INTERNATIONAL SOFTWARE DEVELOPMENT PROJECT STUDY MODULE IMPLEMENTED IN VIRTUAL TEAMS IN COOPERATION WITH WORKING LIFE

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Abstract

This article describes the research results and students' experiences from the International Software Development project study module implemented as a hybrid model in the spring of 2022. The University of Applied Sciences Western Switzerland (HES-SO) organized the study course, and students from Haaga-Helia University of Applied Sciences (Haaga-Helia), Finland, also participated in it.

Due to the COVID-19 crisis, educational institutions were forced to adapt to distance education quickly, affecting teaching and studying in many ways. Paradoxically, however, this distance learning requirement has created innovative opportunities for collaboration. New hybrid pedagogical approaches have been tested, leading to further "physical" learning spaces.

The primary purpose of this International Software Development project study course shared by HES-SO and Haaga-Helia students was to enable them to participate in a real working-life cooperation project during their studies. An essential perspective in the cooperation was also to increase the students' international collaboration skills. During the study period, a survey was also conducted to better understand how the students' computer science skills developed in different areas during the course.

Keywords: international projects, skills development, hybrid learning.

1 INTRODUCTION

In universities of applied sciences, students develop practical skills and experience to meet the challenge of 21st-century operating methods. The task of higher education institutions is to develop the skills, knowledge and qualities needed to prepare students for a professional career. Competence develops best in an environment where students can practice their skills and knowledge. That is why it is common for higher education institutions to strive for active cooperation with working life partners.

In such concrete work-life cooperation projects, students are often offered their first international work experience during their studies. Students, lecturers, and representatives of the business world have several different roles in working life projects [1].

HES-SO and Haaga-Helia are partners and have a so-called dual-degree agreement. This joint study course between both universities of applied sciences was implemented for the second time. In 2021, the course was implemented entirely virtually due to COVID19. A joint intensive week for the students was added to the study course of the 2022 implementation when the students work face-to-face in the same place.

The International Software Development project study module started remotely in February, and fifteen students from HES-SO and eight (nine at the beginning) from Haaga-Helia participated. The students were divided into six groups, each with its real customer partner. During the study period, the students studied many different ways and cooperated with customers by applying theory concretely in practice. The essential competency goal was learning subjects related to software development, deepening skills and acquiring teamwork and project management skills.

The students mainly worked remotely, however in the middle of the study unit, Haaga-Helia students travelled to Switzerland, where the students met each other face to face for the first time. The student groups got to know each other and collaborated in the same space for a week.

Information on the development of students' skills and experiences from the course was collected through a survey. A survey was conducted for the students at the beginning of the study period, and another was completed after the end.

Table 1. Number of students who responded to the survey out of the total number of students.

	Finland	Switzerland	TOTAL
At the beginning	6/9	15/15	21/25
At the end	6/8	5/15	11/24

The objective of this project is to create a first experience of international collaboration, in a secure environment since it is supervised by the two schools and by professors. Moreover, the exchanges are between students of the same course program and the same level of study, eliminating any sort of professional hierarchical pressure on the students and the partner companies involved in the educational project. The partners offer their collaboration to help the students' progress in their learning, without putting enormous pressure on the concrete results of the project. In this pedagogical experience, a double learning process is at the heart of the project: first the acquisition of skills in the SCRUM methodology and then the experience of an international collaboration.

The Business Information Technology program at the University of Applied Sciences in Switzerland trains students at the bachelor (undergraduate) level who have a professional certificate. This training is professional, and its content is regularly updated so that the content and skills developed correspond to the constantly evolving needs of the market. As the school is in a bilingual canton, it welcomes students who have been trained in Switzerland, but whose main language is either French (12 students) or Swiss German (3 students). The use of English for this module places all students in the situation of non-native speakers.

At Haaga-Helia, students can study as an expert in business administration, tourism, hotel and restaurant management, journalism, business service solutions, information technology or sports and leisure management. Haaga-Helia strives to give students the skills to work in international environments and various professional tasks. The studies provide students with practical skills for independent work through several opportunities to the cooperate on projects with real companies. Moreover, Haaga-Helia assists students in finding employment upon completion of their studies.

