DEVELOPMENT OF THE LEARNING PROCESS IN A PROJECT-BASED LEARNING ENVIRONMENT

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ABSTRACT

“the FIRMA“ is a project-based learning environment at Turku University of Applied Sciences (TUAS). The FIRMA offers students an opportunity to work and learn in real customer projects and also gain credits. The projects in the FIRMA are usually related to the ICT field. Typical project assignments include, for example, web development, database or game design tasks, digital marketing and Lego robot building camps for children. Customers are usually local small or medium-sized enterprises. For students, working in a real customer project is a meaningful alternative for learning compared to sitting in a class. For customers, the FIRMA offers a cost effective way of getting small IT-related projects done. In 2016, over 150 students worked in the FIRMA’s projects, earning approximately 1500 ECTS credits. In order to handle such amount of students and ensure their professional growth, we need to define a well-structured and easily applicable learning process. A well-defined learning process clarifies the assessment of the project work for such a number of students and enables the growth of the FIRMA in the future. This paper describes the FIRMA’s learning process. The learning process takes into account both CDIO and TUAS’ Innovation Pedagogy principles. The FIRMA provides an active learning environment that offers integrated learning opportunities covering all parts of the C-D-I-O core (Crawley et al., 2007). Innovation pedagogy is an approach for learning and teaching that enables students to learn working life skills and take responsibility for their professional growth (Penttilä et al., 2013).

KEYWORDS

Learning environment, learning process, assessment, CDIO Standards 3, 5, 6, 7, 8

INTRODUCTION

"the FIRMA" is a project-based learning environment in the Information and Communication Technology (ICT) unit of Turku University of Applied Sciences (TUAS) (Roslöf, 2016). The FIRMA was established in 2015 by combining multiple learning environments, such as "ICT-portti", Education Support Centre Finland (ESC Finland), Network Support Centre Finland (NESC Finland) and Citizen’s helpdesk. All these learning environments were operating at the ICT unit at TUAS but they had different areas of operation. ICT-portti was a joint project and learning environment of TUAS and Turku Science Park. ICT-portti aimed at improving the IT skills of local small and medium-sized enterprises as well as improving IT education in general (Eura, 2007). ESC Finland was a company-like learning environment that was created in co-operation with Microsoft Finland. ESC Finland provided software support for Microsoft products for schools, educational institutes and non-profit organizations (Leivo & Granholm, 2012).

Whereas ESC Finland concentrated on Microsoft products, NESC Finland concentrated on producing open source solutions for the Finnish public sector and local companies. Citizen's Helpdesk provides local citizens with free computer support services, such as software repairs, software updates and removing computer viruses.

Figure 1 illustrates the FIRMA and its current operations in a nutshell. For example, the FIRMA participates in various externally funded projects and offers local companies small IT projects at a reasonable price. Furthermore, the FIRMA's networks and computers are maintained by system administration run by students thus covering also the operate part of CDIO. Students also manage and run the Citizen's Helpdesk.

