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PROJECT-BASED COLLABORATIVE LEARNING IN DISTANCE EDUCATION

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Abstract: This article describes the experiences drawn from an experiment in transferring positive experience with a project-organised on-campus engineering programme to a technology supported distance education programme. Three years of experience with the Master of Industrial Information Technology (MII) programme indicates, however, that adjustments are required in transforming the on-campus model to distance education. The main problem is that while project work is an excellent regulator of the learning process for on-campus students, this does not seem to be the case for off-campus students. Consequently, didactic adjustments have been made based on feedback, in particular from evaluation questionnaires. This process has been very constructive in approaching the goal: a successful model for project organized learning in distance education.

1. INTRODUCTION

Project-organised problem-based collaborative learning has been a successful learning method at Aalborg University (AAU) since its start in 1974 (Fink 1999, Kjærsdam and Enemark 1994, Kolmos 1996). In recent years a number of continuing education programmes based on technology-supported distance education have been developed (Bygholm, Hejlesen and Nøhr 1998, Jensen et al 2003, Lorentsen 2000), and therefore it has been natural to use the 'Aalborg Model' as a basis in the Master of Industrial Information Technology (MII) distance education programme. This article describes how the MII programme (Knudsen et al 2000, Masteruddannelse 2002) has attempted to transfer positive experience from the Aalborg Model in engineering programmes.

The MII programme has been monitored during its first three years of existence (1999-2002) primarily through questionnaires after completion of the basis year, but also through student process reports, plenum discussions and observations made by the supervisors. In addition, an interview based process evaluation was carried out in 2001 (Semey 2001). Secondary sources of experience from literature, in particular (Bygholm, Hejlesen and Nøhr 1998, Bygholm, Dirckinck-Holmfeld 1997, Christie et al 2002, Lorentsen 2000), conferences, workshops and personal contacts have been a valuable input in both shaping as well in adjusting the off-campus programme.

Three years of experience have shown that the Aalborg Model requires significant adjustments in transferring it into a distance education programme. The MII programme uses the latest information technology, in content as well as in form, but has experienced difficulty in achieving as satisfactory study environment as that of the on-campus programmes. Some of the suspected reasons for this include the fact that the target group is different - students are for example typically employed adults - and the fact that the MII learning environment and forms of communication are fundamentally different from those used on-campus.

The primary element in the Aalborg Model is project work, where the students work in groups making a project each semester. The project work takes up half of the study time, and in the rest of the time the students are offered courses. There are two types of courses, general study related courses with exams, and project related courses, examined via the project. Project related courses

provide tools (e.g. Java programming), as well as theory and methods (e.g. object oriented analysis and design) required to carry out the main project. Consequently, direct relationship between courses and project work and a balanced emphasis by the students on courses and project work respectively is of utmost importance. Project work is an excellent regulator of this balance between course assignments and projects with on-campus students, as it helps and activates the students in the selection of what is most important to learn. Our experience indicates, however that this is not the case when it comes to the off-campus students. To compensate for that, didactic adjustments were made at the end of each year.

2. THE MII PROGRAMME - PEDAGOGICAL AND THEORETICAL BACKGROUND

2.1 Content

The Master of Information Technology educations, MII (Masteruddannelse 2002) is a 3-year programme, corresponding to 90 ECTS (European Credit Transfer System units) with an expected study load of 20 hours per week. It consists of a 1-year general basis programme combined with one of five different 2-year specialisations.

The purpose of the basis year is to introduce the most important theories, methods and technologies. The general theme is Distributed Information Systems with focus on system development, data nets and tools.

Courses and project work take place concurrently. A small first project (called a pilot project) focuses mainly on training project work in groups in a learning situation where an important part of the communication is mediated via the Internet. This leads up to the subsequent main project, which can, for example, deal with analysis, design and implementation of a system for processing production data from a database via an Internet browser.

Specialisations have been offered in: IT in Civil Engineering, IT in Industrial Production, IT in Process Control, IT in Distributed Real Time Systems and IT in System Administration. The two-year specialisations consist in selecting special-related courses and project.

