2nd International CDIO Conference
Linkoping University
Linkoping, Sweden
13 to 14 June 2006

Assessment of Interpersonal Skills of Students in the Vehicle Engineering Programme at KTH

B. Alfredsson

KTH Solid Mechanics, 100 44 Stockholm, Sweden

ABSTRACT

The purpose of the assessment was to investigate the impact of integrated teaching and training activities of the interpersonal skills: teamwork and communication, during the first two years of the Vehicle Engineering programme at KTH. The assessment focused on six areas defined in the CDIO Syllabus. The training activities performed in the courses were compared to those defined in the CDIO-based Vehicle Engineering Programme – Objective Document. The student skills and knowledge in the six areas were evaluated and progress in student skills from first to second year was appraised.

The investigation was based on four sources: programme and course documentation; interviews with the responsible teachers for all courses; training materials that were distributed to the students during the courses; web based student evaluation questionnaires. During the interviews the teachers were asked to describe the course activities in the six areas, how it was done including any written or oral instructions and how they appreciated the results in student skills. In the web based questionnaires the students were asked to estimate which courses had contributed to their skills and abilities, rank the status of their skills and in the case of oral and written communication they were also asked what they thought was the most difficult topic.

The results were compiled into diagrams where qualitative comparisons can be made. Comments from teachers and students added further information. Some general conclusions that were applicable for all areas were noted. The consistent integration of learning activities on interpersonal skills into several disciplinary courses improved the student communication skills. It could also be seen in the diagrams that activities with higher demands on the students resulted in larger depth in the student ability. The answers from the first and second year students were compared. In general, the second year students stated stronger skills than the first year students, with the exception of oral presentation. An interesting discrepancy was found between how the students ranked their own abilities and skills in relation to those of their colleagues. They appreciated their own abilities higher than those of their colleagues.

INTRODUCTION

The Master of Science programme in Vehicle Engineering has been reorganised with a new course structure. The first students that followed the new programme started at KTH in August 2003. Through the reorganisation the students have the opportunity to receive a Bachelor of Science after the first three years, although the main purpose for the students should be to continue throughout the full 4.5 years to a Master of Science. At the course level the major changes were performed during the three first years, which contain basic engineering subjects and some advanced topics. The last one and a half years contain a specialisation and diploma work. Some professional and interpersonal skills were systematically included into the new course structure of the first three years following the CDIO syllabus, see Crawley [1]. The expected proficiencies of the Vehicle Engineering students after these years are classified in accordance with the CDIO syllabus by Östlund [2] in the Vehicle Engineering Programme – Objective Document.

OBJECTIVE

The purpose of the present study was firstly to show how the work and training in the interpersonal skills of teamwork and communication have been performed during the first two years with the new programme organisation and secondly to illustrate the outcome in student proficiency.

FRAME OF THE QUESTION

The investigation was performed on commission from the programme responsible, Sören Östlund. The task was limited to seven interpersonal skills in teamwork and communication (Crawley [1]) in accordance with the CDIO Syllabus: 2.4.7 – Time and Resource Management; 3.1 – Teamwork; 3.2.3 – Written Communication; 3.2.4 – Electronic/Multimedia Communication; 3.2.5 – Graphical Communication; 3.2.6 – Oral Presentation and Inter-Personal Communication; 4.3.4 – Development Project Management. The numbers at each area follow the CDIO Syllabus. During the introductory data collection it became apparent that it would be practical to perform the investigation following an adjusted division between the skills. The area 2.4.7 – Time and Resource Management contained two components of different character. One was planning of the students own studies in specific subject courses. The other component concerned planning of time and resources for engineering teamwork projects. Furthermore, the second component was, at this course level, well integrated with 4.3.4 – Development Project Management. Thus, these two skills were treated together since a separation between them would have been artificial. Planning of own studies were investigated separately. In the area 3.2.4 – Electronic/Multimedia Communication few planned activities were performed and the area was included into 3.2.5 – Graphical Communication.

For the now remaining six interpersonal skills the course activities were compared to plan as is stated in the Vehicle Engineering Programme – Objective Document. The co-ordination between different courses was investigated and the student skills in the six areas were studied and compared to course activities and goals. The task included to give suggestions for improvements.

BACKGROUND

Wolfe [3] investigates and describes the use in 2004 of different skills by practising engineers who have graduated from the MIT Department of Mechanical Engineering from 1992 to 1996. The investigated skills follow the definition in the CDIO Syllabus. The results for teamwork and communication are of particular interest in conjunction with the present study. Along the expected proficiency scale, these skills receive very high scores: 99 % of the 308 answering engineers state that they in their engineering occupation must be able to participate, contribute, understand and explain the skills. In the same way 95 % of the responding state that they use the skills at least every week. On the question: where they have attained their skills 30 % answer that that they primarily have gained the teamwork skills through activities at MIT; for communication 33 % states MIT.

The actions for good study technique and planning focused primarily on the basic principle that the students had to spend time on the subject: *If you don't spend time on it, you won't learn it*, Gibbs [4].

METHOD

Four different sources were used for the study. The first source was the Vehicle Engineering Programme – Objective Document and the course descriptions in the study handbook. The activities that are planned for the courses should be described in these documents. The second source was interviews with the course responsible teachers at the 1st and 2nd year.

During the interviews copies of distributed material were compiled. The material consisted of course materials, instructions, guidelines and templates. These materials composed the third form of background documentation. The fourth and final sources were the answers to student inquiries.

The interviews with responsible teachers were primarily performed during the period from Mars 14th to Mars 22nd 2005. At that time the students on the two first years of the Vehicle Engineering Programme had followed the reorganised programme. Thus, the survey was limited to these students and teachers. The teacher interviews were booked in advance. The objective of the study was explained to the teachers and they were informed that during the interviews the teamwork and communication activities were going to be discussed. The interviews were performed at the respective teacher's office. The teacher was allowed to freely inform about the activities that were performed with respect to each interpersonal skill in the course, how it was done, if any written or oral instructions and guidelines were distributed and finally how they as teachers conceived the results in student proficiency. The interviews were summarized in interview notes.

The student questionnaire consisted of 14 questions on the six skill areas. Within each area two or three questions were asked. In the first question on each skill the students were requested to state which courses that had primarily contributed to their skills. The No Course alternative was an available answer as well as multiple courses. In the second question the students were asked to estimate their ability in the specific subject. The students were allowed to chose the one alternative that the best described their ability. For written and oral communication the students were also asked: what in their opinion was difficult. They could choose one or more of several alternatives. In conjunction with the follow up questions the students were invited to give comments.

The students were contacted through e-mail. The inquiry was web-based and since the inquiry programme assigned each student (*e.g.* the e-mail address) an individual password only the invited students could answer. A track record was automatically updated with who had answered. Thus, each student could only answer the inquiry once and reminders could be sent to those who had not answered. For the 2nd year students, the e-mail addresses used were those that the students themselves had recently, during the Solid Mechanics course, stated as their active addresses. It is therefore likely that these students made an active choice to answer or not. Of the 107 students in the 2nd year 20 students had recently been interviewed by personnel at the registrar's office and two students had recently changed from another programme to the Vehicle Engineering Programme. Among the remaining 85 students 50 were randomly selected (*e.g.* using the rand function in EXCEL-2000). For the 1st year students only KTH generated e-mail addresses were available. Since it was possible that all students did not actively monitor these addresses the inquiry was distributed to all 96 students that were registered at the 1st year. The inquiry was performed during the period from April 15 to April 25 2005. On the 21st a reminder was sent to those students that had not yet answered. The answering frequencies were 32 % and 58 % for the 1st and 2nd year students, respectively.

