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Project organized Problem-based learning in Distance Education

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Abstract

Project organized problem based learning is a successful concept for on-campus engineering education at Aalborg University. Recently this “Aalborg concept” has been used in networked distance education as well. This paper describes the experiences from two years of Internet-mediated project work in a new Master of Information Technology education. The main conclusions are, that the project work is a strong learning motivator, enhancing peer collaboration, for off-campus students as well. However, the concept cannot be directly transferred to off-campus learning. In this paper, the main problems experienced with group organized project work in distance education are described, and some possible solutions are listed.

1. Introduction

Project organized problem based learning in groups has been the foundation for the educational system at Aalborg University from its start 27 years ago. Since then, experience has proven this a very successful innovation in higher education [9],[11],[14]. The duration of each student project is normally one semester, and the students spend 50% of their time working in freely formed groups of typically 5–6 persons, with a project selected by themselves. 25% of the time is used on project oriented courses and the remaining 25% on general courses. The learning concept has many merits, e.g. increased motivation, excellent development of analytical skills, and experience in coping with complex real-life problems. Furthermore it gives a high degree of completion.

Consequently, it seems to be an obvious idea also to base our distance educations on the project study form. Traditionally, however, distance education has been characterized by one-way communication and self-study, whereas the project study form is based on collaboration and dialogue. Thus, a successful implementation of project work in distance education requires extensive utilisation of new information and communication technology.

As there is only a limited number of references on project-organized learning in networked distance education available, e.g. [4],[5],[6],[16],[17], our concept is build on experience from on-campus education, but is constantly being modified as new off-campus experience is obtained [10],[12].

The project groups communicate by:

- Document exchange via web
- Asynchronous communication using news, e-mail and discussion fora
- Synchronous communication using net meeting fora, such as Yahoo Messenger (voice and text mediated chat)
- Face-to-face meetings during seminars

During the first year with part time studies the students make two projects, a short pilot project and a main project. For the pilot project, each group prepares a report documenting the results of their project, as well as a report evaluating the collaborative work process. These process reports, together with the students individually evaluations of the first study year and the teachers observations from the pilot and the main projects, comprise the background for this paper.

2. The Master of Information Technology Education

The Master Education in IT Engineering (MII) is a supplementary education, established by the Institute of Electronic Systems at Aalborg University, Denmark. URL: <http://www.mii.itorg.auc.dk>

The MII is an Open University education, which implies payment of study fees (app. \$ 3000 per year). It takes three years of studying on a part-time basis (approximately 20 hours per week) to acquire the Master of IT title.

The MII education leads to one of 5 professional specializations, sharing the first year education. The content of this year is primarily basic theories and skills in: Data Networking, Object Oriented System Development, the Client-Server paradigm, Databases, Human Computer Interaction and Web-tools. The second and third year the students are studying IT concerning their own profession, attending courses of particular interest and making projects about the chosen subject of special study. The MII offers specializations in:

- IT in the Building Process
- IT in Industrial Manufacture
- IT in Control Engineering
- IT in Distributed Real Time Systems
- IT Network Maintenance

3. Project based learning

It has proven a good idea to start problem-based educations with project work by letting the students make a short pilot project in administratively selected groups. This seems also to be the case in distance education [6], so it was chosen to begin the MII-study with a pilot project, titled: “*Make a Web site for your group, to present your projects and the group members*” The objective is to get experience with project and group work in distance education, and to test relevant communication tools.

The rest of the first year is used for the main project, where the groups are formed freely and select their project themselves within the technical frame, that they have to use a client/server application and a database in the solutions. An example of a project is: “*Web-based system for industrial pump selection*”.

Learning approach: One of the views about problem-based learning in groups making a project, is that reflection loops have a predominant place. This understanding of learning processes is based on Kolb’s learning cycle [13], and Schön’s ideas about reflection in the learning process [15]. These ideas are combined by John Cowan to a learning concept based on planned reflection loops [7] or Kolb coils (as paraphrased by Cowan: - experience - reflection - generalization - test -). During a project period there are three planned reflections to enhance the learning process, see Figure 1:

- before (*for*) or in the very beginning of the learning process, to decide what the process shall be to fulfill the learning needs
- *in* the middle of the process, to consider how the process so far has fulfilled the scopes and aims. Whether they are still relevant and what changes in plans if any are necessary
- after (*on*) the learning process, in order to decide what has been accomplished and what is still missing, bearing in mind improvement of future learning processes

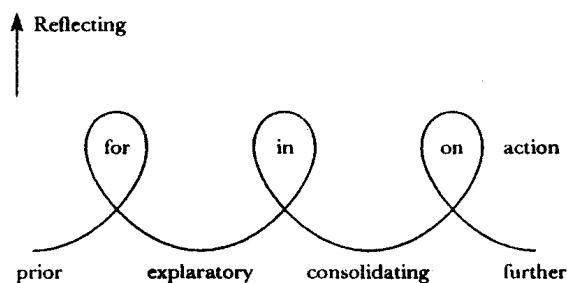


Figure 1: The Cowan diagram [7].