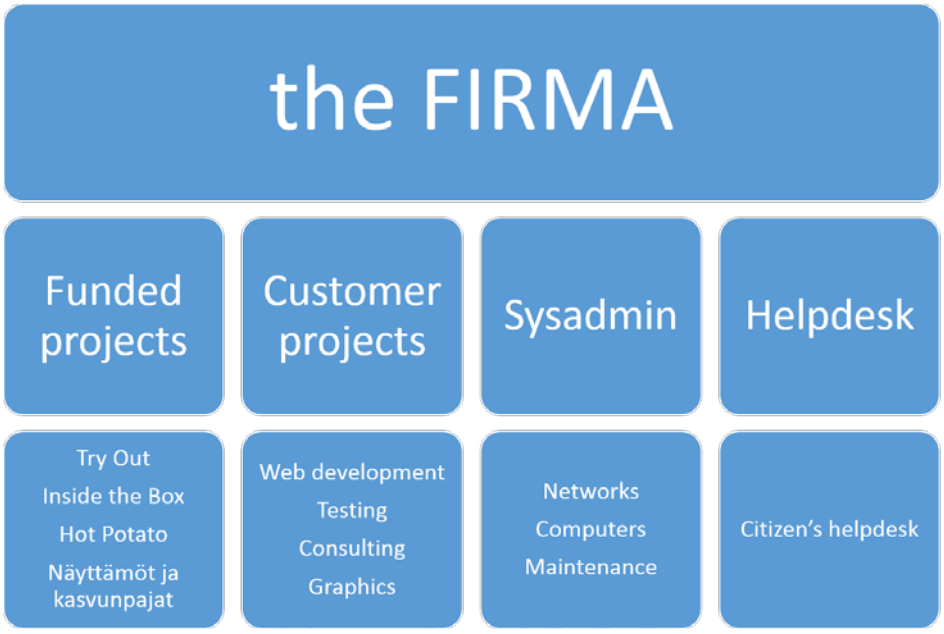

Figure 1. the FIRMA in a nutshell

The FIRMA has many similarities with other learning environments, such as Buro ("Buro", n.d.) or Demola ("Demola", n.d.). Buro or B302 is a media consulting agency at HAN University of Applied Sciences in the Netherlands (http://www.b302.nl/). Buro creates mainly multimedia projects for its customers. Buro has a lot of similarities compared to the FIRMA: in both students work on real customer projects. Buro has less students per year than the FIRMA, but all students get paid and are naturally treated more like employees than students. In the FIRMA only a few students get paid but all students get credits. The learning approach is however the same: Learning by doing. Buro has also started an office B507 in Minnesota State University in Mankato in USA (https://www.b507.us/) and B353 in Ireland will open in 2017.

Demola (http://www.demola.net/) is an innovation environment (or innovation platform) where students get the opportunity to work in teams to solve real-life cases with partner companies. Demola does not operate under any university as such, but students from the University of Tampere, Tampere University of Technology and Tampere University of Applied Sciences can join Demola and get credits. Whereas Buro and the FIRMA are mainly targeted to ICT students, Demola welcomes students from various degree programs ("Demola", n.d.).

THE FIRMA OPERATION AND ADMINISTRATION

Even if the FIRMA is a learning environment and operates under TUAS, it is managed like a real company. That is, a student chief executive officer (CEO) leads the FIRMA, a student marketing manager is responsible for the FIRMA's marketing and graphical image, student project managers manage the projects and student system administrators maintain and develop the FIRMA's network and computers. Students are selected to those places based on their performance in the FIRMA projects and also based on an interview. Figure 2 depicts the FIRMA students having a project meeting.

Figure 2. Project meeting in the FIRMA

Also a few TUAS staff members look after the FIRMA operations. One teacher is responsible for the FIRMA's project process and students getting their credits and grades. Another teacher acts as a key account manager (being responsible of the project contracts and initial negotiations with the customers). Currently also one project engineer is coordinating the funded projects together with the responsible teachers. In addition, it is possible to use other faculty members, both teachers and project staff, as expert mentors if the projects include challenging topics connected to their areas of expertise.

THE FIRMA STUDENTS

Majority of students active in the FIRMA are studying in the ICT-focused Bachelor of Engineering or Bachelor of Business Administration degree programs. Some students study only a few credits in the FIRMA whereas other students study a major part of their degree there. Basically students can complete their whole degree in the FIRMA, except the compulsory science studies (such as mathematics and physics). Students have two ways to enter the FIRMA: They can do internship in the FIRMA or they can attend a course called ICT Services and Projects that contains 7–10 credits of project work in the FIRMA. Figure 3 shows students working in the FIRMA premises at TUAS.

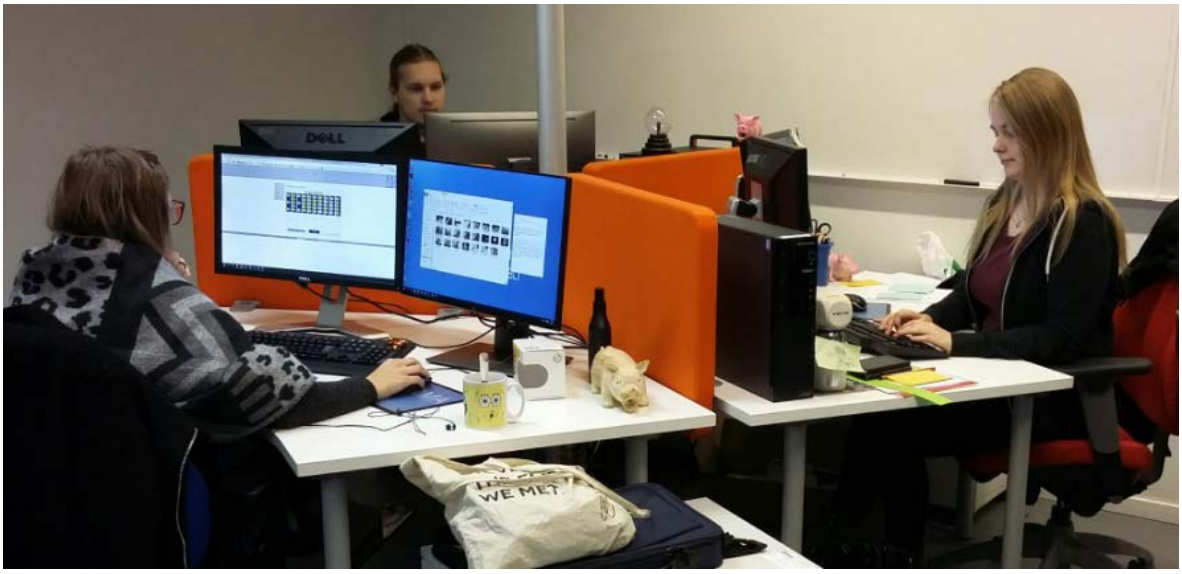

Figure 3. Students working in the FIRMA premises

Students studying in the FIRMA usually start as project members in real projects where more experienced students mentor them. As soon as students' skills and professional self-confidence grows, they start helping out the newer FIRMA students or they even become student project managers. It is also possible to apply for more responsible roles, such as student marketing manager, head of system administration or student CEO.

