# Project course in engineering studies
## Students' expectations on the course

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Conference Key Areas: University-Business Cooperation, Engineering Skills, Engineering Education Research

Keywords: project studies, time use, learning, student's expectations, attitude

## INTRODUCTION

Lecturing has traditionally been the main form of teaching in higher education. It is, however, already widely acknowledged that knowledge transfer in the form of lecturing does not result in deep learning and understanding. The new generation students learn in a very different way than older ones and the information load is enormous [5, 8]. In order to achieve deep learning, students' motivation and commitment needs to be increased and maintained [10, 11]. It is known as well, that students learn better with cooperative learning and when working together. Knowledge transfer will fail, if students do not understand the underlying concepts and do not learn to solve problems as they do in practise [7].

Often means to increase students' commitment and motivation is to transfer more responsibility to themselves about their own learning. Means for this are for example different kinds of independent assignments and projects [5, 6]. As working life is changing the new employees need various work life skills such as analytical and communication skills and ability to work in a team and in a creative manner [2, 4, 6-8, 13, 15]. Thus universities also need to meet requirements from industry that the graduating students would need wider working life skills, in addition to their subject skills.

It is seen important that in addition to knowledge acquisition also students' behaviour and attitudes can be influenced during their education. Nagel et al. [16] defined these

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as knowledge, skills and behaviour. This is in accordance with the principles of curricula development in Tampere University of Applied Sciences, which took place in 2012 and the reviewed curricula were taken into use in 2013. Curricula were designed as competence-based in order to develop not only students' knowledge ("knowing") but also their practical skills ("doing") and attitudes and thinking ("being") are developed. Project-based learning (PjBL) has been introduced as one means in developing students' generic and professional skills. It is typically based on problem-based learning [1, 8]. The aim is to train the students of higher education to meet the requirements of modern working life, where information seeking, analytical skills in relation to information flow, team work skills, flexibility and also creativity are needed [1, 2, 14, 15].

The present working life consists largely of projects and often typical job description includes working in project teams. Project is a defined task or activity having particular aim and timetable [3]. Project based learning (PjBL) in turn takes learning out from the classroom, to the real-life context. It includes following features like finding solution to a problem, students own initiative, end product, timetable and support from teaching staff [9, 13]. Skills and competences in project management and team work are crucial and thus it is important that graduates in engineering programmes achieve these already during their studies. Typical skills needed in projects are problem solving, taking initiative, setting and achieving the goals and managing the time and resources allocated to the project [13]. Typically, self-direction is also needed [8, 9].

Many studies reveal that when students are working in teams in interdisciplinary projects they learn more efficiently project management, communication, time management, reporting and other practical skills needed in working life, which also help them to manage with their course studies [13, 16]. In order to develop these skills in a multidisciplinary teams Tampere University of Applied Sciences, School of Industrial Engineering started a project work course, which was implemented in all degree programmes of the School. These included Bachelor degree programmes of Automobile and Transport Engineering, Bio-Product and Process Engineering, Environmental Engineering, Laboratory Engineering, Mechanical and Product Engineering and Forestry. This Project Work course was the biggest course implementation at the School of Industrial Engineering with 210 students and 27 coaches involved and the duration of the course was Autumn Semester, i.e. 4 months. According to Helle et al [9] project-based courses typically are smaller in size and shorter in duration. Only one course was reported to be corresponding in size with 160 students and 20 teachers, but the duration of that course was five semesters [9].

Most studies concerning project-based learning concentrate on learning outcomes and students' experiences and feedback about the project implementation. So far we have not been able to find studies where students' expectations or perceptions had been studied *before* the project implementation. Expectations and perceptions are important to acknowledge, since they affect the way the project goals can be achieved [13]. This paper describes the Project Work course implementation and focuses on students' expectations, doubts and fears towards the course, which were studied through a questionnaire in the beginning of the course. The aim of the questionnaire was also find out how realistic understanding the students had about project work in general and specifically of the course.

# 1 QUESTIONNAIRE AND METHODS OF ANALYSIS

## 1.1 Course description

Acquiring competences and readiness for project work has been recognised as an important goal in the engineering curriculum applied from 2013 onwards. This curriculum includes a 5 ECTS course “Project work” in the first semester of third year in all Bachelor programmes of the School of Industrial Engineering at Tampere University of Applied Sciences. The expected learning outcomes of the course are:

- Learn to work in a multi-professional project environment as a member of a project group or as a leader of a project team.
- Understand and be able to implement the different stages of project (planning, implementation, evaluation), and the principles of planning, steering and supervision as a part of project.
- Be able to report about the project at different stages.
- Be able to take and give feedback and suggestions.
- Be able to evaluate the success of project

The extent of the Project Work course was 5 ECTS. Supporting project management studies were also organised in most of the degree programmes parallel to the project implementation. In most of the degree programmes this was the first time that students were introduced to a working life project where there was a real client and true responsibility to meet the project requirements. Thus there was more expectations, goals and responsibility required from the students’ performance when compared to courses otherwise.

Coaching was chosen as a pedagogical approach on the course. It was also used during the planning phase of the course to facilitate teachers in taking the coaching role [16-18]. There is no single or simple definition for coaching, since the term can refer to various approaches. In general coaching is understood as an approach and a process where the coachees are helped to find their own strengths, improve their performance and achieve higher goals. The School of Industrial Engineering is strongly devoted to coaching and team teaching as pedagogical approach. Almost all lecturers have taken part in in-house-training on coaching. The Project Work Course implementation was planned by group of six lecturers participating in advanced level training in coaching [18,19].

