Thesis

Problems in cooperative learning: A qualitative overview at mechanical engineering education at the University of applied science Utrecht

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Problems in cooperative learning: A qualitative overview at mechanical engineering education at the University of applied science Utrecht (Hogeschool Utrecht)

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Preface

This thesis is written for the completion of my master educational science and technology at the University of Twente. The last few years I took this master in part time besides my work as a teacher at the university of applied science Utrecht (Hogeschool Utrecht). I was able to incorporate many of the things I learned directly in my daily work. For my final assessment and graduation I wanted to work on a subject which was both interesting and valuable for my own job. Therefore I decided to complete an assignment for the Hogeschool Utrecht in my own work environment.

The research project gave me the opportunity to look at my daily work in a different perspective and also let me have enlightening conversations with my students as well as with my colleagues. During the the project I learned a great deal on cooperative learning. While reading, talking to teachers and students the topic became more and more alive.

With this thesis I hope to contribute to the improvement of the mechanical engineering education at the Hogeschool Utrecht.

I would like to thank my supervisor Erik van Rossum for his support and helping me to push on go through when I was thinking of quitting. Also I would like to thank Jaap Goedegebuur and Mark Tammer for the opportunity to do my research at Hogeschool Utrecht and allowing me to involve students and teachers.

Last but not least would like to thank my friends for their moral support

Leiden, september 2015

Suzan Bosveld

Summary

This document provides an overview of the research focused on problems in cooperative learning at the mechanical engineering education at the University of Applied Science Utrecht in. At mechanical engineering education various forms of cooperative learning are used, this study researches the problems which occur during cooperative learning and provides suggestions for improvement. In this thesis existing literature on the topic is discussed, the research design is elaborated and the results are given and discussed.

It is a qualitative descriptive study which provides an overview of the entire width of the problem. In other words, the research question is quite broad: What are the problems, related to cooperative learning, experienced by students and teachers in mechanical engineering education of the University of Applied Science Utrecht? The themes; (1) Effective groups, (2) Assessment and (3) Supervision, are selected from the literature and form the basis for the sub questions.

Data is collected from two groups, teachers and students of mechanical engineering education. The teachers are individually interviewed using a semi-structured interview in which the previously mentioned themes are discussed. Students received an online survey with open questions on their experiences with cooperative learning. These instruments are chosen to collect rich information based on real experiences. Teachers are selected through convenience sampling and students using stratified purposeful sampling.

The interviews are transcribed and data is clustered and made into analysing networks. One overall network is created and from that four sub-networks, one on each of the three themes and a network which shows the connections between the themes. From the networks the overview of problems on cooperative learning are formulated. These results are connected to the literature, from here conclusions are drawn and recommendations are made.

The results on effective groups are, As follows: A group can be effective when the group is well composed and have an open line of communication. Group members divide the labour equally and have a clear vision. A freeloading student has a great effect on the effectiveness of a group and is perceived as a problem by students and teacher.

The main results on the theme supervision is that teachers do not always have the same approach. Teacher differ in the topic and the style of supervision. Some teachers provide extensive help on academic content and other teachers ask questions about the process. These two styles occur in the same project and this gives the students a feeling of unfairness. The discussion on group dynamics is not a prominent part of the supervision.

On the theme assessment there is discussion on what should be assessed, end result, design process or teamwork. The goals of group cooperation at this moment are not always clear. The second issue is on group or individual assessment. The main opinion is that group cooperation should be assessed with a group grade unless there is a good reason not to. Peer assessment can in some situations be useful to make individual differentiation on grades.

Recommendations for improvements are that student groups need to be composed carefully. Teachers need to know how to deal with struggling groups. There should be debated on the assessment goals of cooperative learning and all teachers and students involved should know the goals.

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1. Introduction and conceptual framework

Every engineer has to work together sometimes, for instance in a project team when developing a product or when managing a production unit. To prepare students for their career, cooperative learning is a popular teaching method in mechanical engineering education.

Cooperative learning is wide spread on the University of Applied Sciences in Utrecht (Hogeschool Utrecht). In Engineering education this instructional strategy was introduced more than a decade ago and is still being used every day. For the last few years a big redesign of the curriculum of engineering education has taken place and the development and implementation of this new curriculum is still going at the moment. In the new curriculum a large part is appointed to cooperative learning, namely one third of the whole program. This indicates that it is found to be important to work in cooperative learning groups. However during the implementation of the new curriculum cooperative learning is implemented in the same way it has always been done without reviewing this is the most appropriate way. Stockdale and Williams (2004) mention that a debate on how to implement cooperative learning is relevant: It is important to consider the way cooperative learning is implemented critically. They state that effective cooperative learning needs thoughtful instructional decisions which are made in advance. This research can be part of the discussion on how to implement cooperative learning in the mechanical engineering curriculum properly.

This first chapter will give a short overview of the literature on cooperative learning. It sums up the main issues of cooperative learning and serves as theoretical framework for the research.

1.1 Cooperative learning

In the university of applied science Utrecht and in other schools and universities in general groups of students work together in cooperative learning groups, to learn how to work with others and learn academic content together. Jaques and Salmon (2006) report that cooperative learning in small groups has become a common educational strategy in the last twenty years.

In 1985 Collier reported the benefits of cooperative learning:

> "First, it reflects practice in business, where most people have to work in groups at some time, and many all the time. But it also allows students to learn from each other, undertake more substantial projects than they might have undertaken on their own, contribute in greater depth to a portion of the project's requirements, and have at the end a more substantial piece of work to show to prospective employers". (Collier 1985 as cited from Nordberg p.482)

Since cooperative learning is so common a great deal of research on the topic is executed. Johnson, Johnson and Stanne (2000), Veenman, Kanter and Post (2000), Webb (1994) and many others studied the topic and all have their own outcomes. This is probably because they all study cooperative learning from different perspectives. Johnson et al. (2000) mention in their meta-analysis, studies are executed on aspects of achievement (group- and individual achievement), higher level reasoning, motivation as well as interpersonal skills.

Much research has been done on cooperative learning but what characterizes cooperative learning? There are several different definitions, a wide spread definition is the definition of Veenman et al. (2000) "Cooperative Learning refers to any of a variety of teaching methods in which pupils are placed in small groups to help one another learn academic content" (p.281). For this paper this definition is used as well. Cooperative learning is, according of Veenman et al. (2000) more than grouping students and giving them a task. Michaelsen, Fink and Black (1996) state that by providing a group of students a collective assignment it does not automatically lead to cooperative learning. "Groups must first develop to the point that members: a) are willing and able to communicate with one another and b) are motivated to prepare to the point that they have something of substance to communicate" p33. Johnson and Johnson (2002) agree with Michaelsen et al. (1996) at this point. By composing a learning group it is not matter of course that the group will work together cooperatively. Students have

to turn into a group instead of staying individuals who are put together. A group is cooperatively working when they are visible as a team. A team is visible when students help each other, share their findings and all group members are informed on all aspects of the work. And all of this to reach a shared goal (Janssen, Kirschner, Erkens, Kirschner and Paas, 2010).

1.2 Goals of cooperative learning

The main goal of cooperative learning is that students learn from working together and preferably learn effectively. Johnson et al. (2000) have found that all cooperative learning methods, studied in their meta-analysis, increase student achievement significantly. When implemented properly, students are expected to learn different skills cooperatively in groups, including academic achievement and interpersonal skills (Gillies 2003). Janssen et al.(2010) declare in their meta-analysis that cooperative learning can be an effective learning strategy when the learning goals are problem solving or promoting retention of study materials. Besides all the positive learning effects as mentioned in the meta-analysis of Janssen et al. (2010) not all studies have found positive results of the learning effects of cooperative learning. Andersson and Rönnberg (1995) for example found that groups, compared to individuals, are less productive on memory recall.

By working in cooperative learning groups students can achieve goals in learning how to work together and reach academic goals. According to Webb (1994) both goals can be reached at the same time. “Students can learn how to work with others to maximize the performance and output of the group” (p.26).