One of the main purposes using this approach with three planned *and guided* reflection loops is to teach the participants to improve the quality, depth and relevance of what has been learned.

During projects on campus, running over a longer period of time (½ year or more) the students themselves reflects within the groups several times in between the planned reflections, see Figure 2.

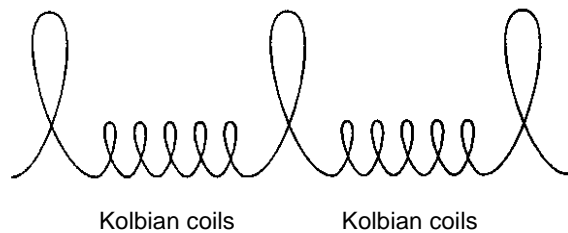


Figure 2: Modified Cowan diagram [7].

These small reflection coils seem to shorten the individual knowledge gap between the students, and it is of great importance that they also take place in distance group work.

Form: The pilot project is started at a seminar (2 days) and run for 2 months, with a seminar in the middle and an evaluation seminar at the end.

A crucial course: “The virtual workplace” about both communication tools (IT) for the virtual work and for face-to-face collaboration is held at these seminars. At each seminar there is time for actual project work, and according to the learning approach this is guided by reflections. The results of the first project experience [12] are used to improve the main project that runs very much in the same way as the pilot project but for a longer time (7 months). It is started at the final pilot project seminar with five additional seminars to come. Formal guided reflections are held at the first, third and last seminar according to the learning approach, and although the remaining seminars are used primarily to enhance the courses, there is also time for project work and meetings with the supervisors, who guide more informal reflections to improve the project work.

4. Experiences with the Project work

Having a lot of good and well-proven experiences with project work on campus, the experiences with project work in distance education is best explained if compared to on-campus project work. First the two types of students and the situation they study in will be explained with focus on the characteristics.

4.1 The characteristics of an on campus engineering student

The typical M.Sc.E.E. student at Aalborg University is male, 18 – 25 years of age, and studies full time, using at least 40 hours a week at the university, where he and his group has their own group room. This 18 m³ room is the home base for most of the group’s work, and they have placed a coffee machine and refrigerator and decorated the walls with posters. Although the university has supplied them with a computer in the room connected to the university net they often bring their own as well and make a local room net.

The students identify themselves as students, with the group as the central turning point, where they help each other with the project and other study activities. Most of the groups also socialize outside the university, and do other kinds of social activities (sports, cultural activities) - even dating or family life. These social activities are carried out in their spare time.

The projects are the driving force in the study and the groups work very hard to obtain a high quality project. This puts a kind of group pressure on each student to do his part properly and not to let the others down by staying at home.

4.2 The characteristics of a distance education student

The MII students differ from the regular M.Sc.E.E. students in several ways, as they:

- Already hold at least a bachelors degree or equivalent
- Have a full-time job and a family, and consequently very little time for studying
- Have varying level of IT-skills (from IT professional to IT novice)
- Constitute an inhomogeneous group of people, regarding:
 - Age (25 – 56 years)
 - Former education
 - Professional career

These students identify themselves as mature professionals. Their home and their job is their base and have first priority when time is running short. They only spend two days every 1½ month on campus, so they have almost no direct connection to the university.

They have chosen to take this supplementary education supported by their company and their family, but studying is done after the company and the family are taken care of, which means mostly in the evenings and alone in front of the computer and books. Only once or twice a week they “meet” with their group on the internet, using voice and text mediated chat for a well planned meeting (1-2 hours) to discuss their project work and possible problems with the courses.

4.3. Positive experiences

A lot of the good experiences from on-campus project work seem to work in distance education as well:

- *Project work is a unique learning motivator*
This is particularly important for distance learners, studying at home after a long days work.
- *Project work enhance peer collaboration*
Studying at home alone may be hard and lonely, and one often gets stuck in even minor problems. Collaboration may be the answer and the way to get forward.

It is of great importance that the students actually meet their fellow students regularly, so the seminars are needed. The students really feel that the important progress in the project mainly happens here. Even if only few hours are free from courses it is helpful. Especially for the complex and difficult part of the project, where important decisions shall be made, face-to-face group work is needed. Also it is observed that the project managing has a very high priority and that the sessions are used as milestones for the project state. It also is a very needed opportunity for the project supervisor to discuss with the students. What also seem to be very positive in project work in distance education is:

- *Face-to-interface meetings combined with face-to-face meetings*
It is commonly felt, that a good networked collaboration requires a prior personal acquaintance. Besides, the students experience that certain parts of the project work, in particular planning and reflection, is much easier accomplished during meetings at seminars.
- *Virtual group meetings with a strict planning and control.*
In face-to-interface meetings, informal meeting behaviour is not adequate, but with strict planning and control, they are a useful supplement to asynchronous communication.

4.4. Negative experiences

The Project work deals with description of well-defined tasks/subtasks, task planning and time planning. The groups as autonomous entities must define common plans. Every student should be confident with the plan and know all about tasks/subtasks and when they are supposed to be solved.

