PROJECT MANAGEMENT AND COMMUNICATION SKILLS' DEVELOPMENT – STUDENTS' PERCEPTION ON THEIR LEARNING

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ABSTRACT

In this paper we investigate the outcomes of a project management course in terms of syllabus fulfilment with regard to the students' perception of increased learning. The course comprises theory as well as practical training in project management, information handling, study design and communication. The student group is heterogeneous and consists of national program students as well as international exchange students representing a wide range of subjects, nations and previous study experiences. Therefore, even if the course formally is a first-year course, the real skills' possession of the participating students varies a lot. This makes this course challenging to teach, and raises several questions: Do all students develop their individual skills during the course, disregarded of the skills level which they entered the course with? Are we focusing on the right set of skills, or are some skills more important to develop than other skills? How should we improve the design of the course to enable each individual student to develop their skills? The paper focuses on the first and second question, because understanding the problem is the first step in any improvement activities. This understanding could thereafter be used for improving the course syllabus in terms of contents, learning outcomes and activities.

KEYWORDS

Project management, academic writing, information handling, study design, basic level course, skills' development, skills' assessment, Standards: 2, 8, 11

INTRODUCTION

When a course has ended, the grades have been distributed, and the course evaluation is finished, one could still ask oneself if the course really gave something for the individual student. The final grade is a result of the assessment of the students' skills in relation to stated learning outcomes according to the syllabus. But what if the students enter the course with different skills' levels? If a specific student already possesses a certain amount of competence within an area, can he or she still learn something in a basic level course?

When teaching courses with a homogenous student basis, these kinds of questions often arise. As a teacher, it is challenging to design a course so all students, disrespect of previous knowledge and abilities, find pleasure and interest in the course contents, and develop their skills further. Sometimes it is tempting to set the level of teaching according to the most advanced students, but then the contents and demands on student performance might diverge from the intended level of teaching and the formal contents as expressed in the

syllabus. This kind of action affects the students with low previous experiences, and might lead to surface learning or in worse case no learning at all. Instead, the solution should be to teach the basics (if it is a basic level course) and still be able to challenge the high-performing or more experienced students. We believe that we have found a way to do this in the basic level course Technical projects and report writing. Student feedback as well as course evaluations gives at hand that students in general are satisfied, but the course evaluation does not prove that we actually developed the students' skills. To do this, we need to focus on the individual students' perception of learning. In this paper we present a method for addressing individual skills' development.

After a general discussion regarding personal and interpersonal skills' development in higher education, findings from the course entitled Technical projects and report writing are presented. The course design and student characteristics are described and thereafter the work with assessment of skills' development is described. We asked the students to state their skills level within 11 predefined areas connected to the course contents. In the end of the course, the students were asked to state their skills' development. Results from the skills' evaluation are presented and discussed, and conclusions regarding the possibilities to further improve the course design are drawn.

DEVELOPING THE PERSONAL AND INTERPERSONAL SKILLS

Engineering students require a broad spectrum of knowledge and skills. Basic skills in mathematics and physics as well as skills and competencies within the major subject area form a sound knowledge foundation. In addition, more general knowledge about business and enterprise contexts, society regulations, sustainability and professional ethics are required. But students also need means to apply the knowledge in different contexts, and therefore the personal and interpersonal skills are pointed out as important in achieving a full spectrum of capabilities for the modern engineers (Yorke and Knight, 2007). These skills comprise communication and team work skills, problem solving and critical thinking, time planning, flexibility and independence in the learning process, to mention a few. Harris and Rogers (2008) found that a panel of 16 UK professors rated students' interpersonal, communication, and work ethic competencies as desired when entering into postsecondary engineering and technology programs, and in a survey of the apprehended future need of competencies in Swedish industry Schwieler (2007) found six categories of competencies as most important: Basic competencies (Reading, writing, calculating), Social competencies (Empathic skills, cooperation, communication), Intercultural competencies (Language skills, open mind towards other cultures), Analytical competencies (Independent problem solving and critical reasoning), Entrepreneurial competencies (Ability to identify and realize opportunities, skills in entrepreneurship), and Managing competencies (Organizing and managing people to meet business goals). The surveys both confirm that broad spectra of knowledge and skills are required of the engineer of today.