2.2 Form

The programme is organised as a technology-based distance education framed by seven two-day seminars per year. A special web-based distance education system, Uniflex (Borch et al 2003), has been developed, to support courses as well as project work. Amongst other things, Uniflex makes the courses available in a standard form comprising introduction, course description, technical content, references, self test, problems with hints, and course evaluation. Each course unit has a built-in newsgroup for discussions, questions and answers.

The seminars take place at Aalborg University from Thursday afternoon to Saturday afternoon. The face-to-face contact with project group members and with supervisors is used intensively for the parts of the project work, which is difficult to handle electronically, general discussion and planning in particular. Also new courses are introduced, typically with a lecture and problem solving assignments to match. Current courses are reviewed with question and discussion sessions and elaborated through further lectures. In addition, there are guest lectures, study course exams, project exams, and evaluations and discussions about the programme.

Project work between seminars is based on weekly synchronous virtual meetings with audio, text and recently video, as students and supervisors have home computers with Internet connection, headsets and web cams. The supervisor follows these meetings, lasting one to two hours. Most groups have chosen to use Yahoo Messenger. In addition to these synchronous meetings, there is asynchronous communication via e-mail and through Uniflex where documents are uploaded and reviewed.

2.3 Target group

Students enrolled in the MII programme are typical distance education students and differ in several important respects from ordinary on-campus students. They already have an education, formal or informal, corresponding to a bachelor degree. Typically, students are full-time employed and have a family, and consequently have less time for studying.

They form a very heterogeneous group, with respect to age, education and expertise. However, all students have a professional expertise in IT, usually related to their daily work. This is of consequence in an education programme where IT is central in terms of form as well as content.

2.4 Learning theory foundation

The programme is based on social-constructivist learning principles, combined with Cowan's 'reflection loops' (Cowan 1998), as it is commonly recognised that reflection has a predominant place in problem-oriented group-based learning. Cowan has combined Kolb's 'learning cycles' (Kolb 1984) and Schön's ideas about reflection in learning processes to a concept based on three planned reflection loops for, in (the middle of), and on (after) the learning process. The so-called modified Cowan diagram is illustrated in Figure 1

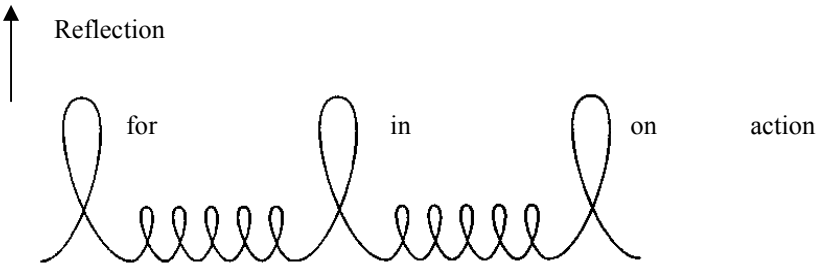

Figure 1. Modified Cowan diagram with three planned reflection loops

In the MII programme, these major reflections are set to take place in three specific seminars. The main purpose is to enhance the quality, depth and relevance of what is learned. In addition, reflection should take place in other seminars and at virtual group meetings. These small, unplanned reflection loops are supposed to level out differences in knowledge between the individual group members, which is indeed needed in distance education.

3. GROUP WORK IN THE PHYSICAL AND IN THE VIRTUAL ROOM

To understand the challenges in adapting on-campus collaborative project and group organised programmes (AAU engineering programmes) to distance education (MII), a further analysis of the differences is required. We have chosen to divide these into three partly overlapping categories:

- Work forms and social structures
- Communication forms
- Personal issues

3.1 Work forms and social structures

In on-campus educations programmes at AAU, students have their physical group room, which is their base every day from 8 a.m. to 4 p.m. They go to lectures together, do course assignments together in the group room, work on the project - often in sub-groups - and take most breaks together. This causes and allows a great deal of relevant informal communication, easy opportunity for help with various minor problems, and a strong social contact.

Off-campus students are only together, face-to-face, during the seminars, while daily studying is done alone at home. Initiative is required to create contact with another group member, e.g. to ask for help, and students have to overcome the risk of disturbing. Consequently, small problems can take a long time to be solved and cause frustrations.