Since autumn 2016 it has also been possible to study the whole competence track in the FIRMA. The competence track means the studies students take on their third and fourth year (in other words, it is their major subject). For each student we set personal learning goals so that we ensure that students' skills fulfill the overall learning goals of ICT engineer education. In practice this means ensuring that competence track students' projects are enough challenging and the projects require learning and mastering of wide range of skills.

In the academic year 2016–2017 the FIRMA competence track is in a pilot phase and therefore only four students are on the track. One concentrates on system administration and the other three concentrate on project work in development projects and project management. In the academic year 2017–2018 about 10 students will be selected to the FIRMA competence track based on an interview. We aim at increasing the number of competence track students in the future.

THE FIRMA PROJECT PROCESS

As mentioned, the FIRMA was established by combining multiple learning environments a few years ago. Best practices from all the learning environments were combined and became the FIRMA's project process. However, the project process had a few shortcomings. First, students only got project credits and no grades (with the grade 'passed'). Second, the quality process was heavy and as such not the most suitable for the FIRMA. Third, students were required to fill in a learning diary each month. Since students typically work in the FIRMA projects only a few hours a week they seldom had anything new to write in the learning diary. The same diary entry was usually copied and pasted to the next month's diary, which did not support students' professional growth. An improved learning process was developed in 2016. At first the project process was divided in two parts: quality process and learning process. The quality process defines means how to maintain and improve the quality of the projects and the operations of the FIRMA (Määttä et al., 2016). The learning process defines how the students are able to demonstrate their competences and, accordingly, gain credits and grades. This paper describes the new learning process in more detail.

The New Learning Process

In the FIRMA, 27 hours of project learning/work equals one credit (according to the European Credit Transfer System definition). Students mark their hours in an hour tracking Excel and return the report monthly. The student CEO collects the hours three times a year for the teacher, who will then give the students credits and grades. Grades are formed based on students' self and group assessment, project's customer's feedback and teacher's assessment. The grading scale used in the assessment uses numerical grading from zero to five, where zero means fail and five means excellent. The assessed areas include the development of technical skills, following of the FIRMA's practices and student's work performance. The rubric can be found in Appendix 1.

The monthly learning diaries were replaced with learning objectives for each project. The project group determines these learning objectives in the first project meeting. The objectives can be the same for each group member, but they can also be different for different students. For example, a project manager's learning objective can be to learn a new project process whereas a project member's learning objective can be to learn a new programming language. After the project is finished, the project group evaluates how well the objectives were met. This helps students to take more responsibility for their own learning as they also have to actively evaluate and reflect their own progress.

When students enter the FIRMA, they are usually assigned to projects based on their own wishes. Some students want to develop their programming skills whereas other students are more interested in graphic design or digital marketing. The first project can be a very small and simple one and as soon as the student's skills and self-confidence grows, the following projects will be more challenging. This way we enable and also ensure the professional growth of the students. Not only in terms of their technical skill but also in terms of professional behavior in the workplace and communication skills with real customers and within the project group. When students get assigned to more and more challenging tasks in the FIRMA, also getting good grades gets more challenging. With a good performance in a first and maybe simple project it is easier to get a good grade than with "just" good performance in a more challenging project later on. When we enable and support the professional growth of students we also start expecting the students to take more responsibility of their project work.

After each project, students fill in the group and self-assessment form. First, they assess how the project went, then their own performance and finally the performance of all the other group members. The project assessment statements include:

1. Project group worked according to the project plan.
2. All project group members were active.
3. Roles and responsibilities were planned and communicated well.
4. Possible problems and obstacles were resolved successfully.
5. I am satisfied with the project outcomes.
6. Project group members communicated well.
7. Project group reached the project goal.
8. What went well in the project?
9. What would you do differently in the next project?

Statements one to seven are assessed numerically with a grade from 5 (I agree) to 1 (I do not agree). Questions 8 and 9 give the students the opportunity to express their opinion about the project's success and reflect their own performance in the project. Answers are used for improving the FIRMA's project process and project working policies.