It is not enough to add a single course in project management and communication in order to train personal and interpersonal abilities, for instance as a project management course or an independent work in the end of the education. Instead, the total education program should be integrating the generic skills' training as a means to teach the basic technical and engineering subjects (www.CDIO.org). This is the reality in the Bachelor program Industrial Management, but to give specific attention to the complexity of project and study planning and management as well as academic and technical communication, we include a course focusing on these abilities in the first semester. The experiences, skills and knowledge

gained in this course help the students to further develop their interpersonal and personal skills during the education. The course is described in the following.

THE COURSE *TECHNICAL PROJECTS AND REPORT WRITING*

Technical Projects and Report Writing is a basic level course comprising 7,5 ECTS. The course is mandatory within the Bachelor program Industrial Management where it is located in the first year, and is also offered for international exchange students. The number of Swedish and international students is normally about 50/50, and the international students belong to different majors at the home universities. The course teaches industrial project management methodology and covers definitions, management, planning and follow up. It also teaches study methods, information handling, oral communication, and technical writing on academic level.

Table 1. Learning outcomes and major activities connected to the learning outcomes

Learning outcome	Activity
Understand the basics of project management	Exercise in MS Project, Project documentation, Individual paper on "project success and failure", Seminar on individual paper
Plan, implement and follow up a minor project	Project documentation, Individual project follow up, Reflection document, Reflection seminar
Understand the different parts of a report and how they belong together	Project report, Opposition, Oral presentation
Understand how to implement a minor study	Project report, Study templates, Project idea seminar, Opposition, Reflection document
Understand what sources of information are suitable depending on the aim of the study	Project report, Tutoring, Opposition, Reflection document
Communicate the results in speech and writing	**Oral:** Project idea seminar, Seminar on individual paper, Presentation **Written:** Individual paper, Project report, Opposition

Almost all student activities are connected to project-based work either directly or indirectly. In the beginning of the course, the students are randomly divided into groups of four by the teacher to ascertain that the groups contains a mix of Swedish and international students, first year and more advanced level students, and students representing different majors. The project groups are thus heterogeneous. The project groups thereafter formulate and plan a project of their own choice. The project idea is documented in a project plan and discussed during a seminar. Thereafter, the groups carry out the study quite independently, with support from scheduled course activities and teacher held supervision. The results are reported orally in form of a presentation and in writing as a report. The students are also asked to report on their individual progress and give reflections on the project work and the course outcomes. The learning outcomes and the activities which are used for assessment are summarized in Table 1. The study was carried out in 2013, when 44 students were enrolled into the course. Two students quit the course either early or a bit into the course due to different reasons.

STUDY DESCRIPTION

The study was developed as an integrated activity in the course which trained the students in self-assessment. Eleven skills factors were extracted from the formal learning outcomes of the course and the course contents; see Table 2. The eleven factors were for analysis purposes grouped into four main aspects: Project management skills, Study design skills, Information handling skills, and Communication skills.

Table 2. Skills factors studied

Learning outcome	Factor	Skills group
a) Understand the basics of project management b) Plan, implement and follow up a minor project	1. Team work and group dynamics 2. Project planning 3. Risk management	Project management skills
a) Understand how to implement a minor study	4. Problem formulation 5. Study methods	Study design skills
a) Understand what sources of information are suitable depending on the aim of the study	6. Information search 7. Assessing relevance and quality of information 8. Reference handling	Information handling skills
a) Understand the different parts of a report and how they belong together b) Communicate the results in speech and writing	9. Report writing 10. Academic writing skills 11. Oral presentation	Communication skills

In the introductory lecture a form was handed out asking the students to assess their level of competence in the eleven different skill factors. The question was formulated as "Please state in this form which skills *you* believe you would need more training in". The scale used was a four-point Licker scale with the options "I would need much more training", "I would need some more training", "I have quite good skills already", and "I have good skills already". 40 students filled in the form during the introductory lecture. In the end of the course, the students handed in a written reflection on the project work and the course outcomes. The students were asked to judge their perceived development in the same eleven skills as in the introductory lecture. The question was expressed as follows: "Please state which skills *you* believe you have developed during the course." and the scale used was a four-point Licker scale with the options "Not much developed", "Developed to some extend", "Quite much developed", and "Highly developed". In total 39 students handed in their reflections. The assessment templates are found in Appendix A.

