

Learning to Collaborate in Student Project Teams: Tools and Processes

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ABSTRACT: *Engineers need to be able to collaborate. Student projects, therefore, typically have two groups of learning goals in addition to the goal of producing a technical product of some kind: a) The acquisition of technical skills and knowledge, and b) the development of project management competence and collaboration skills. A host of tools and methods exist for meeting the technical and the project management challenges, and they enjoy the status of being "objective" and applicable everywhere. The situation is far worse when it comes to tools and methods for acquiring and applying collaboration skills. Under these circumstances, it is only natural that development of team collaboration skills is neglected in favour of more substantive tasks that can be addressed systematically.*

The aim of the present paper is to explain a kit of tools and procedures that may be employed by student project teams and their tutors for promoting the development of collaboration skills. It consists of two modules, one of which deals with the improvement of the processes of the team, whereas the other one is devoted to the development of the individual team members. Although it is preferable to address individual as well as whole team development, significant benefits may be obtained even in cases where one decides to use only one of the modules. This may be desirable for economical reasons or practical ones, such as the amount of time available or the competence of the tutor. The paper also presents the results of a pilot study conducted at Oslo University College that provide provisional indications that the tools and the procedures promote the functioning of the team and the collaboration skills of the team members.

1 INTRODUCTION

Student project teams may encounter many difficulties. One of them is the serious and widespread problem of "free riders", causing loss of team productivity and morale, and harming individual learning. However, even when there are no free riders, membership in a project team is no guarantee that the members will acquire or improve their ability to cooperate and communicate with each other. Such learning, like learning more generally, will depend on the events that happen to the team members or that the team members cause to happen. And importantly, it depends on how the members perceive and think about what happens, how they talk about it, and how they choose to act in response to it. For example, if the team never finds the occasion to review its results and work methods in order to improve performance, its results will suffer and so may perhaps the relationships among the team members. Further, if the members fail to detect harmful events, actions, or inactions, or if they explain them in terms of stupidity, evil intentions, or factors beyond the control of the team, the team or its members may remain passive, react aggressively, or opt for some other unproductive course of action. Therefore, to ensure that learning of collaboration skills take place, tutors need to influence and monitor at least one and preferably all of the various determinants of such learning.

The aim of the present paper is to explain a kit of tools and procedures that can be employed by student project teams and their tutors for promoting the development of collaboration skills. The kit addresses the problems and concerns mentioned. That is, it helps to define occasions for useful team activities to take place, and it serves to structure those activities so that they result in actions that focus on the important problems and that are likely to be effective.

The kit consists of two modules, which may be applied alone or together depending on needs and available resources. One of the modules deals with the improvement of the results and the processes of the team viewed as a system. The other one is devoted to the development of the individual team members. Although it is preferable to address individual as well as whole team development, significant benefits may be obtained even in cases where one decides to use only one of the modules. This may be

desirable for economical reasons or practical ones, such as the amount of time available or the competence of the tutor.

The paper presents the results of two pilot studies conducted at Oslo University College that provide provisional indications that the tools and the procedures promote the functioning of the team and the collaboration skills of the team members.

2 METHODS

The results reported in this paper rely on two groups of methods. First, knowledge from psychology and widely accepted principles of quality development has been used to develop the forms to be filled in by the team members in various phases of the project. Such knowledge also informs the way in which the use of the forms is explained to the students and how the forms are used in the team process. Further, the knowledge underlies the overall structure of the collaboration learning process and its individual parts, such as the agenda of the meetings, how they are being conducted, and the nature of the preparations for meetings as well as the follow-up activities. This knowledge derives from a vast body of literature in learning, cognition, and motivation. It has to do with, among other things, cognitive capacity limitations, occasion setting, control of attention, the importance of making one's own choice, and the role of action planning, feedback, outcome explanation, and action revision in learning processes and quality development.

Second, the provisional assessment of the efficacy of the system of learning support outlined in the paper uses students' responses to a questionnaire asking the students to assess the usefulness of various aspects of this system. The reasons I refer to these studies as pilot studies include: The poor response rate in one of the two studies, the fact that the students in the second study made their assessment after having finished only one third of the project period, and more general concerns regarding the validity and reliability of such assessment responses.

3 TEAM SKILLS AND MEMBER SKILLS: THEY DEPEND ON EACH OTHER BUT THE TEACHER NEEDS TO BE ABLE TO VARY EMPHASIS

Team skills include the ability of the group to set shared goals, to plan, allocate responsibilities, and prevent or resolve conflicts. Examples of member skills are willingness to take one's share of the work, to listen, to voice one's opinion, to provide constructive feedback, and to take initiatives for action. Clearly, the team skills depend on the skills of the individual. For example, the team's success in preventing or resolving conflicts will reflect the individual member's readiness to take his or her fair share of the work and his or her ability to listen.

