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## **Virtual Learning Environments and Learning Forms -experiments in ICT-based learning**

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# Virtual Learning Environments and Learning Forms – experiments in ICT-based learning

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**Abstract** – This paper report the main results of a three year experiment in ICT-based distance learning. The results are based on a full scale experiment in the education, Master of Industrial Information Technology (MII) and is one of many projects deeply rooted in the project Virtual Learning Environments and Learning forms (ViLL). The experiment was to transfer a well functioning on-campus engineering program based on project organized collaborative learning to a technology supported distance education program. After three years the experiments indicate that adjustments are required in this transformation. The main problem is that we do not find the same self regulating learning effect in the group work among the off-campus students as is the case for on-campus students. Based on feedback from evaluation questionnaires and discussions with the students didactic adjustments have been made. The revised didactic model has until now been a positive experience.

## I. INTRODUCTION

The Digital North Denmark is a regional 3-year IT project with a funding of DKK 170 mill. granted by the Ministry of Science, Technology and Innovation. Further funding about DKK 340 mill. is provided by industrial and financial partners and local authorities. The objective is to explore the potentials of the network society for all citizens of North Denmark. The project is parted in four main IT areas with the following headlines: Competences and Education, Digital Administration, IT in occupation, IT infrastructure. The exploitation is done via 89 IT projects. In many of the projects, Aalborg University (AAU) has played an important role.

One of the major projects in the area of “Competences and Education” is ‘Virtual Learning Environments and Learning Forms’ (ViLL), where all 3 faculties at AAU and 4 external partners, Ericsson Denmark[2], IBM, Telia Telecom A/S, and EUC Nord (an educational institution), are collaborating on 14 educational experiments in industry, universities and other institutions. The purpose is to identify, develop and test new virtual learning forms, and to evaluate, develop and test new virtual learning environments and IT-tools. In addition, an enhanced collaboration between educational institutions and industry is of importance.

To support the project an e-learning lab is established at AAU. The objective of this laboratory is to collect and exchange knowledge related to e-learning, and to provide technical and pedagogical service and expertise – initially for ViLL projects. After the termination of the ViLL project in 2004, e-learning lab will be a permanent institution at AAU, providing services internally as well as externally.

Of the 14 educational experiments of the ViLL project,

10 are internal at AAU. Of these 4 are on-campus and 6 are off-campus master educations. In the following, the educational experiment comprising one of the latter will be described in some detail.

In this contribution we attempt to give a comprehensive account of the MII experiment and the major results and experiences, in the scope of the total ViLL project. The paper outline therefore is the following: Organisation and content of the ViLL project, The first years of the MII education experiment, Suggested changes to the MII education based on collected data and experiences, Contribution to the ViLL project and Conclusion.

## II. THE VILL PROJECT

When started four years ago the purpose with the ViLL project was to contribute to the development of North Jutland as a learning region, and that the ViLL project should be very active as to globalize the region as a net based society. This was done by focusing on ICT methods and systems to promote life long learning.

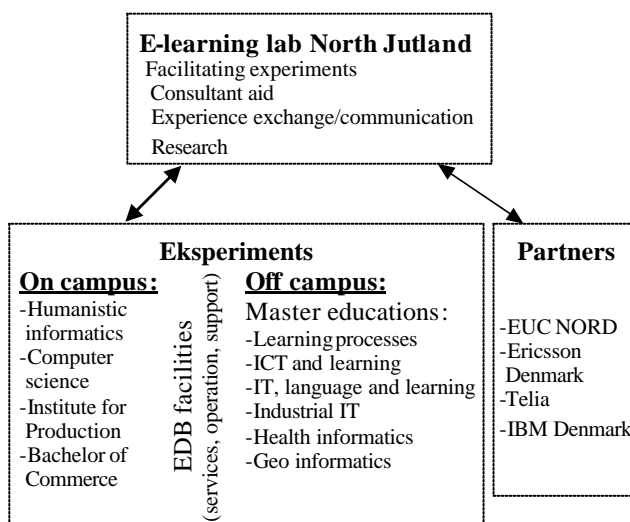


Fig. 1 E-learning lab related to the Experiments and Partners

The ViLL project worked at two levels in parallel. The first level was to implement new ICT activities in the ordinary on-campus education programs and in continuing education programs at the campus as well as in distance education. By implementing new ICT education activities in ordinary and in continuing educations it is possible to get large scale data. At the same time valuable practical experience in virtual learning forms and methods will be achieved. The Second level concerns foundation of an e-

learning lab which should be the on-campus experimentarium for further evolution of the future learning forms after the ViLL project is finished. The diagram in Fig.1. shows the interconnections in the project.