1.3 Assessment

One of the important aspects of cooperative learning is that it should be clear for student which goals must be reached. Various research shows (e.g. Forslund Frykedal and Hammar Chiriac, 2011; Janssen et al., 2010) that it is very important that it should be, from the beginning, clear for students on which aspects they will be assessed and how this assessment is designed. There are several possibilities on which goals student groups can be assessed. Forslund Frykedal and Hammar Chiriac (2011) indicate: “Assessment is, generally, a complex phenomenon and encountered within a group activity it may become even more complicated and difficult to manage” p.332. They make the distinction between assessing academic achievement and the degree of cooperative learning. Students can work together to learn academic content and learn aspects needed to work effectively cooperative and both can be assessed separately. Webb (1994) mentions four different purposes for assessment. (1)Measure individual knowledge and skills, this is known as the traditional form of assessment, where students are graded individually. (2)Measure individual performance after group collaboration, students work together during a course and are assessed individually afterwards. (3)Assess group productivity, in this form of assessment the team accomplishment is tested. (4)Observe the degree of interpersonal skills. How do the students work together, how do they function as a team. Webb (1994) and Forslund Frykedal and Hammar Chiriac (2011) agree that it is hard to assess groups and hard to integrate more than one assessment goal. Therefore according to them one assessment goal should be selected.

Orr (2010) does not agree totally on this, she says, it is not desirable to assess only the group product, she indicates that more aspects should be assessed. This because when assessing group product only, why work together? A group can select the best students to do the assignment to provide the best result. The other students do not work on the assignment. When only assessing the final product this should not be a problem and all team members will earn the same grade. However this seems to undermine the intentional purpose of working with collaborative learning groups. Therefore according to Orr the final product cannot be the only assessment goal when working in cooperative learning groups.

Nordberg (2008) endorses this problem; with the assessment of only a group product an academically good performing student may fail a course because the group he was in delivered a group product of bad quality. This seems unfair for this student and argues for individual grades. However individual

grades can create competition within a group, which is not desirable in a collaborative learning group (Johnson and Johnson, 2002). Nordberg (2008) also notes that when only the group process and inter personal skills are assessed it can discourage students to develop a group product. In fact it does not matter what task the group is performing as long as they work together, this will not motivate students to make something of the given task. This argues for assessing both the group product as well as interpersonal skills.

As already mentioned above individual grades can be uses to assess the individual contributions of the members of a group. A tool to measure individual contribution is peer assessment. This allows students to assess each other on their input in the group result and their participation in the team. By the use of this method students become more reflective and develop a capacity to be critical on their own and other team members' work. Furthermore they develop more self-confidence (Brew, Riley and Walta, 2009). Especially older students and students with more experience in working in student groups benefit from peer assessment. Younger, less experienced students have less view on the group dynamics of cooperative learning, are often more influenced by peer pressure and therefore the peer assessment method is less appropriate for them (Barfield 2003). The reliability of peer assessment is not always guaranteed since students do not always dare to give each other low grades (Brew et al. 2009; Forslund Frykedal and Hammar Chiriac 2011) However it can be a good tool to provide non judging (formative)feedback. (Dolmans et al. 2001)

1.4 Supervision

Besides that students need to know what the goals of cooperative learning are the teacher should coach the group towards these goals. Teachers need to adapt their guidance in line with the needs of the students and train them how to work together (Barfield 2003).Teachers need to observe the group to adjust the manner of executing their supervision. In fact it is not a simple matter of forming groups of students and they will cooperate perfectly together (Barfield 2003; Gillies and Boyle 2010; Webb 1994) The supervision should be student directed, students should be given the opportunity to solve their own problems. Kirschner, Sweller and Clark (2006) state that this in only applicable to students who have already experiences in cooperative learning groups, novice students do need structured supervision and instructional guidance. To achieve a group that works effective and cooperatively, students need to learn to listen to other opinions, how to discuss topic matters and group dynamics, how to consult group members and other social skills (Webb 1994). Important is that this will lead to a group consensus which is required to reach the desired goal (Veenman et al. 2003).

To create motivation amongst students teachers should give feedback. This feedback has to be on the group process as well as on the academic progress. Feedback is a powerful tool to remind students if they are on the right track to reach the goals. Therefore it is important to give feedback early in the process and not too far into the project otherwise the opportunity for the students to learn is reduced (Michaelsen et al.1996).

1.5 Development

In the different articles several aspects for effective cooperative learning are mentioned. These aspects should be taken in to account while developing a curriculum involving cooperative learning.

- A group should be composed in a way that they can work effectively together (Curşeu, Kenis, Raab and Brandes, 2010). Curşeu, et al. (2010) state that to increase the learning effect student groups should be composed carefully, otherwise the effectiveness of the group depends on coincidence. A problem that can occur in poorly composed groups is freeloading. In some student groups there are one or two students who have minimal contribution to the group effort and try to take advantage of the successes of the rest of the group. The so called freeloaders. When a group has the misfortune to have a free loading student in their middle, they can be slowed down in their academic achievement.

- A group of students is responsible for their own process. Dolmans, Wolfhagen, van der Vleuten and Wijnen (2001) indicate that this can be detrimental for academic achievement. Students learn the most on interpersonal skills and are best motivated when they are responsible for the group process together. Even when a group is not the most effective or is held back by a freeloader.
- Every group member should be actively involved in the process (Webb, 1994) It is impossible for students to learn from collaborative group work when the individuals are not actively involved. This implies that there should be tasks for each individual student.
- Teachers should be well trained in supervising student groups (Forslund Frykedal and Hammar Chiriac, 2011; Webb, 1994). In advance the curriculum designers and teacher need to elaborate on the question which is more important, interpersonal or academic growth or both equal important and design the supervision in adjustment to this goal. The teachers should be trained to execute the right form of supervision.
- The goals of assessing the result of teamwork should be very clear (Forslund Frykedal and Hammar Chiriac, 2011, Webb, 1994). A group will be more likely to collaborate when the goal is to learn and work together than when the goal is to realise a perfect product or solution for a problem.

1.6 Conclusion

This brief literature study elaborates a few of the many aspects concerning cooperative learning. It shows that well considered choices should be made when implementing cooperative learning in a curriculum. It should be clear what the purpose of working in cooperative learning groups is, which aspects are assessed (product/ process) and how the assessment is constructed (on individual or group level).

The researcher expects that during the development and implementation of the redesign in the mechanical engineering curriculum these choices are made on gut feeling and that not all teachers are aware of the unnecessary problems that can occur due to this ignorance. To confirm this statement and to improve the situation, this qualitative study aims to gather the views of different teachers on cooperative learning and experiences of students to create an overview of the situation at the mechanical engineering education at the University of applied science Utrecht and provide a proposal for improvement when necessary.

2. Research question

The themes effective cooperative groups, supervision and assessment are selected from the literature and form the basis for the research. These themes are frequently mentioned in many articles and therefore applicable for the specific situation at the engineering education at the University of applied science Utrecht. The themes are held broad so they won't narrow the research down too much at the start of the project.

With this in mind the main research question is also quite broad, and the sub questions are connected to the themes chosen from the literature.

2.1 Main question

What are the issues, related to cooperative learning, experienced by students and teachers in mechanical engineering education at the University of Applied Science Utrecht?

2.2 Sub questions

- Which aspects have effect on the group effectiveness?
- Which aspects on the theme assessment of cooperative learning are relevant?
- What aspects are relevant when supervising cooperative learning groups?

3. Method

3.1 Structure

For this research the structure described in the book 'Basisboek Kwalitatief Onderzoek' of Baarda et al. (2013) is used. Baarda et al. (2013) divides the research process into different stages which are logical steps to take in this research project. Below a diagram of the various phases which Baarda et al. (2013) mention is given.

Phase
1.1 Orientation on the topic/problems ⇩ 1.2 (Preliminary)Research question ⇩
2. Research method selection ⇩
3. Data collection method selection ⇩
4 Survey ⇩ | 4 Interviews ⇩
5. Data analysis ⇩
6. Writing thesis and presentation

Table 1: Research phases based on Baarda et al. (2013).

The timeline of the research with the phases of Baarda et al. (2013) is given in appendix A**.**

3.2 Participants

In this research two different groups of stakeholders are involved. Teachers and students of mechanical engineering education are the respondents. These groups are chosen because they are both involved in group work and have different perspectives on the topic. For each group a different sample selection method is used to provide the best selection of participants.

3.2.1 Teachers

There are approximately thirty teachers teaching at mechanical engineering education. However, not all these teachers are involved in working with student group projects. For this research six teachers are selected to participate. These teachers are all involved in working with student groups The teachers are selected by *convenience sampling*. According to Onwuebuzie and Leech (2007) this sampling technique is used when participants are selected by their presence and their will to cooperate (Onwuegbuzie and Leech, 2007). Five teachers have more than three years of experience in working with student groups. Two of the teachers are women and four are men. This is a reflection of the population of the mechanical engineering teachers. Three of the teachers are supervising groups in all different study years, two only in the first two years and one only the third and fourth year groups.

