Shifting Perspectives in Engineering Education

Edited by Michael Christie

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The use of learning management systems in Engineering Education: A Swedish case study

Ramón Garrote

Introduction

New technology creates many new teaching and learning possibilities but at the same time places great demands on teachers and learners (Scott, 2001). In March 2002 the Swedish government created the Net University to stimulate and mediate net based learning in higher education. SEK600 million was set aside to be distributed between universities who supported e-learning initiatives. Of the total amount SEK500 million was given directly to universities who offered e-learning courses via the Swedish Net University. Some of this material was packaged in a pedagogically sound way and reflected well on teachers educational designers who cared about and understood the special requirements of e-learners. Unfortunately other material consisted of course notes and lectures that were simply downloaded with a great deal of thought for the learner. More recently the Net University has seen the need for more interactive courses that make use of commercial learning management systems (hereafter LMS). LMS such as BlackBoard, WebCT, Fronter, Ping Pong and others provide a way for teachers and learners to arrange course materials in a clear and helpful way as well as providing useful interactive teaching and learning tools. In early 2006 it hopes to be able to recommend that participating universities use one particular LMS in order to gain the greatest pedagogical and economical benefit for the universities and their teachers and learners. The recommendation follows an exhaustive evaluation process.

Learning platforms are used to a different extent in a number of university colleges and universities to support both face to face and distance education. Students can work together on the web, create group assignments, exchange information with links to other pages on the web, send messages to each other, share experiences and points of view and use a number of different tools as a support in their studies.

The teachers can publish messages to the students and to the colleges, publish course contents, times for meetings, lectures and other document. Furthermore it is possible to create evaluations and tests, that totally or partly can be marked by the program in the LMS. It is also an advantage to always have access to updated information about the students and have an opportunity to follow up their work. Through the use of a LMS the communication within the course do not have to be done via external mails with enclosed files. All of the material in a course is gathered in one place.
An LMS offers a simple way for the user to use different web-based tools, that are included in the LMS. Most LMS, including those mentioned above and others such as Luvit, Tutor and First Class have rather similar tools. In Sweden there is no dominant LMS. University colleges and universities have made different choices for reasons of cost or other needs (http://kummel.slu.se/lankar.html#larplattformar).

Aim of the case study

Net University begun after a number of years of great optimism about dot.com companies and e-learning in general. In fact, despite sizeable economic incentives to universities, the number of courses adapted for online delivery is disappointing. In West Sweden, where this case study is situated, only Trollhättan-Uddevalla university college had more than 10% of students online. Although online learning will not doubt increase there is clearly a resistance to implementing it in many universities. Chalmers for example had no students studying online courses. Why is this? In this case study we report on the experience of teachers and learners at the School of Engineering at the University College of Borås which has used the LMS WebCT since 1999.

The author’s interest in how a LMS can be used in education lead to this survey of how the tools, that are included in an LMS, are used. The University College of Borås (UCB) comprises of six academic Schools and has about 10 000. At UCB two LMS are used, Luvit and WebCT. In this study we concentrated on WebCT and examined the extent to which LMS tools were used in 197 courses. As well as investigating the extent to which available tools were used we also wanted to know if tools would be used more often and more effectively if teachers received better support and advice. No distinction was been made between on campus courses (where students physically attend lectures, exercise sessions and labs) and off campus or distance education courses (see Collis, B & Moonen J, 2001. p 42 for definitions of these terms).

Method and material

The method chosen to study the courses using the WebCT LMS was systematic observations to obtain quantitative data (Denscombe, 2000. p 204). To minimize and if possible eliminate qualitative variation in the results a scheme of observations was created (Denscombe, 2000. p 165). The examination was executed by visiting every course and studying what tools in the LMS which were used. The observations were booked in a spread sheet. See below for details.

When the model for examination was created, both reliability and validity were considered. Reliability means the measurement is repeatable and consistent no matter if one of more observers collect data. For this study was to have (Bjereld, et al, 2002. p 111). A high level of reliability is reached when systematic observations are carried out using the same data collection mechanism (Denscombe, 2000. p 174). We created a spread sheet, where every course had one row. There were columns that corresponded to every tool in the LMS. As administrative columns we inserted ‘Examined’, ‘Ladokkod’
and ‘the name of the course’. Furthermore a column called ‘Multimedia’ was inserted to obtain information about which courses used this. Every tool in the LMS that was found in a course during the investigation could be filed in the observation scheme either as ‘existing’ or ‘in use’. ‘Existing meant that the tool is inserted in the course. This could mean that the teacher has inserted the tool in the course and tested it without later using it in active way in the education process. A teacher can decide whether a tool should be seen by the students or not. If a tool was booked as ‘in use’ it means that it has been used in active way in the course. Those cells that are blank show that the tool was not to be found in the course.