The information technology degree can be studied in either Finnish or English in Haaga-Helia. The Finnish language program also includes many English courses, which aim to develop student's English language skills, a necessity in the field. Eight students from Haaga-Helia participated in this joint course implementation, of which six were studying in the English-language program and two in the Finnish-language program. However, none of the student's native language is English, hence this joint international course in English was well suited to supplement their studies.

This joint international software course was primarily implemented online. Still, halfway through the program, Haaga-Helia students travelled to Switzerland, where HES-SO and Haaga-Helia students worked face-to-face for the first time for a week. The study aimed to get information on how students' work is affected by the fact that they meet each other physically. The study also wants to uncover what impact it has on cooperation when students meet face-to-face during a course that has started as remotely and continues as remotely after the meeting.

The student groups got to know each other and shared the same space for one week. To understand the impact of this real-life encounter on the development of students' skills and group dynamics, we sent students a questionnaire before and after the encounter.

Even if it is a short-term trip abroad, the literature shows that it can significantly improve students' analytic and critical thinking skills [2]. As explained in the POLO model [3], it is fundamental to prepare the students before the trip abroad (in our case for the Finns), to guide them during the trip, while mixing learning and visiting and finally to evaluate the learning at the end of the project. As in the POLO model, we work here with partner companies who have an interest in the success of the project.

With the trip abroad, this module not only fulfils the objectives set out in the module description common to both schools:

"*at the end of the module, the student should be able to demonstrate the following professional skills:*

- Consolidate and apply software development technologies
- Integrate into a complex development process with virtual teams
- Apply agile project management methods and tools"

but also develops transversal skills which are part of the final skills reference system of our students.

Based on Orta-Castañon et al. [4], some key competencies for virtual team members have been identified and shared with our students at the beginning of the module:

