

Group dynamics — an integrated part of engineering projects

Johan Bankel

Chalmers University of Technology,
Mechanical engineering programme
Gothenburg, SWEDEN

Lennart Persson

Professional Psychologist
Licensed Psychotherapist
Linnéstadens Psychotherapy Institute
Göteborg, Sweden

ABSTRACT

Since spring 2006 the Mechanical engineering programme has used group dynamics as an integrated compulsory part of the first three years in the five-year programme at Chalmers. It has been an integrated part in the annual one-semester project every year of the programme.

The spirit has been that the same group of teachers should be conducting the group dynamics teaching each year and monitoring the progression of the student skills of handling different types of issues that occur during the work in these three one-semester projects in the programme. The setting for the projects has been slightly different for each year of the programme both in the context, the selection of member as well as the size of the groups.

The supervisors have also been working in a different context both in complexity and number of parallel projects supervised. The third year project (thesis work) also has an extra tensing issue, to grade each student in the group on individual efforts made in the project work.

This report will not only reflect on students' and supervisors' views of group dynamics, but also include reflections from the teaching group and the programme team.

Relevance – What is needed for a supervisor to change group behaviour in a malfunction project group when there seems to be conflicts that are unsolvable? A Professional Psychologist or can the supervisor guide the group to become functional? The report will present a short checklist of key questions to help supervisors to guide group members to improve their collaboration.

Submission Category - paper presentation - Professional development of faculty.

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BACKGROUND

All engineering students might not have seen the full potential of working in groups or in teams. The similarity to working in a group and to a journey can be striking and the travelling is for some a highway in bright sunshine and for others it's a gravel road with lot of dust and difficulties. But the situation on the highway can change quickly due to heavy rain or cold weather. We want therefore prepare our students for all types of weather. The experiences of work in a group can vary from student to student and can also be different from pre-engineering studies and during engineering studies. The learning process is though an individual on-going process and can be both strengthen and challenged in a group. Most students will find their own study groups where they can both flourish and prosper during their engineering studies. The students themselves usually form these groups. Sometimes they will last during the whole engineering studies, but they can also last only for one certain course. The formation of the group is voluntary based and it's the key issue. The grouping is based on both their own preferences and opinion of the work. During a professional career you can seldom choose your own members in your team and therefore it is important that you are prepared to work effectively with all types of team members. To challenge the students opinion of working in a group we think it is important that these challenging issues last at least one semester otherwise we don't think the impact is strong enough in the view of group dynamics. The amount of project time used varies from 25% to 50% of full times studies for the current project courses in the programme.

INTRODUCTION

In the revision 2004/2005, in the context both of the CDIO-initiative [1], [3] and the Bologna process [2], the mechanical engineering programme at Chalmers introduced three core project courses, see table 1 grey shaded squares. The projects are operated as a group task and the group size is between 4-5 students during the first two years of the programme and the size varies between 3-6 students during the third year. The third year project sometimes consists of members from other third year engineering programmes, though not in majority. The group might then be more of a team instead of a group. We are using the definition of a group to have only members with the same educational background and a team including students from other engineering programmes. The three courses have several objectives and among those there are also goals including both communication and group dynamics. Their mission are to Introduce (I), Teach (T) and Use (U) [4] group dynamics during these three first years in the programme.

TEACHING GROUP DYNAMICS EMBEDDED IN PROJECT WORK

The spirit, to integrate group dynamics during project work, is more or less, that when the need will arise the support will be there. It makes it possible to both

practice and learn at the same time, a "just-in-time" system. In practice this is not possible for classes of 150 students. The teaching has to be on a more scheduled basis, at least for the perspective of the teaching staff. This might not be the optimum in the learning context, but more feasible. The teaching of group dynamics will both cover the structure and supporting tools in a more general view of group dynamics instead of the specific tools needed when difficulties arise in a group. Even after tools have been taught or practised, it is not that easy to diagnose your own group and the malfunction of it. The supervisor should or will then play the crucial role of a catalyst of group dynamics tools in order to turn the group into a more working and less malfunction group. The supervisor is probably the key factor of success in changing group behaviour to something positive instead of something negative.

Table 1 Programme plan 2011/2012 for the three first years of the five-year Mechanical Engineering Programme at Chalmers.

