in critical/intensive care there are not any tested validated serious games in markets. Reasons for that can be only guessed but most likely the reason is that the game development process for special educations purposes needs large amount of resources; money and multi-professional collaboration. Well-working validated serious game, as planned ICU game, can give for all nursing students' access to practice and learn basics of critical care safely, for fun, "again and again" and "where ever you want". (Cf. Kaczmarczyk, Davidson, Bryden, Haselden & Vivekananda-Schmidt 2015.) It is also known that critical care nursing competence is transferable and useful also for other fields of nursing (Lakanmaa 2012).

The aim of this innovation project was to develop a serious game prototype simulating and teaching intensive care unit operations. In this paper, the experiences of the Capstone process as well as of the ICU Game development process are reported. The ICU Game development process and CDIO design-implement experiences of Capstone are described, and the key findings based on the ICU Game development results are discussed.

DESIGN-BUILD EXPERIENCES

Capstone innovation project

The ideology behind Capstone is based on the CDIO concept, developed at Massachusetts Institute of Technology (MIT), which strives to develop education to better meet the needs of

working life (Crawley et al. 2014). In Turku University of Applied Sciences, the Capstone project is divided in three main phases: Vision, realization and start-up (Figure 1). The Vision phase follows the Lean start-up process from idea generation and rapid prototyping and vision building (Ries 2013). The realization phase focuses on the project implementation, and it is implemented according to the principles and values of agile development using Scrum as the project management method. The realization phase consists of seven two weeks sprints. The final phase of project is start-up that focuses on reflection and evaluates potential spin-off or start-up opportunities. (Kulmala et al 2014). Actions taken with the project follow the typical agile development process plan-do-test-evaluate (see e.g. Sutherland & Schwaber, 2007). The Capstone innovation project simulates the innovation process and the process that a start-up company would go through to launch a new product or service (Armstrong et al. 2005).
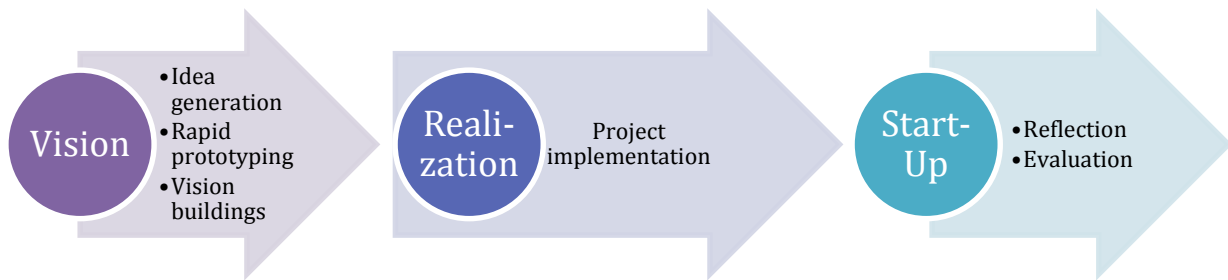