RESULTS

The results were summarised in diagrams that are presented under the respective heading in the analysis section. Each skill opens with a diagram that for each course qualitatively compares the presence and depth of the activity in accord with the Vehicle Engineering Programme – Objective Document against the extent of the activity according to the teachers' statements during the interviews. In the CDIO Syllabus there is a grading of the planned activity in according to: Introduce (1); Use (2); Teach (3). The numbers are used in the presentation in order to graphically distinguish between the activity levels. Based on the results of the teacher interviews it was decided that a slightly modified grading would be more appropriate for what was actually done during the courses. Small or limited activities

were graded (1); extensive student activities were graded (2); the grade (3) was used for extensive activities in combination with teaching of the specific interpersonal skill; a grade (4) was included for extensive activities with planned and documented student reflection of the activity outcome with respect to gained interpersonal skills, see details at each figure caption. Note again that although presented in the same diagram the planned and executed activity levels are only approximately comparable. In some courses separate instructions and guidelines were used, which are summarised in Table 1.

Table 1: Presence of written instructions in the courses: Ch – chapter in the course compendium, L – checklist, I – instruction, T – template and R – review guideline.

	Perspec-tives	Physics I	Num. Methods	Mecha-nics II	Solid Mech.	Product Realizat.	Differen-tial Eqn	Fluid Mech.	Thermo-dynamics
Planning of team	Ch		L			L			
Written report	Ch	I			T/R	T/R	R	I	I
Oral present.	Ch			L					

Next the analysis of each skill contains diagram(s) with quantitative student inquiry results. These results show the proportion of students that have selected a specific alternative. The first diagram show the relative effectiveness of the activities in each course, which can be compared to the activity grades. The second diagram(s) presents the students' opinions about their own skill levels. Summarised students' comments were included into the text, for details on the comments see Alfredsson [5]. Note that the inquiry and interviews were performed when the 2nd year courses in Thermodynamics and Sound and Vibrations had only recently started. The 1st year courses of Analytical Methods and Linear Algebra II; Mechanics I; Numerical Methods and Basic Programming, on the other hand were ongoing since the Christmas and New Year leave.

ANALYSIS

The comparison between planned (Objective Document), executed (teacher interview) and outcome (student inquiry) of interpersonal skills for each course in the two first diagrams should be qualitative. Note again that the ordinates represent different scales. However, if the objective document reflects the activities and the amount of learning, then the diagrams should show good agreement.

Study planning (2.4.7)

Fig. 1 shows that almost all courses contained elements of continuous activities that were monitored or tested. Actual teaching on the subject of good study techniques was according to the teachers only performed in the introductory mathematical course. The students' inquiry answers, in Fig. 2, on which course contribution to their good study technique agreed with the course activities. Note that the reviewed tests in the courses: Differential Equations, Mechanics I and II did not seem to give better impact on study techniques than assignments in Solid Mechanics and Product Realization. An important comment from the students was that *too frequent use of test is not good for the study planning*.

A common student comment is that *the high work load results in the students not having the time for continuous studies*. This comment is partly contradicted by the results in KTH – Material [6] that shows that the students, in general, only uses 5 – 15 hours per week outside the school schedule for studies.

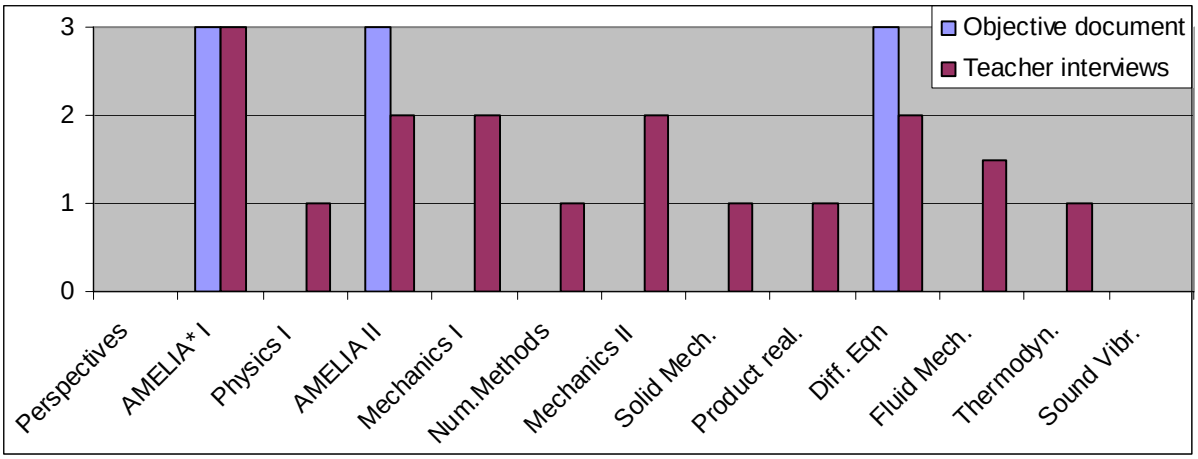

Figure 1: Course activities to support student planning of own course studies. For planned activities according to the objective document the ordinate numbers means: 1 – introduce; 2 – use; 3 – teaching. The implemented activities are continuous throughout the courses and denoted: 1 – assignment/laboratory sheets; 2 – evaluated tests; 3 – evaluated tests and teaching on good study techniques. (*Analytical Methods and Linear Algebra I)

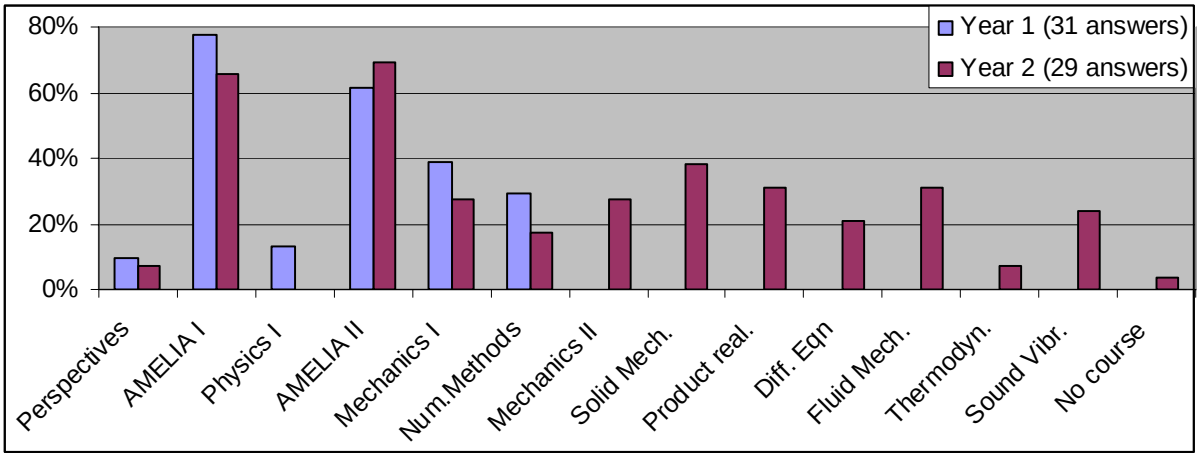

Figure 2: Student answer frequencies to: Which courses have primarily contributed to your ability to use good study techniques? (Multiple answers)