The members of the groups appear to have very different ambitions with the study and they are not equally confident with the Project plan and the task/subtask definitions. This implies that the strong students work far ahead of the weak students. As a consequence the group members professional skills diverse as the semester progress. Some of the students get unmotivated as well. This is quite opposite to the experiences from on-campus groups, where the daily discussions between the students level the difference, see Figure 3.

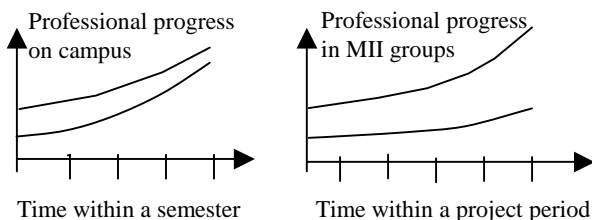


Figure 3. The curves shows the professional progress for the best and the weakest student within a project group. On campus the level between the different students decreases within each project (semester), but for the distance education student groups the level of professional progress seems to increase.

The internal sharing of knowledge, both in the projects and in the courses that normally takes place within a group on campus don't happen yet within the first year of our distance education, and we might conclude that:

- Peer collaboration in project work is especially enhanced between students with the same level of ambition.
- Because exercises in the courses is done individually by each student at home, they don't help and share each other's knowledge as on-campus students do.
- It seems that the Kolbian coils mechanism for sharing experiences don't happen automatically during voice and text mediated meetings.

Supervision of MII-groups is a new and rather difficult situation compared to on campus supervision for several reasons:

- If the supervisor participates in all the face-to-interface meetings he is likely to become either a group member or "a fly on the wall", because the group wants to improve the efficiency of the meetings and don't like the supervisor asking reflective questions.
- If a group "hide" their work and don't contact the supervisor for a long time, he can't just "pop in" and see what is happening, but has to wait for answers to his e-mails or for the next seminar.

5. Suggestions for improvement

For the MII-students, who are not accustomed to project work in learning or to distance education, the small-scale process-oriented pilot project was an excellent introduction to the following main project work, but as soon as the professional demands both in the projects and in the courses increased, the progress of the group members diverted. After two years of continued (but smaller) improvements of the first year of the MII-education the supervisors wants to crack this problem and we think that the following could be a road to follow:

- *Organize formation of more homogeneous groups.* As it seems that different level of ambition between the group members increase skill diversity it is important that all group members have similar levels of ambition. We will try to enhance this by using more time on the process of group formation and project selection. Smaller groups (3-4 persons) will be accepted and we will emphasize the importance of having the same level of ambition and time to put into the project, as well as a common agreement and understanding of the project task.
- *Adjust the project organized model to fit distance education better.* As project work seem to level the professional skills on campus, the courses and project in distance education must be organized so that the groups are forced to reflect in a Kolbian coil manner. This is done by enhancing discussions in fora connected to the courses. Hereby the students can share reflections that will point out where and why the group members have problems. The students in this way help each other by improved discussion. This will be helpful also for the progress in the project, which can be further improved by a closer integration of the project work and the courses. To overcome this all projects must follow the same template. Hereby the teachers have the possibility to plan the content in the courses which is useful for the students when needed in project solutions and they can give project related assignments in the courses. This will be followed up by evaluating the students when the courses are finished at the first following seminar, and then it is expected that the technical level has been generally improved.
- *Better planning of the projects.* Lack of overview of the whole project prevent the students in proper planning and time estimation. By using more time for, and promote a proper and careful analyse of the project in the beginning of the project period, the group will get a better overview of the whole project. The planning must include detailed subtask planning as well. The time schedule must be flexible to catch fluctuations in the group members available study time and the supervisor will secure that the time schedule always is a topic in face-to-face as well as face-to-interface meetings.
- *Adjust the role of the supervisor to distance education and to the characteristics of the distance education students.* The supervisor role is far from as ideal as in the on-campus situation, e.g. it is difficult to promote reflection at the face-to-interface meetings. We have to rethink the role of the supervisor to the special conditions for distant group work focusing on the one hand on the here and now needs for problem solving within the group and on the other hand on their learning needs for reflection. It is a very difficult task because all matches of a supervisor and some students are new and unique, and will develop different according to the project and its conditions. The supervisors will try to improve supervision by being very aware of what they are doing and log their reasoning and the results, so continues discussions and sharing of experiences between them can be made.

6. Conclusion and future work

The experiences with project organized problem based learning in distance supplementary engineering education shows that a lot of the benefits from the educational system at Aalborg University is transferable to distance education. So it seems to be worthwhile to continue our effort to improve the MII program. For this purpose two research project have been defined: ViLL (Virtual Learning Environments and Learning Forms), organized in the project 'Digital North Denmark', and 'Didactic methods in ICT-supported project organized distance education', supported by the 'Danish engineering pedagogic network'.

These projects will undertake a full-scale experiment with the first year students at this years MII education implementing and evaluating the suggestions for improvement in section 5. Future possibilities for improving face-to-interface meetings by using e.g. high quality real time video will also be tested in a brand new e-learning lab.

For the last two years of the MII education we believe in a less rigorous planning of the coupling between courses and projects. This will be further investigated as well.

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