On-campus students are continually motivated by their fellow students, teachers and supervisors, while off-campus students have to motivate themselves when they start studying, typically around 9 p.m., after a long day's work and time with the family.

3.2 Communication forms

Formal communication in MII in relation to project work occurs in synchronous group meetings, with or without participation of the supervisor. With today's technology, synchronous communication over the Internet is an obvious opportunity, and with a little training, efficient virtual group meetings can be conducted. These require more preparation and meeting discipline than face-to-face meetings, though experience shows, that brainstorming, general discussions, solutions to person-related problems, and planning can be difficult to carry out in virtual meetings. The differences between face-to-face and virtual group meetings are otherwise of lesser importance, in particular when the participants already know each other. Experiments in the e-Learning Lab at AAU indicate that better technology with full duplex, whiteboard and better video, can possibly further decrease the difference.

Spontaneous communication, regarding the technical content of the courses, occurs automatically when on-campus students go to courses together and do their assignments together in their group room with the teacher dropping in. The off-campus students, on the other hand, follow courses alone, at different times, so there is no natural communication with fellow students or the teacher about course content. The course newsgroups especially created to cover this communication need are not used sufficiently in spite of motivation efforts from the teachers and a few of the students.

3.3 Personal issues

Distance students identify themselves as mature professionals more than as regular students (Lorentsen 2000). Their job and their family life is their base and have first priority. When lacking time for their studies, the time available is prioritised where the obligations are the strongest, that is on the project. This is because the students' sense of responsibility and solidarity with the group appears to be more important than personal acquisition of course material.

Furthermore, distance students have a lesser need than regular students for both social and professional/technical network within their study groups, as they already to a large extent have a network privately and at work. Contact to the university and in particular to fellow students is nevertheless important to them. They just do not have much time for it.

Many distance students have adapted a more results oriented attitude from their work, and do not identify themselves with the university study environment and form

4. RESULTS OF QUESTIONNAIRES AND PLENUM MEETING

Each year (2000, 2001 and 2002), within a week after completion of the exam, MII students have been asked to complete an evaluation questionnaire containing approximately 60 questions in 7 categories:

- Pilot project
- Main project
- Group work
- Courses
- General about curriculum
- Technology and software tools
- Organisation and private/family life

Any modification and/or addition of questions from year to year have been made with the attention of keeping a valid basis for comparison between the three years. The response rate in 2000 was 10 out of 14 students, in 2001, 9 out of 13 students, and in 2002, 8 out of 8 students.

The questions most relevant to the relationship between project work and courses are listed below in Table I. The answers for each question are given either as typical answers in condensed form, direct quotes in " ", or e.g. 'yes/no = 3/6' meaning 3 answered yes and 6 answered no.

	Question	Response 2000	Response 2001	Response 2002
	Pilot project			
Q1	Do you feel that the pilot project was beneficial to the main project?	Yes	Yes	Yes/no: 4/2.
Q2	Do you have recommendations for alteration in the pilot project?	No	More control	Yes/no: 3/2 More technical. Include Java and OO*
Q3	Mention some positive experiences you had during the pilot project.	Group collaboration	Virtual collaboration	Group collaboration
Q4	Mention some negative experiences you had during the pilot project.	Technology (Luvit (www.luvit.com) and www-based learning	Uncertainty	None in particular. "The project appeared irrelevant"