**LMS tools**

The different tools, that are available for use in the LMS WebCT can be divided into six different groups, namely Pages, Course Content Tools, Content Utilities, Communication Tools, Evaluation & Activity Tools, and Student Tools

<table>
<thead>
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<th>Pages</th>
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<th>Communication Tools</th>
<th>Evaluation &amp; Activity Tools</th>
<th>Student Tools</th>
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<td>Syllabus</td>
<td>Discussions</td>
<td>Quizzes/Surveys</td>
<td>My Progress</td>
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<tr>
<td>Single Page</td>
<td>Content Module</td>
<td>Mail</td>
<td>Self Test</td>
<td>My Grades</td>
</tr>
<tr>
<td>URL</td>
<td>Glossary</td>
<td>Chat</td>
<td>Assignments</td>
<td>Language Selector</td>
</tr>
<tr>
<td></td>
<td>Image Database</td>
<td>Whiteboard</td>
<td>Student Presentations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Index</td>
<td>Calendar</td>
<td>Student Homepages</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Utilities</th>
<th>Student Tips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search</td>
<td></td>
</tr>
<tr>
<td>Course</td>
<td></td>
</tr>
<tr>
<td>Resume Course</td>
<td></td>
</tr>
<tr>
<td>CD-ROM</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Tools available in the LMS WebCT

The tools available in each one of the groups according to the scheme above could be described as follows and the description is about the same as the description of functionality in the report "IT-platform for distansutbildning” which means "LMS for distance education” (Schultz, T. Nergell, M. 2004, Appendix 1 p 17-18).

**Pages**: Organizer Page. This tool enables teachers to create a structure in a course with maps and sub maps.

**Single Page**: A tool that allow you to publish document files, which the students can read and download.

**URL**: This tool enables one to publish links to other pages on Internet.

**Course Content Tools**: These include the following

- Syllabus that enables teachers to publish information about the course, such as name of the teacher, curriculum etc.
• Content Module: A tool that enables to publish a number of documents ranked according to heading and subheading.
• Glossary: A glossary that explains meaning of the words. The function is the same as a dictionary.
• Image Database: A tool that enables the creation of a searchable image database, which the students can look at and may be download.
• Index: The tool enables a direct link to a document in the course.
• Content Utilities
• Search: The tool enables search for keywords that are in the tool Content Module in the same course as you visit.
• Content Compiler: A tool that enables to compile to one major page all pages in all of the course modules.
• Resume Course: The student has the possibility to by the use of this tool to resume to the last visited tool in a course.
• CD-rom: The tool allows the students to reach files directly from a tool within a course instead of downloading them from a web server. This could be done by distributing a CD with all the files to the students.

Communications Tools: these include
• Discussions: The tool is a discussion tool, where students can insert opinions about different topics and give responses to one another.
• Mail: Internal mail in the course, where teachers and student as well as students and students can exchange messages with each other.
• Chat: The tool enables discussions in real time.
• Whiteboard: Students can communicate with each other by text and drawings in real time. Pictures can be imported. The information on the whiteboard can also be saved.
• Calender: The calendar of the course, where all registered in the course can make notes for the course. Only the teacher can permit the students to make notes that can be seen by all in the course.
• Student Tips: A tool that enables the student to every time he log in to see tips and advices from the teacher.

Evaluation & Activity Tools: these include
• Quizzes/Surveys: The tool allows on-line examination, tests or quizzes.
• Test: The tool allows the students to test their knowledge. No book-keeping of their results.
• Assignments: The tool allows the teacher to present an assignment with background and supporting material. The students can upload the assignment to the LMS. Then the teacher can scrutinize the assignment.
• Student Presentations: The tool allows to form groups where they can upload group assignments in progress or finished group assignments to be examined by the teacher.
• Student Homepages: The tool gives the students a possibility to create a home page of their own, that only can be seen by the students in the same course.
Student Tools: these include

- My Progress: The tool allows the students to see the part of the course they have been looking at, for instance what pages they have visited, which they have uploaded or read in the discussions.
- My Grades: The tool gives the teacher a possibility to tell every student just the results they have reached in different sections of the course.