3.2.2 Students

The student population of the mechanical engineering training is approximately 350 students divided over the four years educational program. For the research students are selected by Stratified Purposeful Sampling. This means that the population is classified into strata and from each strata

participants are selected randomly (Onwuegbuzie and Leech, 2007). In this case the purposeful selected sample is the entire population of all mechanical engineering students of the University of Applied Science Utrecht. The different study years are the strata, and from each strata (year) random students are selected. This method is used to get an overview of the different years. Because it is a qualitative research and the participants are asked for rich information. Thirty students are approached to participate and fifteen of them responded. The respondents are twelve male and three female students. This reflects the population of the mechanical engineering education where the large majority of students is male. Among the respondents are four fist year students, five second year, two third year and four fourth year students.

3.3 Instrumentation

To collect the data from the two different stakeholders' two different instruments of data collection are selected. In this section the two instruments will be elaborated.

3.3.1 Instrument teachers

The data of the teachers is collected by semi structured interviews. Themes from the literature review are the input for the framework of these interviews. Semi structured interviews are selected as a data collection instrument since they stimulate the interviewed teachers to tell their own stories on the topic. Rapley (2003) describes this form of interviewing useful when rich and deepen information is needed. The participants are, by the use of open questions, invited to tell their own stories. For this qualitative research it is important to collect rich information and personal stories and therefore this method is appropriate for the research goal.

The interview structure is enclosed in appendix B.

3.3.2 Instrument students

The students are sent an online non-standardized survey with open questions. These questions are open to encourage students to write short stories about their experiences with working in groups. For this group an online survey is chosen so students can answer the questions anonymously. The researcher is also a teacher of these students and an interview with the researcher may possibly influence the answers to the questions. To avoid this, the students were approached by email and asked to email their answers to the researcher or deliver them in a special anonymous drop box. Second reason to use an online survey is that students can decide themselves when they write down their answers, they are not dependent on the researcher's agenda to schedule an appointment.

Two examples of questions are: What do you like about cooperative learning? And what is according to you the biggest problem? Both are open questions, the answers to these questions can be short however they are designed to evoke longer answers. Therefore in the introduction is mentioned that the researcher tries to find stories of experiences.

The entire survey is enclosed in appendix C.

The approval for this research from the committee of ethics in enclosed in appendix D.

3.4 Data analysis

Onwuegbuzie and Leech (2007): "In order to gain insights, qualitative researchers usually strive to extract meaning from their data" p.106. Baarda et al (2013) describes the analysis of qualitative research data: During the analysis of the data the conceptual model for the research will be developed in contrast to quantitative research were a conceptual model forms the framework for the analysis. This means that from the data of the teachers, transcribed interviews, and the written stories of the students, a conceptual model is constructed.

For the data analysis the network method of Attride-Stirling (2001) is used. The purpose of this method is to organize data into a thematic network. These networks can be divided into three organizing levels.

1. Basic theme
   Basic themes are themes derived directly from the text, on their own basic themes are not very informative, however several basic themes together form an organizing theme.
2. Organizing theme
   The organizing themes are the overarching themes of the clusters of basic themes which share the same topic.
3. Global theme
   In the global themes all organizing themes come together.

For this research one overall network with three organizing themes is made. The transcribed texts are analyzed and parts that are connected to the (sub) research questions are highlighted. These chunks of text are clustered on topic and form the basic themes. In appendix E the selected parts of the data are shown. These texts are connected to the basic themes and clustered in the organizing themes which are derived from the sub-research questions. The organizing themes are all connected to the global theme, the topic of the main research question.

4. Results

4.1.Network

The basic theme of the network is cooperative learning. This is directly deduced from the main question of the research. The organizing themes are topics which are discussed in the interviews and the participants have indicated to be important. Notable is that these themes form one network and not several separated networks. The organizing themes are connected to each other.

Example: the importance of professional practice is pointed out when discussing various issues.

One of the answers given to the question what the goals of cooperative learning are, is to simulate the professional practice. It reflects practice in business, an engineer rarely works alone in professional practice.

Teacher 3:
"Er is bijna niemand die volkomen solitair werkt. En in een projectgroep heb je altijd dingen die je met elkaar moet bespreken en tot bepaalde ideeën moet komen en daarnaast gedeeltes die je zal moet aanleveren aan een groep."

On the topic assessing cooperative learning, the professional practice is mentioned because the result, which has to be assessed, of the cooperative learning group should be a product which is similar to the products produced in mechanical engineering companies.

Teacher 6:
"Het doel is dat je een goede werktuigbouwer wordt en een goede werktuigbouwer die ontwerpt een goede machine. Dat is gewoon waar alles naartoe gaat. In het bedrijf wordt je ook afgerekend op het resultaat dat je neerzet."

And even on the theme supervision the professional practice is mentioned, by sharing experiences from his own practice a teacher (T4) creates the link from the school project to the professional practice.

Teacher 4:
"Ik vertelde alleen vanuit mijn eigen praktijk, wat ik gedaan had en zij stelde daar vragen over en toen

kon ik gewoon vertellen wat ik gedaan had."

This shows that these themes do not stand alone, they form a complex network in which all themes are connected. In figure 1 the entire network is given. In the middle the global theme, working with cooperative student groups, and around it the organizing themes good/bad group, supervision and assessment each connected with their own basic themes. The connecting lines show that there is a relation between the various themes.

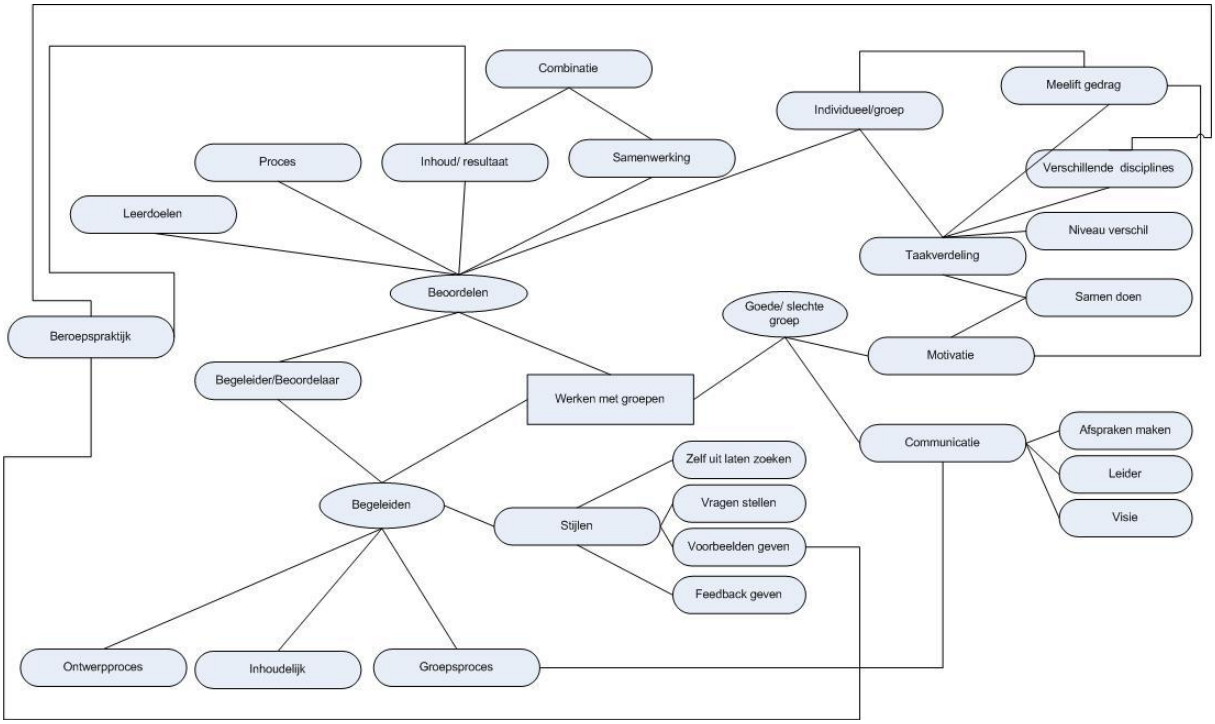

Figure 1: Entire Network

In the next sections each organizing theme is clarified separately and the connections between the themes are explained. In the text references are made between what teachers said in interviews and the answers students gave by email. To be able to trace who said what each student and teacher is given a number. Students; student 1 to student 16 (S1 to S16) and teachers; teacher 1 to teacher 6 (T1 to T6).

4.2. Effective groups

In this section the aspects which are mentioned in the interviews that relate to the functioning of groups are elaborated. Both good and bad practices are taken into account. In figure 2 this part of the network is shown. In the centre of this part of the network stands the theme good/ bad group. This is in this case short for how does a group function. Aspects which can be connected to this theme are: division of the tasks, student motivation, and the communication among group members. These aspects will be discussed in the next paragraphs.