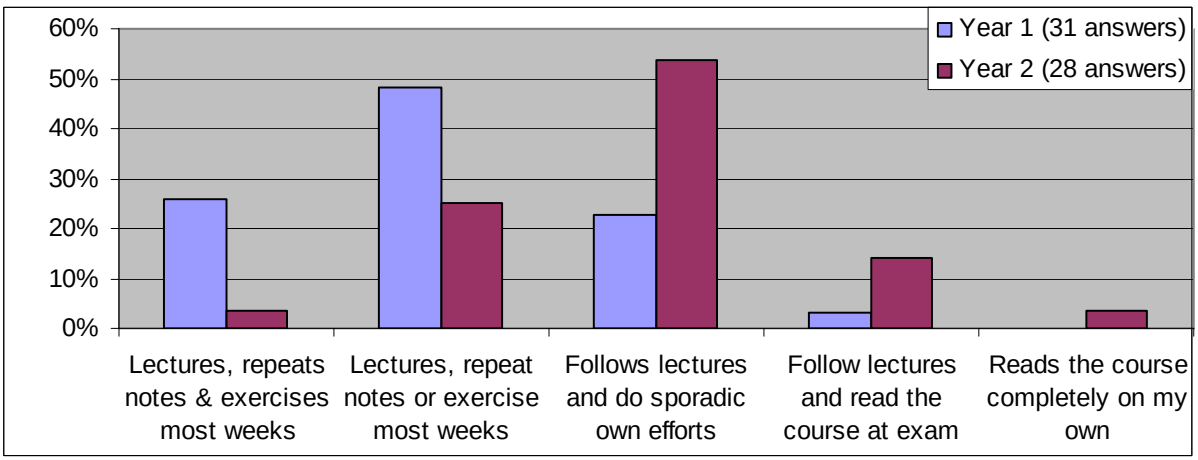

Figure 3: Student answer frequencies to: To what extent do you continuously work with the course content in an average read and exam course? (1 option)

Fig. 3 implies that the 1st year students have better study techniques than those in the second year. Such a conclusion, based on Fig. 3 alone, is however too hasty. For example, second year students might study more effective than the first year students. There was also a difference in answering frequency between student years. The lower frequency among the first year students may indicate that those students who actually did answered belonged to a filtered group of ambitious students. Thus, a second explanation to the trend in Fig. 3 would be that the average level of ambition and following the average study interest were higher among the answering first year students than among the answering second year students.

Time and project management (2.4.7 and 4.3.4)
Major projects, Fig. 4, contribute to the students' ability to plan and manage projects, Fig. 5. It is positive that the 2nd year students, with more training, express larger ability in Fig. 6 than the 1st year students. An interesting teacher comment is that, although the students – in particular 2nd year students – expresses good planning ability, a teacher in a course at the end of the 2nd year found that *a large group of students had problems doing a small assignment on time although the particular assignment had been defined two months in advance*. Both students and teachers note that *student drop-outs from the course or the programme are a problem for project management*. This is especially a problem during early courses.

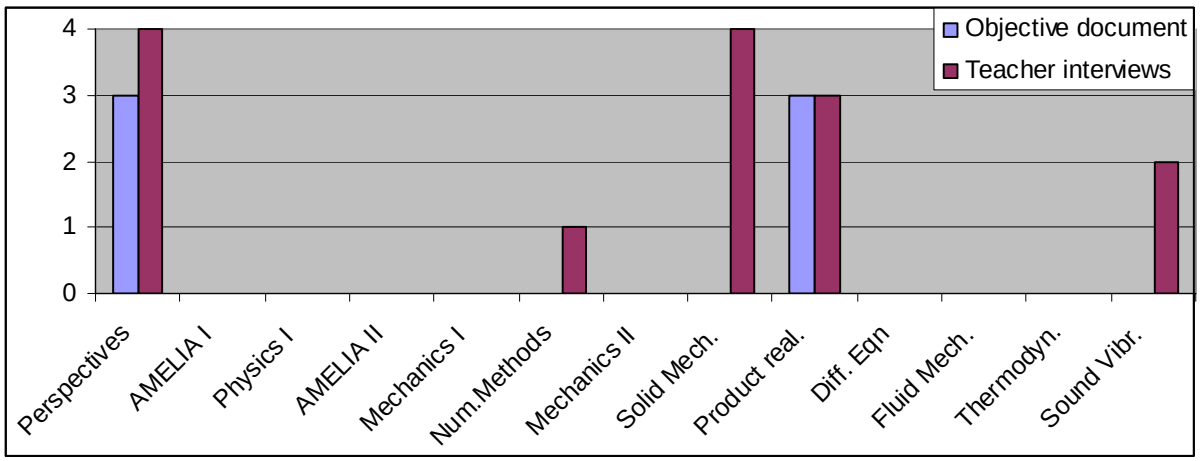

Figure 4: Course activities for time and project management. Planned activities: 1 – introduce; 2 – use; 3 – teaching. Implemented activities: 1 – supervised project management; 2 – independent project management; 3 – teaching and independent project management; 4 – documented student reflection over independent project management.

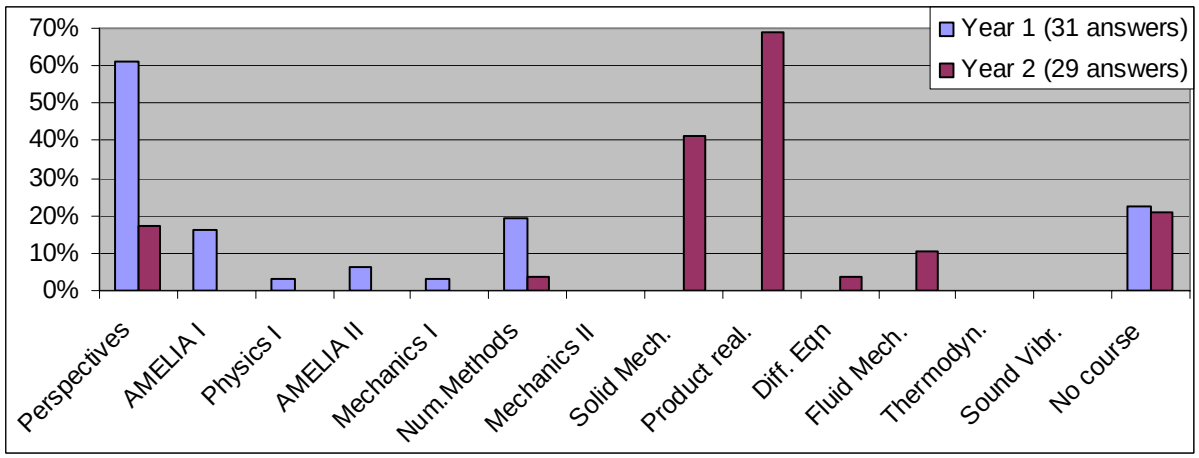

Figure 5: Student answer frequencies to: Which courses have primarily contributed to your ability to plan and manage projects? (Multiple answers)

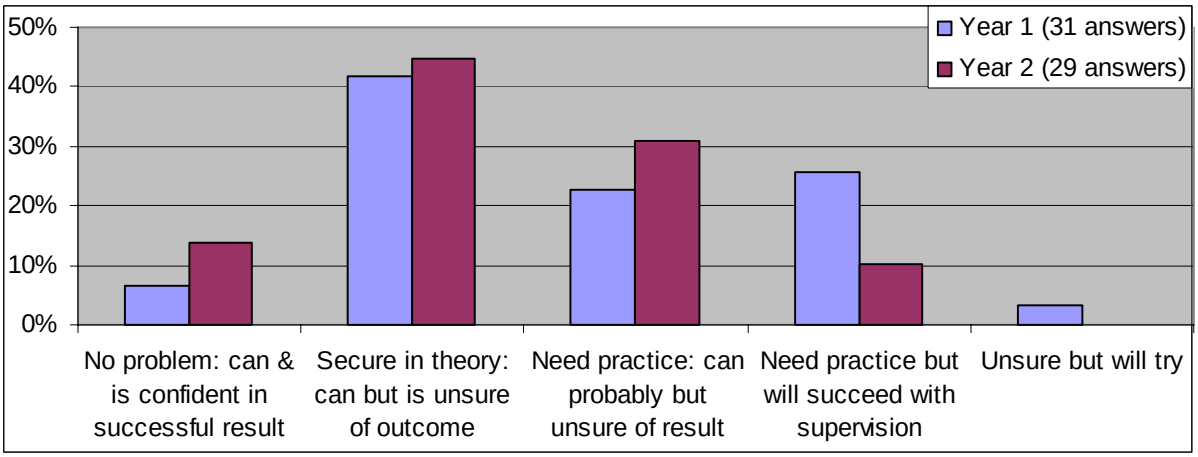

Figure 6: Student answer frequencies to: How well do you master project management, *i.e.* define, prioritise, estimate time, estimate resources and follow up against plan? (1 option)

