
An Analysis of Online Education and Learning Management Systems in the Nordic Countries

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Abstract

This article presents the results from an analysis of online education and Learning Management Systems (LMS) in the five Nordic countries. The analysis is based on literature review and in-depth interviews with 20 selected Nordic training managers. The analysis comprises a broad range of institutions from primary education, secondary education, higher education, distance education, and corporate training.

LMS systems seem to be widely used in Nordic education and there is a clear trend towards large-scale online education. The 20 institutions had experiences with 25 different LMS systems and 12 of the institutions now have more than 50 online courses. Higher education institutions have standardized on a few national student management systems, and they prefer LMS-systems developed in the Nordic countries. Among the 25 different LMS systems that were identified in the analysis, 16 were of Nordic origin. All other systems were of American, Canadian, or Irish origin. The research indicates that ClassFrontier, WebCT, FirstClass, and BlackBoard seem to be the most used LMS systems. E-learning standards do not seem to have had much impact on online education in the Nordic countries.

LMS systems could have reached a point where user-friendliness, cost effectiveness, and integration with other systems is more important than new features. Some interviewees want to integrate the LMS with existing systems and other services such as student management systems, marketing catalogues, online payment, tracking of textbook shipments, registration of examinations, and multimedia tools.

The institutions do not seem to be especially loyal to, or dependent on, one provider of LMS system. Several institutions prefer self-developed systems. They perceive the commercial systems as expensive and complex and want to develop the systems to support their special needs. They wanted cost effective systems with the ability to handle continuous enrollment and integration with student administrative systems and economy systems. In the future, the open source strategy may have an impact on the LMS market.

Introduction

This article presents the results from an analysis of online education and Learning Management Systems (LMS) in the Nordic countries. A more comprehensive and detailed analysis (Paulsen 2002) is available in the complete, one hundred page report. The analysis is an integral part of the European Web-edu project (www.nettskolen.com/in_english/webedusite/index.html) that provides similar analyses from other regions in Europe. The Nordic analysis is based on literature review and in-depth, qualitative telephone and e-mail interviews with 20 selected Nordic training managers who have comprehensive experience using LMS systems. The interviews were conducted from October 2001 to May 2002 according to an interview guide developed by the Web-edu project team. The interview guide identified the following focal points, which also are discussed in this article:

- The institutions and their LMS systems
- Course development tools
- Student support tools
- Tutor support tools
- Administrative systems
- Technology
- Economic issues
- Overall evaluation
- Features in future LMS systems

The Nordic Scene

The 5 Nordic countries are Denmark, Finland, Iceland, Norway, and Sweden. Sweden has a little more than 8 million inhabitants, Denmark and Finland a little more than 5 each, Norway 4.5 millions and Iceland about 300.000 inhabitants. Together they have a total population of about 23 million. Each country is among the wealthiest nations in the world. The countries are also recognized as advanced users of computers and telecommunication technology. According to the key indicators presented in eEurope's Benchmarking program (http://europa.eu.int/information_society/eeurope/benchmarking/index_en.htm), all five Nordic countries are among the six EU countries that have the highest Internet access in households.

The following paragraphs present an overview of the situation regarding national initiatives on online universities, student management systems, and LMS systems in each of the five countries. The issues are further discussed in the articles *Online Education*

Denmark

According to Ranebo (2001) the Danish Ministries of Education and Research initiated a Danish Virtual University in a mission statement on March 27, 2000. The DKr 40 million budget for the period 2000-2003 should be used to support the development of high quality, higher education, web-based courses and provide information about the courses. As one of the interviewees pointed out, this was obviously not a success:

The universities have autonomous responsibilities for their e-learning strategies. A national initiative to establish a Danish Virtual University broke down as a result of disagreement between the involved partners. The only result seems to be a planned portal providing information about e-learning initiatives.

STADS is the dominant student management system in Danish Universities and colleges. All Danish universities except from the universities of Copenhagen and Aarhus use it. The system is developed by WM-Data in collaboration with the universities.

Scandinavia is an important market for FirstClass and some of its largest customers are in Denmark. Skol-kom has more than 200.000 FirstClass users in Denmark. COM-C and Blackboard also seem to be important players in the Danish market according to two interviewees:

Blackboard makes advances in Denmark.

Blackboard seems to grow in the Danish market. COM-C and FirstClass are two alternative, major players.

Finland

According to Ranebo (2001), the 20 Finnish universities have formed the Finish Virtual University (www.virtuaaliyliopisto.fi) as a consortium:

The Virtual University of Finland is a development project that was initiated by the Finnish Ministry of Education during the year 2000. The project is a step in the realization of the overall strategies that the Ministry of Education presented in 1999 in its Knowledge Strategy for Education and Research 2000-2004.