Students assess their own performance in the project also by using the grading scale (see Appendix 1). Each of the four areas (Working in the FIRMA, Developing skills and applying them into practice, Organizational skills and Work performance) are assessed with a grade from 5 (excellent) to 0 (fail). Students also assess all their project group member's using the same criteria that can be found in the rubric. The overall grade is the average of the student's self-assessment and the grade the fellow students have given. The project manager's assessment and opinion is taken into account as well as the customer's feedback. Ultimately, the teacher is responsible in giving the students their grades.

Experiences of the New Learning Process

In general, students and teachers have been satisfied with the new learning process. Students think that the projects have now better "real working life feeling" than before. The new process is more meaningful and its clear description tells who shall do what and when. Students particularly like the new way of setting learning goals for the project together with the project group instead of each student filling in a learning diary monthly.

Better structure and responsibility definitions have also helped teachers to manage the increasing amount of students in the learning environment. However, the new process also has some shortcomings. First, collecting monthly hours for each student from the hour tracking worksheet is a huge effort for the student CEO. Second, reading through all self and group assessments for grading is a huge effort for the teacher. Therefore, an internal the FIRMA project has been started in which students design and implement a web-based hour tracking system that collects the monthly hours automatically for each student. As soon as the project is ready, students fill working hours in the system instead of using an Excel worksheet. Unfortunately, the hour tracking system will not solve the second problem, unless it will be extended to include also self and group assessments.

CONCLUSIONS AND FUTURE WORK

This paper introduced a project based learning environment, the FIRMA. The FIRMA is a good example of a learning environment that is able to provide learning experiences covering all the aspects of the C-D-I-O core model; also the Operate-phase which is often difficult to establish in the context of student projects in the field of ICT.

This paper also presented the FIRMA's new learning and assessment process. We can conclude that the new learning process has several advantages. First, it keeps the focus of learning objectives in the correct topics considering, among other things, working life skills. Second, it provides students with more visibility to their learning progress in form of assessments and grades. Furthermore, a well-defined learning process also alleviates the work load of the teachers. In the future, the FIRMA's learning process will be improved based on the feedback from both students and teachers.

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BIOGRAPHICAL INFORMATION

Sanna Määttä is a lecturer in the ICT unit of Turku University of Applied Sciences. She holds Doctor of Technology and Master of Science degrees in digital and computer systems from Tampere University of Technology (Finland). She is also one of the responsible teachers in the FIRMA, mainly concentrating on developing and improving the quality and learning processes of the FIRMA as well as the FIRMA competence track for third and fourth year students.

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Marika Säisä is a project manager in the ICT unit of Turku University of Applied Sciences. She holds a Master of Science in Technology degree from the University of Turku (Finland). She is the responsible project manager in the FIRMA, mainly concentrating on customer relations and mentoring students with customer projects. She has participated in several national externally funded projects. Currently she works as a project manager in SparkUp Portti, Inside the Box and Hot Potato.

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APPENDIX 1. THE FIRMA GRADING SCALE

	Excellent (5)	Good (3-4)	Satisfactory (1-2)	Fail (0)
Working in the FIRMA: Following agreed practices and working in a team.	Student successfully follows schedules and is often ready ahead of a time. Student works according to agreed practices and creates a positive atmosphere. Student works reliably in a team and encourages other team members. Student takes responsibility of the team's work and schedules. Student uses work time wisely and prepares for his/her tasks.	Student can successfully follow schedules most of the time. Student works according to agreed practices. Student can reliably work in a team. Student uses his/her time methodically but may sometimes fail to do so.	Student aims at following the schedule but sometimes fails. Student is able to work in a team, but often requires guidance. Student is passive: He/she does not take initiative but expects instructions and guidance.	Student does not follow the schedule. Student cannot work in a team. Student does not show any interest in the tasks.
Developing skills and applying them into practice	Students actively shares information and finds out more information about working methods and practices. Student actively finds out about needed software and hardware. Student is able to develop his/her skills independently and is able to apply them into practice.	Student asks advice about working methods and practices when needed. Student is usually able to develop his/her skills and apply them into practice.	Student reacts to feedback but does not actively analyse or process the given information. Student does not search for information or apply it independently but waits for instructions and guidance.	Student neither reacts to feedback nor finds out about working practices. Student does not develop his/her skills.
Organisational skills	Student is able to analyse the FIRMA's way of working (for example management and information sharing).	Student actively seeks for information about the FIRMA's way of working (for example management and information sharing).	Student is able to follow the FIRMA's way of working when instructed.	Student does not follow the FIRMA's way of working.
Work performance	Student is able to work independently and accomplishes his/her duties excellent.	Student can work relatively independently. Student is able to accomplish his/her tasks sufficiently.	Student is somewhat able to accomplish his/her tasks, but needs a lot of guidance and instructions all the time.	Student is not able to accomplish his/her tasks.