		environment).		
	Main project			
Q5	Was the project suitable for distance education?	Yes	Yes	Yes/too complex: 2/4
Q6	Do you prefer that the supervisor propose the projects or, as it was done, that everybody does?	Everybody	Everybody	Everybody/super-visor: 3/4
Q7	2000 & 2001: Did the project work take up too much room compared to the courses? 2002: How much of your study time was spent on project work during the course intensive period December-March?	Yes/no: 4/4 "The main project took too much of our time – it had to be done, it is easier to dismiss the courses." "The project took 80% of the time"	Yes/no: 5/4 "We were not able to limit our project. We were warned not to be too ambitious, but…"/ "The students should have been asked to work on the courses before the project."	Too much: 5
Q8	2000 & 2001: Do you have suggestions how a better, more equal distribution of time on projects and courses can be obtained? 2002: Do you feel that you divided your time optimally between courses and project work?	Better courses "The courses should be introduced earlier, so we can see the relations between project and courses."	Tighter control, hand in solutions "Tighter follow-up on courses"/"Each group hands in a solution of problem for each course"/"Deadlines for handing in problem solutions"/"More communication and discussion in relation to courses"/"Cut down on the projects"	No: 6 "In retrospect I can see: there was too little course studying and too much project." "Tighter control of projects"
Q9	2001: Was there sufficient time for both courses and project work? 2002: Is it too difficult to work on several courses and the project simultaneously?		Yes/no: 3/6	Yes: 6
Q10	2001 & 2002: Could you use the courses for solving problems of the project?		Yes	Yes/no: 2/2, some: 3
Q11	Would it be all right if the supervisors make one project proposal, giving a tighter coupling between project and courses?	No	Yes	Yes/no: 5/2
Q12	What is your opinion of the Aalborg model applied for distance education?	Good but difficult	Good but difficult "The danger is that the courses are given a lower priority at home […], because in the project you have some deadlines as agreed with your fellow group members."	Good/Adjustments required: 2/3 "Too much energy is spent on less relevant activities, a tighter control is necessary."
Q13	What is the hardest part of distant project work? Name examples.	Slow communication	Discipline, motivation	Communication Java
	Group work			
Q14	What was your experience of the group work?	Difficult, slow communication	Surprisingly good	Fine, difficult, positive, fiasco
Q15	Do you feel that your contribution live up to the expectations of the others?	Yes/no: 4/4	Yes/no: 6/2	Yes
Q16	Do you consider your own contribution satisfactory?	Yes/no: 6/4	Yes	Yes
Q17	Do you consider the others contribution satisfactory?	Yes/no: 6/3	Yes	Yes/no: 4/2
Q18	Were all agreements kept?	Yes	Yes, mostly	Mostly
Q19	Did you make sufficiently clear and specific agreements during seminars?	Yes	Yes	Yes
Q20	Was the supervisor kept abreast of events?	Yes	Yes	Yes/no: 5/1
Q21	Do you have recommendations for improvements of the communication?	Sound is missing	Better technology	Full duplex
G9	How were the interaction and the collaboration with the other members of the group?	Good	Mostly good	OK
Q22	Did you have to modify your prior	Yes/no: 4/5	Yes/no: 5/2	Yes/no: 2/3

	impression of group work routines?			
	Courses			
Q23	Have you used knowledge from all courses in the project?	Yes	Yes	Yes/no: 3/1
Q24	Did you work on courses primarily during the recommended period? – If not: why?			Yes/no: ¼ "Strong focus on the project"
Q25	Your opinion on compulsory handing in of project relevant assignments by groups?			Good idea "This type of education requires a little coercion."
Q26	Your opinion on a project free period, where you can concentrate on courses?			Good idea "… if there are tests."

Table I: Questions and responses from 2000, 2001 and 2002.

Selected responses about project/courses at plenum meeting:

The unofficial project course exam seminar in Feb. 2002 became an impromptu evaluation meeting, as students were not adequately prepared for the exam situation. A constructive discussion arose. Many constructive and useful points were noted.

The students stated that:

- as the project was a collaborative assignment, the group members felt a heavier responsibility towards the project than towards the courses and their own learning in general
- they spent more time on the project than the courses (up to 80%)
- they were behind with the project courses, so the technical level in the group varied a great deal and was generally too low
- due to lack of technical insight required for the project, the project work took too long, which in turn decreased the time available for course studying - a vicious circle!

The students also gave recommendations for adjustments to acquire a better balance between course and project work:

- Give project work a lower priority in certain periods
- Work on course content in groups (transfer some of the group-responsibility sense from project to courses)
- Compulsory course assignments by each group
- More course evaluation exams

5. CHARACTERISTICS AND DIDACTIC ADJUSTMENTS

The first three basis-year programmes (ending in 2000, 2001, 2002) all had some different technical, didactic or pedagogical characteristics, and based on experiences, adjustments were made for the following year.