The aim is for a virtual university, which offers Web-based high standard courses also in the international level, to be set up by the year 2004. Through co-operation involving universities, colleges of higher education, research centers and private alternatives the quality and flexibility of training will be reinforced, and research networks will also be reinforced.

The 20 universities in Finland will form the foundation of the activities and so, in January 2001, they established a consortium. Students who study on a full or part-time basis at the virtual university must be officially accepted at a physical university if they want to get a degree. University students do not have to pay for their studies in accordance with Finnish legislation. However, the universities can also sell courses and commission courses on the open market and thus provide courses with tuition fees for the international market, for example. (Ranebo 2001)

Oodi seems to be the dominant student management system in Finish universities. But it does not seem to have such a dominant position as the SMS systems in the other Nordic countries. One interviewee states:

There are 21 universities in Finland and there are 11 different LMS systems. 8 of the 21 universities use the so-called "Oodi" SMS system, but only 5 of them have Oodi in real use. Oodi is based on the Windows and Oracle (+Uniface + WebLogic). You can find more about Oodi at the following address, but unfortunately it's available only in Finnish! www.oodi.fi.

The researcher found an Oodi manual in English via a Google search at http://atk.hkkk.fi/english/manuals/oodiohje_eng.htm

Iceland

According to Ranebo (2001), Iceland has not made any decision to establish a national virtual university:

In Iceland, no overall decision has been taken by the state to assemble all the higher education efforts in the area of distance learning under a national development programme for Virtual University or Web University. This particular area in higher education is relatively broad in Iceland, and distance learning, as a development area is a matter of top priority politically. Due to the size of Iceland, it is fairly easy to gain a fairly good insight into what is on offer nationally when it comes to distance courses. This might be one reason why there has not been a need to create a national comprehensive organization. (Ranebo 2001)

The Ministry of Education requires the schools to apply a student management system named INNA. One interviewee states:

Up till now, we have used a student management named AXEL, which was developed in Iceland. Every school had an individual installation of the same system. Now, the ministry of education requires that all schools use a central web-based system called INNA (www.inna.is). A company called SKYRR (www.skyrr.is) has developed INNA for the ministry of education. Neither AXEL, nor INNA has any integration to WebCT and I cannot see that WebCT will be integrated with INNA in the future either.

Norway

There is no national online university in Norway, but a number of public initiatives that support and fund online education in existing institutions.

In Norwegian higher education, the dominant LMS-system is the Norwegian-developed ClassFronter (www.fronter.com). Some colleges use standard commercial systems, and some institutions have developed their systems in-house. Runnestø and Ristesund (2002, 36) surveyed 54 of Norway's universities and colleges. Out of these, 32 institutions claimed that they offered online education. Several of them had used more than one system as shown in Table 1.

Table 1. Instances of LMS systems in 54 Norwegian institutions of higher education (Source: Runnestø and Ristesund, 2002)

LMS	Number of instances
ClassFronter	21
In-house developed	9
LUVIT	6
IT's Learning	4
First Class	3
Kark	3
WebCT	3
Blackboard	2
TopClass	1
Lotus Learning Space	1
TeamWave	1
Response	1

In Norway, two student management systems totally dominate in higher education. The Norwegian universities and some colleges use FS (Felles System) (<http://www.fs.usit.uio.no/>) and most of the Norwegian colleges use MSTAS (www.enet.no/). The two largest private colleges have chosen alternative solutions. The Norwegian School of Management BI has experiences with Banner and NKI has developed an in-house system called STAS.

Sweden

In Sweden, no LMS-systems seem to be dominant, but a number of standard commercial systems are used. Two of the comments made by the interviewees support this:

The Swedish developed LMS systems are not dominant in Swedish education. There is little national coordination in this field, the universities are very autonomous and the system choices are made locally.

Most of the distance education courses we provide via LUVIT are included in the national network university program, *Nätuniversitet* (www.netuniversity.se). It allows the universities to apply their own online systems and models. In other words, the universities don't need to coordinate their systems or pedagogical models. This is probably good for the universities, but it could be confusing for students who want to follow courses from several universities.

According to personal e-mail communication with Fredrik Rexhammar (March 18, 2002), one of Sweden's leading experts on LMS-systems, Luvit (www.luvit.com), Lecando, Infinity, Grade, Platon, and Web Academy are Swedish providers of LMS systems. In the same e-mail he states that WebCT and Blackboard are the most used foreign LMS systems used at Swedish universities and colleges. In addition, the author has found that the Swedish-developed system PingPong (www.partitur.se) is used by some institutions. An overview of the market for LMS systems conducted in Sweden is available at www.ssv.gov.se/avit/pform2.htm. It lists the following systems: Luvit, Mentor, Telia Instant Education, Maestro, FirstClass, Comenius online, Lecando, Librix, Marratech,

PingPong, Surfa och lär, and WebCat.