Teamwork (3.1)

Again the contribution to the students' teamwork proficiency, Fig. 8, correlates to the extent of group activities, Fig. 7. The larger projects were performed in larger groups, typically three students. The fact that courses without group activities trained the students in teamwork was explained by students studying together. The difference between 1st and 2nd year students in ranking of 1st year courses in Fig. 8 was explained by change in teamwork perspective of the 2nd year students after the major projects in Solid Mechanics and Product Realization. Hence, after these projects those in the 1st year was comparably minor, *i.e.* escalating demands on teamwork skills were noted. The follow up question on how comfortable they are in group work show that they feel experienced and confident in group work, see Fig. 9. No significant difference was found between the years in estimated proficiency.

A relatively large student group stated that *teamwork was not a good learning form*, see also Fig. 9. The student experienced difficulties with teacher assigned groups: *Problems arouse from different schedules and varying learning objectives of individuals.* The teachers found non-functioning groups independently of who had composed the group (teacher or students themselves).

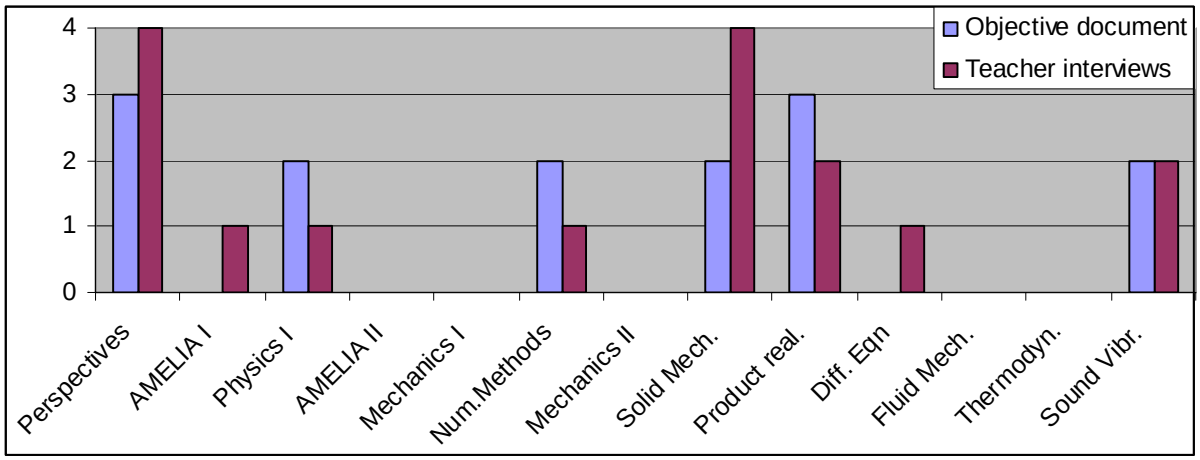

Figure 7: Course activities for teamwork. Planned activities in accord with the objective document: 1 – introduce; 2 – use; 3 – teaching. Implemented activities are denoted by: 1 – small group use; 2 – large course project; 3 – teaching on teamwork; 4 – documented student reflection over teamwork outcome.

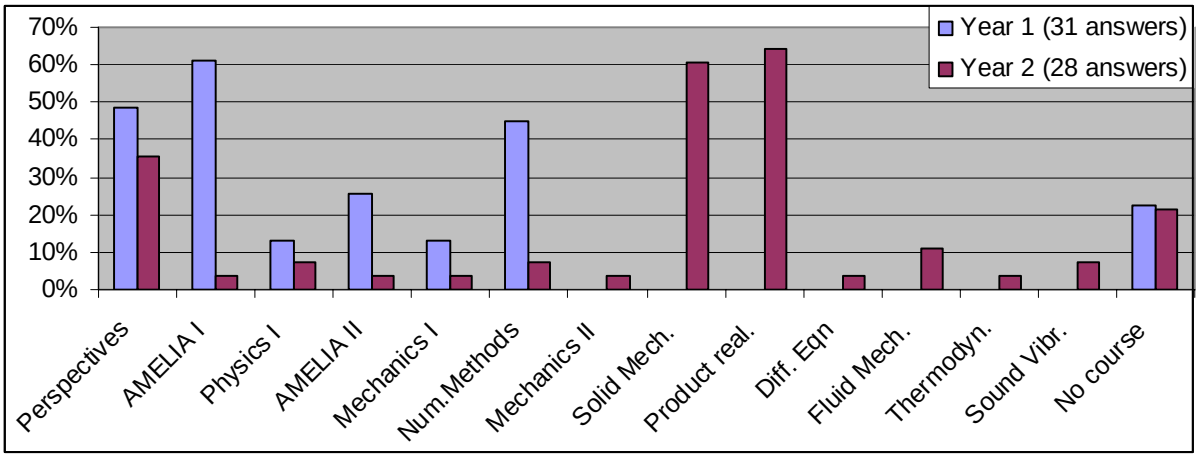

Figure 8: Student answer frequencies to: Which courses have primarily contributed to your ability to work in groups, *i.e.* understand group dynamics, deal with conflicts, keep focus and utilize individual skills? (Multiple answers)

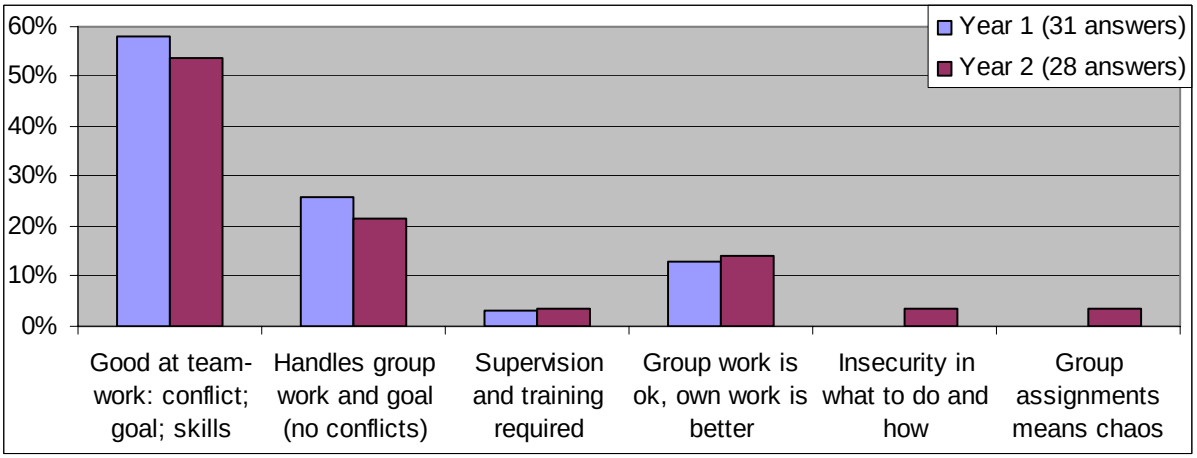

Figure 9: Student answer frequencies to: How comfortable are you with working in a group, *i.e.* deal with conflicts, keep focus and utilize individual skills? (1 option)

