# Students' learning experience in multidisciplinary project groups – Insights from a packaging development course

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*Abstract* — **In a world where technical knowledge gets outdated in an ever increasing speed, it is important that engineering education provides students not only with broad technical competences but also with so-called soft skills such as communications skills, leadership skills and team-working skills. When it comes to team-working skills, group projects have become an inevitable part of most LTH programs. LTH students are used to work in groups and by the end of their education, it can be expected that most of them are successful team players. A complication with regard to the development of team working skills is however, that the working conditions in homogenous teams are very different to the working conditions in heterogeneous groups. While project groups in LTH courses in most cases can be considered to be relatively homogenous, most real-life working groups such as research teams or product development teams are heterogeneous, simply because most real-life problems require a team of professionals with different competences and backgrounds.**

**In an attempt to prepare students for the working environment in multidisciplinary teams, the LTH course Packaging technology and development requires students to form a project group with students from several LTH programs and with different nationalities. When it comes to the results of the group projects, all involved teachers agree that in most cases group diversity has a positive impact on creativity and problem-solving in the teams. At the same time, working in multidisciplinary and multinational teams can be a difficult and frustrating experience for some students. An interesting research question is accordingly how students experience the learning environment in multidisciplinary teams over time. To answer this question, we have during the autumn term 2015 collected written student reflections about their experiences with the multidisciplinary group environment based on a written survey (70 respondents). The students handed in one reflection at the beginning of the group project when they just had formed their groups and one reflection at the end of the course when they had presented their project results. The paper presents the results of the survey data that can be valuable input for other LTH courses that work with or plan to work with multidisciplinary project groups.**

*Index Terms* — **group project; multidisciplinary teams; experienced learning environment; heterogeneous groups.**

## I. Introduction

In engineering education, it is necessary to give students opportunities to learn so-called soft skills in order for them to become prepared for the working life. One such soft skill, that is focused in this paper is the skill of working in teams, something that is practiced through project work in many engineering programs. The key underlying pedagogical principle in student projects is project-based learning- Project-based learning is argued by Mills and Treagust [1] to be a necessary improving complement to existing lecture-centric programmes. They further argue that it is welcomed by both students and industry. Most project-based learning at the engineering faculty in Lund, are carried out within one study program, meaning that the student groups are usually quite homogeneous, at least in terms of educational background, while projects carried out in industry usually are set up of multidisciplinary teams [2]. That identifies a gap in student experiences when it comes to team work in multidisciplinary settings, in relation to the requirements in working environment practices. Recently, some examples of multidisciplinary projects, introduced in engineering schools are found in literature. Such projects are carried out by integrating two or three study programmes into the same course [3], but reporting is sparse and often context dependent. Furthermore, previous reporting has focused mainly on the student experiences when the task is finalized. Therefore, it is of particular interest for us to study multidisciplinary student groups that work with industrial based tasks and investigate the learning experiences of the students in such teams over time. The research question used for this study is accordingly: How do students experience the learning environment in multidisciplinary teams over time?

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## II. Project-based learning

Project-based learning is focusing on learning through experiences in active learning environments [4]. Blumenfelt et al. [5] define project-based learning as "*a student driven investigation of a complex problem that serves to organise and drive learning activities which culminate in a final product that addresses the problem*". In project-based learning students are found to develop deeper levels of understanding of complex issues and concepts [4], they gain problem-solving and communication skills when being involved in project-based learning [6], and they achieve better retention of learned skills and abilities to apply them in new contexts [4]. Such skills are all appreciated in workplace environments. Project-based learning can further be enhanced by using multidisciplinary teams, especially if the task is complex and multidisciplinary in nature [2].

Students who work in multidisciplinary teams are enabled to recognize the uniqueness of their discipline in relation to others, and to acknowledge their own expertise [3]. They are also forced to step out of their comfort zone in terms of getting to understand other perspectives from other disciplines. The latter can be perceived as both challenging and awarding.