Figure 1. Capstone project´s phases in TUAS

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.) For companies and organizations, Capstone is a risk-free environment for developing and trying out new, even bold solutions (Crawley et al. 2014). The game development project used user-centric methods together with possibilities in simulation and virtual pedagogy. The ICU Game capstone innovation project used three phases of CDIO – Conceive, Design and Implement. The project team started conceiving the needs, the specific environment of ICU and possible other tools in the market. After the conceive phase a prototype was designed and implemented in a cyclic process (Figure 2).
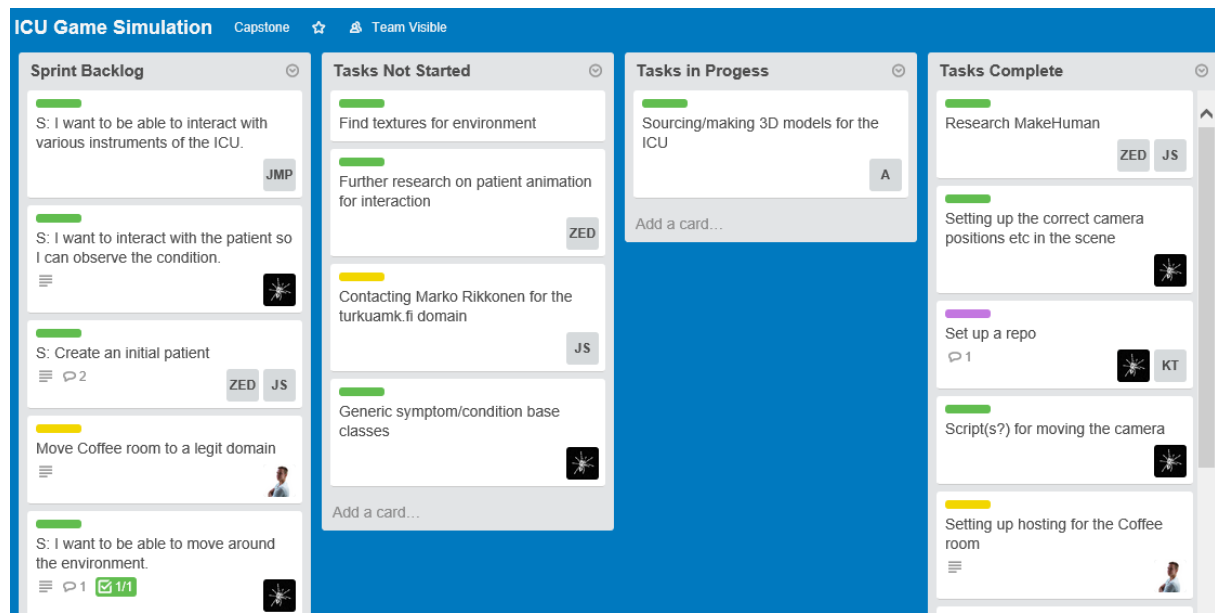
Figure 2. Project working process tool example view

ICU game development process

By playing the ICU game the basic of critical care will be learned lively and grippingly. ICU game consists real patient cases and knowledge packages, tests and ethical dilemmas. The idea is to give feedback for the player immediately and analyzed by calculating competence credits. The main idea is to reward for good performance and guide and give tips in incompetent performance. The structure of the critical care competence and the game idea is based on theoretical framework.

Development of the contents for the game was demanding. The process started in 2013. First the authentic patient cases were gathered and created. The knowledge packages and tests were developed together with nursing students and experts of ICU unit. The first prototype of the ICU game was developed by engineering and library information service students guided by an ICT lecturer. Media lecturer and media students participated in the manuscript writing process of the ICU game. The game idea is based on the selection of action fields and dialog. It can be described that in this prototype phase the game follows adventure simulation game idea (Figure 3).

The very preliminary ICU game prototype test showed how much and what kind of game the students want to play. In autumn 2015 during one critical care nursing course eight paramedic students tested one patient case (Mr. Mäkinen, an acute open heart bypass surgery patient, third day in ICU unit). The outlook of game scored 3.2 and the average score of the questions (9) was 3.5 (1-5 scale, 1= satisfactory 5=excellent). As such they would play the game 5 – 30 minutes sessions and all together 2h - 30 hrs. They suggested to develop the graphics and prefer more happenings to the patient. The five engineering and library information service students evaluated the prototype parallel. Their average score for the prototype of ICU game was 3.3. They think that the game has potential and others than nurses would like to play the game. Most important findings at this stage were to develop

graphics, interactivity and doing in the game. A game based on only dialogs was evaluated too boring.

Figure 3. ICU patient Mr. Mäkinen in an ICU room (picture: ICU Game Capstone project team)

DISCUSSION

The aim of the project was to develop a serious game prototype simulating and teaching intensive care unit operations. The project was conducted as a Capstone innovation project (15 credits). As mentioned above, the ideology behind the Capstone project activity emphasizes an entrepreneurial attitude, creative thinking, regional cooperation as well as agile and lightly organized creation and development in cooperation with entrepreneurs in the region. Mere knowledge is not enough, skills are also needed. A close combination of research and practice develops the students' abilities for real working life situations and thus creates even more skilled and realistic workers for the future. Solutions to the problems are searched in cooperation with other professionals and stakeholders.