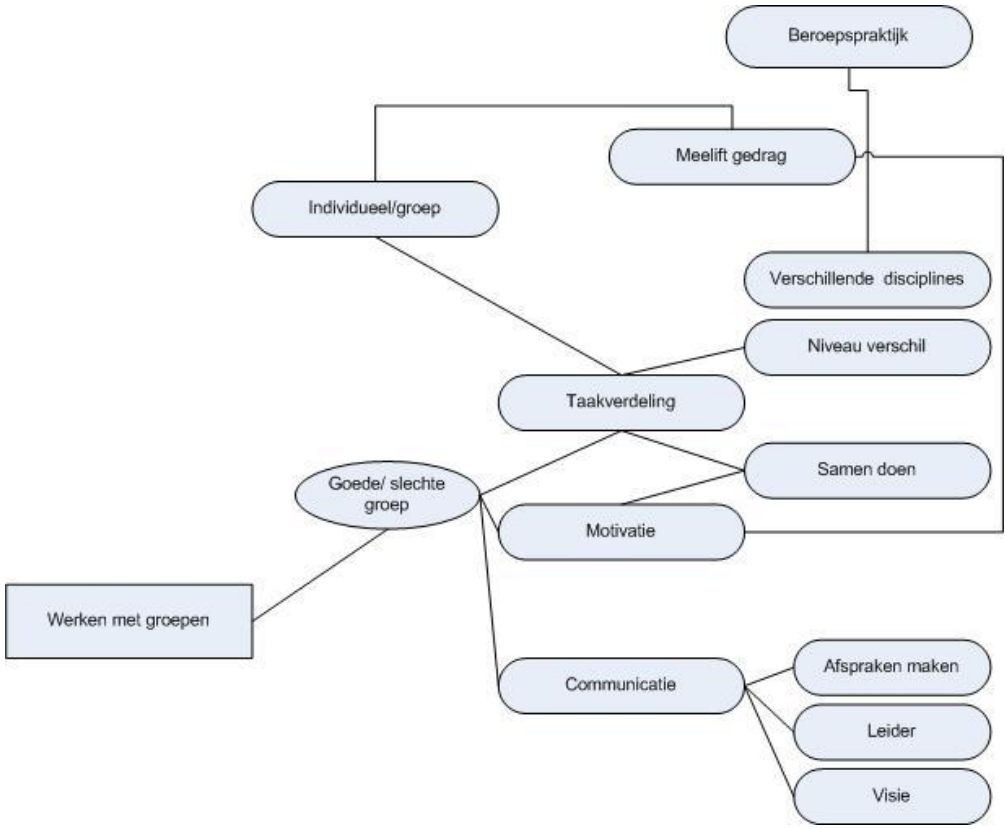

Figure 2: Effective groups

According to several students (S6, S7, S8), an effective group is a group where all students know each other's strengths and weaknesses and where they can depend on the fact that all group members make their contribution. A group that can solve problems, which occur during a project, together, is indicated by several students (S1, S3, S10, S11, S14) as a characteristic of a well-functioning group. These problems can be on content or team aspects, both can be solved by good communication between group members. Students S1, S3, S10, S11, S14 think in the ideal group students have different strengths, so that they complement each other. This makes that students can easily make a division of the different tasks and every student then does what he knows best already. These students indicate that in a good group students are flexible to take on tasks which are not their favorite to execute.

Student 8:
"Een projectgroep is een goede groep als je weet wat je aan de groepsleden hebt en je er op kan rekenen dat ieder groepslid zijn werk doet".

Teachers find the dividing of the work a problem. Students divide the work amongst the group members, each student does the task he or she knows best and when everybody is finished they put all the work together. According to teacher 5 (T5) students do things they already know how to and therefore do not learn much. She also indicates that students do not read the work done by others, therefore they do not learn from each other. In this teachers opinion these groups of students do not

work cooperatively. This connects to Janssen, et al. (2010) a group is cooperatively working as they share their findings and all group members are informed of all aspects of the work.

Student 14 (S14) and Webb (1994) state this aspect as a problem as well, for the end result of the group assignment the division of tasks can be very beneficial because students can work efficiently on a task they already master or like. The individual learning will become minimal, and only on a portion of the complete group assignment. Students 7 (S7) agrees and suggests that it is not always necessary to work together to finish an assignment. Why work together on smaller assignments, he asks. In third year projects students of different programs form cooperative learning groups. Students engineering management, mechanical engineering and electrical engineering work together on the same project. Each student covers the aspects of the project that matches his expertise. According to teacher 2 (T2) this stimulates the division of the work and for some groups it is hard to combine all the individual work into one final product.

Student 14:
"Met projecten op school gebeurt het vaak dat er bij de taakverdeling wordt gekeken naar wie wat goed kan. Hierdoor doet iedereen een onderdeel van wat hij al kan en leert hierdoor geen nieuwe dingen. Aan de andere kant is dit ook goed, (wat je ook doet in groepsverband) als iedereen doet waar hij goed in is en weinig meer, wordt het beste resultaat behaald"

The dividing of the tasks is a main issue for problems in cooperative learning, students and teachers mention that problems occur when a student does not execute his part (S3, S8, T5, T6). Student 5: "Due to the fact that not all students do the same amount of work a bad atmosphere can be created within a group". This will not stimulate the productivity of the group.

By dividing the work between individuals there is often no back-up when the work is not or poorly done. Due to the division of work and the difference in academic level between the students it is obvious that the results can be of varying quality. Student 1 (S1) experiences this as a problem. He prefers groups of students with the same academic level. Student 14 (S14) has a different view, he does not experience this problem as long as all students work for the group result, do their best and ask for help when needed. Especially the last aspect is very important according to him.

When a student is not contributing his share of the project and still wants to share in the group result there is a problem according to all the students and teachers. This so called freeloading can have an effect on the motivation and functioning of an entire group.

Teacher 5 (T5) says the problem of a freeloading student can have different backgrounds, sometimes students have a good reason for not being able to participate properly. However mostly she says the freeloading student is not motivated enough to do his work. How students deal with a freeloading student can be very different. One student (S7) declared that his group wanted to do something about the problem of a freeloader but the teacher did not act in the way he should have according to him.

Student 7:
"In het begin van de studie kan je heel veel last hebben van je groep. Ik zat in een groep waar 2 van de 8 teamleden serieus voor de studie wilden knokken, om dan alles met z'n tweeën te moeten doen is echt heel vervelend. Dit moet beter worden aangepakt wanneer hier melding van wordt gemaakt bij de projectbegeleider".

On the other hand a teacher mentioned that students themselves do not act properly when having a freeloading student in their group. Students do not confront the freeloading student with his behaviour and when talking to the teacher about this problem they do not want to tell which student causes the problem. Because students do not think it is fair that someone can get away with doing nothing and still earn credits. This can have effect on the motivation of the good students, they can lose their motivation because they are doing someone else's his work. In other cases it motivates students to make the best of it with the students who do want to work. Student 3 (S3) experienced the last

example a few times and he did not like this because it does not lead to a very good final result. Teacher 2 and teacher 5 (T2, T5) indicate that good communication between group members and supervisor is very important to overcome problems in group dynamics.

Student 3:
"Doordat mensen hun werk niet deden heb ik in alle 3 mijn projectgroepen een soort van kerngroep zien vormen om het project maar te redden".

Fortunately not all groups suffer from a freeloading student. In groups in which all group members contribute evenly and pursue a collective goal students become more motivated. The communication in a good functioning group is in generally better. Students (S6, S11) indicate that in a good group clear rules and deadlines are set. Students in a good group work together on the assignment and help each other when necessary. They have open communication and students are not afraid to ask others to help them. Several students (S3, S5, S8) say that a good group should have a shared vision on the final result and a strong team leader who leads the group in the right direction. This connect to Michaelsen et al. (1996) they say that "Groups only become cohesive when they have one or more common goals" p. 36. This can be reached by debating what is important for each group member.

The success of a cooperative learning group depends on the individual effort of each student. They need to be motivated to reach the best result together.

4.2.1 Conclusion

In a good group students are motivated and are open in their communication. They debate on what the team result should be and they have a shared goal. In a good group students help each other when necessary. Students think that in a good group all group members different strengths and together they have all the knowledge and skills to execute the assignment. Students find it important to divide the work among students who already master a certain task. Teachers see this as a problem because students do not learn enough from doing something they already know. Besides this aspect, teacher think that students do not exchange their individual results enough, there is not enough debate amongst group members and therefore students do not learn cooperatively.