This structure for the ViLL project has been an excellent forum for exchange of experience, information, best practice, tools etc. Many work shops for ViLL members as well as other interested in the subject have been arranged. The e-learning lab has been used for several experiments and has been the base for some of the projects.

### III. THE FIRST YEARS OF MII EDUCATION

Master of Industrial Information Technology (MII) is a 3 year continuing education program, corresponding to 90 ECTS with an expected work load of 20 hours per week – i.e. half-time, as the students already have a full-time job. It is based on technology supported distance education combined with 7 two-day seminars at AAU per year.

Project-organized problem-based collaborative learning has been a successful learning method at AAU since its start in 1974, not the least in engineering educations [3], [8], [10]. When the MII education was developed for start in 1999, it was therefore obvious to use this so-called Aalborg model as a basis. The core of the MII educational experiment is consequently to transfer the on-campus learning method to technology based distance continuing education.

The merit of distance education is to provide educational opportunities to individuals at times and places of their convenience. Traditionally, distance education has been characterized by one-way communication and self-study, whereas on-campus project-organized learning is based on dialogue and collaboration. This apparent conflict suggests that the Aalborg model cannot be directly transferred to distance education.

Both for on-campus and off-campus studies project work in groups is the primary element. Before making the main project work the students use substantial time for course study. Two kinds of courses are lectured, general study related courses with exams, and project related courses planned for the project and examined via the project. Time for courses and project is fifty-fifty.

The conditions for the on-campus students are positive for several reasons. The groups are formed by 6-7 students of nearly the same age having their own group room, which is their base for all activities. Together they go to lectures and they are together at the following course assignments in the group room. The teacher consults the groups when doing their exercises. They plan their project work with milestones and divide the project work in sub-parts, supporting sub-group work. The group has an assigned supervisor for the project work. Weekly meetings based on written introductory material gives the student valuable feedback and also give the supervisor an idea of the level of the individual student. It should be clear that this PBL method really stimulate and create a great deal of formal as well as informal reflections. At the same time the student easily gets help for minor problems. They get good experiences and this facilitates creating a strong feeling of solidarity.

The conditions for off-campus studies are not that positive for several reasons. The MII-groups are formed by

2-5 students often with very different age, with different profession and different level of experience from their professional life. The students have different ambition levels and are physically placed all over Denmark. They do not have a group room but meet at conferences over the Internet. They are goal-directed and used to work alone which, in a group organised learning situation, can be a weakness. In project based learning, collaboration is a precondition for a good result. For this reason a small first project (called pilot project) focuses mainly on training working in groups, supported by a course in 'Technology based collaboration'. It is very important that the individual students reflect over what he/she is learning and also share experiences with the other members of the group.

From [9], which report a systematic evaluation of the first years of the MII off-campus education, both positive and negative results are stated. The main positive results are a general satisfaction with the distance education form, appreciating the flexibility and that the project groups learned to organize and conduct efficient virtual meetings quite rapidly. The main negative result is that the feeling of group solidarity and responsibility puts too much emphasis on project work at the expense of coursework. Statements from students:

- 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 supervisors experienced [4] that 7 seminars from September to June meant that the intensity of the group work was concentrated to the seminar and the period just after. It was too easy to postpone problems and discussions to the next seminar. The solution has been to cut down the number of seminars to 4.

Based on the experiences from the first year of the MII-program, the involved staff and students proposed 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

These changes also should lower the work load which the students find to high.

### IV. CHANGES IN MII BASED ON COLLECTED DATA

So far the project has not been questioned [5], as part of the learning strategy for off-campus students, even though this is very difficult for technical problem solutions and the main reason so far why courses do not get the intended

priority.

Though every first year of the MII education had some smaller didactic adjustments, e.g. strengthening the relationship between courses and project and unofficial course exams at the seminars, where also assignments were discussed and reflections on the relations between the course and project were performed, it seem not really to remove the main problems. [7], [9] Recommend more radical didactic changes including a project-free period. This should force the students to concentrate on the course study. The basis year is now divided up into three phases as seen in Fig. 1. The arrow shows the time for seminars and that the number of seminars is reduced from 7 to 4.

Special attention will be given to Phase I as results from this period now is available. Phase II and III are in progress but some experiences will be reported.