The three Swedish distance education consortia have received considerable governmental funding since 1993-94. (Hillefors et al, 22 and Ranebo 2001). At most, the three consortia offered 40-50 courses to 5000-6000 students (Hillefors et al, 26). After nearly ten years of operation, their results are not impressive and their funding will be discontinued. Instead, the government has recently established *Nätuniversitetet* (<http://www.netuniversity.se>) as a new national body to fund and coordinate the activities. In 2002, *Nätuniversitetet* will provide financial funding for the equivalent of 2 350 full-time students at 30 Swedish higher institutions.

All Swedish universities are using the student management system LADOK or LADOK NOVAU that are owned by a consortium of 37 institutions in higher education in Sweden. The LADOK consortium (<http://www.ladok.umu.se/>) provides the following information at its web site:

LADOK is a computer based student admission and documentation system for a university or university college. It focuses on administration of undergraduate and graduate students. The system is locally deployed and managed by the institutions.... The LADOK-system consists of two major parts, the admission system and the documentation system. They are integrated and share data, e.g. name, address and other facts about applicants and students.... The system files contain information for student identification, general eligibility for university studies, admission to courses and study programs, registration on courses per semester, course data, credit points from courses, awarded degrees and international studies.... Data from LADOK are exported to the ministry of education and other agencies for follow-up purposes. An important objective of LADOK is to prepare the annual invoice to the government for studies on the undergraduate level at an institution....

(www.ladok.umu.se/pendok/LADOK_short.html)

Overview of the Institutions and their LMS Systems

The analysis comprises a broad range of institutions from primary education, secondary education, higher education, distance education, and corporate training. But about half of the institutions are characterized as public universities. It includes public and private institutions as well as both providers of LMS services and costumers of LMS services.

Table 2 shows that the analysis includes 20 institutions from all Nordic countries. Five of them are Danish, four Finish, one Icelandic, five Norwegian, and five Swedish.

Table 2. Institutions Sorted by Country

Name of Institution	URL of Institution	Country	Type of Institution
Danmarks Netskole	www.netskole.dk	Denmark	Consortium of public technical colleges
Center for Fjernundervisning	www.cfu.dk	Denmark	Distance education center at business college
The Centre for the Interdisciplinary Study of LearningAalborg University	www.vcl.auc.dk/default-engelsk.htm	Denmark	University centre
Ventures	www.ventures.dk	Denmark	Consortium
University of Southern Denmark	www.sdu.dk/indexE.html	Denmark	Public university
University of Oulu	www.oulu.fi/english/	Finland	Public university
University of Art and Design Helsinki	www.uiah.fi/english.shtml	Finland	Public university
University of Kuopio	www.uku.fi/English	Finland	Public university
University of Tampere	www.uta.fi/English/index.html	Finland	Public university
Comprehensive College in Akureyri	www.vma.is	Iceland	Vocational college with a distance education department
The Competence Network	www.nkn.no	Norway	Commercial provider of LMS-related services
Nettskolen	www.nettskolen.no	Norway	Commercial provider of courses
Nettgymnas	www.nettgymnas.no	Norway	Private secondary school
Globalskolen	www.globalskolen.no	Norway	Semiprivate provider of primary education for children abroad
NKI Fjernundervisningen	www.nettskolen.com	Norway	Private distance education institution
Midhögskolan	www.mh.se	Sweden	Public university
Statens skolor för vuxna	www.norrk.ssv.se	Sweden	Public distance education institution

Skandia	www.skandia.com	Sweden	Global savings company
University of Uppsala	www.uu.se	Sweden	Public university
University of Lund	www.lu.se	Sweden	Public university

Among the 25 identified LMS systems, 11 are listed as "other LMS". This means that it is not the primary LMS system used at the institution at the moment. It could be a system that has been used in the past, a system that is tested for future use, or just a secondary system used for special purposes. It is interesting to observe that Table 3 shows that 11 of the 20 institutions have experiences with one or more "other systems". This indicates that the institutions are not especially dependant on, or loyal to, their providers. This situation is both a result of local autonomy and historic development.

Table 3 shows that there are large variations among the institutions with regard to the number of online courses, tutors, and students.

The numbers of online courses range from 850 [NKN] to 4 [Skandia]. The high number of courses listed by NKN is explained by the fact that it includes courses from 50-60 course providers. There are however eight institutions that claim to offer more than 100 online courses.

The numbers of online tutors range from 10 or less [Nettgymnas and Globalskolen] to hundreds. Four institutions claim to have more than 100 online tutors. [NKN, NKI Fjernundervisningen, Midthögskolan, and Aalborg]

The numbers of online students range from a few hundreds to several thousands. Even though the numbers regarding online courses, tutors, and students not necessarily are comparable and reliable, one may conclude that most of the institutions offer online education in a large scale. If one characterizes institutions that offer at least 50 online courses as large-scale providers of online education, 12 of the 20 institutions are characterized as large-scale providers of online education. In a previous international analysis of web-based education (Paulsen 2000) only 3 of the 22 Nordic institutions surveyed in 1998-99 offered more than 50 online courses. The analysis indicates that there is a clear trend towards large-scale online education in the Nordic countries.