The important principles of coaching in this course were 1) having trust in students, 2) focusing on learning process and 3) emphasising team work. Focusing on learning process in coaching includes the notion that the project might not reach the expected outcome. If the students, however, learned from the process and the process increased their project management competences, the result can still be seen as a positive learning experience. Evaluation criteria for the course were defined in order to focus on the project teams' process and individual students’ development and skills. In coaching the coaches are helping coachees to empower themselves by facilitating self-directed learning, personal growth and improved performance using dialogue and discussion [17-19]. Thus the students are helped to find their own ways and responsibility to solve the issue or question in the project. Total of 27 coaches belonging to the teaching staff of the School of Industrial Engineering and course coordinator were appointed to this course. Students feelings, opinions and attitudes on project work course and coaching as a pedagogical approach in advance, were studied

by an online questionnaire in the beginning of the course and the results are presented and discussed in this paper.

### 1.2 Questionnaire implementation

The course started on September 4th with a common introduction, forming the project groups and meeting with the coaches of the groups. On the very same day a link to a questionnaire was sent to all students participating the course and they were asked to answer the questionnaire within two weeks. After reminding them once before the deadline, eventually 99 students out of total number of 210 students participating the course answered. Thus the proportion of respondents was 47 %. The questionnaire consisted of multiple choice and free form questions students' expectations for the course, coaches and project group they work in, as well as what do they fear and doubt on the course, what are their goals and what do they expect from their group coaches, which were appointed from the teaching staff.

## 2 STUDENTS' EXPECTATIONS

### 2.1 Background information

From the amount of 99 respondents 63 % were male students and 36 % female students. Mostly the students were Finns (86 %). Other nationalities represented were Russian (4 %), Chinese (6 %), Irish, American (US) and German all with 1 % share. *Table 1* summarises the share of respondents by degree programme.

*Table 1.* Number of students answering the questionnaire by degree programme, gender and nationality. N=99 (47 %).

| **Engineering Programme** | **Share from respondents (%)** |
|---|---|
| Automobile and Transport | 6,1 |
| Bio-product and Process | 18,2 |
| Environmental | 13,1 |
| Mechanical and Product | 31,3 |
| Laboratory | 16,2 |
| Forestry | 15,1 |
| **Total** | **100** |

### 2.2 Expectations

When students were asked to name three most important expectations to gain or achieve when doing the project work, they chose mostly options *Practical work* and *Learning by doing*. This is well in accordance with the fact that most students studying in universities of applied sciences Bachelor's degree programmes are practically oriented and prefer doing instead of theoretical studying. Third most important thing to expect was gaining the C*redits for the degree* (*Fig. 1*).


*Fig. 1.* Students' expectations on the Project work –course. 1= Credits for the degree 2 = Contact to the companies, 3 = New friends, 4 = Studying across degree programme, 5 = Networking, 6 = Moments of success, 7 = Practical work, 8 = Learning by doing. N=99.

### 2.3 Fears and doubts

The three most common issues that the students were afraid or had doubts on were the difficulty in keeping the timetable, that the results achieved would not be what expected and that there is not enough time to do the project (*Fig.* 2). Thus the issue of most concern clearly seem to be related to time management and achieving the goals of the project.

### 2.4 Time use and work forms

Students were asked to estimate how much time they are going to use for the project. The course extent 5 ECTS means that each student should use on average 135 hours during the autumn semester for doing the project. Majority (42 %) of the students estimated that they would use only 51-80 hours for the project, 25 % planned to use 81-110 hours and only 8 % of students were planning to use as much time to the project as dimensioned by the amount of credits (*Fig.* 3). Previous studies also show that students often do not use as much time on studying than dimensioned or expected (e.g. [10,11]).

Students mostly preferred working in groups with their class mates (44 %), i.e. their friends and acquaintances, rather than in multidisciplinary, international groups or using foreign language (*Fig.* 4). Only 14 % of students were ready to work in multidisciplinary team. The rest of the respondents wanted to work either alone (17 %) or in a work pair (23 %). Yet 84 % of the respondents replied that him/her (individual student) has the responsibility of the project. Only 6 % said that the project group is responsible and 1 % said that the project manager or client had the responsibility of the project.