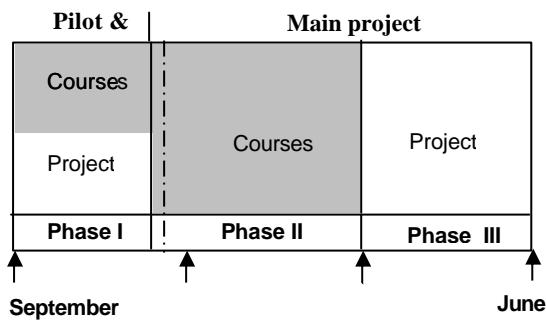


Fig. 2. Phases in the basis year. At the dotted line it is time for evaluation of the pilot project. Phase II is project free. Phase III is course free. The arrows show time for seminars

#### A. Phase I: Pilot project and related courses

The aims of Phase I (Eight weeks), and the didactic changes for this period, are:

- 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 pilot project, in this case construction of databases
- The third aim is to move attention from the project to the course
- The fourth aim is to lower the work load

The following courses supported the goal of the project:

- Computer Supported Collaborative Work (CSCW)
- WWW-technologies
- Databases

Supporting the primary aim in Phase I this was headed by a two days seminar at Aalborg University at which the courses and pilot project theme were introduced. The groups were formed and the group members had their first experiences in virtual collaborative work in the e-learning lab, equipped with sound and video facilities using software tools as Yahoo Messenger and MS Netmeeting - software tools the groups were supposed to use at the following virtual group conferences. Special attention was made on the virtual study portal Uniflex created at Aalborg

University [1], because this is where the students get their courses, place their documents and get their every day study information.

To fulfil the second, third and fourth aim the course in databases was carefully planned consisting of 6 blocks with 3 main exercises. The following demands are set for the course: First, the milestones for answers to exercises should be followed strictly. Second, the lecturer promised to give feedback shortly after getting the group agreed exercise solution. Third, the connection between exercises and a possible solution to the database project was very close. Fourth, the three exercises should be answered by the group, forcing the group to discuss and reflect in their conferences about possible solutions. These demands should guarantee that the course was ahead the project solution.

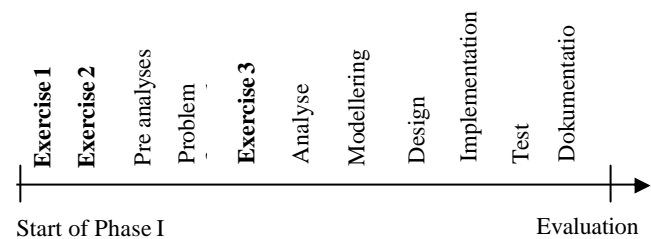


Fig. 3. Progress along a time axes

Because the deadlines for exercise 1 and 2 were rather demanding the group should not have time in their conferences to discuss project content. In this way we not only postponed the start of the project, the students also learned the definitions and meaning of terms normally used in database construction before discussing the pre-analyses and formulating the subject of their own database.

As the primary aim is to get experiences in collaborative group work on the Internet using IT-software tools, the subject for the database is of secondary importance. The 3 database exercises concerns elements of designing a family database where information of the individual family member e.g. forename, surname, address, age, sex, phone number, web address, children, father, mother, profession and so forth is located. Choosing this database subject as the pilot project gives valuable information when working out the project and writing the project report. The consequence should be saving time and workload. The groups just had to make further work on and refinement of the lectured commented exercises. This seems easy, but considering that the database should be effective, reliable and consistent there still is a lot of thinking, reflection, discussion and decisions to be made. Also the work needed theory and methods from the two other courses. The outcome can be seen on Fig. 3, and Fig. 4.

When the project is finished and the reports are written they are uploaded to Uniflex together with an URL where to find the implemented result. It is recommended that the Project report should be limited to 10 pages and the Process report to 3 pages (Fig.5).