Despite such functional dependencies, I have found it helpful to design and implement two distinct versions of a system for supporting the team's development. The "full" version includes a module whose explicit focus is on the team as a whole as well as a module focusing on the individual members. The "light" version consists of the team module only and thus do not explicitly address the behavior of each member separately. The light version is the "cheapest" one in terms of the time and skills required by the tutor and, to a lesser degree, in terms of the time spent by the student. In any concrete case, therefore, the choice between the two versions will be a matter of the resources that the tutor and the students are able to devote to developing team skills and individual skills. Cf. below.

4 AN OVERVIEW OF THE TEAM PROCESS

The logic of the process conforms to the usual loops of quality and goal directed learning: Planning what to do, doing it, assessing and explaining the results, planning new action etc. The process is summarized in Table 1 below.

Table 1. An overview of the team process.

Phase Version	Start	Assessment 1	Later assessments according to need	Final assessment
<i>Full</i> (focus on team + members)	<ul style="list-style-type: none"> • Group exercise • Collaboration agreement 	<ul style="list-style-type: none"> • Team improvement report • Each member's self assessment • Team meeting with tutor • Each member's personal improvement plan 	Same as assessment 1 but briefer. Main focus is on follow-up of earlier improvement plans of the team and the members	Focus on the whole process from project start to finish. Focus on transfer of learning to new projects
<i>Light</i> (focus on team)	<ul style="list-style-type: none"> • Collaboration agreement 	<ul style="list-style-type: none"> • Team improvement report • Feedback by e-mail from tutor • Brief team meeting with tutor if the team feels a need for it 	Same as assessment 1 but briefer. Main focus is on follow-up of earlier team improvement plans	Focus on the whole process from project start to finish. Focus on transfer of learning to new projects

I have practiced the full version of team support system with small classes totaling 15-20 students divided into 4-5 teams, whereas the light version has been applied in large classes up to about 130 students organized into approximately 30 teams. In both cases I was the only tutor. In the full version, the teams have performed two assessments during the project work (after 1/3 and 2/3 of the project period) in addition to the final assessment. In the light version of the support system, only one assessment (before midterm) has been conducted, plus the final assessment. I shall comment briefly on each of the major phases of team process support outlined in Table 1.

5 STARTING THE TEAM WORK

The purpose is to lay the foundation for collaboration by defining and agreeing on aims and principles. This is hypothesized to raise the consciousness of the members of why and how to cooperate in a productive way, to increase motivation and commitment, and to prevent and solve conflicts. In the full version, the team process starts with an exercise designed to highlight the potential usefulness of teamwork and the possible obstacles that need to be overcome. The students work on a certain task, first alone and then together as a team. The results are scored, presented, and discussed, and the students draw conclusions in terms of team advantages and team challenges. Approximately 2 lecture hours (2x40 minutes) are used for this.

Next, the members of each team work out and sign a collaboration agreement. They do this by filling in a one-page form (cf. Annex 1) that has been presented to them by the tutor. The form has been discussed by the students and accepted by them as meeting the challenges of teamwork. In the light version the collaboration agreement is the only start activity.

6 FOLLOWING UP THE TEAMWORK: CONSTRUCTIVE ASSESSMENT

The teams are required to assess the results and the team process so far, to explain failures and problems, and to make a plan for actions that may improve the situation. This is done by filling in a one-page form (cf. Annex 2) that embodies the logic of the improvement process in a way that is easy to grasp. The two major challenges for the team in this work is:

- To describe the causes of a problem in terms of concrete actions that the team or its members have taken or failed to take. There is a strong tendency for the group to assign causes to external events that

they think they cannot influence. Or, if they describe actions, they do it in such vague or general terms that they are of little help. In both cases, the team renders itself impotent to improve things.

- To make the action plan concrete and realistic. It should respond to the causes identified, and specify responsibilities and deadlines so that it can and will be executed.

The major struggle of the tutor is to help the teams meet these two challenges, i.e. to empower the groups to detect and assume responsibility for their problems.

In the full version of the process, the individual team members are required to prepare for an improvement meeting by filling in a questionnaire (cf. Annex 3). They are asked to indicate their degree of agreement with each of 9 assertions referring to individual behaviors relating mainly to various aspects of communication that are important to team functioning. Importantly, they are instructed to view their own behaviors from the perspective of their fellow team members. In collaboration, the ability to see things from the point of view of others is vital.