Written Communication (3.2.3)

Larger and more challenging reports, Fig. 10, contribute more to the students' ability, Fig. 11. The second year students, with more training, estimate better ability to write reports than the first year students do. Two student comments were, however, noted: *no development or increase in demands is noted as the education continues* and that *instructions and templates differ from one course to another*. The teachers find that the reports need some iteration between supervisor and student group before it becomes good. At the first attempt the ambition level and quality are often too low but after commenting it becomes good. Several teachers conclude that: *they can when they want to*. A contradiction is found in that a teacher in the 2nd year *sees a requirement for teaching in report writing* whereas the students, according to Fig. 12, *state that they are good at or very good at writing technical reports*. The second follow up question, Fig. 13, concerns what is difficult with report writing. The opinion that, norms and structure are difficult decreases from the 1st to the 2nd year students. This indicates that the formal writing craft improves with practise. To structure the material, clear and concise writing and the separation between objective results and subjective conclusions are, however, ranked as equally difficult, Fig. 13.

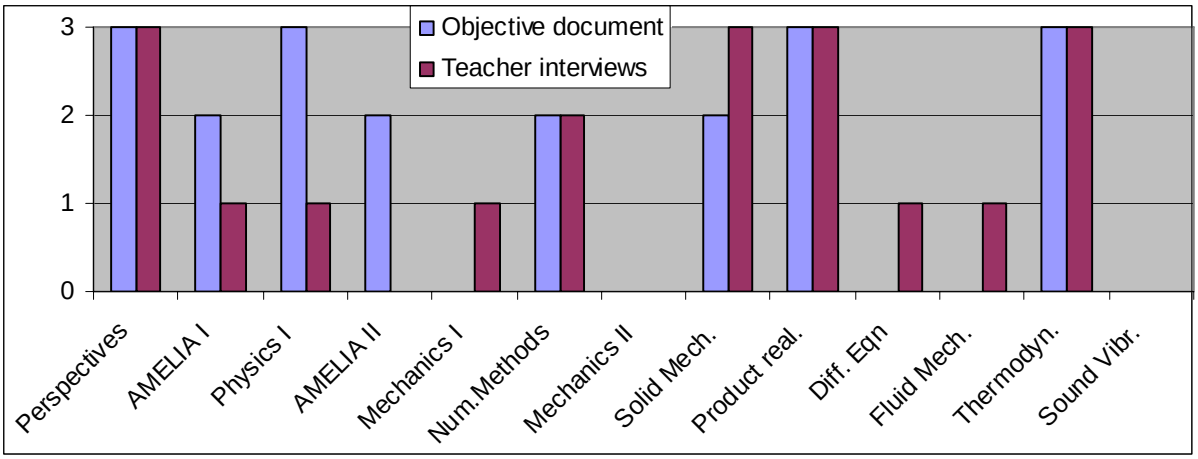

Figure 10: Course activities for written communication. Planned activities: 1 – introduce; 2 – use; 3 – teaching. Implemented activities: 1 – laboratory or minor report, 2 – project report, 3 – project report with teaching or instruction/template.

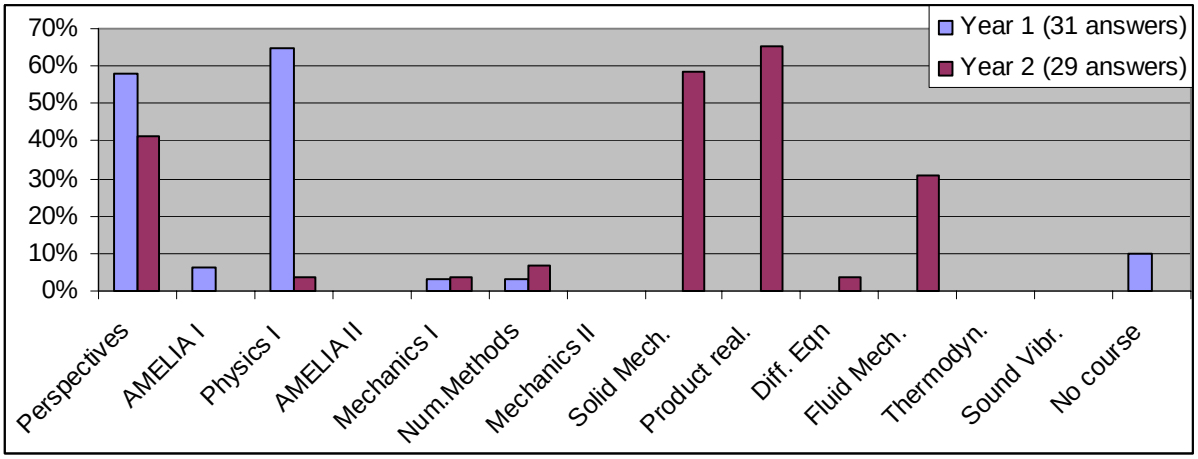

Figure 11: Student answer frequencies to: Which courses have primarily contributed to your ability to write technical reports? (Multiple answers)

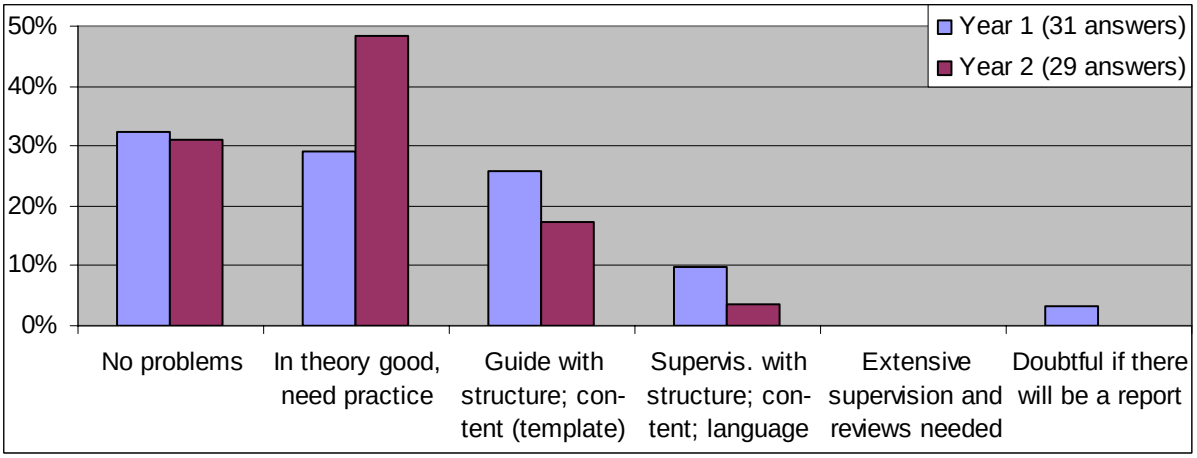

Figure 12: Student answer frequencies to: How good is your ability to write technical reports, *i.e.* structured, focused, comply with standard, separate results and conclusions? (1 option)