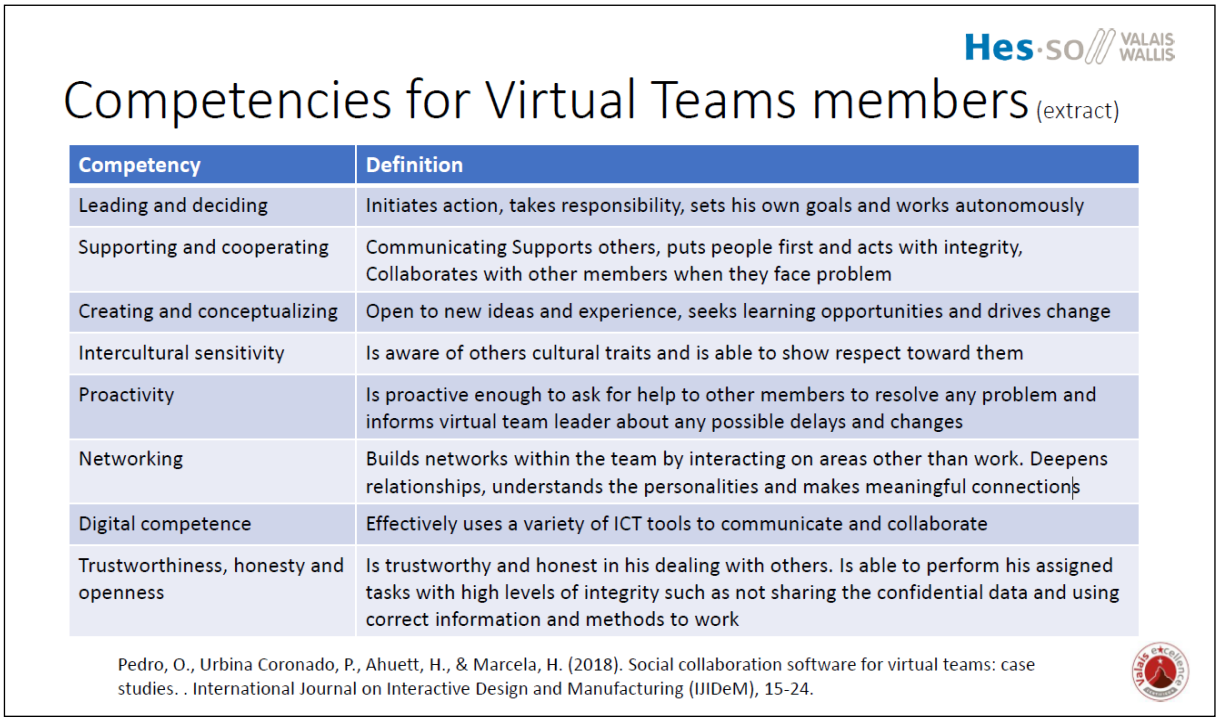

Figure 1. Competencies for Virtual Teams members.

Edwards & Sridhar [5], presents three basics which have a positive influence on efficiency, effectiveness, and satisfaction level: (1) ease of use of technology, (2) trust between members, (3) well defined task. Our methodology is built to answer these three recommendations.

2 METHODOLOGY

The methods applied in this course are SCRUM and Learning by Developing (LbD). SCRUM was used as a development method in the study because it is well suited as a method for agile software projects. For the students to understand the SCRUM method, familiarization with it was also part of the content of the course. The LbD method, on the other hand, was included because it is well suited as a teaching and learning method at universities of applied sciences in courses where genuine customer cooperation is carried out. In the following paragraphs, both have been explained in more detail.

2.1 Using Scrum as a professional methodology

Scrum was used as the study course method in cooperation with working life. Scrum is one of the most well-known agile methods used in software development. Empiricism and lean thinking are the basis of Scrum. According to empiricism, knowledge comes from experience and decisions are made based on what is observed. Focusing on the essentials and reducing waste are the core of lean thinking. In Scrum, an iterative, incremental approach is used to optimize predictability and manage risks. The basic unit of Scrum, the Scrum Team, is a small group of people that includes one Scrum Master, one product owner

and one developer. A Scrum team is not hierarchical and does not have sub-teams but is a unified unit of professionals with a product goal that they focus on at a time. Scrum team members have all the necessary skills, i.e. they are cross-functional, to create value in each Sprint. Furthermore, Scrum team members are self-managing, and team members are responsible for deciding who does what, when and how [6].

Scrum has four formal events for review and adaptation. These are Sprint Planning, Daily Meeting, Sprint Review and Retrospective. When an item in the product development queue or a product version is said to be "done", everyone should understand what "done" means. Although the definition varies significantly between different scrum teams, team members must have a common understanding of what the work done means to ensure transparency. The scrum team's "definition of done" estimates when work related to a product release is complete [6]. (Figure 2).

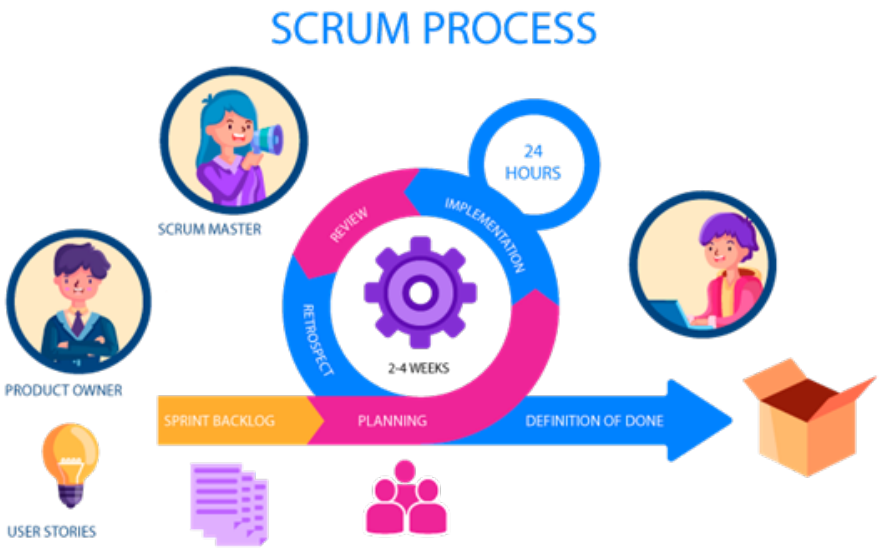

Figure 2. Scrum process [7].