4.3. Supervision

The second network is on supervision. In figure 3 this network is shown. In the centre of this part of the network stands the organizing theme supervision. Around that the basic themes connected to supervision are shown. The basic themes are the aspects on which a teacher can coach student groups; design process, academic content and group dynamics. Another basic theme is style of supervision and the roll of supervisor and assessor. The last mentioned is discussed in section 4.5 because that theme does not only concern the organizing theme supervision.

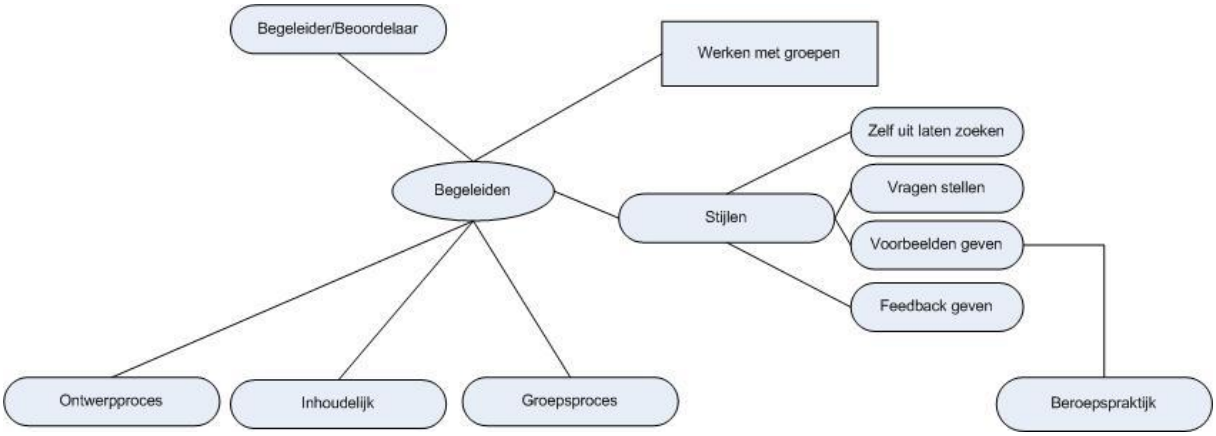

Figure 3: Supervision

The first aspect is the topic of supervision, what do teachers find important to supervise groups on. The interviews show that teachers have different approaches. Some teachers say they are focused on content matters (T2, T4), for example these teachers check if the calculations are done right. Other teachers (T3, T5, T6), are more focused on the working process, which steps a group is making and if these are the correct steps to take. Teacher 3 (T3) says; “when students only learn academic content and nothing on the design process they only learn one trick”. She tries to teach students to take the right steps in the design process and teach them that the project they work on is an example, these steps are useful for other projects as well.

None of the teachers have their main focus on the team communication and group dynamics. It seems that the focus of teachers is not entirely the same, however after further questioning it seems that most teachers who think they are focusing on the content are actually using the content to coach on the working process and implicitly on the team communication and collaboration. Therefore all three aspects are topic in the conversation during supervision sessions. Teachers switch their focus depending on the project or group (T2). Teachers 1 and 5 (T1 and T5) give the group the responsibility to decide what the topic of the supervision should be.

Teacher 5:
“Ik vind het wel belangrijk om ze te laten beseffen dat ze vanaf het begin heel erg zelfstandig zijn en dat het hun project is en dat zij ook alles moeten aankaarten”.

Besides the topic, on which the supervision focuses, there is the approach of the supervision. Almost all interviewed teachers point out that they ask questions about the work process and let the students do the work. Mostly these questions are process oriented. What are you doing? Where should that bring you? and who is going to do that?

The extent to which a teacher is helping the students is divers, from figuring out themselves to listening and giving feedback to providing information and pro-active participation. Teachers 2 and 6 (T2 and T6) do like to help students actively and discuss the content substantively. Other teachers do not help actively and try to motivate students to figure everything out themselves.

Teacher 2: “Ik vind het soms ook leuk om pro actief met ze mee te denken”.

Sometimes these different approaches occur during the same project for different groups. A teacher (T2) stated that this is a problem and there is an ongoing discussion among teachers on this topic because for students it is not fair if some groups are helped by the teacher and others are not.

Webb (1994), teachers (T3, T5) and students (S9, S15) mention that students should learn how to work together efficiently and learn how to deal with problems in collaboration to avoid real conflicts. Group projects are an educational tool where students can apply what they have learned on cooperative learning and learn more by experiencing it themselves (T1).

Teacher 1: “Je kan alleen maar leren over samenwerken door samen te werken”.

4.3.1 Conclusion

It seems there are many differences in the manner of supervision, however there are many things teachers do the same. The design process is the main topic of supervision and teachers ask the students questions about this process while coaching a group. The discussion of the group dynamics is not a prominent part of the supervision, it is a side issue that is not a structural topic of supervision meetings. The amount of help a teacher provides during the project is different among teachers. Some help actively and other let the student figure everything out themselves.

4.4. Assessment

Susan Orr (2010) describes that it is a complex thing to perform group assessments. Therefore assessment is the third organizing theme of the network. In figure 4 this network assessment is shown. This network includes the basic themes learning goals, product, process and collaboration. These three aspects are mentioned when being asked what should be assessed during cooperative learning. Another basic theme connecting assessment is group or individual. This is about the discussion on grading cooperative learning individually or for the entire group collectively.

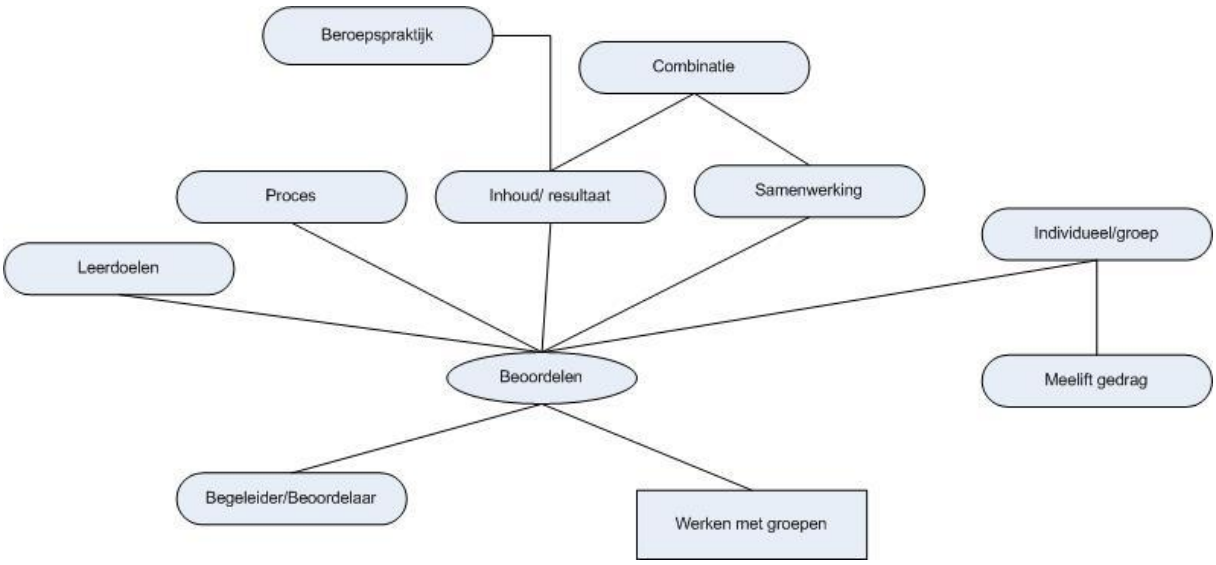

Figure 4: Assessment

Teacher 1(T1) points out that the assessment should be on the goals of the project, these goals are leading and should be set clear before the assessment tool is developed. Both teacher 1 and teacher 3 (T1, T3) agree that besides what is assessed, it should be clear for students on what aspects students are assessed. In their opinion this now is not always the case.

Teacher 3:
"Ik denk dat het om te beginnen voor studenten heel duidelijk moet zijn wat ze waar ze op afgerekend worden. Nu is dat nog een beetje diffuus".

What are the main goals of group projects and what should be assessed? There are many similarities between the answers of students and teachers on what should be assessed. Both groups find the end result the most important aspect of a group project. Therefore this should be the main part of the assessment according to them. By the end result teachers mean the actual physical result (in engineering education students build their own designed products) and the report with the argumentation for the end result. The report should be the main assessment tool (T3, T6).An argument for assessing the end product is that the education leads to mechanical engineers. The end product reflects the professional practice of the mechanical engineer where professionals have to develop products that work and meet the requirements of the client.