Year 1, Quarter 1	Quarter 2	Quarter 3	Quarter 4
Programming in Matlab 4.5ECTS	Calculus in a single variable 7.5ECTS	Linear algebra 7.5ECTS	Calculus in several variables 7.5ECTS
Introductory course in mathematics 7.5ECTS	Computer aided design (CAD) 4.5ECTS	Statics and solid mechanics 7.5ECTS	Solid mechanics 7.5ECTS
Introduction to mechanical engineering 7.5ECTS			
Year 2, Quarter 1	Quarter 2	Quarter 3	Quarter 4
Mechanics - dynamics 7.5ECTS	Machine elements 7.5ECTS	Thermodynamics and energy technology 7.5ECTS	Industrial production and organization 6ECTS
		Integrated design and manufacturing 7.5ECTS	
Engineering materials 7.5ECTS	Material and manufacturing technology 7.5ECTS	Sustainable product development 4.5ECTS	Industrial economics 4.5ECTS
Year 3, Quarter 1	Quarter 2	Quarter 3	Quarter 4
Mechatronics 7.5ECTS	Automatic control 7.5ECTS	Bachelor diploma project 15ECTS	
Fluid mechanics 7.5ECTS	Elective 1 7.5ECTS	Elective 2 7.5ECTS	Mathematical statistics 7.5ECTS

IMPLEMENTATION

The integrated activities consists of lectures, seminars, group tasks and exercises where the lectures are for the whole class and during the seminars the students are divided into smaller groups consisting of a number of project groups.

The activities aims to integrate both theory and practice, relate to students' past and present experiences in group dynamics, cooperation, conflict, etc.

EXERCISES

The practice of exercises is based on experiential learning. Some exercises are aimed at analyze aspects of cooperation by solving a group task. Some information has been provided as non-verbal solving others by verbal communication.

Another aim is to make group members more aware of how their own behaviour can help to facilitate or impede the resolution of common problems. Making group members aware of how the group handles frustration, for example, by group regression where the group abandons purposeful and work-oriented activities.

Students are given roles as observers of group exercises.

The purpose of this is to practice the observation of processes in smaller groups, and to have experience from the process of communicating the observations (feedback) to a group or in other words: to practise peer response.

Other exercises have been problem-based and served to:

Investigate the exchange of information in a work-focused group and focus attention on cooperation during group problem solving.

In the exercises the student has the instruction to observe how leadership behaviour emerge during group problem solving

They can see and experience that roles and subgroups arise during problem solving and see how decisions are made in groups under different conditions and requirements, for example, during time pressure or demands for consensus.

Additional training were meant to improve the students skills in giving each other positive and negative feedback in structured form, how the students perceive the other group members and how they work, behave and cooperate in the group.

The purpose of this was to help each other in personal development, and facilitating group development.

The purpose was also to make the students aware of the strength of providing feedback and receiving feedback and to make this a recurring activity and tool for personal and group development and growth.

The aim for students is to gain experience in reflecting upon their own self-image,

how you think others perceive me in the group, my view of others in the group and others' image of me in the group.

They were also asked to discuss in the groups how they affect others and how others affect themselves.

In connection with this individual feedback, the groups also had to implement "process talk" for instance, the individual feedback has been discussed, and talking about the received feedback in the group, the latter has though been voluntary.

The process talk has been work-related and relationship-related issues, i.e. both in conversations among group members about conditions related to the work to do and also talk about conditions related to the interaction, relationships and feelings between the group members.

Questions that have been discussed in project groups are:

- what do you expect and want from this group?
- how do you want the group to act so that you can feel free and safe. For example:
 - * what will you deal with, what is your task?
 - * how shall we relate to each other?
 - * how shall we communicate?
 - * how to handle practical issues?
 - * how to handle time, absence from the group?
- how to receive and give feedback?
- what is your preferences around process talk / meta-communication?
- how do you want to contribute to the group?
- what are your strengths in group work?
- what are your weaknesses in group work?
- what help do you want from the group?
- how do you perceive how you influence others in the group?
- how to be influenced by others in the group?

Additional issues that are important to both consider and discuss are:

- what present problems do you feel that this group has?
- how is it expressed?
- why do you think this group has this problem?
- Is there anything that prevents you from being as effective as you would like to be in this group?
- what is the best about this group?
- what must be done to the group to work even better?
- what can be done to prevent future problems?
- what must be done so that you can work even better?
- is everyone happy with the results?
- should something be changed?
- how decisions are made?
- does it work well?
- can anyone come up with his or her contributions?

The main purpose of this is, that the students through exercises learn something that they can have personal benefit of, in the present group, both in situations and its organization. This should also facilitate and streamline the group and the group member's work.

DISCUSSION

During and after all types of activities there are always some aroused drawbacks, it could be misconceptions, change of handling opposite of the original purpose or other types of less wanted effects. Even if, in this case, most group members are well aware of group dynamics and can use tools to prevent some malfunction group issues, there must be a facilitator of help, at first hand, the supervisor. Supervisor's awareness of group dynamics differs [5] but all have to relate to the performance of their groups. Supervisors have different styles in their supervision but not only, but also different needs of feedback (monitoring level) from their groups. When supervisors discover or receive indications of less good performance in their groups, the level of malfunction is related to their own style of supervision and monitoring level. The group itself can usually handle most malfunction issues after the group members have received feedback. In the case where there is a strong positioning of different views in the group, a useful method to use is to make the group start to reflect upon the problems. Each member should answer a number of questions like: how does this group work (function)? What type of problems do you think this group has? How is that expressed? Why do you think this group has these types of problems? How do you want this group to work (function)? What makes you less effective in relation to what you want? What is best with this group and why? What has to be done in this group to make it work better (function)? What has to be done, so that you can work better in this group? The sequence of questions is important and takes each member in the group from an objective view to a specific view of performance and reflection. Each question should be addressed and discussed in order to find a solution or a working model to tackle the problems. There might take several of meetings until most of the problems have been handled.