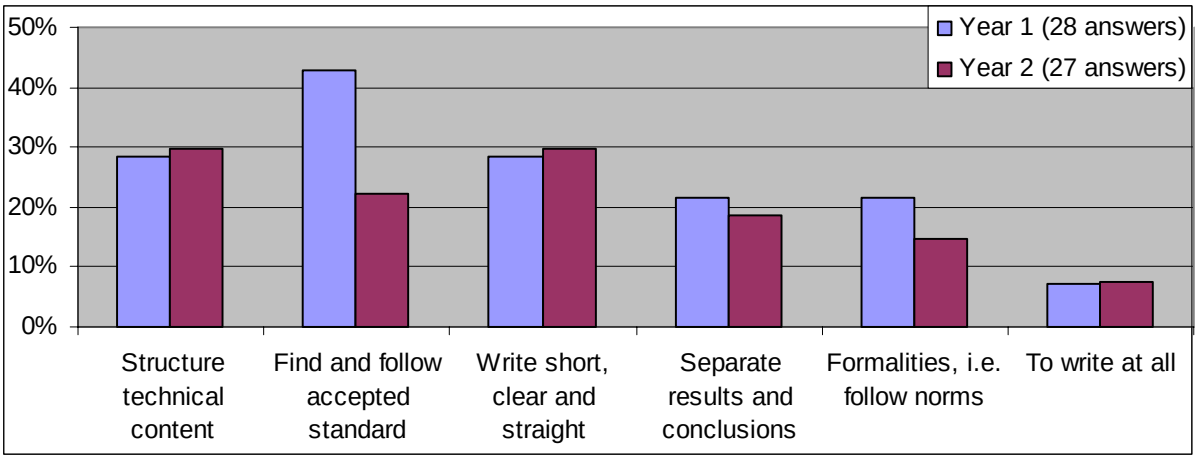

Figure 13: Student answer frequencies to: What is in your current opinion difficult with writing technical reports? (Multiple answers)

Graphical Communication (3.2.5)

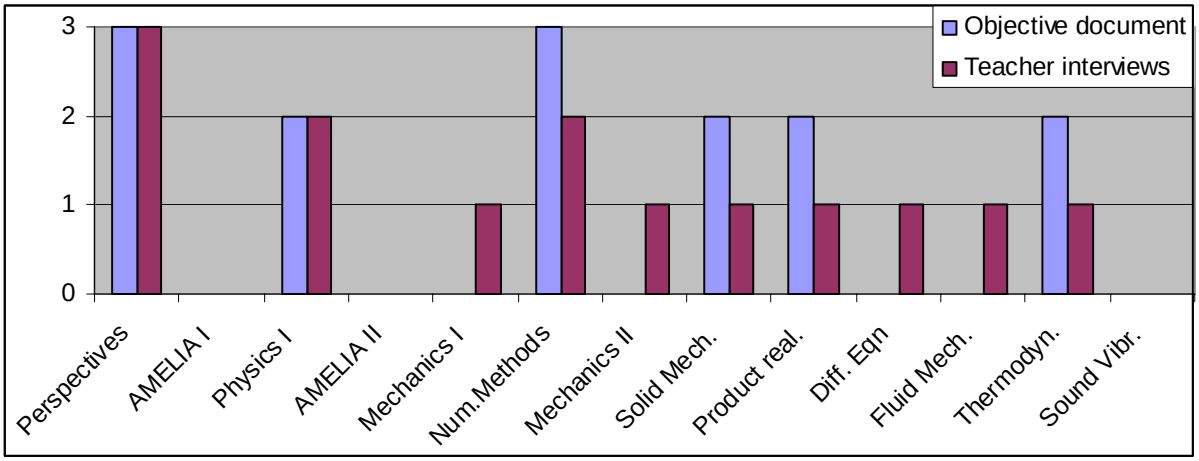

Figure 14: Course activities for graphical communication. Planned activities: 1 – introduce; 2 – use; 3 – teaching. Implemented activities: 1 – use graphs and pictures; 2 – teaching on graphs; 3 – teaching on visual communication.

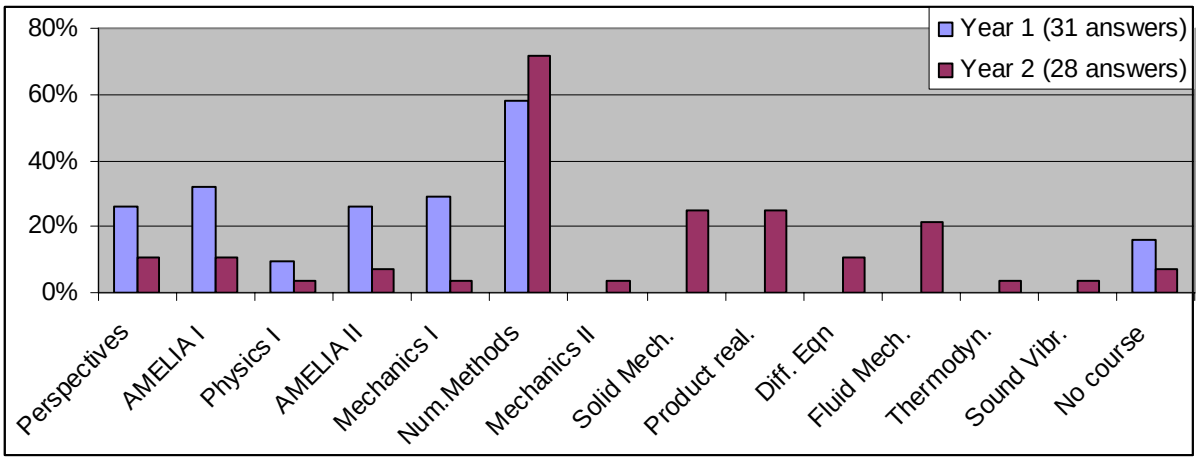

Figure 15: Student answer frequencies to: Which courses have primarily contributed to your ability create pictures and graphs? (Multiple answers)

The students point out Numerical Methods and Basic Programming as particularly useful for doing good graphs, Fig. 15, which compares to the course activities, Fig. 14. Solid Mechanics, Product Realization and Fluid Mechanics receive fairly positive appraises. This can be a result of graphical training in large project reports. According to Fig. 16 the students state that they know the craft and any required support is in selecting content for the graphs.

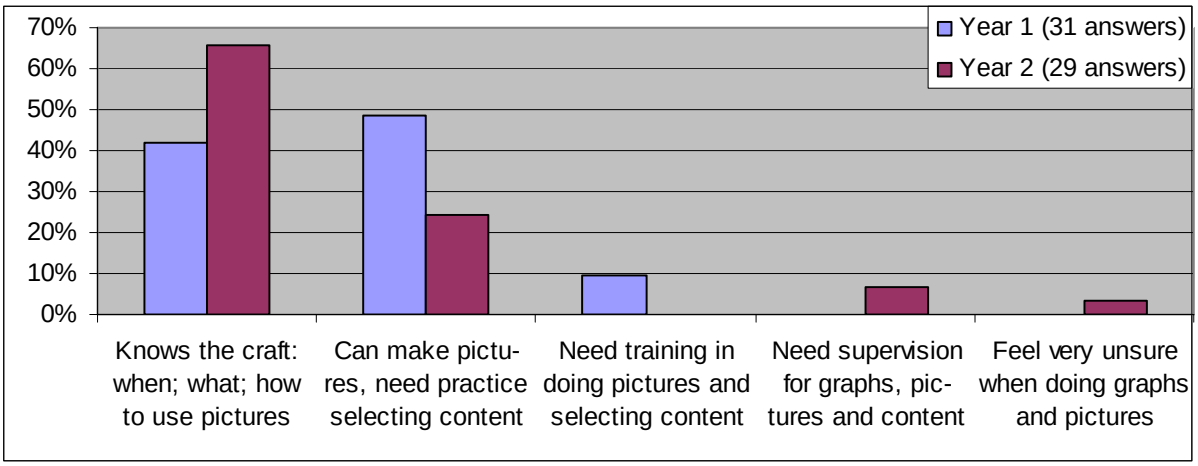

Figure 16: Student answer frequencies to: How good is your current ability to make pictures and graphs, *i.e.* correct graphs; show relevant information; interesting; explaining? (1 option)

Oral Presentation and Inter-Personal Communication (3.2.6)

The students note in their comments two difficulties with oral presentations in the basic courses: *the large group sizes result in very time consuming activities when all should present* and *with limited training the ability to present well decreases*. Comments by the teachers indicate that *the students overall are good at oral presentations*. Oral presentation is the only skill where the first year students feel more confident than the second year students, Fig. 19. The amount of planned and executed oral presentations is compared in Fig. 17. The students *argue for more oral practice*, which is confirmed in Fig. 20 where they indicate those issues that cover the presentation as difficult. Furthermore, the second year students indicate them as more difficult. The students also state in their comments that *more and individual feedback is needed*.