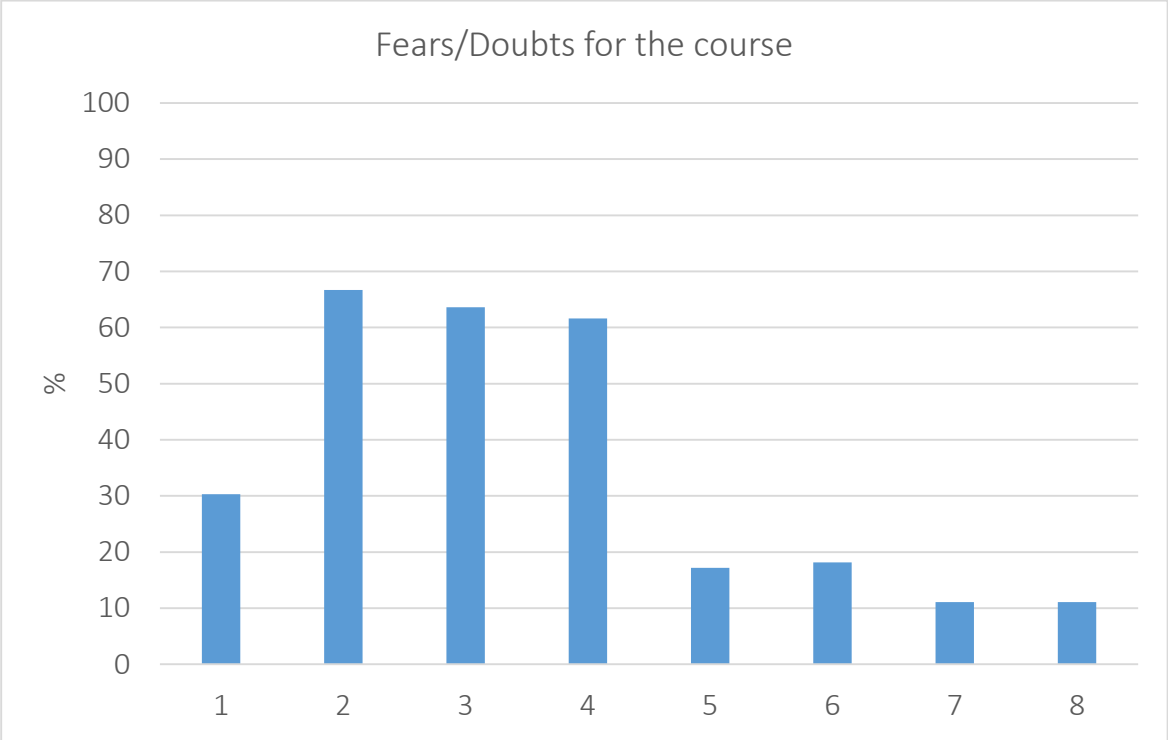


*Fig. 2.* Students' fears and doubts for the Project work –course. 1 = Group dynamics does not work, 2 = Timetable does not keep, 3 = Achieved results are not what expected, 4 = There is not enough time to do the project, 5= I do not like the project theme, 6 = I have to use Finnish/English language, 7 = I have to do all by myself, 8 = Other, what? N=99.

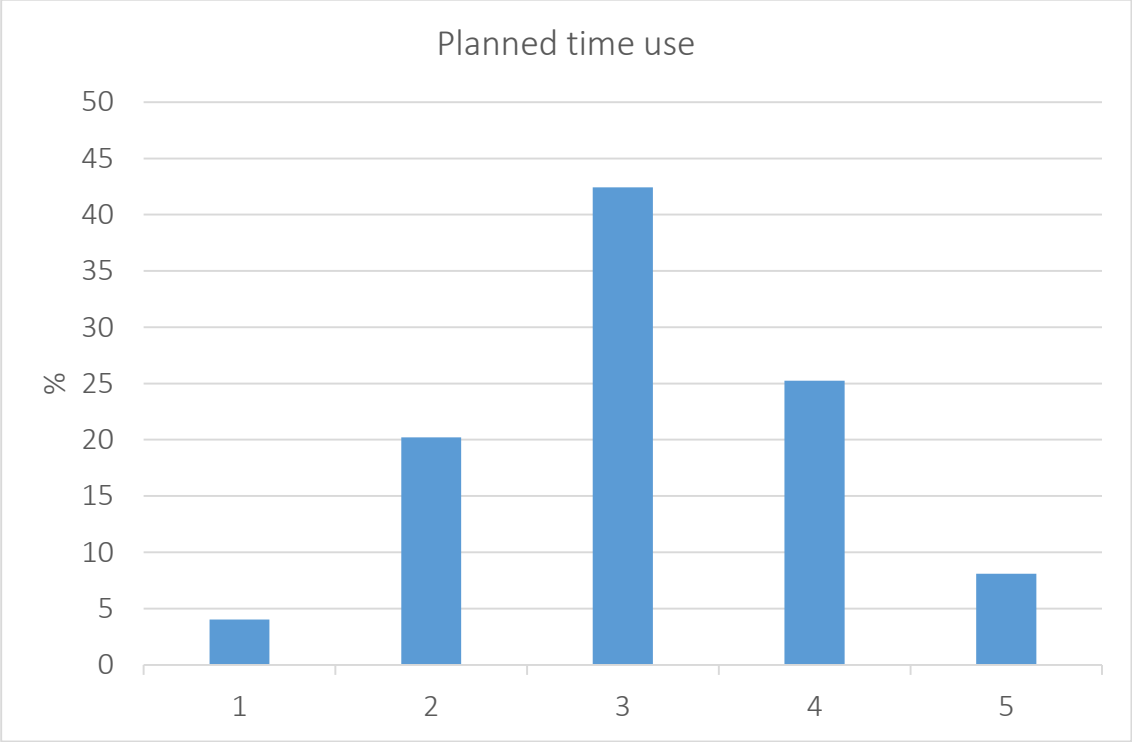


*Fig.* 3. Students' planned time use on the course. 1 = 10-30 h, 2 = 31-50 h, 3 = 51-80 h, 4 = 81-110 h, 5 = 111-140 h. N=99.