Multimedia: This tool can be described as follows

- Multimedia: The tool gives a possibility to upload streamed films about different sections of the course or instructions about how different computer systems work. This column has been created in order to find out to what extent that multimedia are used in different courses.

The Investigation

With the use of the observation scheme an examination was done of all of the courses (197 units), that were registered in the LMS WebCT at UCB on 8/7/2005.

Pages

<table>
<thead>
<tr>
<th>Organizer Page</th>
<th>Single Page</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>In use</td>
<td>106</td>
<td>95</td>
</tr>
<tr>
<td>Exist</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Not found</td>
<td>84</td>
<td>101</td>
</tr>
</tbody>
</table>

Figure 2: Result of examination of Pages
Organizer Page
The examination comprise 197 courses, 106 use organizer page, 7 have just inserted it without using it and 84 do not have it at all. This means that 54 % use this tool, 4 % have inserted it in the course and 42 % have not used it.

Single Page
This tool has been used in 123 courses, 13 have inserted it and 61 did not use it at all. In per cent this means that 62 % used the tool, 7 % have inserted it in the course and 31 % do not use it.

URL/Web address
Here 95 courses use the tool, 7 have inserted it and 101 have not used it. This means that 48 % use the tool, 0.5 % have inserted it and 51 % have not used it

Course Content Tools

![Graph showing the result of the examination of Course Content Tools](image)

<table>
<thead>
<tr>
<th>Tool</th>
<th>In use</th>
<th>Exist</th>
<th>Not found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus</td>
<td>56</td>
<td>36</td>
<td>105</td>
</tr>
<tr>
<td>Content Module</td>
<td>118</td>
<td>18</td>
<td>61</td>
</tr>
<tr>
<td>Glossary</td>
<td>12</td>
<td>3</td>
<td>182</td>
</tr>
<tr>
<td>Image Database</td>
<td>2</td>
<td>0</td>
<td>195</td>
</tr>
<tr>
<td>Index</td>
<td>0</td>
<td>3</td>
<td>194</td>
</tr>
</tbody>
</table>

Figure 3: Result of the examination of Course Content Tools

Syllabus
The syllabus is used by 56 courses, 36 have only inserted it as a headline and 106 have not inserted it at all. In per cent this means that 28 % use syllabus, 18 % have inserted it as a headline and 54 % have not inserted it at all.

Content Module
This tool has been used in 118 courses, 18 have inserted it and 61 do not use it at all. In per cent this means that 60 % use the tool, 9 % have inserted it in the course and 31 % have not used it at all.
Glossary
This tool has been used by 12 courses, inserted in 3 and has not been used at all by 182 units. This means that 6 % have used it, 1.5 % have inserted it and for 92 % it has not been an option.

Image Database.
Image database has been used in 2 courses, no one has inserted the tool and 195 have not used it at all. Only 1 % of the courses has used the tool.

Index/register
No course is using the tool.

Content Utilities

Figure 4: Result of Examination of Content Utilities

Search
The tool has been used by 3 courses, 9 have inserted it and 185 have not used it at all. Here 1.5 % have used it, 4.5 % have inserted it and 94 % have not used it at all.

Content Compiler.
This tool has been used in 2 courses and has not been used at all by 195 courses. This means that 1 % has used it and 99% have not used it.

Resume Course
Resume course has been used in 5 courses, no course has inserted the tool and 192 courses have not used it at all. Only 2.5 % have used the tool.
CD-rom
During the investigation no such link was found.

Communication Tools

![Bar chart showing usage of various communication tools](chart.png)

Figure 5: Result of Examination of Communication Tools

Discussions
The tool is used by 46 courses, 56 have inserted it and 95 do not use it at all. Here 23 \% have used it, 28 \% have inserted it 49 \% do not use it at all.

Mail
This tool has been used in 43 courses, inserted in 40 courses and has not been used at all by 114 courses. This means that 22 \% have used it, 20 \% have inserted it and 58 \% of the courses have not used it.

Chat
Chat has been used in 14 courses, 28 have only inserted the tool and 155 have not used it at all. In per cent this means that 7 \% use the chat, 14 \% have inserted it and 79 \% have not used it.