Teacher 5:
"Het doel is dat je een goede werktuigbouwer wordt en een goede werktuigbouwer maakt en ontwerpt een goede machine. Dat is gewoon waar alles naartoe gaat".
Teacher 6:
"Ik heb de neiging zelf om iets meer het product te beoordelen. Omdat het erom gaat dat ze een goed product neerzetten en als dat door middel van een of ander wazig proces is gegaan dan hoeft dat niet perse een probleem te zijn. Ik vind zelf het product, het resultaat beoordelen het belangrijkste".

Despite the fact that there is a lot of agreement in the answers on what should be assessed there are differences in opinion as well. Teachers agree that the physical end result and report with argumentation should be part of assessment. On other aspects that can be assessed teachers do not agree. One teacher (T4) thinks the focus of assessment in the first year should be on collaborative learning and less on end result. Other teachers (T1, T3) think the opposite, in the first year the technical content and design method should be the main aspect of assessment and collaboration is topic of discussion with the supervisor. These teachers think that students learn from the experience of working together and it should not be aspect of assessment. Teacher 2 (T2) thinks that it is not necessary to select one aspect for assessment. He indicates that it should be possible to assess more aspects at once. This can be a combination of group participation and final result.

Besides the topic of assessment the question if it should be a group or an individual result is discussed. Some students(S13, S14) think it is logical that a group assignment is assessed with a group result. The work is for the team, each student has their own role in this process, not every students can achieve the same but that is part of the game, a group result is therefore the most obvious choice.

Student 14:
"Het groepsresultaat telt. Ik vind niet dat een ander een hoger cijfer moet krijgen, omdat hij/zij zijn/haar onderdeel heel goed heeft gedaan. In een groep werken vraagt meer dan alleen je eigen onderdeel goed doen. Als iemand beter is moet hij het groepsresultaat omhoog brengen en niet alleen het eigen resultaat".

Not all students agree on this. Students (S6, S15) think, if there is a reason, a differentiation in the group result should be made. If a student does not put enough effort in the project he does not deserve the group grade and should be given a lower grade. According to this students effort is the reason to deviate the group result.

Student 6:
"Aan de ene kant werk je samen als een groep en zou je ook dezelfde beoordeling moeten krijgen, maar in een aantal gevallen vind ik dat de beoordeling per persoon in een groep mag verschillen".

Student 15:
"Uiteraard is groepswerk iets dat je met een groep doet. Echter komt het altijd voor dat een paar personen meer doen dan de rest, terwijl iedereen dezelfde beoordeling krijgt. Ik vind dit oneerlijk iedereen zou evenveel moeten doen om hetzelfde cijfer te halen. Als er mensen zijn die minder hebben gedaan, moet het behaalde cijfer naar beneden worden aangepast".

The interviews reveal that teachers find this a difficult issue. Teacher 5 gives an example of a group in which two high achieving students are assigned a project together with two lower achieving students. The two high achieving students motivated the other students to achieve above their normal level, however the two of them did the important parts of the project and the lower achieving students supported them. The four of them worked together perfectly so despite the fact that the academic achievement of the individual students is different they all deserve the same high grade. Teacher 2 has a different example: one student had put in all the effort to involve two other students. He alone did the main part of the work. This teacher thinks the current assessment method does not provide properly in cases where the teacher has the feeling the group grade is not a fair reflection of the input of individual students.

Teacher 6 argues that is hard for a teacher to see what the input of the individual students exactly is. This is because the supervision meetings are quite short and what happens outside these meetings is out of the teachers sight.

There are several ways mentioned on how individual input can be measured. Students can write reflection reports in which they elaborate on their own role in the collaboration and their contribution in the group result. Teacher 6 mentions that this provides a pile of extra work for the teachers and he questions if students who did a small part of the work write a fair reflection. Another tool for measuring individual input is peer assessment. Both teachers and students came up with this method.

The experiences with executing peer assessments are various among the interviewed teachers and students. Some students (S1, S3, S5) find peer assessment a good tool to discuss the contribution of the individual team members. They mention however that it should not be done only at the end of a project. Student 9 said she dislikes peer assessment because in her view it does not support collaboration, students can feel attacked by the feedback of their peers. Therefore she thinks students do not speak out in peer assessments held early in the process.

Student 5:
"Waar ik een groot voorstander van ben is het beoordelen van elkaar in het bijzijn van iedereen. Op dat moment wordt het voor iedereen en ook de docent duidelijk wie er echt heeft gepresteerd gedurende het project. Mochten er mensen het niet eens zijn met elkaar wanneer er iemand wordt beoordeeld, kan dit meteen worden besproken en worden rechtgetrokken".

Teachers have both positive and negative experiences with peer assessment. Negative because students do not give each other low grades because they do not want to lose friends (T5). Therefore teacher 6 says that peer assessment is not reliable. Teacher 2 indicates that in later years students can assess each other fairly. He mentioned that he wants more peer assessment included in the projects he is involved in. This is in line with Barfield: "Results indicated that older students are more likely to be dissatisfied with a group grade experience as compared to middle and younger aged students. P. 366

The last option to assess students individually is addressed by teacher 1.He would like to make the student responsible for their own assessment. At the beginning of the project each student makes a plan on which aspect he would like to be assessed. These goals are discussed with all group members so every student knows who has what goal and on which aspects they should assess that student on.

Teacher 1:
"Ik zou het mooi vinden als de student in het project zijn eigen doelen opstelt en er dus ook een eigen toetsing op gaat maken".

4.4.1 Conclusion

Generally, teachers and students think the final result should be assessed. This should be the physical product and the corresponding report. Remarkable is that students speak of the physical product when speaking of the final product and teachers mean the report when they mention the final product. Collaboration is often not a part of assessments. A combination of final result (report) and group collaboration is a good option to assess as well. It all depends on the goals of the project.

The teachers think it is hard to assess individually because they do not see everything that happens. However they do agree that in some cases an individual grade is required. Teachers do not agree on peer assessment as a fair assessing tool. Some teachers say that students find it hard to assess good friends fairly, peer assessment is in their eyes judging friendship instead of collaboration. Other teachers think peer assessment is a good way to register individual differences.

4.5 Connection

Besides the basic themes which are directly linked to an organizing theme, some themes are broader and are connected to more than one organizing theme. These aspects are placed between the organizing themes. In figure 5 the part of the network which shows the connections is given. In the figure only the themes which represent the connections are included, for clarity other themes are left out.

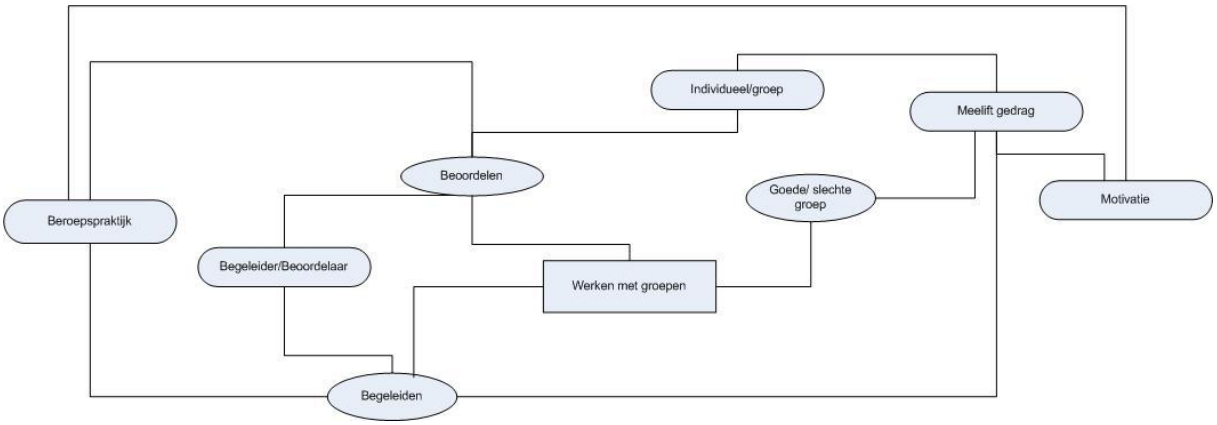

Figure 5: Connection

The first aspect is mentioned in section 4.1, the professional practice. This is indicated as the main goal why there are cooperative educational methods implemented in the engineering curriculum. The program trains students to be engineering professionals. Therefore projects which reflect the professional practice are incorporated. An engineer must develop reliable products. For this reason according to teachers as well as students the reflection of the professional practice should be included in the goals, the supervision and the assessment of cooperative learning projects. In addition, students (S4, S15) get motivated by the idea of working towards a functioning product.