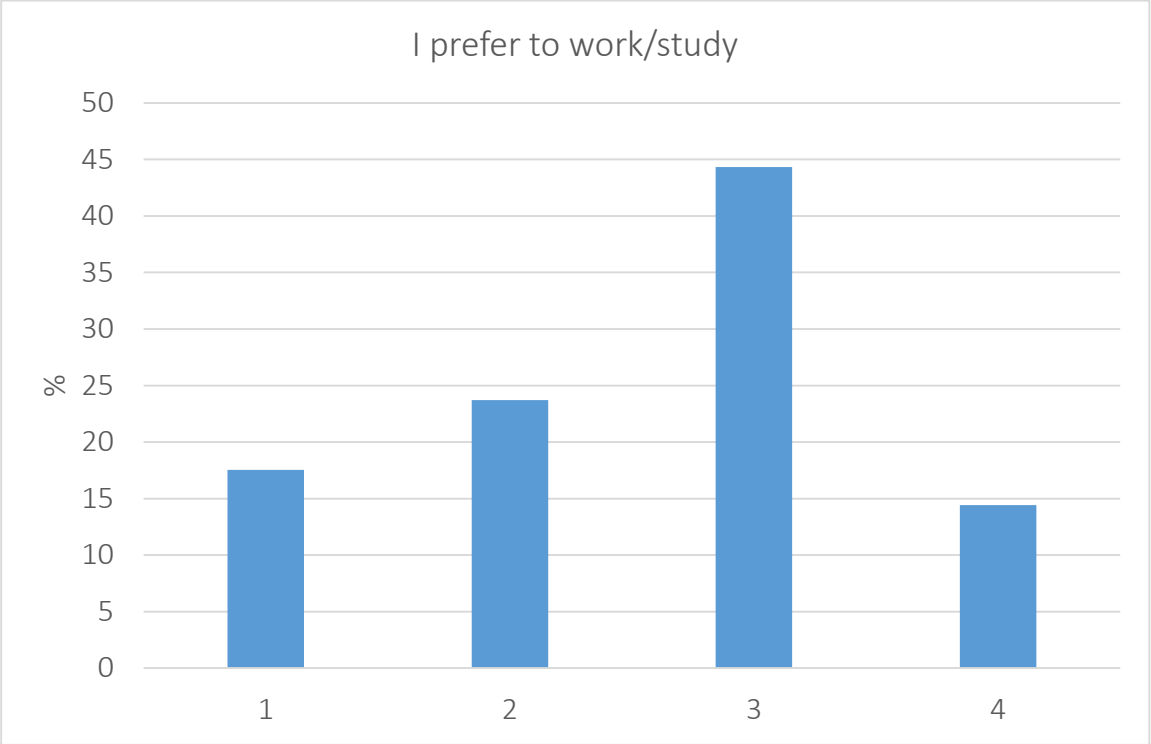


*Fig.* 4. Students' preferred work form in a project. 1 = alone, 2 = in pairs, 3 = with friends in a group, 4 = in a multidisciplinary group.

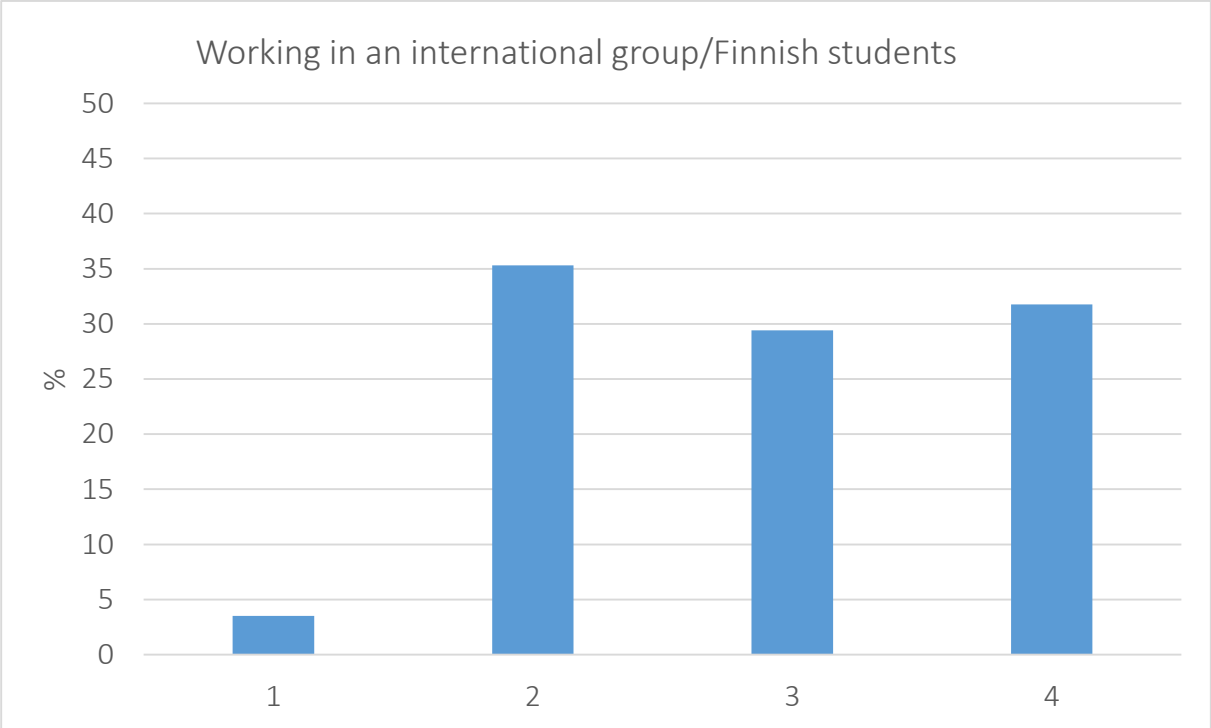


*Fig.* 5. Finnish students' attitudes towards working in an international group. 1 = no way, 2 = I'll be happy to try, 3 = I find uncomfortable, but manage, 4 = no problem.