STUDY RESULTS

In this section we account for the results gained from the study. First we look at the overall answers, thereafter if the answers vary depending on background variables of gender, subject area and study type. Finally, the data are analysed with respect to the four skills' groups as defined above; project management skills, study design skills, information handling skills, and communications skills.

Overall perception

A minor part of the students perceived that they possessed good skills in one or more of the eleven skills addressed when entering the course, see Figure 1. **Information search** and **project planning** were the skills the students had most experience from while **risk management** and **academic writing** were the skills students thought they needed most training in. When combining the two lowest values ("I would need much more training", "I would need some more training") and the two highest values ("I have quite good skills already", "I have good skills already") *team work and group dynamics*, and *information search* were skills that the students perceived they had most experience in. Five skills appear as the ones in need of most training;

    1) Risk management,
    2) Problem formulation,
    3) Academic writing,
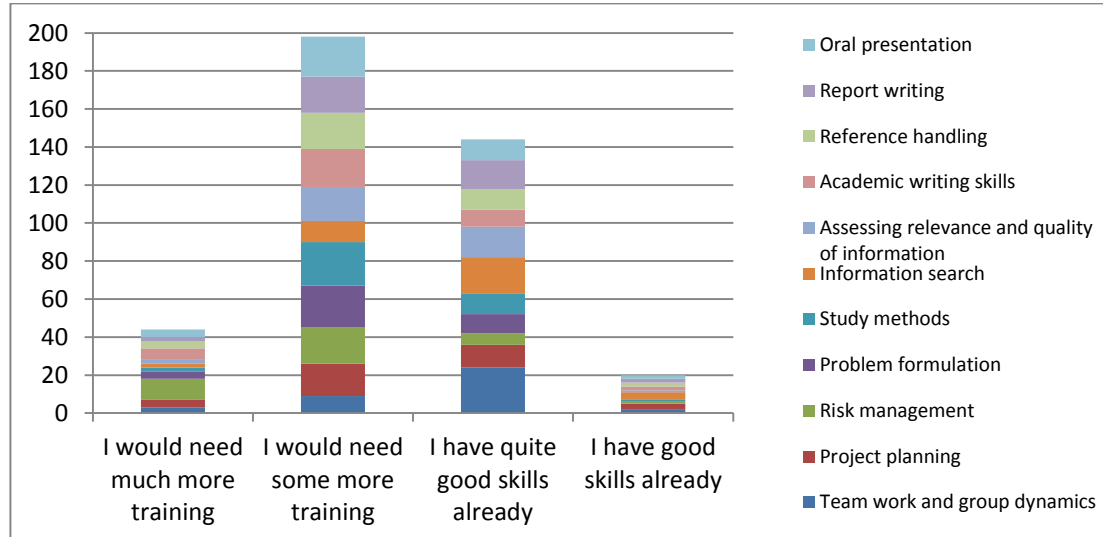   4) Study methods, and
    5) Oral presentation.