Whiteboard
Here the tool has been used by 1 course, 5 have inserted it and 191 have not used it. This means that 0.5 \% have used the tool, 2.5 \% have inserted it and 97 \% have not used it.

Calendar
The tool is used by 24 courses, 94 have inserted it and 79 do not have it at all. Here 12 \% have used it, 48 \% have inserted it and 40 \% do not use it.
**Student Tips**

This tool has been used in 4 courses, inserted in 3 courses and not used by 190 items. This means that 2 % have used the tool, 1.5 % have inserted it and 96.5 % have not used it.

**Evaluation & Activity Tools**

![Figure 6: Result of Examination of Evaluations & Activity Tools](image)

**Quizzes/Surveys**

Quizzes/surveys have been used in 39 courses, 5 have only inserted the tool and 153 have not used it at all. In per cent this means that 20% use quizzes/surveys, 2.5 % have only inserted it and 77.5 % have not inserted it at all.

**Test**

Here the tool is used by 8 courses, 6 have inserted it and 181 have not. This means that 4 % have used the tool, 3 % have inserted it while 93 % have not used it.

**Assignments**

The tool has been used by 26 courses, 5 have inserted it and 166 do not have it at all. Here 13 % have used it, 2.5 % have inserted it and 84.5 % do not have it at all.

**Student Presentations**

This tool has been used in 3 courses, inserted in 7 courses and not used by 187 ones. This means that 1.5 % have used it, 3.5 % have inserted it and 95.5 % have not used it.

**Student Homepages**
Student Homepages have been used in 4 courses, 34 have only inserted the tool and 159 have not used it. In per cent this means that 2 % use Student Pages, 17 % have only inserted them and 81 % have not used them at all.

Student Tools

![Bar chart showing usage of Student Tools]

Figure 7: Result of Examination Student Tools

My Progress
Here the tool has not been used in any course, 7 have inserted it and 190 have not. This means that 3.5 % have inserted it while 96.5 % have not used it.

My Grades
The tool has been used by 41 courses, 6 have inserted it and 150 do not have it at all. Here have 21 % used it, 3 % have inserted it and 76 % have not used it at all.

Multimedia
This possibility has been used in 2 courses, inserted in 3 courses and not used at all by 192 ones. This means that 1 % have used it 1.5 % have inserted it and 97.5 % have not used it at all. Multimedia has been inserted in the above figure for convenience sake because although it does not belong to any of the groups it is an interesting feature in an LMS.
For an overall summary of the results of the investigation and the comparative uses of the various LMS tools see the following diagram.

Discussion

The reason I undertook this investigation was that the School of Engineering at the University College of Borås noticed a decrease in the number of new students. Despite an effort during Spring 2005 only the same number of students as last year have been recruited to the School of Engineering at the University College of Borås. This has been a trend over recent years. In fact in Sweden there are significant difficulties in recruiting students to engineering education. A similar trend have been observed in the USA. Professor Russel Jones has noted ‘the number of high school graduates who enrol in engineering programs in the USA has been declining significantly in recent years, despite a sustained and increasing demand of technical graduates by employers of engineers. In the middle of the 1980’s, engineering schools graduated some 80,000 Bachelors degree
students per year. This number has dropped by 25% since then. It is evident that students select other, often less demanding, paths to the technical employment marketplace—such as computer focused courses of study or quasi-engineering programs with less rigorous mathematics and science requirements”.

Jones points out that during the 1990’s great efforts were made to improve engineering education via eight different Coalition programs. The model programs developed by many of the Coalitions have also been good models for others to adopt. They include the following features:

- Inversion of the curriculum, to bring engineering subjects into earlier years of a program in order to keep student interest in engineering high and to provide a rationale for the study of mathematics and science which heavily dominates the first two years of engineering study.
- Just in time coordination of mathematics and science coverage, within the context of engineering problem solving courses, as the major educational stream.
- Engineering design throughout the curriculum as a major theme, beginning in the Freshman year
- Holistic, integrative experiences for undergraduate engineering students.
- Links to pre-college education, and increased recruitment and retention of under-represented groups.
- Integrated development of educational tools, including utilization of advanced technologies in the educational process.

