Educating the engineer as a reflective practitioner who is qualified to participate in project work

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ABSTRACT: In this paper results from a longitudinal case study from Aalborg University is presented. The objective of the research was to develop and evaluate a model for supervision that was qualified for educating engineers that develop competences in projectmanagement and teamwork as well as in their profession. Theoretical the model is based on Niklas Luhmann' theory of operative constructivism and Donald Schön' theory of reciprocal reflection in action. Two examples demonstrate how the supervisor can facilitate a learning process in communication and projectmanagement as a more or less integrated part of the professional supervision. The findings from the research indicates that the students become more conscious about their way of dealing with project management and as a result of a reflective practice, they begin to experiment with different methods of management and communication within the project group. Concerning their theoretical understanding of their profession no clear conclusion can be made.

INTRODUCTION

During a problembased and projectoriented study the students are facing 3 major learning objectives. 1) They must develop themself as problem solvers. 2) They must learn how to learn though participation in projects. 3) They must learn to organize and collaborate within a project organization. A survey carried out at Aalborg University indicates that during the first 5 semesters at the engineering study, the students are having most difficulties with the third learning objective. They use a lot of time and energy to develop a project organization where the intended synergism of working together in a group actually occurs. [1], [2].

In this paper a method for supervision in the problembased and projectoriented study used at Aalborg University is developed using Niklas Luhmann's theory of operative constructivism [3] and Schön's theory of reciprocal reflection - in - action [4]. Using this approach to supervision imply that the students develop themselves as reflective practitioners. The characteristic of a reflective practitioner is that it is a practitioner that is able of solving problems in a reflective and creative manner [5], [4]. The objectives for the supervision is to facilitate a learning environment there the students can reach the tree learning objectives listed above. In this paper special attention will be giving to the development of communicative and organizational skills.

METHOD

The paper is based on a 3 semester long case study carried out as a part of a Ph.D. study. Participatory Action Research (PAR) was used to develop a coherent model for supervision and assessment in the problembased and projectoriented study at Aalborg University [6]. During 3 projects with duration's of 4 to 5 months, I was supervising the same group of students at the engineering faculty. During that period discussion with the students about the supervision was on the agenda.

THEORY

According to Luhmann's theory of operative constructivism a student can be viewed as an autopoietic system that learns by constructing still more complex understandings of his surroundings. By increasing his "system" complexity he reduce the complexity of his surroundings [3]. One result of this constructivist theory is that the supervisor cannot teach by telling the student the right knowledge. Instead the supervisor can try to perturb the students understanding by asking reflective questions. The student then have to decide to chose a new understanding that reduce the complexity coursed by the supervisors questions.

Schön's conception of reciprocal reflection - in - action describes a way of implementing a reflective communication between supervisor and students that is in accordance with Luhmann's theory [4], [7]. See figure 1. The supervisor have to participate in a reciprocal reflection - in - action by altering between the role of the expert that knows that to do and who demonstrates good examples and the facilitator who initiates a reflective dialog of the similarities and differences between his examples and the students project. The supervisor should invite the students to imitate eg his problem solving method on their own problem. It is important that it is not a blind imitation, but an imitation supported by a reflective dialog that focus on the uniqueness in every example. The student's way of imitating the supervisor's examples is an important backtalk to the supervisor about what the students understood and did not understand.

Schön' studies of the reflective practitioner was an attempt to understand why some practitioners did a better job than others.

He describes the reflective practitioner as a person who is eksperimentel and reflective throughout the working process. Schön uses the term reflection in action for such a process. Reciprocal reflection in action is a communicative process that implies that the participants are reflecting in action.
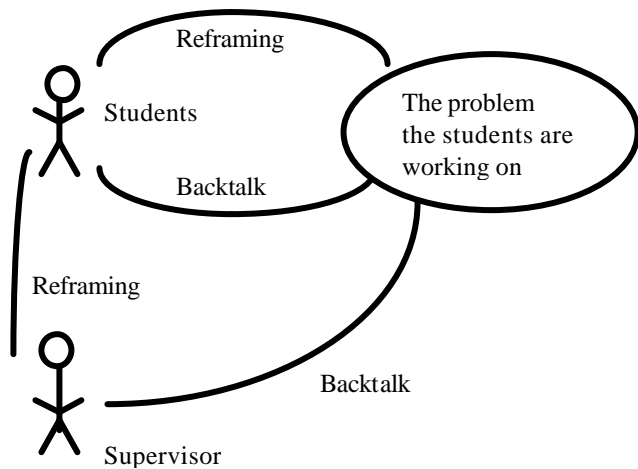

FIGURE 1. Reciprocal reflection – in - action describes a reflective communication between the supervisor and the students. The students are reflecting - in - action then they shifts between reframing their current understanding of the problem they are working on and listening to the problems backtalk. The supervisor is reflecting - in - action when he takes the students problem solving as his own problem.