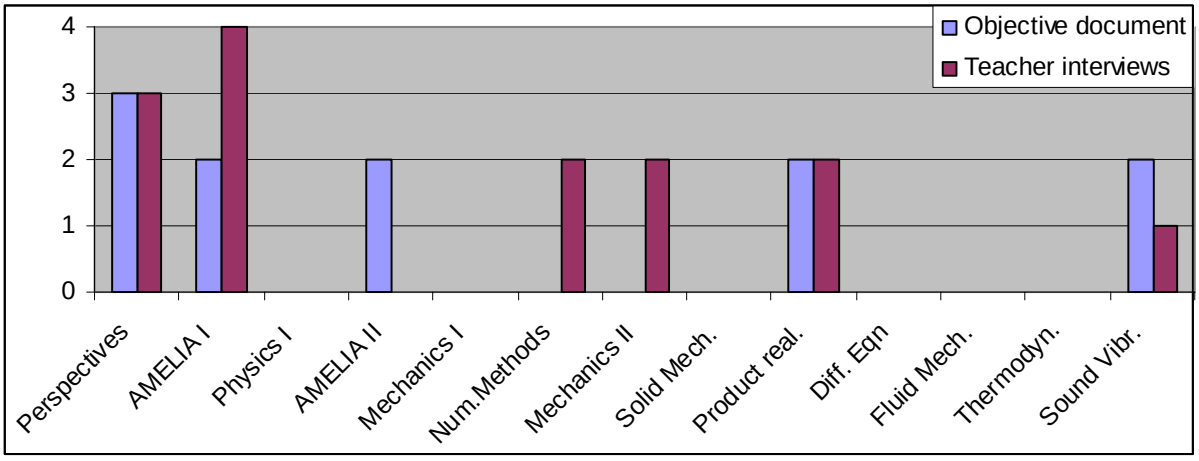

Figure 17: Course activities for oral communication. Planned activities: 1 – introduce; 2 – use; 3 – teaching. Implemented activities with presentation for: 1 – supervisor; 2 – group; 3 – group and teaching; 4 – group and student opposition.

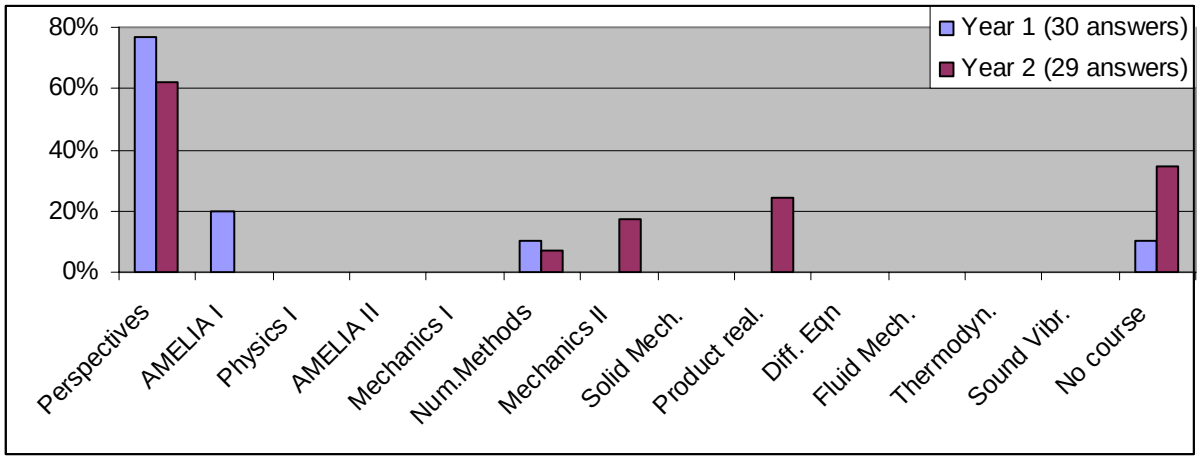

Figure 18: Student answer frequencies to: Which courses have primarily contributed to your ability to orally present a material well and clearly for a group? (Multiple answers)

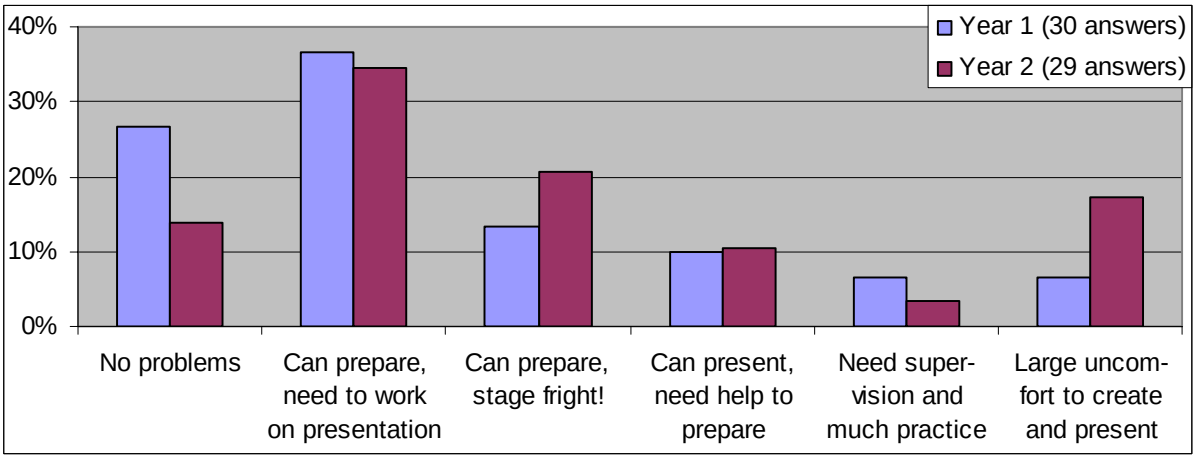

Figure 19: Student answer frequencies to: How good is your ability to prepare and conduct an oral presentation, *i.e.* structure and prioritise content; formulate text and pictures; present; keep within the time limit; engage the listener? (1 option)