## III. Method

The reporting of learning experiences from students in project-based learning, is more common on undergraduate levels, while reporting on the same from university levels is sparse [4], although some examples from different contexts and countries do exist. Many of these studies however, report generally on project-based learning, and only few on experiences from multidisciplinary student teams. In order to investigate students' learning experiences from working in multidisciplinary teams, we therefore have taken a qualitative and explorative approach in order to gain a richer understanding of students' experiences. The study presented here is carried out in a course at the master's level at the engineering faculty of Lund University. The course Packaging Technology and Development runs yearly with approximately 70 students from different educational programs such as biotechnology, chemistry, machine design, industrial economics and some international master programs. In the course, companies provide tasks to create new packaging prototypes, and the students carry out this task in teams of 4-5 students per team. The students form the teams under the following requirements for a group to have: a) both female and male students, b) at least two study programs involved, and c) at least two nationalities involved. When these group requirements are presented to the students, the teacher highlights important benefits of multidisciplinary teams to increase the probability that students accept the requirements and that they develop a positive attitude towards the group project. About 70 students enrolled in the course 2015, were asked to individually write down reflections about their learning experiences. The students made one reflection in the beginning of the course, when the groups were formed, and a second reflection when the course ended.

The results from the student reflections were analyzed following a grounded-theory inspired approach. The statements of the students about their attitude towards the group requirements (at the beginning and at the end of the course) were coded and sorted into expected/ experienced benefits and expected/ experienced challenges of working in multidisciplinary teams. In addition, we compared the students' expectations of the multidisciplinary team project at the beginning with their actual experiences afterwards.

## IV. Results

An important overall result from the analysis of the reflections at the beginning of the course, is that most students reported the expectation of benefits while it was fewer students that raised concerns with regard to working in multidisciplinary teams. TABLE I provides an overview of the most commonly expected benefits and challenges of working in multidisciplinary teams. It can be concluded that most students started the project with an overall positive attitude. Looking at commonly expected benefits, it is obvious that most benefits relate to the project itself. Students expect that the multidisciplinary character of the team will help them to solve the project task. In addition to project-related benefits, students expect that working in a multidisciplinary team is a good training for their future career. Commonly expected challenges of multidisciplinary teams relate mainly to expected difficulties in the group's working process but most students do not expect this to negatively impact on the projects' results.

TABLE I: EXPECTED BENEFITS AND CHALLENGES OF WORKING IN MULTIDISCIPLINARY TEAMS

| | Students' expectations |
|---|---|
| Expected benefits | - Diverse perspectives on the task<br>- Broader knowledge to solve the task<br>- Multiple problem-solving approaches<br>- More creativity<br>- Preparation for future work life |
| Expected challenges | - Problems to schedule team meetings<br>- Different ambition levels within a group<br>- Less efficient/ takes more time<br>- Difficult to combine different ways of working<br>- Less open working climate |

The most important overall result with regard to students' experiences of the multidisciplinary group environment (reported at the end of the course) is that students were overwhelmingly positive even more than at the beginning of the project. TABLE II presents experienced benefits and challenges of working in multidisciplinary teams. Besides benefits related to the project as such that many students had expected beforehand, there were some additional commonly experienced benefits. It was interesting to discover that students appreciated to work with students from other programs as it develops their network.

TABLE II: EXPERIENCED BENEFITS AND CHALLENGES OF WORKING IN MULTIDISCIPLINARY TEAMS

| | Students' experiences |
|---|---|
| Experienced benefits | - More knowledge and skills to solve the task<br>- Diverse perspectives on the task<br>- Better project results<br>- Develops network for the future<br>- Develops self-confidence/occupational identity<br>- More efficient way of working |
| Experienced challenges | - Problems to schedule team meetings<br>- Different ambition levels/ uneven work loads<br>- Less efficient/ takes more time<br>- Difficult communication/ more disagreement<br>- Lower grades for more ambitious students |

In addition, there was acknowledgement of the fact that the multidisciplinary project allowed them to contribute with their specific skills which helped them to build up their self-confidence:

*"It was also fun to see that there actually is a difference between programs and that I can contribute with my background. It is a proof that I've actually learned something during my studies, something that I might doubt sometimes. This has given me confidence when looking for a job after my education. "*

Experienced challenges resembled to a great extend what students had expected to be problematic, but the relative amount of negative statements compared to positive statements was, as previously mentioned, lower after the project than at its beginning. Negative experiences were in most cases reported in parallel to positive ones. On one side

there were students who draw the overall conclusion that it was worthwhile to spend extra time and effort to make the multidisciplinary team work:

*"It caused extra work since there was often disagreement about small things and since things that normally would have been evident had to be explained. However, the problems were outweighed by the extra perspectives."*

On the other side, there were a few statements of deep frustration:

*"It can be hard to realize the benefits associated with different backgrounds and areas of expertise, especially if the team members have very different goals and way of working."*

An interesting result was that despite the fact that lower working efficiency is one of the common experienced challenges, there were also statements supporting the hypothesis that multidisciplinary teams work actually more efficient:

*"First time I was in a group where everyone worked, gave ideas, opinions and showed interest in every step […]".*

*"It is a way to cut out the distractions and focus on the actual task more easily."*

## V. Discussion

Previous research on the effect of multidisciplinary group work in higher education [7] has shown a change of student emotions from apprehensions and doubt before the project to feelings of pride and satisfaction after completion of the group task. While in our case most students already had positive expectations at the project start it was confirmed that the actual experience of the multidisciplinary group environment exceeds the students' expectations. Commonly experienced benefits of multidisciplinary teams reported in our case include benefits related to better project results (such as diverse perspectives, more creativity, more knowledge and skills) and benefits for the individual student such as increased self-confidence, network development and preparation for their future careers. These results are in line with Irvins [7] who found that *"multidisciplinary team working has a positive effect upon self-image of the students, and, [..], a beneficial effect upon the actual performance of the greater majority of the students."* Looking at the experienced challenges of working in multidisciplinary teams in our study, it appears that students highlight on one hand certain pre-conditions that cause problems and on the other hand they describe the experience of a more difficult or more-time-consuming working process characterized by conflict or misunderstanding. In line with Irvin's results [7] there were however surprisingly little conflicts reported by the students. Reported problematic pre-conditions in our study include different levels of ambitions in the group, problematic interpersonal chemistry, different parallel courses that make it hard to book meetings, and the use of English as a second language that can lead to communication problems. It appears that only the problem of having different parallel courses is actually related to the multidisciplinary character of the team while all others seem to be common challenges in student groups. It seems inevitable that students are faced with some problematic pre-conditions when forming a team with students from different programs, backgrounds and cultures. Most multidisciplinary teams will accordingly experience one or several of the described challenges during their working process. What seems to divide the many students with a positive overall learning experience from the few ones that get deeply frustrated is whether they are able to turn appearing difficulties in the working process into something positive or not. The end-state of a positive learning experience from multidisciplinary project work that developed from a frustrating situation has been described by others [3] as maturity. While our analysis has compared students' overall reflections at the beginning and end of the multidisciplinary project, it seems relevant for future research to study this maturing process at the level of the individual students to shed light on what can positively influence this process.

## VI. Conclusions

Solving real-life problems requires in most cases a team of professionals with different competences and backgrounds. In an attempt to prepare students for a multidisciplinary working environment, the LTH course Packaging technology and development requires students to form a project group with students from several LTH programs and with different nationalities. This study presents how students in the course perceive the multidisciplinary working environment over time, based on a written survey with 70 respondents. The results of our analysis show that the use of multidisciplinary project teams are well received by most students, both at the beginning and end of the course. Commonly experienced benefits of multidisciplinary teams reported in this study include benefits related to better project results such as more diverse perspectives, more creativity, and broader knowledge and skills as well as benefits for the individual student such as increased self-confidence, network development and a good preparation for their future careers. Our study shows moreover that there are potential challenges in the multidisciplinary group environment but that in most cases students perceive that those are outweighed by the experienced benefits.

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