Figure 1. The overall skills' perception when entering the course

In the end of the course the development of skills was perceived as quite much or highly developed by in average 61% of the students, see Figure 2. Highest development was perceived in the skills **reference handling**, **report writing**, and **academic writing**. When combining the two lowest values ("Not much developed", "Developed to some extent") and the two highest values ("Quite much developed", "Highly developed") *reference handling*, *report writing,* and *academic writing* were skills that the students perceived they had developed the most (in other words the same skills that most students ranked as the most developed). The three skills which appear as the ones less developed were oral presentation, assessing relevance and quality of information, and risk management.
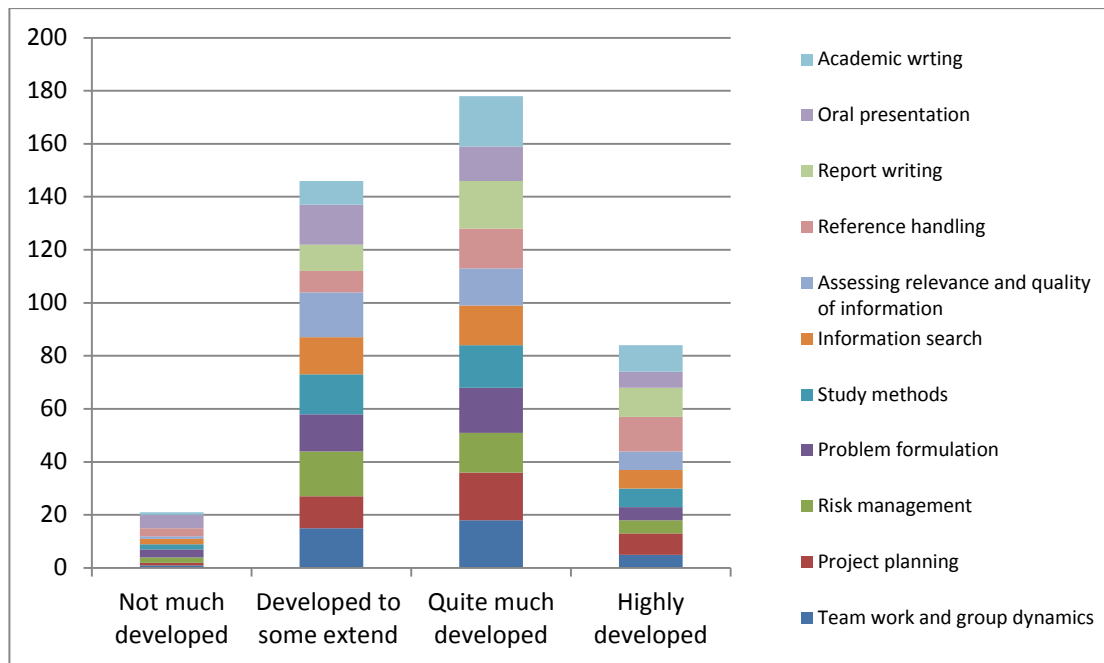
Figure 2. The overall perception of skills' development

In twenty-one cases the students selected the alternative "Not much developed". We wanted to find out whether the answers were spread amongst the student group or originated in a couple of individual students alone. The latter would mean that some students perceived that they had learned very briefly during the course. A closer investigation showed that the twenty-one answers were given by twelve different students. Half of them had answered "not much developed" only once, while three answered "Not much developed" twice and three times respectively. In contrast, eight out of these twelve students rated the development of one or more skills as "Highly developed" and the median answer was "Developed to some extent" or "Quite much developed". In other words: all students found their skills to be developed to some extent in one or more out of the eleven skills defined.

Perception with respect to gender, major subject area and study type

A non-parametric test was conducted for three background variables: gender, major subject area, and study type. For major subject area the groups were Industrial Management (IM), Engineering (ENG) and Other subjects (OTH) and for type of study the groups Programme student (PROG), Exchange student (EXCH), and Single subject student (SING) were used. The Mann-Whitney U Test was used for analyzing differences between groups. For the variables subject area and study type the Kruskall Wallis test was first used to determine overall significant differences, and thereafter the Mann-Whitney U test was conducted for pairs of groups to determine which groups differed in which aspect. In practice, this is made by comparing first group 1 with group 2, thereafter group 1 with group 3, and finally group 2 with group 3. The results from the tests are found in Table 3 (for readability purposes only the variables showing significant differences are accounted for).

The tests showed significant differences on the 95%-level for a couple of the skills. For gender differences were seen when entering the course for the skill report writing. Male students perceived their skill level as being higher when entering the course than female students. The test showed no significant differences in the perceived development of the

skills in the end of the course. Both male and female perceived they developed their skills about the same. For subject field, differences were noted in perceived project planning skills when entering the course, and for risk management in the end of the course. Engineering students ranked their perceived skills level in project planning higher than the students in other study fields. For risk management, the test showed that programme students perceived their skill's development higher than the rest of the students. For study type only one skill showed up differences: there were significant differences in the perceived development of risk management skills for programme students compared to exchange students. The programme students perceived a higher skill's development than the exchange students