Table 3 also shows that there are substantial variations in the number of years in use and course duration. The number of years in use range from less than one year to 15 years [NKI Fjernundervisningen]. Eight institutions claim to have up to 2 years experience. Only six institutions have five or more years of experience.

The typical course duration seems to be several months. This is not surprising since most of the institutions in the analysis are educational institutions that traditionally offer longer educational programs to students, not shorter courses to companies.

Table 3. Information about Surveyed Institutions Sorted by LMS

Name of Institution	LMS	Other LMS	# Online Courses	# Online Tutors	# Online Students	# Years in Use	Typical Course Duration
University of Southern Denmark	BlackBoard	BettyCom, EDWIN, FirstClass, COM-C	110	50-60	240 in the department and 15000 at the university	7	
Nettskolen	ClassFronter CourseKeeper		10	15	150+150	2	2-3 months
Nettgymnas	CourseKeeper		6	6		<1	1 school year
Globalskolen	FirstClass	PedIT Imaker	28	10	180+150	1	1 school year
The Centre for the Interdisciplinary Study of Learning, Aalborg University	FirstClass	Virtual-U	11 programs	120	880	8	1 semester
Ventures	FirstClass	None	A number of programs	50	3000	5	Typically on semester, but also offer individual enrollment
University of Art and Design Helsinki	Fle3 - Learning Environment	WebCT	20			4	4-16 weeks
University of Oulu	LC Profiler		41	???	2500 users		Several weeks or months
Skandia	LUVIT	None	4	???	650	2	6 months

University of Lund	LUVIT	Lotus Learning Space	250		6000 of the 23000 students are LUVIT users	5	
University of Uppsala	Ping Pong	FirstClass	50	50	20000 personal accounts, 2000 real users	1.5	0.25-0.5 school year
NKN	Saba	WebLearn Plus	850	hundreds		1	3 hours – 6 months
Danmarks Netskole	Self-developed		40	30	7000 course enrollments	<1	16 weeks
NKI Fjernundervisningen	SESAM (Self-developed)		250	125	3300	15	6 months
SSVN	SSVN2000 (Self-developed)	LEKTOR	50	20-25	500-1000	1	Few weeks – several years
CFU	TopClass	BlackBoard	20	Equivalent of 4 full-time positions	500	4	1-4 months
Midthögskolan	WebCT	FirstClass West	200	Between 100 and 200	2-3000. 40% at a distance, 60% on campus	5	0.5 – 4 semesters
University of Kuopio	WebCT	Verkkosalkku, Verkko-opisto	200		4500	3	40-160 hours
University of Tampere	WebCT		140		3700	3	
Comprehensive College in Aukureyri	WebCT	None	180 online courses, 10-20 apply WebCT	95	750	4	1 semester

Table 4 shows that the 20 institutions had experiences with 25 different LMS systems. It is interesting to observe that the majority (16 of 25) of the LMS systems are of Nordic origin. All other systems were of American, Canadian, or Irish origin.

The analysis further shows that 3 institutions (Danmarks Nettskole, NKI Fjernundervisningen, and SSVN) have chosen to use self-developed LMS systems. One additional institution (Globalskolen) states that it will convert to a self-developed system.

The commercial LMS systems that are most widely used among the institutions in this analysis are FirstClass and WebCT. The strong position of WebCT is not surprising, since WebCT and BlackBoard presently are the two dominant LMS systems on the international market (Observatory on Borderless Higher Education, 2002). FirstClass' European headquarter is located in Sweden. Scandinavia is an important market for FirstClass and some of its largest customers are in Denmark. Skol-kom has more than 200.000 FirstClass users in Denmark. It is also important to know that a comprehensive analysis (Runnestø and Ristesund, 2002) shows that the Norwegian system ClassFronter is very dominant in Norwegian higher education.

The commercial LMS systems are available in several languages, but Nordic institutions prefer to use their national languages. This is a special problem for Iceland, since few providers find it interesting to develop a version for the Icelandic population of less than 300.000 inhabitants. There are also examples of Nordic Institutions that choose to use the English language version, since new versions are first released in English.

Two of the LMS systems in this analysis, Virtual-U and Fle3, are referred to as open source systems. The interviewees who point this out are very positive to this, and it will be interesting to see if the open source strategy will be able to compete with the other commercial systems.