Scrum's roles, outputs, events, and rules are immutable, and even if it is possible to implement Scrum only partially, the subsequent result cannot be called Scrum. Scrum exists only as a whole and is well suited as a framework for other techniques, methods, and practices.

2.2 Learning by Developing

The Learning by Developing (LbD) action model has been applied as the pedagogical background theory of the study course and research because it is well suited to such a study course implemented in cooperation with working life. The development-based learning model (LbD) effectively creates the skills needed in working life. The LbD model encourages students to take on challenges and act self-directedly. The student learns to combine theory and practice, problem-solving skills, and critical thinking and reflection. In targeted and guided work, the know-how of project work and the management of entities develop, i.e. at the core of learning, an exploratory and developing approach. Development-based learning requires the student to be active, committed and build and share expertise in teams. LbD also fits well with the Scrum methodology used in the Study Course. Close cooperation with working life makes networks of students and teachers with different partners. The cornerstone of the LbD action model is not only looking at theoretical problems but constantly looking for solutions to real situations arising from working life [8].

The three dimensions of LbD, learning of individuals, learning of communities and building new competencies, are essential elements. In LbD, authenticity refers to a genuine work-life connection. Experientiality means giving meaning to knowledge building and essential processes that lead to new ways of doing things, which are needed to reflect on personal experiences and be innovative. The partnership means cooperation between students, teachers, workplace experts and customers, which

includes mutual commitment. The requirement of research is related to higher education. Creativity is essential to creating something new. [9] (Figure 3).

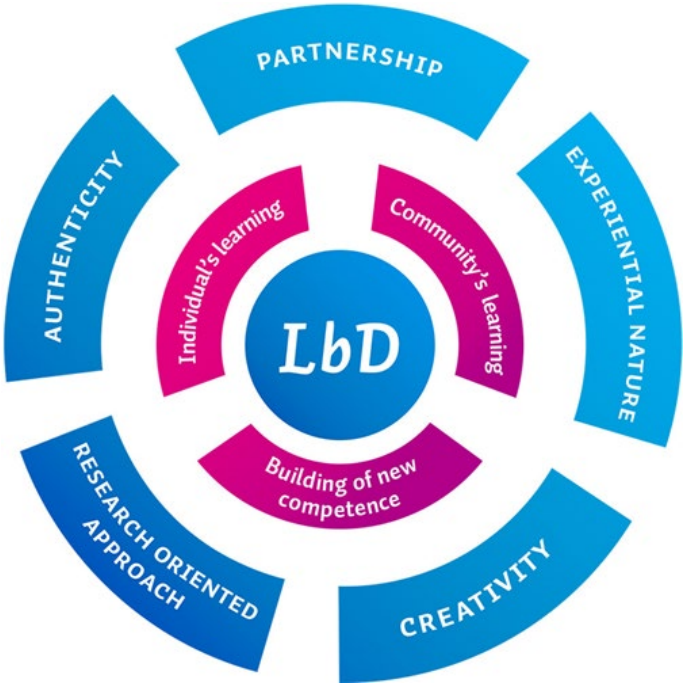

Figure 3. The characteristic of the LbD model [9].

The LbD action model is based on a pragmatic learning concept that emphasizes cooperation, action, changing the individual and the environment, and the role of experiences and interaction. In LbD, learning is active and consists of restructuring and building experiences, handling new situations, and acting purposefully. Learning by Developing (LbD) is an innovative action model based on authenticity, partnership, experience, and research. The starting point of development-based learning is a development project that truly belongs to working life, renewing practice, the progress of which requires the cooperation of teachers, students and working life experts, and where, at its best, new know-how is developed. [10].