Table 3. Test results

Gender		N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
Report writing (before)	Female	9	12,22	110,00					
	Male	30	22,33	670,00	65,000	110,000	-2,579	,010	,019[b]
	Total	39							
Study field		**N**	**Mean Rank**	**Sum of Ranks**	**Mann-Whitney U**	**Wilcoxon W**	**Z**	**Asymp. Sig. (2-tailed)**	**Exact Sig. [2*(1-tailed Sig.)]**
Project planning (before)	IM	20	13,90	278,00					
	ENG	12	20,83	250,00	68,000	278,000	-2,147	,032	,044[b]
	Total	32							
Project planning (before)	ENG	12	12,04	144,50					
	OTH	7	6,50	45,50	17,500	45,500	-2,253	,024	,036[b]
	Total	19							
Risk management (after)	IM	21	19,36	406,50					
	ENG	12	12,88	154,50	76,500	154,500	-2,017	,044	,063[b]
	Total	33							
Risk management (after)	IM	21	15,50	325,50					
	OTH	6	8,75	52,50	31,500	52,500	-1,982	,047	,065[b]
	Total	27							
Study type		**N**	**Mean Rank**	**Sum of Ranks**	**Mann-Whitney U**	**Wilcoxon W**	**Z**	**Asymp. Sig. (2-tailed)**	**Exact Sig. [2*(1-tailed Sig.)]**
Risk management (after)	PROG	21	20,79	436,50					
	EXCH	13	12,19	158,50	67,500	158,500	-2,638	,008	,013[b]
	Total	34							

b. Not corrected for ties.

Perception with respect to skills' groups

Project management skills

The project management skills' group covers the skills team work and group dynamics, project planning and risk management. The total numbers of answers for the three questions are found in Figure 3. Around 57% of the students rated that they would need more or much

more training in project management skills and 16% would need much more training. In the end of the course about 59% perceived that they had developed their skills quite much or highly, whereof 16% perceived that they developed the skills to high extent.
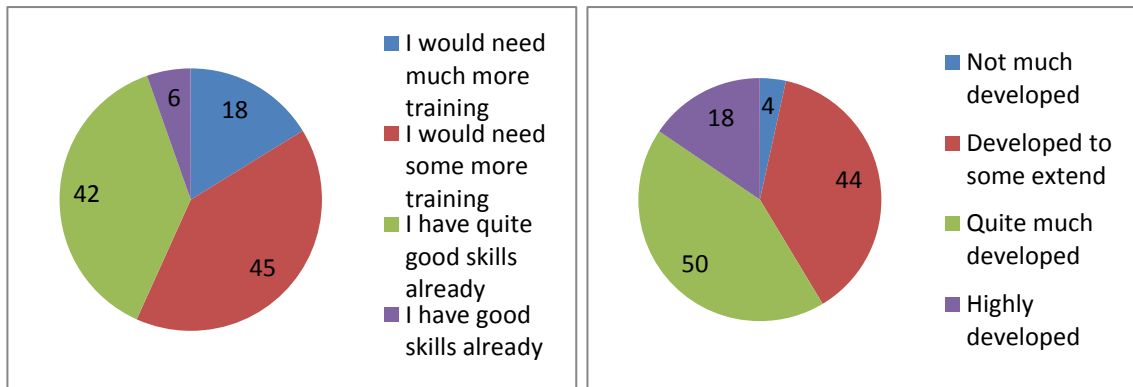

Figure 3. Project management skills
a) Skills' perception when entering the course b) Perceived skills' development

Study design skills

The study design skills' group covers the skills problem formulation and study methods. The total numbers of answers for the three questions are found in Figure 4. Around 70% of the students rated that they would need more or much more training in study design skills and 8% would need much more training. In the end of the course about 57% perceived that they had developed their skills quite much or highly, whereof 15% perceived that they developed the skills to high extent.
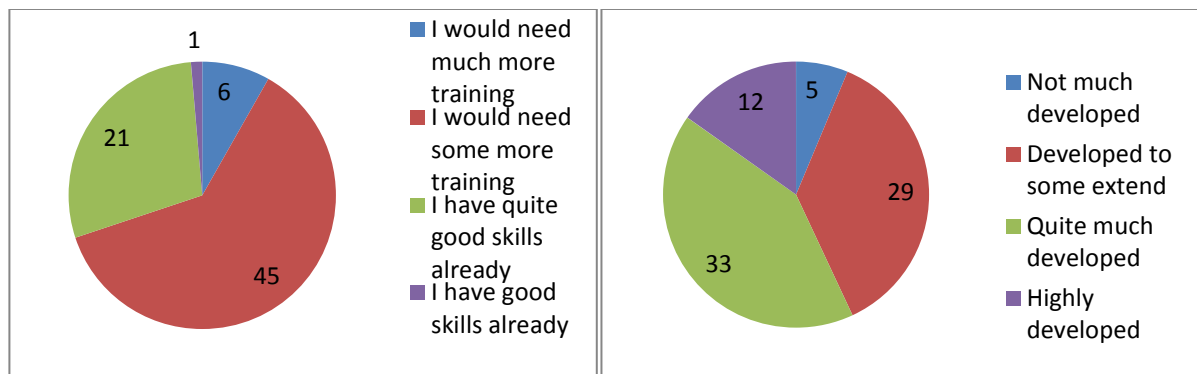