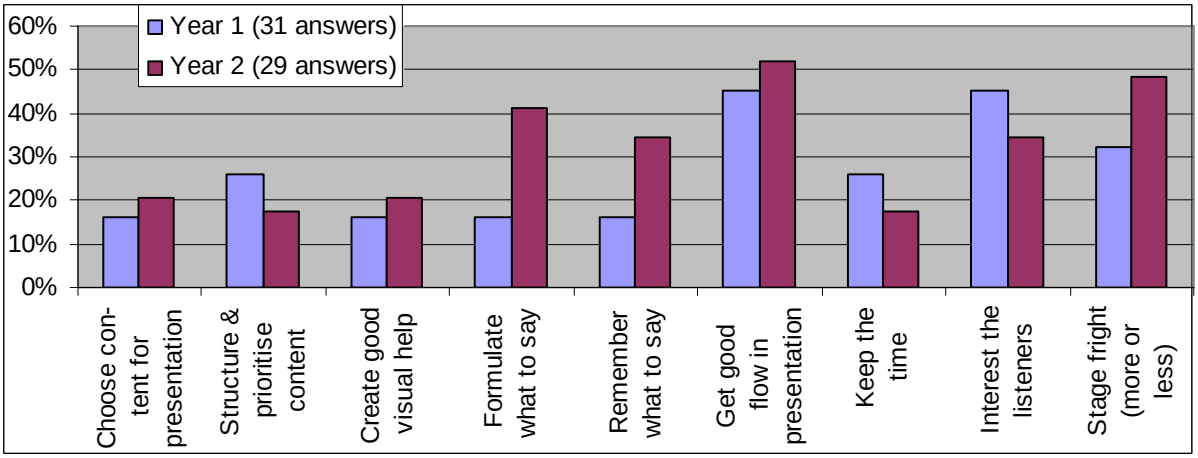

Figure 20: Student answer frequencies to: What do you find difficult at preparing and conducting of oral presentations? (Multiple answers)

Common and overall results

For all teamwork and communication skills more courses contain activities than what is stated in the objective document. In only one course the ambition is higher in the Objective Document than during the course execution. An overall conclusion for all skills is that the presence and height/quality of activities according to the teachers and in the course documentation is reflected in the student questionnaire results on contribution to their skills. Thus, the integration of interpersonal skills gives results.

The figures show that more demanding tasks gave a larger skill depth, which is seen when comparing Figs 4-5; 7-8; 10-11; 14-15; 17-18. In the answers to the follow up questions with appreciated ability the second year students grade their abilities higher than the first year students in all skill areas except for oral presentation where limited effort is used during the first two years, see Figs 17 and 18. Thus, the conclusion that training gave improvement.

An interesting comment was noted when the student own reflection was compared to their comments on their colleagues. When describing themselves, the majority appreciate themselves as relatively skilful. Comments on colleagues indicate that they often find that *their colleagues are less skilful or have lower ambition levels*.

A recurrent comment for many skills was that *supervision and demands often differ between different assistants* when the courses have multiple parallel group sessions. This applies to the grading of tests and reports as well as to the supervision of projects and report writing. A measure that by judging on the absence of comments seem to work is the use of review guidelines that are distributed in advance to the students.

DISCUSSION

Wolfe concludes that teamwork and communication, together with personal and professional skills, such as critical thinking, get the highest ranking with regard to which demands are placed on the skills and how often they are used by practising engineers. At the same time teamwork and communication get the lowest rank with respect to learning at MIT. Assuming that the situation is similar at KTH the ongoing work to systematically include these skills into the programme was important. Another conclusion by Wolfe, which was assumed to be transferable to KTH, is that separate courses or additional lectures on these interpersonal skills will not contribute much to the proficiencies of the students. Wolfe instead suggests a planned and deliberate integration of these skills into the subject courses. Wolfe also notes that if the students are going to increase their abilities, then the skills should be trained at continuous intervals throughout the education. Based on the present results it was added that the complexity, difficulty, independence and demands on the execution of the tasks that train the interpersonal skills should increase throughout the education. The escalation does, however, have to be suitably steep. If the challenge does not increase, then the motivation will decrease and the learning may become negative.

Here only the effort to achieve good study technique (2.4.7) through the continuous spending of time on the subject has been investigated. Good study technique also contains the quality of studying. For instance any deliberate actions to support deep learning and diminish surface learning, Biggs [7], have not been investigated.

The sample of answering students is to some extent mentioned in the previous section. There was a difference in answering frequency between the classes. The students that relinquished to answer did so by there own choice. There was no reason to believe that these students experienced a substantial different proficiency in the presently investigated interpersonal skills. This conclusion is supported by Blom [8], who presents interview results with 11 selected students that during 2004 – 2005 take the second year at the Vehicle Engineering Programme. The results of these interviews agree with the present conclusions.

CONCLUSIONS AND RECOMMENDATIONS

Some general conclusions were noted. The consistent integration of learning activities on interpersonal skills into several disciplinary courses improved the student teamwork and communication skills. Also, higher demands on the students resulted in larger depth in the student ability. When the first and second year students were compared, the second year students, in general, stated stronger skills than the first year students. The single exception was oral presentation. An interesting discrepancy was found between how the students ranked their own abilities and skills in relation to those of their colleagues. They appreciated their own abilities higher than those of their colleagues.

Based on the results and the analysis some recommendations were made:

- Integrated training in interpersonal skills gave results, which was encouraging for the initiative. Continued work, within the courses as well as between courses, with progression of demands on the skills throughout the programme will improve the results.
- The objective document needs updating since the interpersonal skills were trained in more courses than was described in the document. The level of ambition indicated in the document may also differ from what was executed in the courses.
- The study technique and planning of own studies should be separated in the objective document from activities and teaching in project management. This would better reflect the actual training activities during the first year.
- The activities in time and resource management could be combined with those in development project management.
- The scope of activities defined in the Objective Document varied substantially when performed in different courses. One way to distinguish the differences in the Objective Document would be to use the name introduce for the less extensive activities.
- At parallel evaluations of tasks with examination character, for instance short question tests, the demands must be equal between groups. A clear review guideline with correction principles for each question could be an excellent tool, in particular if it is distributed among the students. A further supportive action would be if the responsible teacher is present during the evaluation.
- It is unfortunate that two courses with two major group projects, Solid Mechanics and Product Realization, are placed simultaneously during the education. The students experience priority and coordination difficulties, in particular if the groups are composed with different students.
- Tasks with a common problem that are used in multiple courses need to be thoroughly coordinated and established to achieve the expected learning goals.
- The presence of instructions, templates and guidelines in the different courses support the students. Comments from the students indicate that co-ordination of these would be helpful for the students.
- A common version of reference material in interpersonal skills should be selected or developed jointly between the teachers in the programme. The material would then be used throughout the programme with start from the Perspective course.
- The inquiry answers show that oral communication needs to be strengthened. More and individualised feedback should be implemented.
- An important, but unresolved, question is how to handle the exchange of teachers in courses so that the integrated training of interpersonal skills continues.
- Some student comments indicate that these have not always understood the purpose of integrated interpersonal skills in the subject courses. In the case of teamwork, it might be further emphasized that these are there to simultaneously train in teamwork; manage and lead groups; attain further subject knowledge. The case of teacher composed groups need more and clear explanation to why the form was selected.

REFERENCES

[1] Crawley, E.F. *The CDIO Syllabus – A statement of goals for undergraduate engineering education,* MIT, USA, www.cdio.org, page 5, 2001.
[2] Östlund, S. *Farkostteknikprogrammet – måldokument*, Farkostteknikprogrammets kansli, KTH, Stockholm, Sweden, 2004, in Swedish.
[3] Wolfe, K.E. *Understanding the careers of the alumni of the MIT Mechanical Engineering Department*, MIT USA, 2004.
[4] Gibbs, G. Using assessment strategically to change the way students learn. In *Assessment Matters in Higher Education*, Brown, S. editor.
[5] Alfredsson, B. *Uppföljning av att arbeta i grupp och att kommunicera inom Farkostteknikprogrammet (HT2004 – VT2005)*, KTH Solid Mechanics, 2005, in Swedish.
[6] *KTH – arbetsmaterial från självvärdering till HSVs utvärdering av alla civilingenjörsprogram*, through S. Östlund, 2005, in Swedish.
[7] Biggs, J. *Teaching for Quality Learning at University, 2nd edition*, Open University Press, page 86, 2003.
[8] Blom, K. *Intervjuer årskurs 2 teknologer*, Farkostteknikprogrammets kansli, KTH, Stockholm, Sweden, 2005, in Swedish.