Most problems that occur, working in groups, are of course the lack of clear goals, unclear communication and blurred structure. There are some key themes that the students discussed as important for the work in the group and these are:

- the importance of frames for the group's functioning. That means, for example,
- the importance of to have a structure about time, place, people, and what rules to apply in the collaboration.
- the structure guides the group's cooperation to verbalization, symbolization and work.

Further important aspects that have been discussed are:

- that objectives and goals of the group's work are clear.
- that the roles of team members are clear and constructive.

- that the rules and standards for how the cooperation is going to be is clear.
- that the decision rules are clear.
- that the feedback procedures are clear.

CONCLUSIONS

There have been expectations that knowledge of group dynamics and group processes and reflection on one's own group and self-awareness raises the possibility that the group can act in a constructive manner and reduce the risk of destructive processes in groups.

It has become clear that when students have been able to abstract and symbolize their own group process they have been able to create a distance to the events which means that they have been able to handle situations in a constructive manner. Participants will gain in this way not only to react affective but can also use their analytical skills to handle a situation that has arisen. They have been able to regard the group from a different perspective. This perspective, the movement in perspective, is a prerequisite for constructive handling of problem situations and conflicts.

Students, giving each other positive and negative constructive feedback (peer response) on their way of being and working in the group, have had the effect that this had improved their functioning in the group. They have also been very motivated to implement this method.

This has led to a greater cohesion and efficiency of the group. They have learned to formulate an idea of their own ability and their own barriers for further development. The aim is to use the group as a resource for personal development. This exercise is performed within a fixed structure.

Although meta-conversation about the group's functioning as a whole has led to constructive discussions on the objectives, methodology, roles, norms, and leadership. They have taken up the conflicts in the group and discussed the causes and how to address them. They have gained knowledge of how conflicts arise and how they can be prevented. They understand that you do not need to love each other to work together.

The aim has been that this method, that through reflection and abstraction of the group's functioning and the group members own role in that group, is implemented as a structured tool in the group work.

The students were very motivated to understand the unconscious processes in groups and have been very open with their own thoughts and feelings in this knowledge work.

An overall conclusion is that if the group and group members can understand the importance of group dynamic concepts and draw conclusions from them, leading to an executive in the group, the group may dedicate their efforts to what is their purpose, which is labour.

THE FUTURE

It is desirable to ensure the continued implementation and constructive group processes a greater quantitative effort is desirable.

That means a frequent recurrent training method for meta-conversation and reflection, a frame of both sequence and progression.

A qualitative investment in supervisor training is important, so that supervisors can understand and manage group dynamics and psychological processes of groups and individuals during their supervision. This may include theoretical studies and guidance on the supervision of experienced supervisors.

The medical education in Gothenburg has now begun to introduce feedback in focused group talk during the physician education.

The introduction of a reflective approach in education has great potentials to make an impact in later work when it becomes a natural approach to groups and organizations in general.

This is especially valuable since many of the students at Chalmers may be in a management position, where competence in group and team dynamics as well as self-knowledge is a prerequisite for a good group climate, group effective functioning and to get a sanctioned leadership.

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APPENDIX

GROUP DYNAMICS OBJECTIVES

The learning objectives or purpose of training group dynamics has been to create opportunities for the students to learn about groups and group functioning, to understand various group processes and how they are manifested in the group. A partial goal is to understand and recognize different group theoretical concepts as for example a regression in groups and group defences.

A further goal is to understand the meaning of the frame concept and its impact on group process and group dynamics.

It is further important that the students comprehend and recognize the existence of different types of groups with different conscious and unconscious purposes and under what circumstances they are created. This is in line with the ability to be able to identify constructive and destructive group processes.

To build a stable structure in groups its important to understand and identify role-taking and role assignment processes as well to as make norms visible and conscious.

It is useful for students to see that there are different types of leadership and to see the interplay between leaders and group.

As in all human interactions it is of great value to understand the importance of communication for the group's functioning, both verbal and nonverbal communication and get knowledge of what facilitates or impedes communication within a group. You cannot escape being affected and affect others in a group and the more knowledge and skills you have to identify processes in a group the higher your chance is to resolve conflicts in a group and between groups.

An important goal is further to gain an increased self-awareness of own strengths and weaknesses, and how they as individuals influence the interaction of the group.