5.1 First year (2000)

Characteristics: LUVIT (Manufactured by Luvit AB, Lund, Sweden, www.luvit.com), a www-based learning environment was used for overall organisation. Unfortunately, this system performed rather poorly, in part because it was not intended for project work, but mostly because of numerous technical problems. Synchronous communication was text based chat on Netmeeting.

Adjustments: A new WWW-based system, Uniflex, was developed by the MII-staff to replace LUVIT. Better chat tool with sound was introduced. Control of project work was tightened. Changes of form and content of certain courses were performed.

5.2 Second year (2001)

Characteristics: All main projects had to comply with a client-server structure to strengthen the relationship between courses and projects.

The groups learned to conduct efficient virtual meetings with text-based chat, and some had success with sound-based chat as well.

Adjustments: An even stronger integration of courses and projects was required, and a tighter control was asked for.

5.3 Third year (2002)

Characteristics: A stronger integration of courses and projects was implemented by:

- introducing phases for concurrent courses and project work with specific technical subjects
- giving small problems and assignments in the course units that were relevant to the projects
- conducting unofficial project course exams, in the form of discussions of these assignments and their relations to the project at a seminar at the end of each course unit.

As the feedback from the questionnaire and the plenum in section 4 indicates, this did not succeed.

All groups successfully used voice-based chat for project meetings.

Adjustments: see section 7.

6. ANALYSIS

From the contact with the third year's students during seminars and virtual group meetings, the supervisors got the definite impression that most students had trouble prioritising their time optimally between several courses and project work. This leads to frustrations and inefficiency. The information from the students at the plenum meeting also clearly confirmed this impression of how they felt, when they were in the middle of the process.

The evaluation questionnaire, on the other hand, presented the students' opinion after they had finished the semester when the students had a better overview of the semester. They also had satisfactory project reports and a successful examination behind them and the frustrations at a distance. This might have lead to an exaggerated satisfaction with things as they were.

The answers to the questionnaire, Table I, are, true enough, more ambiguous, but there were also fairly distinct trends, supporting the impression above:

There was a clear positive opinion about project-oriented study, which was characterized as 'good but difficult' (Q12). Many mentioned group collaboration as a positive experience (Q3). All the respondents wanted the freedom to choose their own project, but the students in 2001 would also have allowed the supervisors to make the choice if that had lead to better coupling between project and courses (Q6, Q11). An increasing number of respondents indicated, that the main project was too complex and supervisor planned projects might be preferable (Q5, Q6, Q11). About half of the respondents in 2000 and 2001 thought that the project work took too much time compared to courses (Q7, Q8), but in 2002, almost everybody thought they spent too much time on the project and too little on courses and found several simultaneous courses with the project too difficult (Q7, Q8, Q9). Many, in particular in 2001 and 2002 mention a general need for tighter control (Q2, Q8) of the project work as well as the project related courses. In 2002, less satisfaction with the Aalborg model in the implemented form was expressed, as half of the respondents wanted adjustments (Q12). There was, for example, strong support of a project-free period combined with compulsory assignments and examination of assignment problems (Q25, Q26). In the response selection (Table I) and in particular the direct quotations, it is impossible to be completely neutral, but we believe that our premises are fairly correct, and the conclusion is well founded.

Our conclusion is that our efforts in tightening control after the first and second year (see section 4) did not have the desired effect and that a more efficient adjustment should be implemented.

Although we hesitate to deviate too much from the problem-oriented project-based model (Aalborg Model), we believe this is a natural and necessary adjustment for distance education - and in any case, that this experiment gives us a valuable experience.

7. DIDACTIC ADJUSTMENT PLAN

To obtain a better learning process for the students, the following plan has been agreed upon for the 2002/2003 academic year.

The semester is divided into three distinct phases; see Figure 2 and the description below.