The participants in the improvement meeting include the team members, the process tutor and tutors within specific fields of engineering. The latter tutors, who serve as advisors or supervisors, are also in a cooperative relationship with the group. They are therefore asked to fill in the same questionnaire before the meeting. The meeting takes place within a carefully specified framework of procedures and rules designed to ensure that the meeting meets its objective and that stress and risk are minimized for the participants. The main objective is that each participant leaves the meeting with his or her personal improvement plan. The plan specifies actions that the participant is determined to undertake in order to improve the way he or she contributes to the team. The present paper does not allow a detailed account of the process during the meeting. The major part of the meeting consists of informing the others about one's responses to the various assertions in the questionnaire and receiving feedback from them. Reasons for responses are provided and discussed. The participant in focus ends the discussion by assessing if a change in behavior would be desirable. If yes, he or she judges if such a change is possible and if he or she is motivated to undertake it.

Overall, the nature of the improvement meeting is such that it is advisable as a tutor to have some background in psychology including therapy. One needs to know what one is doing and why. The sensitivities and the self-confidence of the participants are involved, and damage may be inflicted if the process is not handled properly.

In terms of time costs, improvement meeting 1 has typically lasted for about 1.5 hours. Groups with larger problems require more time, in one case more than 2 hours.

7 COMPLETING THE TEAM WORK: CONSTRUCTIVE FINAL ASSESSMENT

The major difference between the final assessment and the assessments conducted during the project period is the need for the improvement plans to refer to behavior in future projects with different participants or to what one would do if one could redo the project from the beginning. Moreover, the final assessment must take into account the experiences of the team and its members over the whole project period, including the way the assessments have been conducted and followed up.

8 DOES IT WORK: THE EXPERIENCES SO FAR

The setting. The full version of the team support system is currently (spring semester 2004) being tried out in a multi-national class of 16 third-year students at the Oslo University College, Faculty of Engineering. The students attend a one-semester course referred to as the European Project Semester, and all lessons and written and oral communication are in English. Depending on their interests, the students have been assigned to four project teams with members from different countries. In the course of the semester they are expected to carry out a real-world project on a technical task that has been commissioned by a company. The company provides a supervisor, and the faculty provides the team with a tutor with the relevant technical expertise.

The pilot study. Each student was asked to make an anonymous assessment of the team support process so far on March 14, 2004, with only about one day to respond. Team formation started about 5 weeks earlier, but work on the projects had started only recently because of a lot of introductory lectures in various subjects believed to be necessary background knowledge. The questionnaire is reproduced in

Annex 4. 11 of 16 students responded, which gives a response rate of 69%. Table 2 summarizes the responses.

Table 2. Students' assessment of team support: Summary of responses

Process element	Your assessment so far					Sum	Mean score
	Totally useless 1	Mostly useless 2	Somewhat helpful 3	Quite helpful 4	Very helpful 5		
1. Moon-landing exercise	0	0	3	5	2	10*	3.9
2. Collaboration agreement	0	2	4	3	2	11	3.5
3. Team improvement report	0	1	4	3	3	11	3.7
4. Individual self-assessment	0	0	4	4	3	11	3.9
5. Improvement meetings	0	2	0	4	5	11	4.1
6. Total process support so far	0	0	5	6	0	11	3.5
Sum	0	5	23	29	20		3.8

* One of the 11 respondents arrived to late to take part in the exercise.

Discussion. One of the problems of using questions with graded response scales of this kind (Likert scales) is the well-known tendency for respondents to avoid the extreme categories and seek toward the moderate ones. This tendency may not be immediately evident from the data in Table 2. During the improvement meetings, however, a strong and explicitly voiced aversion was manifest among most students to use the extreme categories, including the most positive response of 5. This was true both when they stated their self assessments and when they gave feedback to another member of the team. They were unable to offer any other reason for not saying 5 than the general assertion that “things can always be better”. Apart from the assessment being performed in an early phase of the project, there are also a number of other problems with this way of assessing the usefulness of a team support system. Space considerations do not permit a discussion of these.

If we take the data at face value, they seem to offer a reasonably positive indication that the system has been helpful in the initial phase of the project. There is no space for discussing the details.

A similar pilot study with a response rate of only 22% was carried out among 116 first-year students towards the end of the fall semester 2003. The teams had completed their projects and had received the light version of team support. The results offered similar positive indications but do not merit further discussion here.

9 CONCLUSIONS

Student assessments and personal experience as a tutor to student project teams offer preliminary indications that both the full version and the light version of the team support system are helpful. However, there remains uncertainty as to how effective they are relative to the zero option of no team process support at all or any other specified way of supporting the team. We lack precise information about what works and why it works. There is a need to follow up the present pilot study throughout the project period including the final assessment. There is also a need for more “objective” experimental studies that permit comparison of various ways of promoting the development of team collaboration skills.