EXAMPELS OF SUPERVISION USING RECIPROCAL REFLECTION IN ACTION

It is obvious that a supervisor in an engineering curriculum should be concerned with the students problem solving and theoretical understanding. But he should also be concerned with their way of communicating and organizing the project work. If they fail doing that the learning process may fail as well. The following example demonstrates that using reciprocal reflection in action the supervision, at the same time, is able to deal with theoretical aspects of importance for the actual project together with the students' ways of organizing and communicating in the group.

A supervision session with a group of 6 students, where theoretical aspects of a problem were discussed, was tape recorded in order to be able to have a succeeding discussion of the communicative environment in the project group. The supervision session began with a short presentation of possible communicative contributions to the following discussion. The used model for communicative behaviour categorizes contributions in tree categories. 1) Task-helping contributions that are helping the group getting on in the discussion. Eg by proposing a new concept, summarizing the discussion, or testing if there is a common understanding in the group. 2) Contributions that promote the communicative environment. Eg by encouraging others to participate, to follow others ideas and to be open-minded. 3) Contributions that are categorized as non-functional behaviour. Eg. Defending own position, attacking another person's position, overtalking or chattering.

After the theoretical discussion about problem solving, that was the main reason for the supervision session, the tape was played for the students. While listening to the tape the students should categorize their own contributions in accordance with the communication model precented ahead of the session. Afterwards the supervisor and the students discuss how to improve the communication in the future.

According to the model of reciprocal reflection in action it is important that the supervisor acts as a good example to be followed. The supervisor should be communicating the same way as he wishes the students to communicate. While reflecting on the communication, examples of functional and non-functional contributions should be recognized, and each student should write down in which way he or she wishes to improve in following discussions. Throughout the rest of the semester, the supervisor can, from time to time, make a short timeout during a supervision session and ask the students about the communication. Has it improved? In what way? How can it improve further?

An important learning principal in reciprocal reflection – in – action is that the learners though an ongoing reflective dialog becomes conscious about both objectives and means in the project process. In addition the students needs a model to compare with together with a demonstration of the model from an expert. In the above example a consciousness about communication is developed and compared with a model for good communication in a group. The next example will be dealing with project management.

Very often a group of students that are novices in projectmanagement will set out to agree to have a collective management where everybody makes decisions in common. They do not want a dirigent during the meetings and they have no rules for good behaviour or how to work as a team. As a supervisor it is possible to facilitate the groups development of skills in projectmanagement by asking questions like:

• Why don't you have a project leader in the group?
• How are the group organizing the project management?
• Which tasks are the management system facing?
• How are you going to organize to deal with those tasks?

Such questions initiate a discussion of the groups experience with projectmanagement. During that discussion the supervisor can present concepts of good management rules and reflect together with the students about similarities and differences compared to their own experiences. A result from such a discussion should be the student's own list of operational learning objectives.

CONCLUSION AND DISCUSSION

Though a tree semester period a group of students have worked on becoming reflective practitioners. The case study referred to in this paper indicates that in some aspects they succeeded. According to the task of developing a reflective and eksperimentel projectorganization, they succeeded. Throughout the period they developed an organization that responded quickly and accurately to disturbance from both within the organization and from outside. In that way whey developed a

functional learning environment for their studies. It should be stressed that this is a requested competence in many project-oriented companies.

When it comes to understanding the theoretical aspects of the curriculum, the case study do not show any significant difference compared with other groups of students. Though an important result is that their understanding of the relation between the practical and theoretical parts of the project, is better than usual in similar study projects. This could be related to the reflective dialog in reciprocal reflection in action, there similarities and differences between several examples are reflected and related to theories.

In order to put reciprocal reflection in action into practice, the supervisor must be an expert in all aspects of the learning objectives set up for the students. He must be a reflective practitioner himself. He must be competent both in the theoretical and practical aspects of the profession the students are studying. In addition he must be an expert in project management, in theory as well as in practice. Well - I am not. This may be a major criticism against the model for supervision described in this paper. If you as a supervisor wants to experiment with reciprocal reflection in action – Go ahead, but be aware of possible limitations in your own competences and consider them as your learning objectives. I believe that it is important to practice supervision knowing that it is a learning process for you as well for the students. As a reflective practitioner you must experiment with- and reflect upon your practice while practicing.

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