Student 15:
“Aan het eind van een project heeft iedereen een trots gevoel wanneer we een goed werkend product neer hebben weten te zetten”.

The second aspect is on the border between supervision and assessment and addresses the question if the supervising teacher can be the assessing teacher.

At this moment the supervising teacher is also the person who does the assessment. Whether this is a desirable situation is argued by the interviewed teachers. Teacher 1 has a strong opinion. He states that the trust bond between students and teacher is gone when a teacher is first coaching a group and then assessing the same group. He thinks someone else should do the assessment.

Teacher 1:
“Je kan niet de coachende beoordelaar zijn. Dan vertrouwt de groep jou nooit en zal dan met zijn hulpvragen nooit bij jou komen. Die groep zal jou antwoord altijd wantrouwen. Is dat antwoord dan op de coachende vraag of is dat antwoord op een sturende vraag”.

Teacher (T3) agrees; she asks, what do you assess? Your own coaching skills or how good a group performed? Teacher 4 (T4) indicates that he develops a sort of bias when he has to assess students who he coached himself. There is a bond between him and the students. This could hinder him during assessment. A solution for this problem is mentioned by several teachers (T1, T2, T3), there should be a designated other teacher who can do the assessment, with or without the supervising teacher Other teachers (T5, T6) have less problems with the problem mentioned above. They have no problem assessing the students themselves. Teacher 5 (T5) states that from the beginning she is clear to students, she says, during the project you can ask me anything and I will give you feedback.

However after you hand in your work I have to judge you and I will not be gentle. By being clear she can separate both rolls for herself and the students.

Teacher 5:
"Ik zeg wel van, maak alsjeblieft gebruik van mij want ik ben hier nu om je te begeleiden. Straks lever je het werk definitief in en dan is het bikkel hard. … als ik beoordeel ben ik gewoon keihard".

The last aspect is freeloading, which is already mentioned in section 4.2. However this does not only affect the effectiveness of a group, it affects all aspects. Freeloading students ask for a different approach in supervision. Teacher 3 says that when there is a freeloading student, the supervision should be more focused on the working method.

Teacher 3:
"En als je een groep hebt die niet goed functioneert omdat iemand steeds niet komt of omdat ze eigenlijk niet met elkaar uitwisselen dan heb je eigenlijk een methodisch gesprek".

For students a freeloading students affects their motivation (S3, S6, S7, S14) and gives the group a bad atmosphere (S15) which affects the collaboration.Freeloading causes that both students (S2, S15) and teachers (T5, T6) do not think it is fair that a freeloading student should share in the group's result. Therefore it also affects the manner of assessment. Teacher 6 says he would like parts of projects to be executed in small groups or individually to discourage freeloading.

Teacher 6:
"Ik denk dat het ook heel belangrijk is dat er gedeeltes zijn die je in kleinere groepen doet of zelfs individueel omdat je dan beter je eigen expertise kunt ontwikkelen en niet meer kunt meeliften. Want dat kan echt niet".

Student 2:
"Minder gemotiveerde mensen die profiteren van de gemotiveerde mensen".

4.5.1 Conclusion

All aspects mentioned in the interviews are in some way connected to each other. For some of the aspects this connection is more visible. Professional practice is connected to all aspects included in this research. The educational program leads to mechanical engineering professionals, therefore the professional practice has a great influence on the content of the program. It influences the goals and results of cooperative learning and motivates students. The second connection is the coach versus assessor, teachers have different opinions on this aspect. Students do not mention this as a problem. The last connection is freeloading, this is a big problem and can influence all aspect of cooperative learning, it demands extra effort during supervision and makes it questionable if a group grade is a fair assessment.

5. Conclusions and recommendations

In this section the important aspects of the previous chapters are summarized and recommendations for improvement for the mechanical engineering education in Utrecht are given. These recommendations are derived from the literature on which chapter 1 is based.

This research reveals that there are differences in how people experience cooperative learning. Many aspects mentioned in the interviews do correspond with the literature on the topic. The problems experienced by the teachers and students at the mechanical engineering education in Utrecht are the same as mentioned in articles of previous research. According to this literature some of these problems can be reduced or solved. In this section recommendations for improvement are given.

The first problem is that the goal of cooperative learning is not always clear for students and in some cases the goals of cooperative learning are not clear for teachers as well. Students do not know on

what aspects they are assessed and what is expected of them. It can occur that students do not do the right things to complete the assignment because it is not clear what is expected of them. Forslund Frykedal and Hammar Chiriac (2011) and Janssen et al., (2010) indicate that it is very important for students to know in advance which learning goals they should accomplish and on which aspects they will be assessed. For teachers these goals should be clear as well, otherwise it is not possible to work towards these goals and students learn the wrong things. An additional effect of different interpretations of the goals between teachers is that different group are approached differently and therefore learn different things during the same project.

To reduce this problem the learning goals should be well discussed amongst the involved teachers. The interviewed teachers had some disagreement on what should be assessed. Some said the final result is the most important aspect and others said the design process which leads to the final product is the most important aspect of a group project. It is worrying that there are different views on what should be assessed. However it is probably not a very big problem, every project has its own goals and matching assessment tools. Teachers involved in the same project have to debate the goals and assessment tool and use it in the same way. Other projects can have different goals and therefore different assessment goals and tools. The goals and assessment tool should be communicated to the students clearly and be available for students before the start of a cooperative assignment. What the goals should be for each project should be decided by the curriculum designers.

When teachers have more discussion on the goals and the assessment they should also debate the manner of supervision they are going to use. This would reduce the problem of differences in supervision by the teachers. Students and teachers indicated this as a problem because some teachers provide more help than others. The assessment of groups will become more fair when groups are coached in the same way.

Teachers indicate that students divide the work and do not debate their individual results and therefore there is not much collaboration in the teachers opinion. Teachers think that students are not able to collaborate properly because they do not know how to. In their opinion more attention is needed in the curriculum on learning to work in teams. Johnson en Johnson (2002) state that “putting students into groups to learn is not the same thing as structuring cooperation among them. Cooperation is much more than physical proximity to others, discussing material with other students, helping other students, or sharing materials with other students, although each of these is important in cooperative learning” p. 95. This indicates that it is not enough to put students together in a group and let them loose. Students need to be trained and coached to work cooperative properly. By educating students on aspects of group dynamics and structural collaboration students become more able to execute group assignments without problems. Teachers have to motivate students to work cooperative and design the assignments in such a way that it is necessary to work as a team.

The biggest problem in cooperative learning groups mentioned by students is freeloading. Students indicate that in most groups there is someone who is not contributing enough. Teachers do recognize this problem as well and the freeloading phenomenon is extensively described in literature. Orr (2010) states that there are many reasons why a student is not contributing and that these reasons can be very complex. Therefore she says, it is not possible to provide a single solution on how to deal with freeloading students. However it is always important, when dealing with a freeloading student, to keep the conversation going and try to find the reason why this student is not contributing. Knowing the situation of the student can help to find the solution.

To be able to have a constructive conversation with a student group and especially with a group with a freeloader, teacher need to have the right knowledge and skills. A course in how to become a good coach could help to gain this knowledge and skills, teachers will then be more able to deal with freeloading students and student groups in general (Forslund Frykedal and Hammar Chiriac, 2011;Johnson and Johnson, 2002; Webb, 1994).

Besides teacher training, the composition of a group could help to reduce the risk of freeloading students. Curşeu, et al.(2010) found that teams which are composed on relational ground function better than randomly composed teams. This means that groups of students with the same background or the same fields of interest form more effective groups than students with less common grounds. When composing groups this can be kept in mind.

Freeloading behaviour contributes to the discussion on the question if cooperative learning groups should be assessed as a group or individually. Because there can be freeloaders, it only seems fair to give all the group members the same grade if all students in the group have contributed an equal amount of work at the same academically level. Therefore the assessment should be individually. However students and teachers mention that for them it is not self-evident that students in a group are assessed individually. This is because students work for the group and not all students in a group contribute in the same way. For example the group leader has less input on academic level and more input on a social level. Only when a student does not contribute enough the grade for that student should be marked apart from the group grade. Besides the difference in individual contribution Webb (1994) says that it is not possible to assess group assignments individually without sending mixed messages. She states that when assessing students individual they are putting less effort in the group and more in the individual aspects to gain a higher grade. This causes the opposite to the aim of cooperative learning. It remains a complicated issue. Orr (2010) formulated the challenge which educators are struggling with: “The challenge lies in the need to find an assessment approach that disentangles individual contribution in the interests of fairness” p302.