When Finnish speaking students were asked if they were ready to work in an international group most of them (67 %) were positive about it, 29 % found it uncomfortable, but manageable and only 3 % replied that they do not want to be in an

international group (*Fig* 5). 38 % of the foreign students (N=13) did not want to work using Finnish at all, which is understandable, since many of them (7) were exchange students and spending only one or two semesters in Finland. Foreign degree students, however were willing to try or were ready to use their Finnish skills, even though it might have been challenging and hard.

### 2.5 Expectations to the coach

When students were asked about their expectations towards their coaches the three most common choices were getting answers to their questions and guiding questions and good quality contact teaching (*Fig* 6).

### 2.6 Aims and roles

Students were also asked to choose in their opinion the three most important aims they have for the course (*Fig* 7). These were professional development, skills in project management and getting contacts to companies. Getting credits for the degree were not their first priority in terms of aims of the course.

Students preferred mostly to have the role of technical experts in their project group (*Fig* 8, *Table* 2). Environmental and Mechanical Engineering students mostly preferred working as a project manager and students of Automobile and Transportation, Bio-Product and Process, Laboratory Engineering and Forestry were mostly interested in the role of technical expert. Other roles were not ranked that interesting by the students (*Fig* 8).

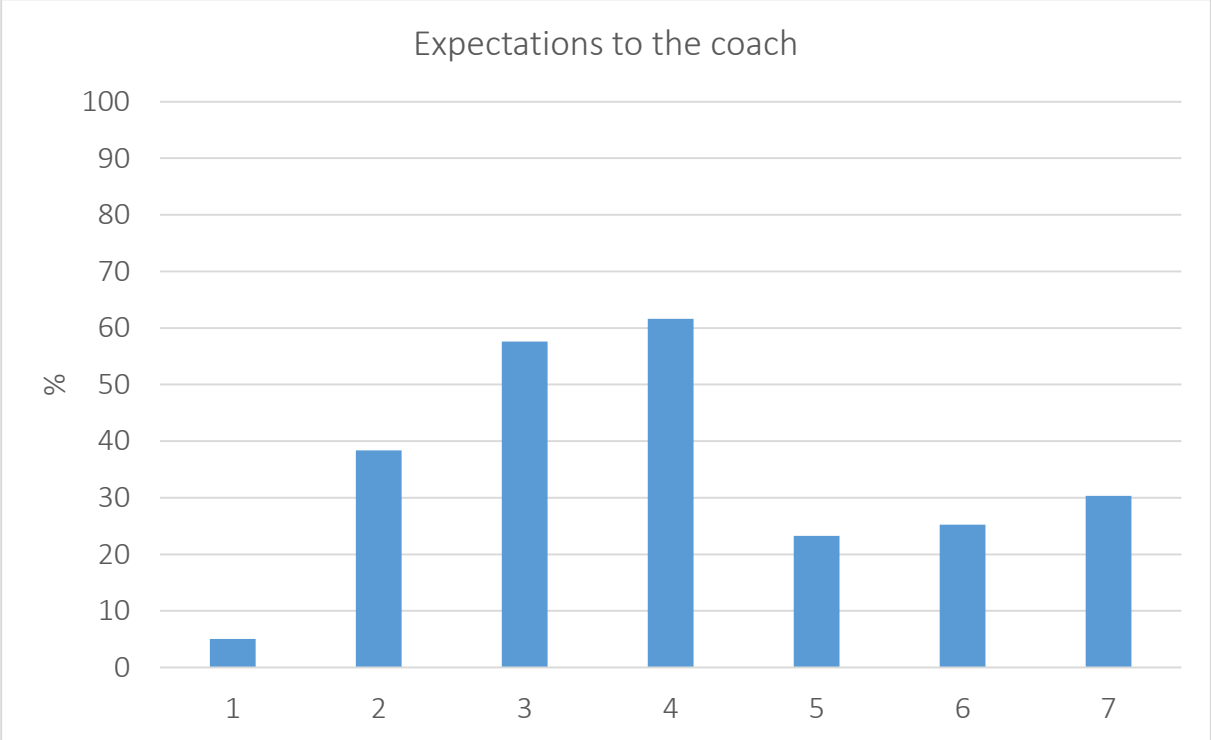


*Fig. 6*. Student's expectations to the coach of the team. 1= 24/7 availability, 2= good quality contact teaching, 3= guiding questions, 4= answers to our questions, 5= exact instructions how to do the project, 6="shoulder to lean on", 7 = commitment to the group