Figure 4. Study design skills
a) Skills' perception when entering the course b) Perceived skills' development

Information handling skills

The information handling skills' group covers the skills information search, assessing relevance and quality of information, and reference handling. The total numbers of answers for the three questions are found in Figure 5. Around 51% of the students rated that they would need more or much more training in information handling skills and 7% would need much more training. In the end of the course about 62% perceived that they had developed their skills quite much or highly, whereof 23% perceived that they developed the skills to high extent.
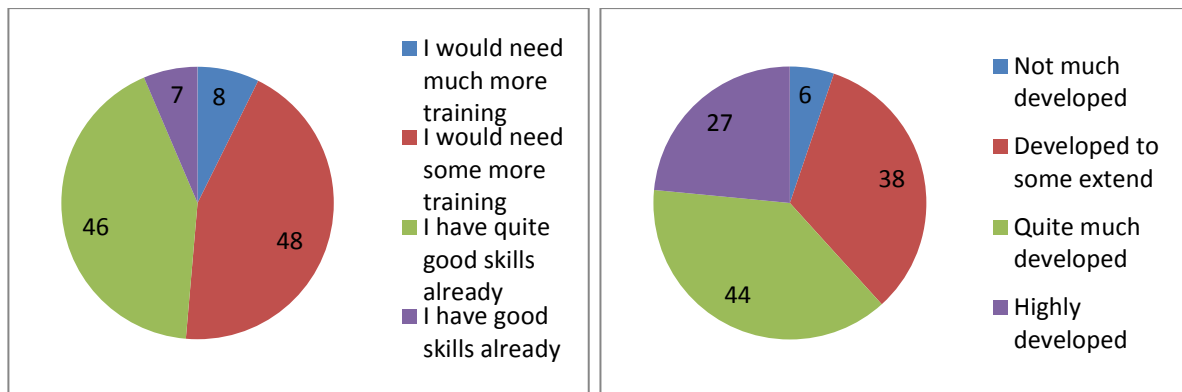
Figure 5. Information handling skills
a) Skills' perception when entering the course b) Perceived skills' development

Communication skills

The communication skills' group covers the skills report writing, academic writing, and oral presentation. The total numbers of answers for the three questions are found in Figure 6. Around 64% of the students rated that they would need more or much more training in communication skills and 11% would need much more training. In the end of the course about 66% perceived that they had developed their skills quite much or highly, whereof 22% perceived that they developed the skills to high extent.
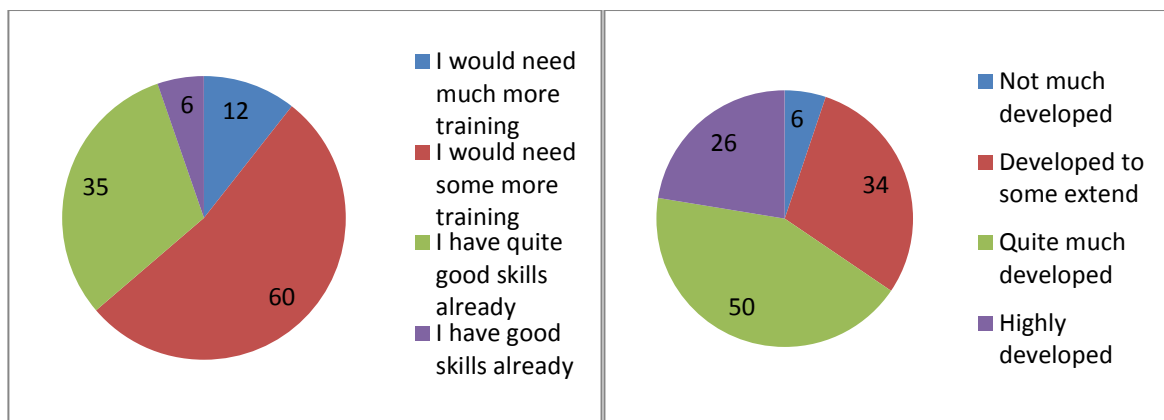

Figure 6. Communication skills
a) Skills' perception when entering the course b) Perceived skills' development

RESULTS DISCUSSION AND CONCLUSIONS

Do all students develop their individual skills during the course, disregarded of the skills level which they entered the course with?