Peer assessment could be a solution to still have some individual assessment on aspects of collaboration. However it should be taken into account that it suits older students better than first year students (Barfield 2003; Brew et al. 2009; Forslund Frykedal and Hammar Chiriac 2011). In the first year it can be used as a formative tool and in later years summative (Dolmans et al. 2001).

A solution to assess individual work is mentioned by teacher 6, let students execute (parts of) a project individually so there is no other student to lean on. Whether this is a good solution depends on the goals of the assignment. When the goal is to measure individual growth in academic skills it can be a good solution. It must then be examined what purpose it still serves to work cooperatively. This is in line with Orr (2010), she asks; why work together when it is not being assessed. Therefore it is important always to remember, when creating assignments, is cooperative learning the appropriate educational strategy to reach the desired goals?

5.1 List of recommendations

The recommendations from the text above are listed here.

- Students groups need to be composed carefully (Curşeu, et al., 2010).
- Teacher need to be trained in giving the right supervision (Forslund Frykedal and Hammar Chiriac, 2011;Johnson and Johnson, 2002; Webb, 1994).
- Involved teachers need to debate the learning goals, assessment tools and coaching approach.
- Learn students how to work cooperatively (Johnson and Johnson, 2002; Kirschner, Sweller and Clark, 2006).
- The assessment tool should fit the goals.
- Decide if cooperative learning is the appropriate educational strategy for the goals that need to be reached (Orr, 2010).
- The learning goals and assessment tool are clear from the beginning (Forslund Frykedal and Hammar Chiriac, 2011, Webb, 1994).
- The learning goals and assessment tool are available for students (Forslund Frykedal and Hammar Chiriac, 2011, Webb, 1994).
- Be carefull in how to handle a freeloading student (Orr, 2010).
- Use group assessment unless there are reasons not to (Webb, 1994; Orr, 2010).

- Peer assessment can be useful, however use it when students are ready for it (Barfield 2003; Brew et al. 2009; Forslund Frykedal and Hammar Chiriac 2011)

All recommendations mentioned above seem to be connected with each other and every possible solution seems to have some advantages and disadvantages. However no matter which solutions are chosen to be implemented, the most important thing is that there is clarity for all parties on how cooperative learning is used and which goals should be reached.

Note:
This research was conducted on a small scale, the results are interesting for the development and implementation of cooperative learning in mechanical engineering education at the university of applied science in Utrecht. The results are pretty similar to what is mentioned in literature, it is therefore likely that the same issues are relevant for other educational programs. However, I would recommend to examine the specific situation before using the results of this study.

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7. Appendices

Appendix A: Planning

In paragraph research method the different phases of the research are elaborated, these phases are the basis of the timeline. In table 2 the different phases and their outputs are given.

In the last column the deadlines are given, these deadlines are feasible because they are based on the researcher's agenda. The planning assumes that the researcher weekly has two days to execute the research, therefore some phases go through a long period of time. Important outputs are the formulation of the research question, the approval of the ethical committee, this research proposal, the collected data, conclusion and the thesis accompanied with the final presentation.

Phase	Activity	output	Deadline
1.1	Problem orientation HU		21-3-2014
1.1	Problem orientation Literature study		16-05-2014
1.2	Formulating research question	Research question	25-4-2014
2	Selecting research method		4-4-2014
3	Selecting sampling method and selection participants		18-4-2014/ 20-6-2014
3	Approval ethical committee	Approval	9-5-2014
3	Writing research proposal	Research proposal	29-8-2014
4	Developing Students survey	Survey	30-5-2014
4	Developing Teacher Interviews	Interview structure	22-8-2014
4	Execution Students survey		13-6-2014
4	Execution Teacher Interviews	Collected data	1-2015
5	Transcript teacher interviews		2-2015
5	Coding transcripts (teachers and students)	Coded data	3-2015
5	Analysing and Clustering information		4-2015
5	Connecting data with literature		7-2015
5	Draw conclusions and recommendations	Conclusions	7-2015
6	Writing thesis	Thesis	7-2015
6	Hand in thesis		9-2015
6	Green light conversation		
6	Preparing presentation		
6	Presentation	Presentation	

Table 2: activities and deadlines

Appendix B: Instrument teacher interview

Handvat interview docenten

Onderwerpen die aanbod moeten komen:

- Waarom groepswerk
- Problemen
- Beoordelen
- Begeleiden

WAAROM (+/-10 min)

Wat is volgens jou de belangrijkste reden voor groepswerk?

- Waarom werken we in groepjes?
- Wat is het doel?
- Welke vaardigheden zijn belangrijk in groepswerk?
- Is er/Wat is het verschil tussen groepswerk in jaar 1 en in jaar 4?
- Zijn de projecten geschikt als groepsprojecten?

PROBLEMEN(+/-30 min)

- Wat vind je leuk aan het begeleiden van groepen?
- Wat vind je lastig aan het begeleiden van groepen?
- Wat heb je meegemaakt aan problemen?
  Welke problemen zie je vaak?
  Hoe ga je om met problemen?
- Wat maakt een groep een goede groep?
- Wanneer is een groep effectief?

BEGELEIDEN (+/- 10 min)

- Wat voor soort begeleiding vraagt groepswerk volgens jou?
  Zijn er verschillen in begeleiding tussen collega's?
- Wanneer zijn studenten het meest gemotiveerd?
- Wat doe je om studenten te motiveren?
  BEOORDELEN(+/- 10 min)

Wat beoordeel je bij groepswerk? (proces/resultaat/…)
Beoordeel je de groep of individuen? Wat is volgens jou het beste?
Vind je dat studenten een stem in de beoordeling moeten hebben?

Hoe ziet het ideale groepje er volgens jou uit?
Wanneer leert een groep het meeste?

Appendix C: Instrument student questionnaire

Beste (NAAM),

Zoals je misschien wel weet ben ik naast docent aan de HU zelf ook aan het studeren. Ik ben bezig met het afronden van de Master Educational Science and Technology (onderwijskunde) aan de Universiteit Twente. De afronding van deze studie bestaat uit het opzetten en uitvoeren van een onderzoek. Dit leek mij een mooie kans om een onderzoek te doen binnen werktuigbouwkunde om zo een bijdrage te kunnen leveren aan een betere studie en leeromgeving. Mijn onderzoek wil ik graag gebruiken om te inventariseren hoe groepswerk wordt ervaren door studenten en docenten en met behulp van literatuur een verbeterslag te kunnen maken.

Om dit goed te kunnen doen ga ik verhalen van ervaringen van studenten en docenten verzamelen en analyseren. Dit is waar ik jouw hulp bij nodig heb. Het is een kwalitatief onderzoek, dat wil zeggen dat ik niet op zoek ga naar gemiddeldes maar dat ik op zoek ben naar ervaringen van studenten waar ik informatie uit kan halen.

Mijn vraag aan jou is: Wil je de vragen die hieronder staan beantwoorden en naar mij terug sturen?

- Wat vind je leuk aan het werken in een projectgroep?
- Wanneer is een groep volgens jou een goede groep?
- Wat zijn volgens jou de grootste problemen die voorkomen bij het werken in een projectgroep?
- Wat moet er volgens beoordeeld worden bij groepsprojecten en wat moet er eventueel meewegen?
- Zijn er nog andere ervaringen die je met mij wilt delen met betrekking tot het werken in groepswerk?

De antwoorden zullen anoniem verwerkt worden, alleen ik zie je naam in je email staan. Mocht je wel graag meewerken maar wil je dat ook ik je naam niet weet kun je je antwoorden in mijn postvak leggen of in de inleverbox bij het Stip gooien.

Op 20 juni wil ik graag de antwoorden gaan verwerken, zou je je antwoorden uiterlijk 19 juni willen opsturen?

Heel erg bedankt voor je antwoorden, dit helpt mij goed verder!

Met vriendelijke groet,

Suzan Bosveld

Appendix D: Approval of committee of ethics

Geachte onderzoeker,

Dit is een bericht vanuit de webapplicatie voor de aanvraag van de boordeling van een voorgenomen onderzoek door de Commissie Ethiek.

Aanvraagnr.	: 14241
Titel van het onderzoek	: Problemen in groepsonderwijs
Datum aanvraag	: 05-06-2014
Onderzoeker	: S. Bosveld
Onderzoeksbegeleider	: E.J. van Rossum
Lid Commissie Ethiek	: G.J.A. Fox
Gebruik SONA	: Nee

Uw onderzoek is goedgekeurd door de commissie.

Appendix E: Data analysis

In deze anonieme versie zijn is de data-analyse verwijderd ivm privacy redenen.
Bij interesse neem dan contact op met de schrijver.