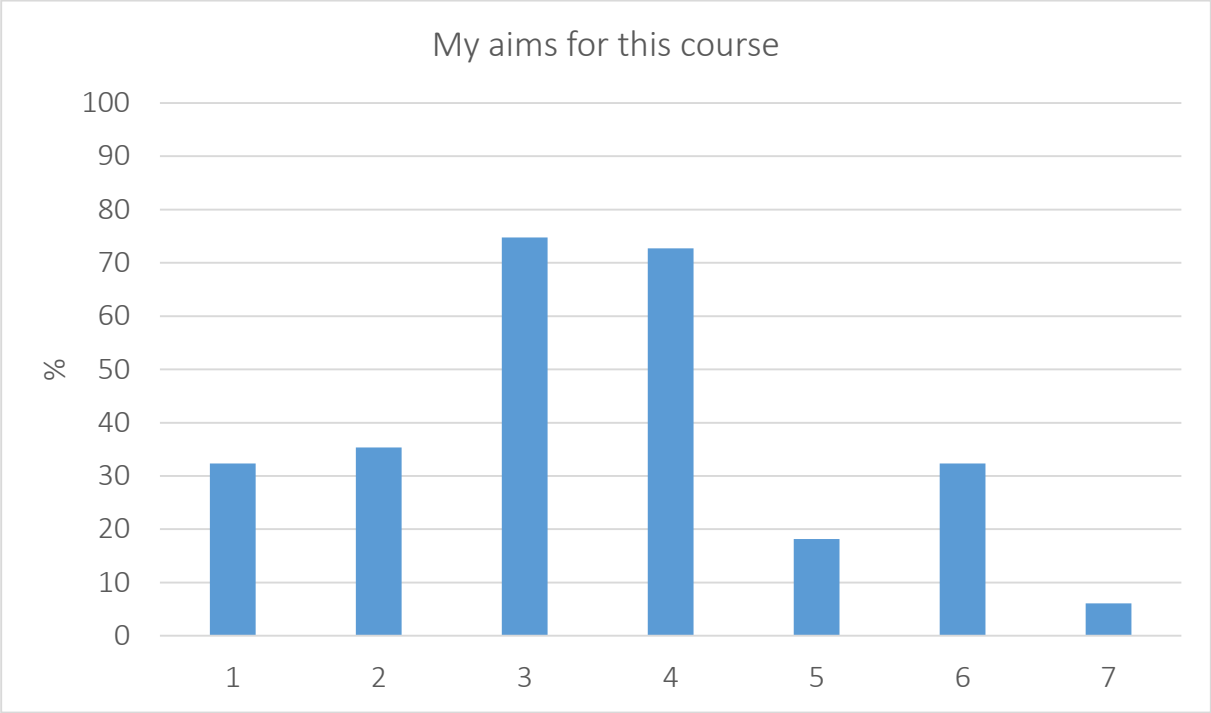


*Fig. 7*. Student's aims for the course. 1 = get contacts to companies, 2 = learn team work skills, 3 = professional development, 4 = skills in project management, 5 = networking, 6 = get credits, 7 = internationalization.

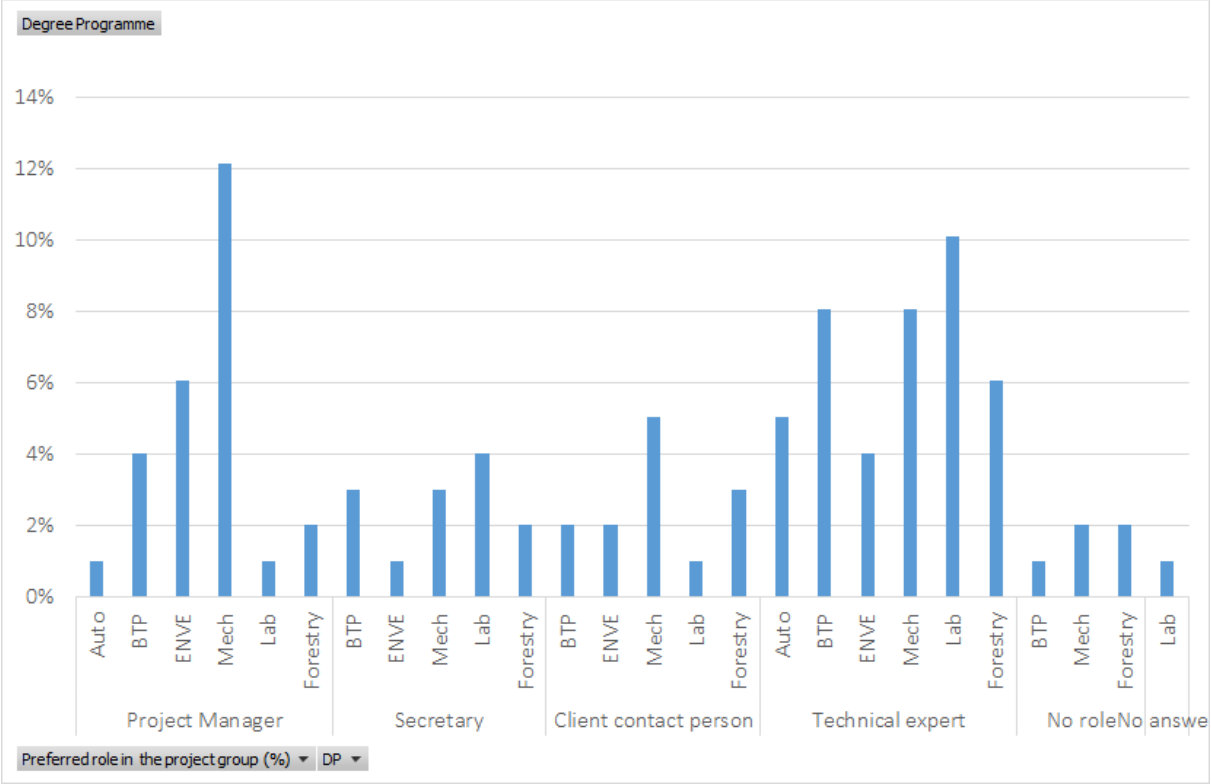


*Fig.* 8. Preferred role in the project group by degree programme. Auto = Automobile and Transportation Engineering, BTP= Bio-product and Process Engineering, ENVE = Environmental Engineering, Mech = Mechanical Engineering, Lab = Laboratory Engineering, Forestry.