2.3 Measuring the perception of the students with two surveys

To measure the students' perception of their learning, they completed a questionnaire at time t=1 (at the beginning of the project) and then an identical questionnaire at time t=2 (at the end of the project). The objective of this measurement is to determine whether students made progress in their learning and to identify whether any responses were over or underrepresented.

The questionnaire was created with Google Forms. The administration of the questionnaire was done electronically: a link was sent to the students by e-mail and a reminder was sent 10 days later. The first questionnaire received 21 responses. The second mailing was done in the same way, with a lower response rate, since only 11 responses were collected. This difference can be explained by the fact that the students were at the end of their training year and either in the examination period or already at the end of their semester of study. Their interest in this survey therefore decreased, despite a reminder by e-mail.

The questionnaire was processed with the Sphinx software and p-value calculations were established online with MedCalc's Comparison of means calculator (www.medcalc.org).

Fourteen items were analyzed and compared between the beginning and the end of the semester.

3 RESULTS OF THE LEARNING EXPERIENCE

Each item was cross-referenced with the time at which the question was asked: at the beginning of the project or at the end. Thus, the real and theoretical values were observed, the Chi-square values were calculated, the means were compared and finally, a graph was produced.

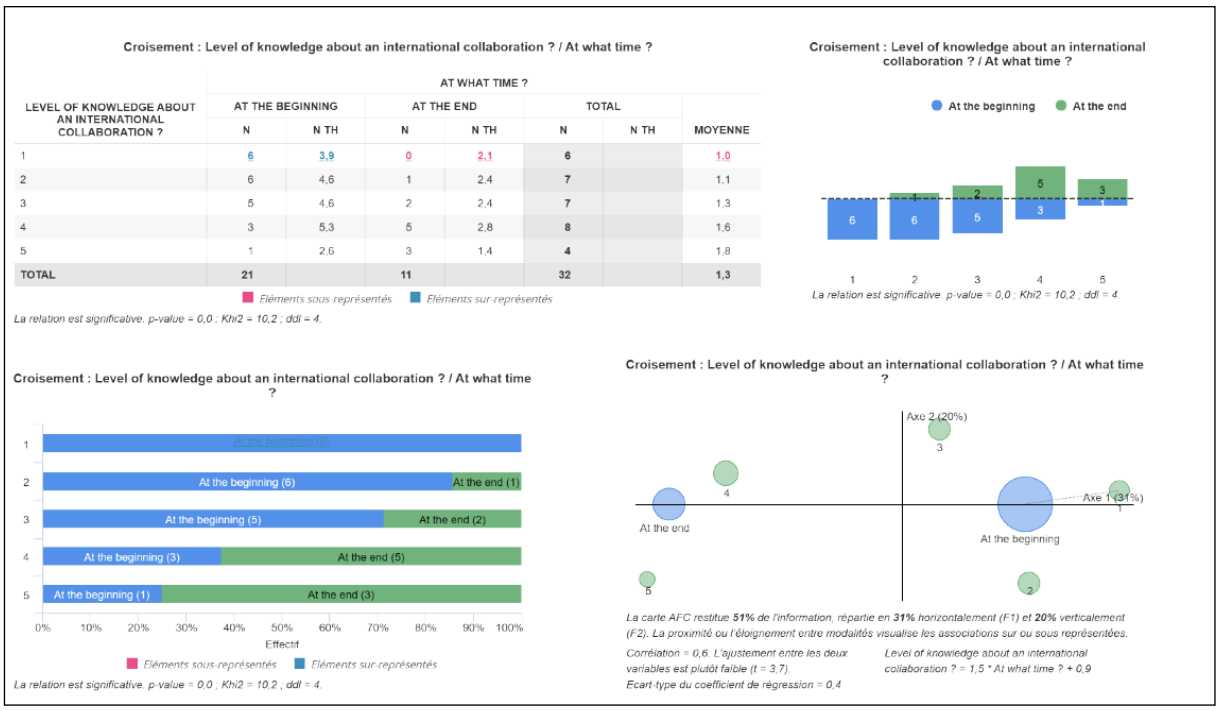

Figure 4. Analysis performed for each item (here the first one).