Overall, it seems like most students perceive that they learned something useful during the course. In the beginning of the course five skills were seen as the ones in need of most training, namely risk management, problem formulation, academic writing, study methods, and oral presentation. In the end of the course the students perceived they had developed their skills in reference handling, report writing, and academic writing the most. Academic writing was the only skill mentioned in the list of skills in need of more training. Interesting to

note is that the recent development of the course has focused on the training of the writing abilities, so maybe this could be a token of successful course design. On the other hand, if we look at the skills the students perceived less developed we find oral presentation and risk management. This implies that the future course development could focus on these areas.

The findings show that the perceived need and perceived development varies between student groups. Engineering students perceived that they possessed better project planning skills than others when entering the course. Engineering students often work in project form, sometimes already in their first year, so this seems quite natural. The industrial management and programme students perceived their risk management skills as more developed than other students. This might be connected to the field of study itself, but in this course the differences could also be based on the fact that the industrial management students almost completely overlapped the group of programme students. These students took the course as the second course in the first semester, thus early in their studies, whilst the other students were more experienced. The more experienced students might have encountered risks related to project management before in their studies. Another possible explanation already mentioned above is that we might have missed to address the risk management part correctly during the course. To reach a better understanding of the results regarding skills development, the data could be further compared with the formal grades given in the course and with the written student reflections.

A possible reason for low rating of the oral presentation skills could be the low attendance in the oral presentation training activity, which precedes the final presentation of the project work. Only about half of the class attended this activity. To learn more about this, the findings from this study could be compared with the formal course evaluation where, amongst others, the student assessed the different activities. If the evaluation indicates poor performance of the activity, the activity should undergo further development. An alternative measure could be to make the oral presentation training session mandatory.

If we look at groups of skills, we find that the study design skills and communication skills were the ones students' needed more training in. Information handling skills seems to be the skills most students have some previous knowledge. In the end of the course, the skills perceived as most developed were the information handling and communication skills, thus there was no direct correlation between the skills students perceived they needed more training in and the skills they perceived as most developed. One possible reason for the differences could be that previous knowledge, especially in information handling, was a good basis for deepened knowledge in the specific skills aspect. The inconclusive results could be an indication that the course content in general is relevant, thus that we should focus on all four skills groups even in the future.

The learning assessment method presented in this paper suits several purposes. Firstly, it gives valuable insights on the personal development of each student, both with respect to the skills level when entering the course and the perceived development during the course. Secondly, it gives input for course development. We believe it is a good addition to formal course evaluations, which often do not address questions regarding personal development and detailed understanding of the contents of a course. Most importantly, it gives possibilities for the students to develop their reflective and self-assessment skills. The results from the study also give some interesting insights for the educational research society regarding student skills' development, and indicate a need for further studies addressing the learning progression when developing skills.

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BIOGRAPHICAL INFORMATION

Mirka Kans, Ph. D. holds a position as associate Professor in Terotechnology and has been program director for several educational programs since 2004 and forward. She is active in developing the education practices and curriculum according to student centered and active learning concepts (e.g. in form of CDIO), and in close collaboration with industry. The research is focused on data and IT requirements for maintenance management and how to support maintenance by means of IT.

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Appendix A

Individual learning plan 1SE002 Technical projects and report writing

Please fill in this form stating which skills **you** believe you would need more training in.

Skill	I would need much more training	I would need some more training	I have quite good skills already	I have good skills already
Team work and group dynamics				
Project planning				
Risk management				
Problem formulation				
Study methods				
Information search				
Assessing relevance and quality of information				
Academic writing (individual writing skills)				
Reference handling				
Report writing				
Oral presentation				

Name:_____ Field of studies:_____

Individual learning assessment (extract from the reflection document instructions)

Please state which skills **you** believe you have developed during the course.

Skill	Not much developed	Developed to some extend	Quite much developed	Highly developed
Team work and group dynamics				
Project planning				
Risk management				
Problem formulation				
Study methods				
Information search				
Assessing relevance and quality of information				
Academic writing (individual writing skills)				
Reference handling				
Report writing				
Oral presentation				