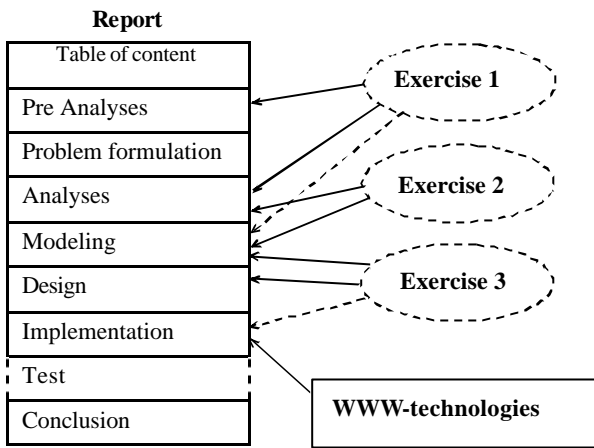


Fig. 4, Project report and main sources

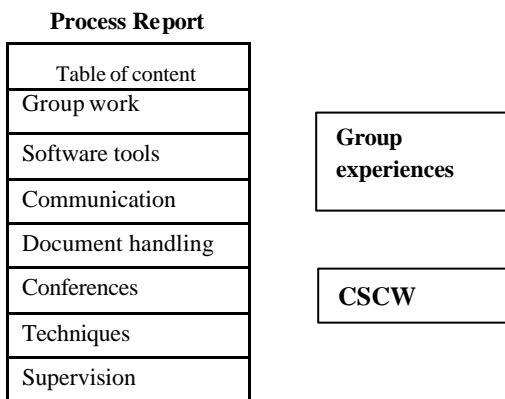


Fig. 5, Process report and main sources

### B. Phase I: Questionnaires

The Pilot project seen as an experiment [6] had five parameter changes as inputs: The dead lines for database course exercises were fixed, the technical subject was changed from web-page design to database construction, the Pilot project period was shortened from 12 weeks to 8 weeks, the feedback reply time for exercise solutions was shortened and the 3 exercise solutions were worked out by the group and feedback was given to the group.

The questionnaires should be formulated as to confirm whether the changes have been effectual for the aims. Therefore the questions were grouped in four, one for each of the mentioned aims of phase I.

- Group 1: About experiences in web-based group-organised project work and collaboration and communicative tools.
- Group 2: About database theory, construction and implementation on a server with access from a client.
- Group 3: About Priority between course work and project work
- Group 4: About workload

The questionnaires were created just before finishing the project work and before the evaluation. It was uploaded to

Uniflex and the students answered the questionnaires after repeated encouragements. An example of a question is shown in Fig. 6.

The dot area gives a fast and rough view of the opinion but the comment area often gives a much more valuable feedback, so the students were encouraged to write in the box

11. What is your opinion about choosing design of databases as subject for the pilot project?				
Very good	Good	Average	Not so good	Bad
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Comments:				
<div style="border: 1px solid black; height: 30px;"></div>				

Fig. 6, Example showing the on-line scheme for the questions

### C. Phase I: Answers and Results

The number of questions in the four groups varies. Group 1: 10, group 2: 7, group 3: 5 and group 4: 2. This section summarizes the answers and states some results.

*Group 1:* The score in this group spread from average to very good. It certainly is new for everyone to work virtually. Web technology is known to some extent, as IT is part of everyone's job. Minor technical problems in relation to learning and use of Yahoo messenger as the communication channel were easily solved. Conferences based on agenda, chairman and reporter was also natural after few trials. Because the students are determined in their daily work they also made their conferences short and effective, two hours at the most. The portal Uniflex also got a high score, because the students rather quickly found it useful for document exchange, and as their main docking place for work notes, referenda, exercises and parts of the report. The portal e-mail feature was extensively used but the offered news groups were not. The answers clearly pointed out that the main complains were based on technical constraints, such as drop out of the audio connection and lack of possibility to use Microsoft Netmeeting's white board, because the members were connected with dynamic IP allocation or were protected behind a firewall. Even though video camera is fun it is not a must to use in conferences. The main result is that the students are satisfied and confident with group work on the Internet. They have the feeling of belonging to the group and they have the feeling of group solidarity.

*Group 2:* The score in this group was very high, good to very good. The students found the course well planned, the exercises were well prepared and the content was suitable for the project work. The textbook was mostly useful because theory and hands-on examples were presented. But for implementing the solution on a server the student had to find help elsewhere. The lecture got high marks for fast and valuable feedback on the exercises. For this reason the students claimed that their supervisor was not sufficiently visible. But as the supervisor needed not be an expert in database construction this was expected as planned. The result is very satisfactory. The tight coupling between the course and the project was achieved. Despite

this the students realized that modeling, design and implementation of their own database required rethinking and reflection, realizing that there still was a lot of problems to take care of.

*Group 3:* In the start conferences were mainly concentrated on solving the exercises but all conferences used some time on the project as well. Time used on courses and project spreads from courses/project - 20/80% to courses/project 70/30%, and it seems that the students with some knowledge in databases used more time on the project. As the group work did function very well, knowledge from the experienced students was exchanged to the less experienced students under their conferences.