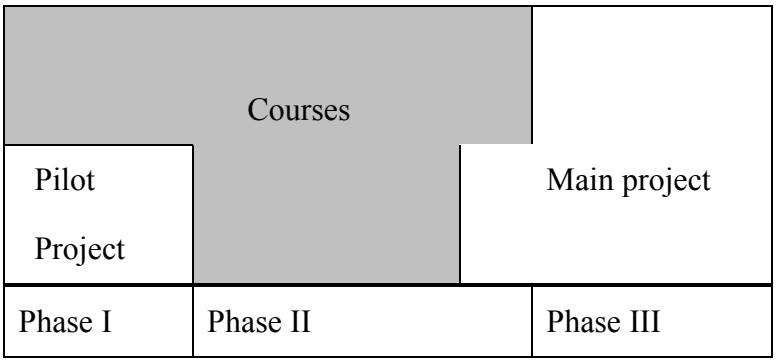

Figure. Distribution of project and course time.

Phase 1- The Pilot Project

Duration: 2 months

Aims: The primary aim is to learn group-organised project work in web-based distance education, including a familiarisation with relevant collaborative and communicative tools. The secondary aim is to become familiar with the technical content of the project, in this case construction of databases.

Content: Introduction to the education and solution of practical problems. Project work, two project related courses and one study related course unit.

Comment: The pilot project period has been reduced from 3 to 2 month, and the content changed to involve design of a database, which can be useful to the main project.

Phase 2 - Courses

Duration: 4 months

Aim: To acquire knowledge and comprehension of course subjects, (c.f. Blooms taxonomy (Bloom)).

Content: Remaining five courses. For the four project-related courses: compulsory course assignments by groups with strict deadlines, and oral examination of these assignments at seminars. An objective is to transfer some of the group-responsibility sense from project to course work.

Comment: The project-free period is a drastic change. Control of course work is strengthened.

Phase 3 – Main Project

Duration: 3 months

Aims: Application, analysis, synthesis, and evaluation (Bloom) of the technical subjects, in particular interdisciplinary application. Experience from project work in a learning situation in a virtual environment, including documentation in a report.

Content: Project work.

Comment: The duration of the main project is reduced considerably and the students can choose between ‘problem’ and ‘assignment’ type projects (Kolmos 1996).

Requirements from the course teachers:

- They must be very active in answering questions promptly and set an alarm if the deadlines are not met.
- They must be active in keeping the dialogue between the students running so that the groups collaborate virtually on the assignments, asynchronously in newsgroups and synchronously at chat meetings.
- They must supply assignment problems relevant to the project, preferably subsets of the project, and of a complexity that makes it possible for most students to cope with. It is essential that the students frequently experience success.

8. CONCLUSION

Three years of experience with the MII basis year indicates that a successful project-based and group-organised learning model for on-campus engineering programmes cannot be transferred to distance education without significant adjustments. While project work is an excellent regulator of the learning process for on-campus students, this does not seem to be the case for off-campus students.

As the project is common for a group, the group members feel a heavier responsibility for the project, than for the courses and their own learning in general. A vicious circle sets in as the majority of the time available is spent on the project, leaving too little time for the project related courses, which leads to weaker technical and theoretical insight to solve the project problems. Time is spent inefficiently on the project, which in turn decreases the time left to work on courses.

Didactic adjustments were made after the first two years, but these adjustments have not had sufficient effect. Therefore, new and more drastic adjustments are planned based on the first three years of experience with the off-campus programme. The main feature of these adjustments is a project-free period where the students concentrate on course work. This is supplemented with a stronger control of the course work, including compulsory course assignments by groups. The objective is to transfer some of the group-responsibility sense from the project alone to both the course units and the project. A stronger correlation between courses and projects is also planned, by relating the course assignment problems to the projects.

These adjustments are based on student feedback, in particular from evaluation questionnaires, formal and informal discussions, and they are in agreement with the general experience that distance education programmes require a more strict planning and control than on-campus programmes.

Although the didactic adjustments implemented so far have not lead to an indisputable success, the students have presented satisfactory projects and improved in both the process of making the project and in documenting during the specialisation semesters. It is therefore our contention that the adjustments that have been implemented in the first three years of the experiment of adapting the Aalborg model to distance engineering education have been on the right track towards the ultimate goal: a successful model for project-based, group-organized learning in distance education.

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