*Table 2.* Preferred role in the project group (N=99).

| Role | % of the students |
|---|---|
| **Project manager** | 26 |
| **Secretary** | 13 |
| **Contact person for the client** | 13 |
| **Technical expert** | 41 |
| **No role** | 5 |

### 2.7 Free form answers

Students were also asked in free form questions about their previous experiences in doing a project, if they were able to identify what a project is and their feelings about the project work course.

57 % of respondents said or identified that they had done different projects earlier in their studies or work. 60 % of respondents were able to describe or define what project is. Typically, the characteristics of a project were known – defined aim, scope and timetable and that the project has different defined phases, such as planning, implementation, meetings etc. or a project was described according to the end result (e.g. a computer game). In the free form comments concerning the course students expressed that the course is a welcome change for their regular courses.

*Project work studies are awaited part of our education, because it helps deepen learning the best and creates preparedness to working life* - Student, Laboratory Engineering

Students were asked about their previous experiences of projects and understanding about project in free from questions. These included for example how this course in their opinion differ from other classroom courses. 79 students replied to this question (80% of all respondents). They were describing the course with the following expressions:

- More independent work, taking more responsibility
- Practical doing
- Planning time use
- Taking more initiative
- Networking, meeting new people
- Business contacts
- More time consuming
- Responsibility to the client/company
- More freedom to do the work

Seemingly the work load and time use was of biggest concern also in the free form answers. Students were looking forward to practical doing and independent work. It was also seen as a chance to be in multidisciplinary group and learn from others, but this was not preferred by majority of the students. Some of the students also saw the course as an opportunity to develop their working life skills and contacts.

*This course is a great chance to show up your skills and develop something you miss. Also the course gives you an opportunity to be in real-life-worker shoes but with an*

*ability to make mistakes (something that is not welcome during ordinary working process)* - Student, Bio-product and Process Engineering (translated from Finnish)

Students seemed to realise that taking responsibility of the project and meet the needs of the client are important issues on the course.

*In a project there is a client to whom you do the work. You cannot do the work just somehow, but you must do carefully and well. Sometimes when you study for yourself, you do not give 100 %. In this project you must.* -Student, Forestry (translated from Finnish)

Some students, but rather few eventually felt that the Project Work –course offered them an opportunity to get to know possible future employers.

*Free working life contacts, suits me!* - Student, Mechanical and Product Engineering (translated from Finnish)

In the degree programme in Forestry Problem-Based Learning has been the pedagogical method for years already. Thus their students seemed to be more ready and aware of what to expect from the Project Work course.

*At least PBL, one has had a lot of skills in working in team and learned new things about yourself (strengths/weaknesses)* -Student, Forestry (translated from Finnish)

We teachers and instructors would like to think that all courses in the curricula prepare students for their future career as engineers. This is not always, however, realised by the students themselves. When students were asked what courses had prepared them for the Project Work course, 35 % of students either did not answer at all or answered that they are not able to identify any courses. Most of the students (75 %), however, did either list courses that they felt had been useful for the Project Work course or stated that all their studies had helped in this. The listed courses varied largely student by student, but included both professional studies, where smaller exercises had been carried out as a project and also language and communication courses as well as previous group work tasks within courses.

The questionnaire results and free form answers reveal that the students were looking forward to the project work in groups, but on the other hand they were also a bit insecure and uncertain of how they would manage. Their expectations towards the coaches of the group were somewhat unrealistic, since they were expecting to be taught on the substance and that they would get clear answers to their questions, rather than being supported of using their own strengths or finding their own solutions. Coaching as a pedagogical approach seemed not to be familiar to the students.

*It is going to be a windy autumn* – Student, Bio-Product and Process Engineering (translated from Finnish)

In the course also international students were involved, so some of the projects was implemented using English language. This was of concern for many students, since they were suspicious or even reluctant to work in international group. This was seen in the way the wanted to form the groups. In the beginning of the course some students who got into an international group, wanted to change the group or cancelled their enrolment. The students of the International Degree Programme in Environmental

Engineering, who study in English, were used to and comfortable in working in international groups.

## 3 DISCUSSION

This chapter discusses the results from two perspectives: 1) what were the biggest expectations and doubts and 2) how realistic perception the students had about projects in the beginning of the course. The results are mainly discussed with literature on learning outcomes of project work courses in engineering [1-2,5-8] as studies on expectations in the beginning of project work were scarce.

In project work courses or implementations students are required to engage in more independent work and have self-management skills [1, 8]. This means that a person needs to know his/her own strengths and weaknesses and use them for the project in a reasonable way. It is critical in higher education that graduates would meet these goals and put their skills into practise [1, 8].

Undergraduate students in University of Applied Sciences are typically more practice oriented and prefer learning-by-doing approach rather than theoretical studies. This showed in the expectations of students based on the students' comments and their questionnaire replies. Thus the Project Work course appeared to be a welcome change to classroom teaching and subject courses. In general students were truly looking forward to the Project Work course and the different approach in learning. They were mostly looking forward to the practical work and learning by doing. This set a good starting point for learning on the course.