The skills to network, question and develop existing and new solutions in a user-oriented way and the ability to think flexibly are central competencies for the professionals of the future. One solutions to increase the ICU staff competencies of the future, can be serious game combining with the simulation education. The capstone project was a good example of experimental learning too. The CDIO standard 8 describes active learning experiential when students take on roles that simulate professional engineering practice, for example, design-implement projects, simulations, and case studies. In addition, the result of the project has effects on teaching and learning in the nurse education. The use of the prototype brings an element of active learning in the nurse education too.

The ICU game can be entertaining. The idea is to use the game in theory learning, combined to simulation learning and in clinical practice orientation. Critical care is interesting and full of drama. There are persons among ICU staff - everything can happen to patients and to staff.

There are elements in ICU game for entertainment game when animation and graphics are at the same level as in television hospital series. There should be fun and lively animations in the game manuscript. The game cannot replace the real simulation learning in groups and real practice placements in hospital in nursing education but it can make the preparation for the simulation practice and clinical practice more effective. The game is good extra supplement method for clinical learning. The game gives equality, control, authentic patient cases and effective boost for clinical orientation and lectures. In addition, in the game, the pictures and stories learn vividly.

CONCLUSIONS

The ICU game capstone project was a good example of design-build experiences and it carried out CDIO standards 5 and 8. In addition, this capstone innovation project was also a good example of multiprofessional collaboration between engineering education and nursing education. Furthermore, the capstone project agile development process plan-do-test-evaluate supported the project excellently.

The results of the present Capstone project can be used when planning and implementing serious game in healthcare sector. In addition, there is room for a serious game integrated simulation education for ICU nursing courses. However, the development work of the game is still needed dreadfully. In this paper the phases of development of the first Capstone project were reported.

REFERENCES

Alarcon, E., Bou, E,. Camps, A., Bragos, R., Oliveras, A., Pequeroles, J., Sayrol, E. & Margues, F. (2013). Designing CDIO Capstone Projects: A System thinking Approach. Proceedings of the 9th International CDIO conference, Massachusetts, June 9-13, 2013.

Crawley, E., Malmqvist, J., Östlund, S., Brodeur, D., & Edström, K. (2014). Rethinking engineering education - the CDIO approach (Second edition ed.): Springer.

Kaczmarczyk, J , Davidson, R, Bryden, D, Haselden, S & Vivekananda-Schmidt, P 2015. Learning decision making through serious games. The Clinical Teacher 12, 1–6.

Kulmala, R., Luimula, M. & Roslöf, J. (2014). Capstone innovation project – pedagogical model and methods. Proceedings of the 10th International CDIO conference, Barcelona, Spain, June 16-19, 2014.

Lakanmaa, R-L. Competence in intensive and critical care nursing. Development of basic assessment scale for graduating nursing students. Academic dissertation. University of Turku. Available from: http://www.doria.fi/bitstream/handle/10024/76824/Annales%20D%201014%20Lakanmaa%20DISS.pdf (1.2.2016)

Ries, E. (2013). The Lean start-up. Crown Business, New York.

Sutherland, J & Schwaber, K. (2007). The Scrum Papers; Nuts, Bolts and Origin of an Agile process.

BIOGRAPHICAL INFORMATION

Elina Kontio, is a Doctor of Sciences in Health Sciences. She received the M.Sc. in Nursing Science (2003) from University of Turku, Finland and is a registered Nurse. At the moment she is a Research Group Leader of eHealth Technologies and a Principal Lecturer in the Faculty of Business, ICT, and Chemical Engineering at the Turku University of Applied Sciences. Her primary areas of interest includes eHealth, Health Informatics and decision-making in hospitals.

Riitta-Liisa Lakanmaa, is a Doctor of Sciences in Health Sciences. She received the M.Sc. in Nursing Science (2002) from University of Turku, Finland and is a registered Nurse. At the moment she is a Research Group Leader of Healthcare Clinical Expertise group and a lecturer in the Faculty of Health and Wellbeing at the Turku University of Applied Sciences. Her primary areas of interest includes nurse competences and intensive critical care.

Corresponding author

Dr. Elina Kontio
Turku University of Applied Sciences
Joukahaisenkatu 3C
20520, Turku, Finland
+358 44 907 2088
elina.kontio@turkuamk.fi