Jones sums up by saying that engineering education in the United States has been undergoing a systematic and healthy reform, leading to more emphasis on undergraduate education in engineering faculties. It has also resulted in an improvement of the educational process and the participation of graduates in this process.

New technologies create new possibilities for learning, but at the same time they demand considerable changes in attitude towards learning and pedagogy. Flexible learning, including distance education, has become an integrated part of our education system and will be more important in the future. This view is supported by the Ministry of Education in Sweden. Via the Bologna Process the EU and member states have worked to make education compatible across Europe. It has done this for instance through the introduction of a double credit systems that allows students to participate in courses given by other universities. It has also committed funds to support target courses based on technologies that enable flexible learning.

In 2006 Sweden doubled the budget for the Net University from 30 to 65 million Swedish crowns and gave it a larger responsibility to support universities and university colleges who introduce IT-supported distance education. Mrs Ann-Sofie Fredriksson, information officer at the Net University, says in an article in the magazine Computer Sweden nr 98 2005, that this initiative involves a new type of pedagogy. It is not enough to just make lectures available on Internet. In an earlier chapter in this book Christie et.al., argue that it is not sufficient to just acquire the infrastructure in the form of a LMS.
and leave the rest to teachers. expect the rest to take care of itself. The technological
development within the field of LMS is so fast there is a need for administrators, ICT-
specialists, educational designers, teachers and students to work together. Without this
cooperation the best features of traditional teaching and learning will be lost and the
potential for a new and improved pedagogy through web based learning be unrealised.

In my experiences as an ICT-adviser at the University College of Borås teachers do not
have the time nor motivation to become experts in how to use a LMS. This investigation
showed that the most fundamental tool in LMS, the pages where teachers can create a
structure in a course, publish document files and links to pages on the internet and allow
students to download information was used by 48-62 % of the courses in our survey. The
most used tools here were course content tools, used by 60 % while the syllabus function
was used by 28 %. The glossary is used in 6 % of the courses while the use of an image
database and index is negligible. The need to use an image index varies with the content
of the course. The use of an image database is important when a large number of pictures
are needed to illustrate the content of the course. With few pictures in a course teachers
solved the problem by using an icon that showed that there are pictures. The use of
content utilities was as a whole negligible.

The use of communication tools was varied. Discussions, mail, chat and calendar have a
frequency use that varies from 12 % to 23 %. Whiteboard and student tips have a
negligible use while evaluation and activity tools such as quizzes/surveys and
assignments have been used in 13 % to 20 % of the courses. The use of quizzes/surveys
can be dependent on the type of course, the course plan and teachers familiarity with
using and trusting this tool. Assignments and its frequency of use also depends on the
type of course, the plan of the course, the choice of examination in the course and the
teachers familiarity with the tool and his time and readiness to examine assignments with
partly or wholly open questions. Assignments with open question have a tendency to be
of a larger volume than assignments with more specific questions. The use of Student
Tools was also low with My grades being used in 21 % of the courses while the use of the
tools My activity is negligible. The use of the multimedia is negligible.

A general conclusion is that all courses probably do not have a need to use all of the tools
in a LMS. Depending on the content of a course, the course plan and whether it is an on
campus or at distance course there can be different needs. Another point of view that can
influence the use of a various tools in the courses is the familiarity with using LMS
among the students. Students who have got used to using an LMS from year one at the
university college or university ought to be ready to use most of the possibilities in a
LMS by their third year. For the further development of the use of LMS it is important to
offer continuous education, competence development and support in how to use a LMS.

Recommendation

Our survey indicated that LMS is not being used to its full capacity at the School of
Engineering at the University College of Boras. If we are to change this situation at Boras
and other engineering schools it is important to offer user support by experts on LMS. To
simply transfer files on to an LMS without considering the design of the platform or the pedagogical use of all its capacity is counterproductive. All those concerned in the engineering education enterprise will be disappointed and dissatisfied and an extraordinary opportunity to combine pedagogy and technology missed. Researchers also have a key role to play, for more work needs to be done on how young peoples’ learning styles have been affected by the out of school use of the internet and other ICTs. It is important, for example, to find out how students acquire knowledge outside the formal learning environment in order to tailor online learning at universities to their needs and learning styles.

References

Jones, R. at http://www.worldexpertise.com
http://www.worldexpertise.com/Developments_in_Engineering_Education_and%20Acc reditation_in_the_US.htm