*Group 4:* The students generally claimed their ability to keep workload on or below 20 hours/week. One answered that he in the last 14 days had to work much more. From [2] it was seen that before the changes the groups generally found it difficult to keep work load under 20 hour/week. Consequently, some improvement seems to be the result of our changes.

#### *D. Evaluation of the Pilot Project*

As indicated in Fig. 2, the evaluation of the Pilot Project is placed between seminar 1 and 2 indicating that the evaluation is performed online. Headed by the supervisor and controlled by a censor the examination was planned for about 2-3 hours on the net. Before the examination the group had planned their presentation. A copy of the group composed Power Point presentation was attached a mail and all participants were expected to have a copy of this as well as a copy of the project report and the process report at hand. After the group planned presentation based on the power point slides the supervisor and censor asked questions directly to the individual student about content in the reports and professional subjects related to the proposed solutions.

The experience with net based evaluation is that it is very satisfactory for everyone. But to be a success it requires discipline and a serious plan for the progress of the examination made by the supervisor and agreed upon of all the participants. E.g. if the audio connection for one or more of the participants breaks down the supervisor has to detect this and start a catch-up procedure.

A positive side effect for both the students and supervisors is that the number of seminars can be reduced because examinations until now have been part of face-to-face meetings.

#### *E. Preliminary experiences from Phase II and III*

As we now are in the middle of Phase III it is all too early to form conclusions about the expected success from our changes. But as seen in Fig. 2, Phase II and III is not overlapping forcing the students to study when the courses are offered and concentrate on the project when it is time for that. Looking at the number of email exchange and the number of group meetings in the course period it is markedly lower then in Phase I and what is seen now in Phase III where it is clearly higher. One remarkable observation is that it looks like the content in the email and the questions we get in Phase III are at a higher professional level than seen before. One cause could be our

changes but other factors also count e.g. more of the students are experienced with the Aalborg model as they got their bachelor from AAU. The course lecturers report that the changes have caused an enhanced learning in Phase II. Questionnaires after Phase III will hopefully convey more reliable information on the effect of the changes on Phase II and III.

## V. CONTRIBUTION TO THE VITUALEDUCATION SOCIETY

It has been mentioned above that the university has developed its own web based distance education tool, Uniflex [1]. It has proven to be very useful when coping with engineering projects. The tool has been improved from time to time when students and supervisors got new ideas. Uniflex is used in the e-learning lab as one of the tools the students experiment with at the first seminar.

In the ViLL project period quit a number of articles and papers have been written documenting best practice at the time ending up with the need of real radical didactic changes compared to the normal on-campus "Aalborg model".

At the web address:

<http://www.control.aau.dk/~mk/WiLL/ViLL-rapport> you will find:

- Articles (12) mostly in English published in proceedings
- Project descriptions (2) for the ViLL project (in Danish)
- Evaluation schemas (5) documenting interviews and questionnaires (in Danish)
- Experiments (4) documenting e-learning lab experiments (in Danish)
- Work papers (5) for guiding the progress in the research (in Danish)

## VI. CONCLUSION

The MII project examines how didactic changes combined with technical tools can be used to transform the positive on-campus PBL experiences to off-campus programs.

As teachers and students all have a technical background and are confident with information technology it is not surprising that we have had the major problems on the didactic part of the education. Until now we can conclude:

- In distance education the project work in groups is inspiring, motivating and improve the learning process
- In distance education though there is a danger for the student to give priority to the project work on expense of the courses because of group solidarity
- Our attempt to transform this group solidarity to course study is to plan project free periods where the study and exercises are a group responsibility
- The well planned pilot project was very much appreciated
- Virtual group meetings with text, audio and video are functioning very well when carefully planned and conducted with discipline

- Face-to-face meetings are valuable as supplement to virtual meetings, in particular for planning and discussions in depth but
- It seems a good idea to reduce the number of face-to-face meetings from 7 to 4 so the students do not postpone problems to the next seminar, but find solutions at the virtual meetings
- It is a very good experience to evaluate the students over the internet, but it must be well planned and headed by the supervisor
- It is a necessity to have a web-portal for the whole education
- For the group work Uniflex is an excellent tool for document handling and version control

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### Links:

Det Digitale Nordjylland (in Danish):

<http://www.detdigitalenordjylland.dk/>

E-learning lab (in Danish):

<http://www.ell.auc.dk/>

ViLL-project (in Danish):

<http://www.ell.auc.dk/dk/3/default.asp?query=1>