Gaining credits for the degree was also an issue many students were looking forward to. The time students planned to allocate on the course, however, implies that they were underestimating the work load or looking for "easy credits". For example, Kolari et al found that students tended to use far less time for their studies, but still felt overloaded with work [10,11]. It seems that underestimating time use and overestimating work load is quite typical among undergraduate engineering students [10,11]. According to the ECTS (European Credit Transfer System) we define the extent of one credit as 27 hours of student work. Thus the total average time allocated for Project Work –course (5 ECTS) was about 135 hours per student. Their questionnaire answers revealed that the students were mostly were planning to use far less time; 42 % of students were planning to use 51-80 hours for the course and only 8 % planned to use the time allocated for the project. Connecting this with the fact that students strongly expressed a concern on time management raises the question of students' skills for self-regulation and planning, which are important project skills [5,8, 12,13, 15].

Students’ aims for the course were mostly related to developing their generic and professional skills, which is in accordance with the aims of the curriculum and also many previous research studies [1, 2, 5, 7, 8, 13, 15]. The three most popular choices were professional development, project management skills and team work skills and taking responsibility of their decisions. This is well in accordance with the aims of project-based learning (PjBL) [1, 6-9, 12-14]. In project-based learning, which was implemented on this course, learning takes place outside classroom in a real-life context [e.g. 6, 8, 9]. In general project-based learning has been worth implementing even though it is not without challenges [12].

Most of the students were also able to define what a project is in the beginning of the course. They were also able to identify which courses or events had helped them to prepare for the Project Work –course implementation. These were for example smaller exercise projects implemented within different courses as well as InnoEvent, BioHub and other innovation projects organized at Tampere University of Applied Sciences. Also language studies and different professional engineering courses were named as helpful in carrying out the project. Students were very much looking forward to practical working and problem-solving opportunities. This indicates that the students' expectations on contents and learning opportunities were realistic as project-based learning is regarded as an ideal method for achieving generic competences like team work skills, information retrieval and analysis skills [1, 6- 8, 12, 15].

Total of 14 % of students on this course were international, both exchange students and degree students in international degree programme in Environmental Engineering. Thus some of the groups were international. Most of the students were ready to work in an international group. About one third of the students were reluctant to step outside their comfort zone and work in an international group. This was somewhat surprising and has to be worked on in next course implementation. The students of international degree programme seemed to be more ready to work in international group and even suggested implementing the course only in English.

*Drop the bilingual approach for the materials and just present everything in English.*
Finnish student, Environmental Engineering (International programme)

Some of the foreign students in turn felt that they were left a bit outside because not all information about the projects was in English language. The reason for this was that the clients wanted the project results in Finnish. This is a challenge in such a big course implementation, where also exchange and international students are taking part in.

Students seem to seek for certain comfortability in the working environment, since almost half of the students (44 %) preferred to work with students they already knew. This indicates the typical human characteristic of being rather safety-oriented and stay within the comfort zone than change too much in the learning environment. Leap from classroom teaching to project-based learning is already a big change. Yet the reality of project work is based on multidisciplinary groups and one course aims is to practice this. Lima et al [12, 13] also found in their study that students preferred groups with friends, which was not always a good thing. Group work includes sometimes also conflict and time management, which typically are the challenges in projects and affects the group dynamics [12, 13]. In a way students welcome the new learning approach, but at the same time they are concerned also whether they are able to meet the requirements of the project and partly want to hold to old comfortable practices.

In addition to time management and having enough time for the project, the students were mainly concerned about being able to reach the outcomes expected by the client. This is quite understandable as the students had very vague perception of the goals of each project when they answered the questionnaire [ e.g. 12].

Even though the course implementation emphasised students' own responsibility and initiative, it seems that their expectations to their group coaches were still more teaching–oriented, since they mostly expected clear answers and contact teaching

approach from their coaches. It might be that coaching as a pedagogical process is now known for most of the students. This might also indicate some kind of uncertainty to take responsibility. It is expected and feared at the same time. This is in correspondence with the findings of Lima et al. [13, 14]. Project–based learning is found to be time consuming which was of concern for students in this study as well, but eventually has been worth implementing [8]. Paradigm change from teacher-centered learning to student-centered learning using PjBL requires "a leap of faith" [9, 12] also from students, not only from teachers.

## 4 CONCLUSIONS

The study on the expectations of third year engineering students in the beginning of Project Work –course can be summarized.

- The students were looking forward to practical work and learning by doing.
- The students' expectations and perception of the nature of project work were quite realistic
- Students are somewhat afraid of the responsibility and whether they are able to meet the goals of the project
- Time management is clearly of concern and estimating time use is challenging.
- Expectations for coaching and time needed were unrealistic and coaching as a pedagogical approach is rather unknown.
- Some of the students were rather reluctant to work in international or multiprofessional groups.

The challenges revealed by this study can be overcome by using coaching approach already in earlier phases of studies. This is possible as almost all lecturers in the department have participated in coaching programme. The challenges on students' willingness of working with new people can also be mitigated – at least to some extent - by pedagogic arrangements in which students from different programs work together or study same phenomenon from their own professional perspective and share the results. As team work of lecturers is encouraged in the department, also this should be possible.

**Acknowledgements**
The authors wish to thank Y-Campus coaches Mikael Juntunen and Timo Nevalainen, coach peers Ulla Häggblom, Petri Pohjola, Sami Suhonen and Eeva-Leena Tuominen in the Advanced Coaching training for making the Project Work course possible. Tampere University of Applied Sciences, School of Industrial Engineering has financially supported this study, which is gratefully acknowledged.

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