Table 4. LMS Systems Sorted by Original Nationality

LMS systems	Original Nationality	Language of LMS	URL of LMS	Institutions using LMS	Institutions using Other LMS
Weblearn Plus		English			NKN
West					Midthögskolan
BlackBoard	American	English, Danish	www.blackboard.com	Southern Denmark	CFU
Lotus Learning Space	American		www.lotus.com		Lund

Saba	American	English, Norwegian	www.saba.com	NKN	
FirstClass	Canadian	Norwegian, Danish, Others	www.firstclass.com	Globalskolen, Ventures, Aalborg	Midthögskolan, Southern Denmark, Uppsala
Virtual-U	Canadian		www.vlei.com		Aalborg
WebCT	Canadian	English, Swedish, Not available in Icelandic	www.webct.com	Midthögskolan, Kuopio, Tampere, Akureyri	UIAH
BettyCOM	Danish				Southern Denmark
COM-C	Danish				Southern Denmark
EDWIN	Danish				Southern Denmark
Self-developed	Danish	Danish		Danmarks Netskole	
Fle3	Finish	Finnish, Swedish, English, Spanish, French	http://fle3.uiah.fi/	UIAH	
LC Profiler	Finish	Finish, English	www.lcprof.com	University of Oulu	
Verkkosalkku, Verkk-opisto	Finish				Kuopio
TopClass	Irish	English, Danish	www.wbtsystems.com	CFU	
ClassFronter	Norwegian	Norwegian, English	www.fronter.com	Nettskolen	
CourseKeeper	Norwegian	Norwegian, English	www.coursekeeper.com	Nettskolen, Nettgymnas	
Imaker	Norwegian		www.imaker.no		Globalskolen
Self-developed: PedIT	Norwegian	Norwegian			Globalskolen
Self-developed: SESAM	Norwegian	Norwegian		NKI Fjernundervisningen	
LEKTOR	Swedish	Swedish			SSVN
LUVIT	Swedish	English, German, French, Chinese, Swedish, Danish, Norwegian	www.luvit.com	Skandia, Lund	
Ping Pong	Swedish	Swedish, English, German, French	www.partitur.se	Uppsala	
Self-developed: SSVN2000	Swedish	Swedish		SSVN	

Course Development Tools

The interviewees have different views on how satisfactory the systems are for course creation. But, the LMS systems are usually not used for development of the course content. A broad range of external tools is used to develop the content before it is published in the LMS system. The interviews show that the LMS systems use text, multimedia, sound, html-pages, graphics, and tests that are developed with external software. The software tools for course creation referred to in the interviews are listed in Table 5.

Table 5. Software Tools Used for Course Creation

Software tool	Type of content	URL
Word	Text	
PowerPoint	Text	
Macromedia Authorware and Director	Multimedia	
Flash	Multimedia	
Windows SoundRecorder	Sound	

Wimba	Sound	www.wimba.com
FrontPage	HTML-pages	
DreamWeaver	HTML-pages	
Netscape Composer	HTML-pages	
Viewlet	Graphics (Screenshots)	www.qarbon.com
Coral	Graphics	
PhotoShop	Graphics	
ReadyGo		www.readygo.com
ToolBook		
Autotest	Tests	
Webwinder	Tests	www.webwinder.com/quiz/quiz_MC_Ref.html

Development of course content is not trivial, and teachers rarely develop course content without support from others. They seem to use content developed by others, collaborate, or work in teams. Some teachers participate in development courses, have support by web-designers, or support staff.

Reusability and sharing of content could be useful. Export features, archive functions, and standards could make this easier. Several comments indicate that the systems are perceived as flexible and open to differing didactic possibilities. But a few comments indicate that some systems could be perceived as inflexible with regard to didactic possibilities. To make course development easier or to increase productivity, some institutions provide or require that the content must adhere to special structures or templates. However, institutions that do not use the commercial systems maintain that their systems are especially designed and used to support their chosen didactics.

In some cases, individual teachers design the content. In other cases, the teachers do not develop the course content themselves. But, it seems to be common that teachers collaborate or work together with other specialists to develop course content. Some claim that their system is easy to use by teachers and course developers. But obviously some support and training for teachers is useful. This could include contact with experienced tutors, teacher training, dedicated discussion forums, and support services.

Generally the interviewees confirm that the LMS systems support a wide range of media types. Most institutions seem to apply some multimedia. But, several interviewees are cautious about too much use of multimedia due to bandwidth limitations or lack of development tools. And other institutions seem to be even more cautious about including online video.

Assignment and assessment is a complex topic that should be applied in a pedagogic framework. The most frequent mentioned type of online test is multiple-choice questions. Among the other types of assignments and assessments mentioned are interactive assignments, quizzes, portfolio assessment, and surveys. Some of the interviewees are skeptic to computer-based assessment since it does not correspond to their pedagogical model or teaching tradition. Some of the systems have no built in tools for assignments or assessment. However, there are external tools that could be used to design assignments. The interviewees especially mentioned Autotest and Webwinder. WebCT seems to provide a range of useful tools. LUVIT, PingPong, Saba, and SSVN2000 also seem to provide useful tools for assignment and assessment.

Student Support Tools

There are user groups, such as sales people that work together in one company, that do not ask for online communication. But, the LMS systems seem to provide a lot of opportunities for student interaction through e-mail, distribution lists, discussion forums, chatting, bulletin boards, whiteboards etc. Discussion forums seem to be the most important tool for group communication. The institutions often organize a number of forums for various user groups and purposes. But, use of e-mail is also important, especially for institution with individual course progression. Chatting requires discipline and could be improved technically, but it has several interesting applications such as for example to reduce costs related to international communication. Among the other features that were mentioned for improving student interaction were tracking, integrated FAQ-services, personal presentations, pictures, and class lists. Finally, some comments reflected on students' opportunities to interact with the course material, the environment, and other students.

Many, but not all LMS systems, offer tools for both synchronous and asynchronous communication. Some institutions add external communication tools to offer additional communication services such as chatting, audio chatting, audio conferencing, and sharing of documents. Asynchronous communication via discussion forums and e-mail seem to be the preferred services for student-to-student communication. Several of the systems seem to provide some form of chatting as a tool for synchronous communication. The experiences with chatting are varying. It could be useful for social purposes and for informal communication in smaller groups. But several institutions limit the use of chatting since it is inflexible in time. Chatting may however be useful for formal project meetings.

Technical and administrative support is a challenge that requires more or less resources. Both the numbers of support staff and support hours differ. Support is not available 24 hours a day, but some institutions offer support after normal office hours. The communication with tutors is handled both via e-mail and discussion forums. One institution claims that it guarantees students response from tutors in less than 48 hours.

In general, the systems seem to have limited use of library resources. The most common services are links to existing internal and external Internet resources. Some institutions provide special services such as online journals, articles, library services, and bookshops for their online students.

Some comments indicate that the LMS systems need improved functionality with regard to feedback on work assignments. And tutors seem to be pivotal with regard to feedback on work and assignments. It is interesting to observe that some systems provide special mailboxes for submission of assignments, opportunities for online registration and presentation of grades, and real-time accounts for individual teacher remuneration.

Tutor Support Tools

Some institutions do not express a need for automatic tracking of student progression since their performance is measured by tutors or work competence. Tracking of students could, however, be useful for administrators, tutors, and students. But, one should be aware that some students are apprehensive about being monitored. Most systems seem to have some tracking of what students have done and when they did it. This may include which assignments they have completed, which web pages they have opened, and which tests they have taken. WebCT seems to provide tracking services that the users are satisfied with. They include tracking of quiz scores, log ins, pages accessed, and comments written. A few interviewees focus on the systems' ability to provide advanced administrative reports on enrollments, course activity etc. The self-developed SSVN2000 tracking system is especially interesting since it provides excellent tracking of students with individual progress plans.

Group management includes tasks such as entering information about students, classes and the services they should have access to. This is easy to handle with few students, but could be much work in a large-scale system. Many systems allow teachers to form groups and establish discussion forums. Other systems rely more on system administrators for group management. In some systems, students may establish services such as chatting sessions and group calendars.

Some comments express lack of functionality and tools for grading and examination results. Other comments indicate that there are many options and tools available for online assignments and that course designers should utilize the special pedagogical opportunities that are available online.

Some interviewees focus on the ability for teachers or students to follow the students' activity and progress. Other interviewees describe the administrative challenges of tracking students with individual progress plans.

Some comments express a need for improved administrative systems between tutor and institution. The contact between tutors and the institution could be supported by special contracts, separate discussion forums, support services, face-to-face seminars, and training.

Administration

Some institutions have no need for integration between the LMS system and the economy system because they do not charge any tuition fees. WebCT does not seem to offer any support for payment of fees. NKI has developed the SESAM LMS system, which is fully integrated with the economy system. Most of the institutions have separate economy systems with little integration with the LMS. Some, do however, express ambitions and needs for such integration. Online payment via credit cards and special counters for calculation of variable fees could be implemented. NKN has special needs since it also handle online enrolment to face-to-face courses.

Most of the institutions provide students with individual passwords. There are, however, examples of simple solutions in which many students share one password and advanced solutions that allow individual students to have just one password to all university systems. Most institutions seem to be pleased with their password systems. But there are diverging opinions on the workload generated by students who forget their passwords. User management could represent a heavy workload, which could be organized and automated in several ways. It is necessary to have a strategy for terminating the passwords. Distribution of virus could be reduced if the discussion forums are designed properly and encryption could be used to provide secure connections.

The interviews indicate that the LMS systems are not especially successful for storing and retrieving student records. One institution has established a project to integrate the LMS with the student administrative systems; another sees this work as a major challenge. Other institutions have developed separate databases for information that is not handled by the LMS. Several institutions comment on the needs and efforts to integrate the LMS systems with national student management systems in Sweden (LADOK) and Denmark (STADS). The users of SESAM, CourseKeeper, and Saba claim to have LMS systems that are well integrated with the student records databases.

Some systems do not include examination and certification records. Other systems provide online information about grades. Several of the interviewees are concerned about the opportunities and challenges regarding integration with the administrative system that records the student grades. One interviewee from Denmark was concerned about privacy issues and how much information the systems should handle with regard to examination and certification records. Finally, one of the interviewees stated that exams should be larger and more project oriented to become more supportive of online education.

Some of the interviewees provide positive statements about the facilities for administration of courses, classes and tutors. Other

statements are more negative. It is especially interesting to observe that several systems seem to lack facilities and services on the level above individual courses.

Technology

There are some free LMS systems that follow the open source policy, and the two users of open source systems were positive to open standards. There seems to be three categories of server solutions, and all seem to work well. In the first category, the institutions have access to commercial service providers that host the LMS. In the second category, the institutions host the LMS for internal use. And in the third category, the institutions host the LMS for internal use and as a service for other institutions. The institutions that have access to a service providers that hosts the LMS seem to be positive to the solution, but they experience some problems with limited access. Several institutions have chosen to host the LMS internally. They are typically either the institutions that have self-developed systems or larger institutions with high internal ICT competence that can operate commercial LMS systems locally. The users of the commercial systems claim that the systems are stable and reliable. The users of self-developed systems also experience few problems. Virus attacks and firewalls, however, are mentioned as serious problems. A few institution that have self-developed systems hosts the LMS for internal use and as a service for other institutions. One benefit of this is cost sharing.

FirstClass depends more on client software than other LMS systems. Other comments point out that there is no need for any special client software. But, problems with firewalls could be difficult to solve. The institutions seem to differ on how much they rely on necessary client software for special courses. Several institutions seem to minimize the need for additional client software. But some special courses and subjects, for example about statistics, require additional client software. And other systems and courses rely with more or less success on additional client software such as special plugins or Microsoft Office products.

LMS systems could be perceived as flexible, since both course content and system services could be updated regularly. Technology and templates limit the flexibility of the didactics, but it may increase the productivity. The interviewees are aware of the e-learning standards specifications, and several claim that their system follow the standards. But few claim that the standards are important to their institution.

The interviewees talk about LMS systems as large-scale systems capable of handling thousands of users. The interviewees are confident that the systems can handle a large number of users without special technological problems. The interviewees did not seem to be concerned about how the systems technically could organize the administration of large numbers of students, courses, and tutors. One mentioned, though, that large-scale operation could impose some pedagogical challenges.

Some comments express the fact that students have all kinds of connections to the Internet ranging from low speed modems to broadband access. But the speed of the LMS system does not seem to be any problem. The bottleneck seems to be the network bandwidth and local lines. To handle this, the institutions adapt their bandwidth requirements to the users' equipment. Due to the bandwidth limitations, several of the institutions limit their use of high bandwidth content.

Economic Issues

Some of the interviewees view the cost of the LMS as confidential information. Others say that it is hard to estimate or that they don't know it. The main costs reported on self-developed systems are related to a few positions in a development team and to server hardware and software. The costs and pricing structure for the commercial systems vary from system to system. This could make it difficult to compare the real prices. The costs mentioned range from under 5000 euros to over 100000 euros per year. None of the interviewees expressed sincere concern about high prices.

One obvious advantage with self-developed systems is that the institutions pay no annual fees. The commercial systems have various pricing structures and prices for annual fees. The fees could depend on the number of user licenses, the number of years the contract is signed for, or just for actual upgrades.

The Swedish and Finish institutions report that they have no tuition fees. Institutions in Denmark, Norway, and Iceland do report that they charge tuition fees, although many of them also receive additional funding from the state. The research did not find any examples of institutions that had implemented online invoicing.

As the number of users in an LMS system grows, it seems necessary to divide the management and maintenance responsibilities among a number of people. It seems like the interviewees have vague knowledge about the systems' maintenance and operation costs. The issue is perceived as complex and hard to estimate. The costs could be funded externally and it seems to include part-time work for from one to six internal people, but it could also constitute a fee per student to the ICT-department.

It seems like the interviewees have little knowledge about how much time and money that is spent on training staff and students to use the LMS systems. The external costs could be low, since training primarily seems to be handled by internal staff.

Overall Evaluation

There were several positive comments about the Nordic commercial systems. The systems were characterized as immediate, flexible, and open. The interviewees focused on their ability to save time and increase quality of learning, as well as their strong communicational and statistical features. It is especially interesting to observe that the interviewees value systems that support Nordic pedagogical traditions and national, academic user groups. The negative comments about the Nordic commercial systems were related to incompatibility with other platforms and products, limited student privileges, and the provider's uncertain financial situation.

The comments on overall evaluation on WebCT were predominantly positive. The interviewees used phrases such as: a good choice,

offers all basic tools, works reasonably well, moderately cost effective, and easy to use. But, it could be hard to get support for local adaptations in Iceland. For example, WebCT version 3 was not available in an Icelandic version.

The positive comments made about other commercial systems used terms such as simple, flexible, well working, many features, very satisfied, and provides most of the functionality we need. The most noteworthy negative comment about the other commercial systems was related to FirstClass' use of client software.

The users of self-developed systems are also satisfied with their systems. Some of the reasons for their choice are that they perceive the commercial systems as expensive and complex and that they can develop their systems to support their special needs. Among the advantages that were mentioned were the ability to handle continuous enrollment, cost effectiveness, and integration with student administrative systems and economy systems.

Features in Future LMS Systems

LMS systems could have reached a point where user-friendliness, cost effectiveness, and integration with other systems is more important than new features. Some interviewees want to integrate the LMS with existing systems and other services such as student management systems, marketing catalogues, online payment, tracking of textbook shipments, registration of examinations, and multimedia tools. Others would like to have more flexible systems and tools. Several would like more use of multimedia, especially with regard to audio and video services. Some topics and languages need better representation of characters, symbols and user-interfaces. Other features the interviewees would like to see in the future were alternative ways to organize and visualize the learning process, better tools for synchronous communication, better ways to personalize design elements, and more national and international collaboration.

Important Findings

The analysis resulted in a number of important findings that are listed in the following and sorted according to Nordic issues, integration issues, economic issues, and issues of special interest to providers of LMS systems.

The following findings are especially related to Nordic issues:

1. LMS systems seem to be widely used in Nordic higher, further, and continuing education. It is not easy to find such Nordic institutions without experiences with LMS systems.
2. The analysis indicates that there is a clear trend towards large-scale online education in the Nordic countries. It shows that 12 of the 20 institutions offer at least 50 online courses. According to a 1998-99 analysis, (Paulsen 2000) only 3 of 22 surveyed Nordic institutions offered more than 50 online courses three years ago. Further, the interviewees talk about LMS systems as large-scale systems capable of handling thousands of users.
3. The Nordic universities have standardized on a few national student management systems. The systems are LADOK (Sweden), MSTAS (Norway), FS (Norway), STADS (Denmark), INNA (Iceland) and to some extent Oodi (Finland).
4. Nordic institutions seem to prefer LMS-systems developed in the Nordic countries. Among the 25 different LMS systems that were identified in the analysis, 16 were of Nordic origin. All other systems were of American, Canadian, or Irish origin.
5. The research indicates that ClassFronter, WebCT, FirstClass, and BlackBoard seem to be the most used LMS systems in the Nordic countries.
6. The interviewees are aware of the e-learning standards, and several claim that their systems follow the standards. But few state that the standards are important to their institution, and e-learning standards do not seem to have had much impact on online education in the Nordic countries.

Other important findings are related to the increasing need for integration between LMS systems and other online education systems:

7. LMS systems need to be integrated with a number of other systems in an organization that aims at providing efficient, large-scale, online education.
8. The integration between the LMS systems and the student administrative systems seems to be relatively poor.
9. The integration between the LMS-systems and the economy systems seems to be very poor.
10. Several of the interviewees are concerned about the opportunities and challenges regarding integration with the administrative system that records the student grades.

Cost effectiveness becomes more important as the institutions become large-scale providers of online education, and the following findings are related to economic issues:

11. The costs and pricing structure for the commercial systems vary from system to system. This could make it difficult to compare the real costs.
12. The interviewees have vague knowledge about the systems' maintenance and operation costs. The issue is perceived as complex and hard to estimate. Further, it seems like they have little knowledge about how much time and money that is spent on training staff and students to use the LMS systems.

Finally, these findings should be of special interest to providers of LMS systems who want to compete in the future market:

13. The institutions do not seem to be especially loyal to, or dependent on, one provider of LMS system. The majority of the

institutions had changed system, planned to change system, or operated secondary systems.

14. LMS systems could have reached a point where user-friendliness, cost effectiveness, and integration with other systems is more important than new features.
15. The open source strategy may have an impact on the future LMS market.
16. LMS systems are usually not used for development of course content. A broad range of external tools is used to develop the content before it is published in the LMS system.
17. It is especially interesting to observe that several systems seem to lack facilities and services on the level above individual courses.
18. Several institutions prefer self-developed systems. They perceive the commercial systems as expensive and complex and want to develop the systems to support their special needs. They wanted cost effective systems with the ability to handle continuous enrollment and integration with student administrative systems and economy systems.

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