Out of the fourteen items analyzed, 8 showed a significant difference between the beginning and the end of the semester. The comparison of the averages showed that all the items saw their average increase at the end of the semester, which was obviously expected, but is reassuring on the seriousness with which the students answered this survey.

Table 2. Table with the 14 items, the initial and the final mean.

Level of knowledge about...	Mean scores at the begin-ning	*Sd (begin-ning)*	Mean scores at the end	*Sd (end)*	Diff.	*p*
... an international collaboration	2.4	1.2	3.9	0.9	1.5	0.0010
... critical knowledge acquisition, evaluation, and utilization	1.9	0.6	2.9	0.9	1.0	0.0007
... international team dynamics	2.7	1.3	4.3	0.6	1.6	0.0006
... analytical thinking and argumentation	3.3	1.2	4.0	1.0	0.7	0.1086
... creativity and initiative	3.5	1.1	4.4	0.9	0.9	0.0267
... co-development and service design skills	2.9	1.0	3.8	1.0	0.9	0.0219
... technology and digital competence	2.4	0.9	3.0	1.0	0.6	0.0948
... oral and written communication (including language skills)	2.6	0.9	3.1	0.8	0.5	0.1322

... networking skills	2.0	0.9	2.4	1.2	0.4	0.2958
... international experiences	2.9	1.4	3.8	1.2	0.9	0.0805
... ecological social and economics sustainable dev.	2.5	0.7	2.9	1.0	0.4	0.1959
The principle of sharing a concrete project with students from another culture/language seems relevant to me.	3.6	1.2	4.0	1.2	0.4	0.3776
Physically meeting students from the other school during joint courses seems relevant to me.	3.4	1.4	3.9	1.4	0.5	0.3449
Would this type of collaborative project in the future be interesting to you?	3.6	1.3	4.5	0.7	0.9	0.0416

df = 30 for all items

The higher mean score at the end of the project is highly encouraging, as it validates that the students will be interested in carrying out this type of collaboration in the future. The three items that show the best p-value scores are those in which the word "international" appears:

- Level of knowledge about international team dynamics (+1.6pts/p=0.0006)
- Level of knowledge about critical knowledge acquisition, evaluation, and utilization (+1.0/*p*=0.0007)
- Level of knowledge about an international collaboration (+ 1.5pts/*p*=0.0010)

The second highest mean is for "level of knowledge about creativity and initiative". Here again, students judge that their level at entry was already good (3.5/5) and the progression is again 0.9pt (*p*=0.0267).

On the other hand, the worst mean score concerns "level of knowledge about networking skills", even if a slight progression is noted at the end of the semester, it should be emphasized that the students consider these skills to be lacking. An effort will be made in the next edition of the module to train the students of the awareness of the acquisition of this skill.

4 CONCLUSIONS

In summary, for this study, it can be stated that the results of the student survey show that the level of knowledge of the students about international collaboration and team dynamics, as well as the critical knowledge acquisition, evaluation, and utilization, have progressed significantly.

As a result, valuable information was obtained about the 24 students who attended the course. The answers of the student who participated in the study show that they are aware that in the future their job will require them to work with multi-cultural and international teams, perhaps even spread over several geographical or virtual locations. Their feedback in the open-ended questions of the questionnaire was unanimously favourable to this educational experience and positive in relation to their own learning.

SCRUM was used as the development method of the course, which is well suited for software development projects. A development-based teaching and learning method was applied as a pedagogical method. The development-based way is appropriate for studying units involving a real customer project. In the LbD action model, studying combines theory and practical work in customer projects. The student learns many skills needed in working life in addition to technical matters. Students' communication and teamwork skills develop and working life skills and understanding customers' needs also increase.

The results of the research help to plan things that should be developed and considered in such international cooperation study courses. Furthermore, the research results provided valuable information on adapting the next corresponding study course to make it work even more successful.

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