Project:	Group / Members:	Date:
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COLLABORATION AGREEMENT

1 Level of ambition

With regard to: The quality of report. Learning. Other things

2 Investment of time and effort

How much time? Willingness to put in extra effort if needed? Equal contributions from all members (within differing individual limits)?

3 Leadership and organization

Leader or not? Roles / division of responsibility? Quality assurance?

4 Mutual help and support

5 Communication

About what? How?

6 Social climate

Attitude to each other? Attitude to the tasks? Attitude to frustrations? Shared social activities?

7 Accountability

Attitude to agreements? Consequences of failure to meet an agreement?

Date:

Signatures:

Group / Subject:	Members:	Date:
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IMPROVEMENT REPORT

Which are the group's achievements and resources?

WHAT HAS THE GROUP TACKLED *WELL*?

CAUSE

What does the group itself want to *improve*?

**WHAT HAS THE GROUP
TACKLED *LESS WELL*?**

CAUSE

ACTION

**HOW CAN THE TUTOR/THE UNIVERSITY *SUPPORT* THE GROUP'S
WORK IN A BETTER WAY?**

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Tutor's comments:

Annex 3

IMAGINE THAT YOU SEE YOURSELF FROM THE POINT OF VIEW OF
THE OTHER GROUP MEMBERS:

HOW WELL HAVE YOU PERFORMED AS A MEMBER OF THE GROUP SO FAR?

**I HAVE BEEN KEEN TO TAKE MY PART OF
THE JOB**

Absolutely not - - - - - to a large extent
1 2 3 4 5

**I HAVE CONTRIBUTED TO EFFECTIVE USE
OF THE TIME AND RAPID PROGRESSION IN
THE WORK**

Absolutely not - - - - - to a large extent
1 2 3 4 5

I HAVE BEEN A GOOD LISTENER

Absolutely not - - - - - to a large extent
1 2 3 4 5

I HAVE TAKEN INITIATIVES FOR ACTION

Absolutely not - - - - - to a large extent
1 2 3 4 5

I HAVE COME UP WITH NEW IDEAS

Absolutely not - - - - - to a large extent
1 2 3 4 5

**I HAVE RESPONDED CONSTRUCTIVELY TO
THE IDEAS AND INITIATIVES OF OTHERS**

Absolutely not - - - - - to a large extent
1 2 3 4 5

**I HAVE VOICED MY TRUE OPINION AND
ENCOURAGED OTHERS TO DO THE SAME**

Absolutely not - - - - - to a large extent
1 2 3 4 5

**I HAVE GIVEN POSITIVE FEEDBACK TO
OTHER GROUP MEMBERS**

Absolutely not - - - - - to a large extent
1 2 3 4 5

**I HAVE PROVIDED ASSISTANCE AND
ENCOURAGEMENT TO OTHER GROUP
MEMBERS WHEN THEY NEEDED IT**

Absolutely not - - - - - to a large extent
1 2 3 4 5

For every assertion: put a cross at the number you think most appropriate for the others' assessment of your contribution to the group so far.

EPS team process:

How do you assess the support you have received so far?

The process support provided by Reidar Kvadsheim in connection with the project work includes a variety of activities and tools. When you have completed the project in June you will be asked to assess the totality of the support your project team has received throughout the project period. However, it will be helpful at this stage to know how each group member feels about the process support you have received until now. *Therefore, I want you to make your own individual assessment of each of the process elements you have experienced so far.*

Please consider each of the process elements mentioned below and how I had hoped it would benefit the team process. Draw a circle around the number that most closely expresses your assessment of the usefulness of this element.

Process element	Intended usefulness	Your assessment so far				
		Totally useless 1	Mostly useless 2	Somewhat helpful 3	Quite helpful 4	Very helpful 5
1. Moon-landing exercise with discussion	<ul style="list-style-type: none"> Get to know each other, have fun Awareness of the challenges of group collaboration 	1	2	3	4	5
2. Collaboration agreement	<ul style="list-style-type: none"> Useful discussion and agreement on matters that are important for collaboration 	1	2	3	4	5
3. Team improvement report	<ul style="list-style-type: none"> Help the group analyze the situation in a systematic way and improve what needs to be improved 	1	2	3	4	5
4. Individual self-assessment	<ul style="list-style-type: none"> Attention to the way one's own behaviour affects collaboration Possibility for useful feedback from the other group members 	1	2	3	4	5
5. Improvement meetings	<ul style="list-style-type: none"> Helpful feedback Useful discussion Better communication Feel safer, better understanding of each other Basis for improvement 	1	2	3	4	5
6. Total process support so far	<ul style="list-style-type: none"> Improved skills as a team member Feel better in the group 	1	2	3	4	5

Your comments / suggested improvements: