Technology-Enhanced Learning Tools: A Survey of Use in European Higher Education

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Abstract: - The main aim of the paper is to investigate which technology-enhanced learning tools are used in European higher education, to what specific purposes and how intensively they are employed, and what costs are associated to them. The source of presented information is based on responses of 100 universities from 27 European countries to a "Learning Tools Survey", which has been created in Vienna University of Economics and Business Administration and which was distributed under the terms of the European Union's Sixth Framework Programme project Intercultural Learning Campus (iCamp).

Key-Words: - Technology-Enhanced Learning, Learning Tools, Learning Systems, Survey, Europe, Higher Education, iCamp Project

1 Introduction

The principal idea of technology-enhanced learning is to support learning activities via information technology. Recently, this combination has a great impact on higher education institutions. Nevertheless, it can be quite difficult to analyze how the rapid development of technology-enhanced learning influences the everyday life in universities, which tools and how effectively are used, and what costs are spent on it.

One of the initial particular objectives of the project Intercultural Learning Campus (iCamp) [1], funded by the European Commission under the Information Society Technologies (IST) of the Sixth Framework Programme (FP6), was to investigate the current state in the field of technology-enhanced learning in European higher education area. Thus, lots of European universities were addressed with the request for help by means of filling the questionnaire constructed chiefly by Fridolin Wild and Stefan Sobernig with the Institute for Information Systems and New Media, Vienna University of Economics and Business Administration. The iCamp partners have collected altogether 100 positive responses from 27 countries [2], [3].

The results of several similar research works and surveys have been presented e.g. in [4] (from the European perspective) or in [5] (from the developing nations point of view). Quite comprehensive surveys reflecting the situation in the United Kingdom are regularly published by "Universities and Colleges Information Systems Association (UCISA)" [6], [7]. Besides, an example of a local viewpoint (University of Bari, Italy) can be found in [8].

The main intent of this paper is to present and interpret the selected key outputs of the mentioned "iCamp" technology-enhanced learning tools survey. Some results of this survey have been already published in [9], [10] and previously analyzed in [2], [3].

The article also endeavours to pick up the treads of previous comparing [4], [11] or analyzing [12], [13], [14], [15], [16] works.

The paper is organized as follows. In Section 2, the European project iCamp is shortly presented. Subsequently, the Section 3 brings closer look at the scope of learning tools survey and process of dissemination among universities. The Section 4 then provides the classification of responding organizations from various viewpoints. Further, characteristics of tools portfolio, supported functionalities and usage intensity are outlined in Sections 5, 6 and 7, respectively. Next, the Section 8 briefly deals with potential for improvements and the Section 9 contains information about e-learning responsibility and financial sources. And finally, Section 10 offers some conclusion remarks. On the top of that, the complete list of all represented tools

and systems is provided in the *Appendix* at the end of the paper.

2 iCamp Project

As it has been already adumbrated, iCamp, running during 2005-2008 under IST FP6 of the European Commission, is a research and development project from the area of Technology-Enhanced Learning, which fulfils the conditions of collaboration and social networking across systems, countries and disciplines in higher education with a special focus on the integration of the new member states and the accession countries.

According to [17], the primary objective of an iCamp Space has been to provide interoperability among different open source learning systems and tools, while this conception has been built on existing interfaces and it has integrated shared community features. The content for this collaboration within social communities has been provided through distributed networked repositories including content brokerage platforms, online libraries, learning object databases, etc. Here, the Simple Query Interface (SQI), as a quasi-standard developed in previous projects, has served as the basis for further development and improvements with regard to system interoperability.

The driving principle behind the necessary technical challenges is the innovative pedagogical model of iCamp based on constructivist learning theories. Roughly speaking, iCamp creates an environment for a new way of social networking in higher education that puts more emphasis on self-organised learning, social networking and the changing roles of educators.

All in all, since iCamp is not creating an additional e-learning system, but facilitates interoperability, a main advantage is that universities and students can continue to use and further develop their tools and services, and at the same time connect to other systems.

Initially, ten partner institutions were involved in iCamp, while the eleventh one was summoned during project progression. All partners can be found in the following list:

- Centre for Social Innovation - ZSI, Austria (Coordinator: Barbara Kieslinger)
- Jozef Stefan Institute, Slovenia (Contact: Tomaž Klobučar)
- University of Leicester, United Kingdom (Contact: Effie Law)
- Universidad Politécnica de Madrid, Spain (Contact: Juan Quemada)
- Vienna University of Economics and Business Administration, Austria (Contact: Fridolin Wild)
- AGH - University of Science and Technology, Poland (Contact: Jan Kusiak)
- Kaunas University of Technology, Lithuania (Contact: Danguole Rutkauskiene)
- ISIK University, Turkey (Contact: Selahattin Kuru)
- Tallinn University, Estonia (Contact: Mart Laanpere)
- Tomas Bata University in Zlín, Czech Republic (Contact: Tomáš Dulík)
- Siemens AG, Germany (Contact: Karsten Ehms)

The more information about the iCamp project can be found e.g. in [17], [18], or directly on the project web page [1].

3 Learning Tools Survey

The survey related to the tool deployment in technology-enhanced learning was firstly answered by the nine iCamp project partner organizations (Jozef Stefan Institute absented from this due to the purely research status, and, Siemens AG was not taking the part of the project during that period) in the time from March until May 2006. The related preliminary results have been presented in [19]. Subsequently, the survey was disseminated among an array of European universities (from April to July 2006). However, not all respondents were willing to fill this quite complex on-line or printed questionnaire in English neither under a potential "motivation reward". Finally, the responses of exactly 100 universities from 27 countries (including iCamp partners), which seems to be a very representative figure, have been successfully gathered and evaluated.

The scope of the survey covers the use, impact and evolution of the learning tools [2], [3]. The "use" means primarily how are used the learning technologies to the intent of functionalities and interoperability. Then, the tool usage intensity and organizational embeddedness were comprised in

the "impact" part. And finally "evolution" was focused on potentials of interoperability, portfolio and development and also on the financial and staffing resources. The more detailed overview on survey coverage is [3]:

- USE
  - Which
  - How
    - Functionalities
    - Interoperability
- IMPACT
  - Tool Usage Intensity
    - Activities
    - People
    - Artefacts
  - Organizational Embeddedness
    - Activities
    - Finances
    - Responsibilities
    - People
      - Learner
      - Staff
- EVOLUTION
  - Interoperability Potentials
    - Tool2tool
    - Cross-org
    - Collaboration
  - Portfolio Potentials
  - Development Potentials
  - Resources
    - Finances
    - Staffing

4 Responding Organizations

As it was mentioned above, the total number of collected responses has been exactly 100. There was an effort to comprise representatives of all types of countries in the meaning of EU-15 States, New Member States, Acceding Countries, Candidate Countries, and Potential Candidate Countries. The final distribution of answers among, in total, 27 represented countries can be seen in Fig. 1.

Fig. 1: Representation of Countries

Then, the classifications of respondents from two different viewpoints are provided in Fig. 2 and Fig. 3.

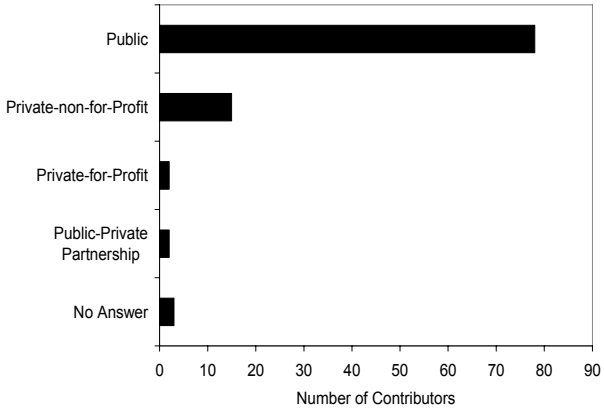

Fig. 2: Type of Organization (Public vs. Private)

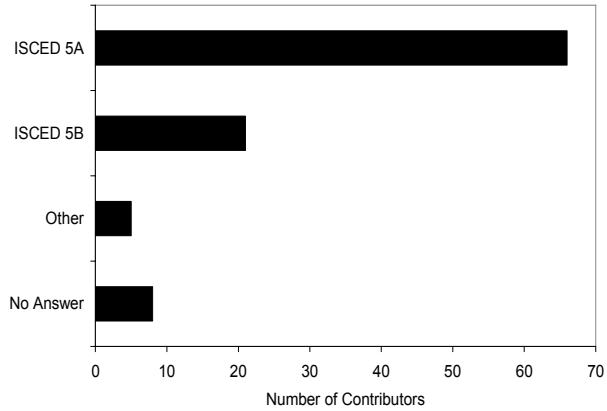

Fig. 3: Type of Organization (Education Classification)

The bulk of organizations were public. Much fewer of them can be classified as private-non-for-profit and the others are of practically no consequence. Similarly, the majority of survey contributions came from organizations which belong to ISCED type 5A ("ISCED level 5A programmes are tertiary programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and profession with high skills requirements." Moreover, they must satisfy a sufficient number of the criteria.) [20]. Only about 20% of respondents classified themselves to ISCED 5B ("Qualifications in category 5B are typically shorter than those in 5A and focus on occupationally specific skills geared for entry into the labour market, although some theoretical foundations may be covered in the respective programme. The content of ISCED level 5B programmes is practically oriented/ occupationally specific and is mainly designed for participants to acquire the practical skills, and know-how needed for employment in a particular occupation or trade or class of occupations or trades – the successful completion of which usually provides the participants with a labour-market relevant qualification.") [20].

5 Portfolio Characteristics

The survey results on characteristics of tools portfolio show that the institutions offer altogether 182 different tools (which occurred 290 times). As expected, the most significant and frequent items are learning (content) management systems (LCMS) – there were 71 sorts of LCMS in 146 installations among all tools. An institution operates, on average, 1.6 systems.

Tool	Number	Occurrence
Learning (Content) Management System	71	146
(Pure) Content Management System	15	20
(Pure) Administrative Information System / (Pure) Course Management System	18	19
(Pure) Authoring Tool	22	26
(Pure) Learning Object Repositories	14	18
(Pure) Assessment Tool	10	10
(Pure) Collaboration Tool	32	51

Table 1: Tool Categories

Considering the other categories of tools, it was found 15 (pure) Content Management Systems with 20 occurrences, 18 (pure) Administrative Information Systems or (pure) Course Management Systems in 19 instances. Then, 22 kinds of (pure) Authoring Tools in 26 installations and 14 different (pure) Learning Object Repositories, which occurred for 18 times, have been identified. Besides, it appeared also 10 organizations using (pure) Assessment Tools and finally, 32 various (pure) Collaboration Tools with 51 installations.

To sum up, the tool categories were represented by numbers shown in Tab. 1, while the complete list of all represented tools and systems is provided in the *Appendix* of this paper.

Focusing more deeply on L(C)MS, there is quite balanced state among open-source, self-developed and commercial systems. The paper [4] has analyzed the experiences of 113 European experts, usually the systems managers in the institutions, in 17 countries, with the LMS that they have purchased or developed themselves. It has revealed 52 different commercial (with 134 instances) and 35 self-developed (35 instances) L(C)MS. Under assumption of slightly bigger sample size (113 vs. 100), the comparison of the situation several years ago with the contemporary state of the art, the distribution of commercial tools seems to be relatively constant. However, there is a great increase in self-developed tools.

The numerical formulation of the types and also concrete products can be found in Tab. 2.

Tool	Occurrence
Open-Source L(C)MS	47
Self-Developed L(C)MS	44
Commercial L(C)MS	42
Moodle	44
Moodle + Other	29
Moodle + Commercial	15
WebCT	14
Blackboard	5
eDoceo	3
Discendum Optima	3
Eden	2
Fronter	2
Hyperwave	2
Ilias	2
Learning Cubes	2

Table 2: L(C)MS – Types and Products

As can be seen, the most widespread system is Moodle. It has in average 663.07 and a maximum of 3,600 active users in the cases where it is the only L(C)MS. When all 44 installations (including combinations with the other systems) are considered, the average number of users is 1,800.73 with a maximum of 28,500. This result concurs with surveys [6], [7], where Moodle was reported to be the most commonly used system in the United Kingdom (by 55% of institutions) both in 2008 and 2010.

Looking more closely on the five biggest systems (from the number of active users point of view), the following L(C)MS appear:

- WebCT (two instances)
- learn@WU/.LRN
- CampusNet (self-developed)
- Blackboard
- eLSe (self-developed)

Compared to the Paulsen's report [21], several formerly used systems vanished as the others were entering the market. The missing tools are e.g. Next Generation Learning, TopClass, Virtual U, Web course in a box and DisCo.

Further, intense discussion on the portfolio characteristics can be found in related works [2] and [3].

6 Functionalities

The analysis of supported functionalities which are used by contributor institutions has brought the results from Fig. 4.

Fig. 4: Supported Activity Types

The dominant types of activity are text-based communication and assessments – they are used in almost every system. Still more than half of the respondents reported the use of quality assurance and evaluation and collaborative publishing. An array of other activities, such as individual publishing, social networking, authoring learning designs or audio/video-conferencing are still supported, but more rarely. The most unusual are tools for user portfolio management and simulations + online labs. Altogether, the multimedia-oriented activities are much less

supported then the classical, mainly text-oriented, ones.

7 Usage Intensity

From the Fig. 5, which is intended for illustration of ability and will to work with technology-enhanced learning tools, it can be seen that all academic staff uses such tools and systems in only 3 institutions. Then, decreasingly, "many" teachers use it in 42, "some" in 29, and "few" in 21 cases.

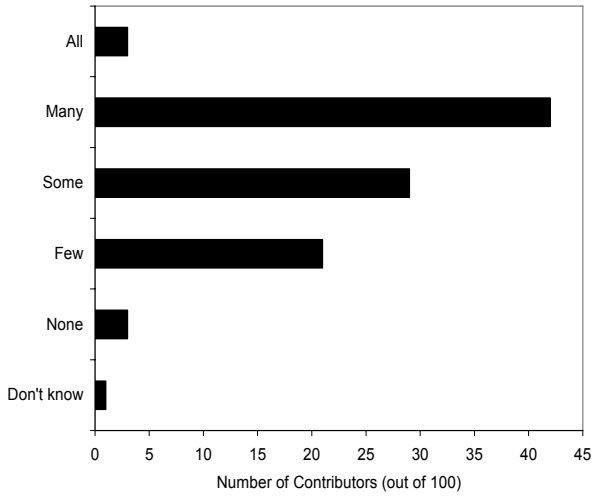

Fig. 5: Academic Staff Using Technology-Enhanced Learning

Generally one can say that the bigger a university is and the more students it has, the more technology-enhanced courses it offers. According to expectations, the number of online courses grows in time and it is higher than several years ago [21]. Nowadays, or actually during 2006 as the interviewing period, only 22% of the institutions have up to 15 courses, 56% offer more than 15 courses and 22% decided not to answer. Looking at the greater values, already 36% of universities manage more than 100 courses and 5% have more than 1000.

From the specific key functionalities point of view, the most frequently used ones are course management and delivery – 54% and 49% of institutions referred them as "frequent use". The other activities, still with the whole range of usage intensities, i.e. authoring and collaboration were reported rather moderately, infrequently or experimentally used.

From another viewpoint, the study [6] has reported that the "availability of technology-enhanced learning support staff" is the leading factor for encouraging the development (which is considered to be connected also with consequent usage intensity), followed by "availability and access to tools" and "senior management support". On the other hand, the presence of a "committed local champion" for promoting the whole process has declined in importance during the last years.

8 Potential for Improvement

The ideas of contributors on potential future improvements in various customizations and enhancements of the learning tools to fit their specific requirements are visualized in Fig. 6. It shows that the needs are very heterogeneous. The most preferable would be the extension and adaptation of existing functionalities, followed by localization of the user interface and system integration. Nevertheless, many other modifications of all types would be useful for an array of answering institutions – e.g. lay-out and design of the interface, creation of new modules or usability improvements.

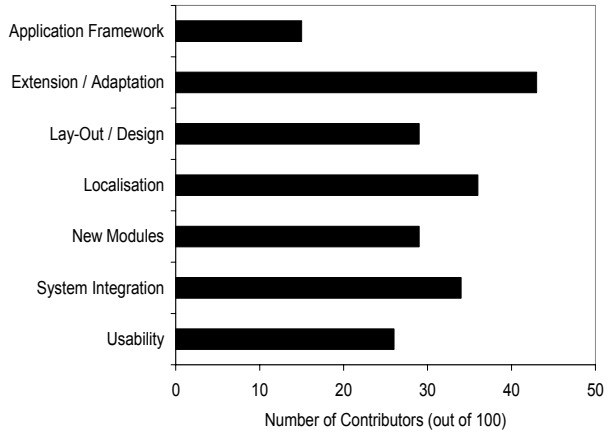

Fig. 6: Types of Customization

9 Responsibility and Financing

In most cases, a specialized e-learning unit is responsible for technology-enhanced learning. However, considerable degree of responsibility lies also on other groups, such as computer centers, faculties or departments, institutes or chairs, or the rectorates themselves – see Fig. 7.

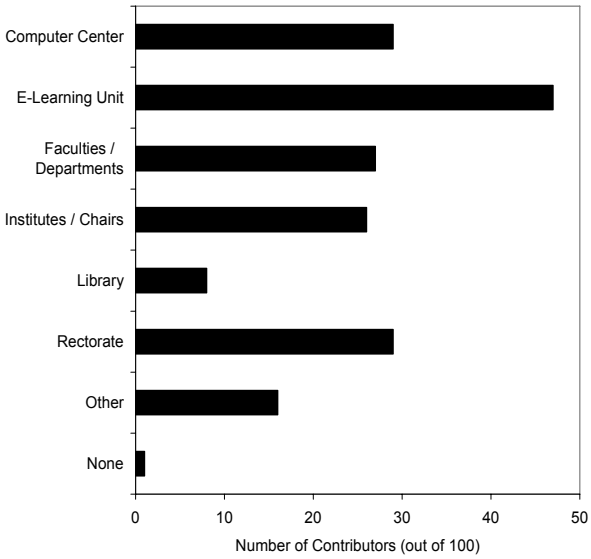

Fig. 7: Responsible Unit

Regarding the budget which is at organizations' disposal for technology-enhanced learning purposes, the most contributors are able to spend only less then 10,000 EUR per year. On the other hand, relatively many universities devote to these activities up to 500,000 EUR yearly or, the biggest ones, even more. The most common source of finances is a regular budget. The significant role play also research grants or public (non-research) funding. The detailed overview of the budgets and their sources are shown in Figs. 8 and 9, respectively.

The report [6] has revealed that "availability of internal funding" has declined in importance during the last years, but in spite of that, a lack of "money" still remains among the top 3 barriers for potential development (together with lack of "time" and "academic staff knowledge").

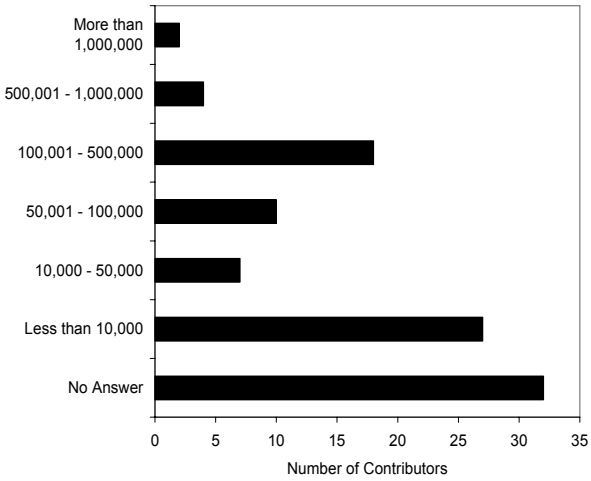

Fig. 8: Yearly Budget (in EUR)

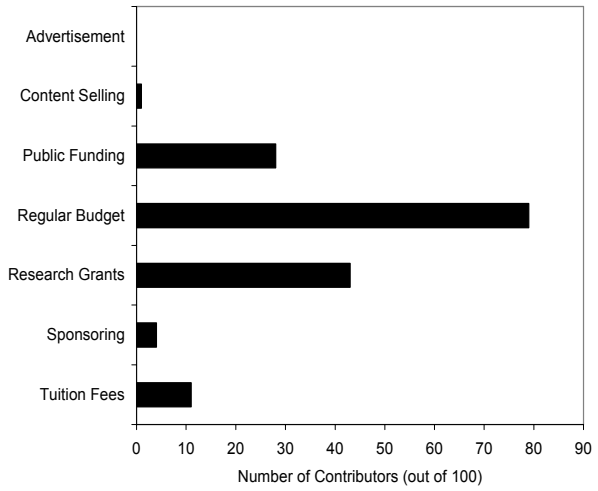

Fig. 9: Financial Sources

10 Conclusion

This paper has been focused mainly on use, impact and evolution of technology-enhanced learning in European higher education. It has presented information gathered via "iCamp Learning Tools Survey", which was distributed to an array of European universities during the year 2006. The survey has been created primarily by Fridolin Wild and Stefan Sobernig with the Institute for Information Systems and New Media, Vienna University of Economics and Business Administration.

Looking only at L(C)MS, the most popular and widespread one is Moodle. This fact has been confirmed also by other similar surveys – e.g. [6], [7]. All in all, synchronous, multimedia communication and collaboration tools suffer from the lack of organizational support and rather traditional technology-enhanced learning functionalities are nowadays used within universities.

In spite of the fact that several institutions use service integration, more inter-organizational cooperation would be useful aiming at the joint arrangement of the tools portfolio offered. Besides, more interoperability considering learning services and learning repositories is necessary. Usually, the tools itself have adequate number of users, but cross-organizational collaboration is not supported enough [2], [3].

On the whole, the perspective scenario of nowadays world seems as the university motivated by improving the quality of teaching process with its own powerful educational platform, however

also with intense connection to the open-source environment.

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Appendix – represented learning tools:

Learning (Content) Management Systems:

- ATutor
- Barborka (Self-Developed (SD))
- Bildungsportal Sachsen (SD)
- Black-board
- Campus Online (SD)
- CampusNet (SD)
- CeWEbs (SD)
- CIS (SD)
- Claroline
- Clix
- Course Management System (SD)
- Digital Media for Artists (SD)
- Discendum Optima
- Dossiers Electrònics (SD)
- Dynamic Power Trainer
- Eden
- eDoceo
- e-ducation
- e-learning shell – eLSe (SD)
- Eleum (SD)
- ELGG
- ELIS (SD)
- eNcephalon (SD)
- FirstClass
- Fronter
- Hyperwave
- IBM Lotus Learning Space
- IBM Lotus LMS
- Ilias
- IS LMS (SD)
- iTutor
- IVA (SD)
- JaTeK (SD)
- Korppi (SD)
- KUG-Online (SD)
- learn@WU (SD)
- Learning Management System (SD)
- lerndorf (SD)
- Luvit Education Center
- Matera ITE (SD)
- Moodle
- MS Class Server
- MySchool
- OLAT
- Orange Solutions Learning Cubes
- owl (SD)
- Ping-Pong
- Portal (SD)
- Scholion (SD)
- SIS (SD)
- Studium Online (SD)
- TEE (SD)
- Theducation
- Tribal LE
- TUWIS (SD)
- Virtual Medical Campus (SD)
- VUW++ (SD)
- WBT Master (SD)
- WebCT
- twelve SD L(C)MS were not stated

(Pure) Content Management Systems:

- aloha (SD)
- blogs (SD)
- communicom
- Drupal
- ELK (SD)
- EpiServer
- ePrints
- LifeType

- Plone
- StreamSync
- typo3
- Wordpress
- XIMS (SD)
- ZMS
- one SD system was not stated

(Pure) Administrative Information Systems /
(Pure) Course Management Systems:

- Bach (SD)
- Course Online (SD)
- CourseWeb (SD)
- electronic study information system (SD)
- i3v
- Internal Administration System (SD)
- ISIT (SD)
- Kepler University Study Support System (SD)
- LPIS (SD)
- MinPlan (SD)
- Neverlost
- SCAM ePortfolio (SD)
- STAG
- Student Registration System (SD)
- WebOodi
- webTOPI
- two SD systems were not stated

(Pure) Authoring Tools:

- Acrobat
- APMG (SD)
- ApuMatti (SD)
- Breeze Presenter
- Cmap
- Course Development Toolkit CDK (SD)
- Dreamweaver
- eXe
- FinalCutPro
- Flash
- Framemaker
- Frontpage
- Hot Potatoes
- IBM Workplace Collaborative Authoring Tool
- Imaptica
- Kobilica (SD)
- Macromedia Captivate
- Macromedia Studio MX
- Microsoft Producer
- Nvu
- Screencoder
- XMLspy

(Pure) Learning Object Repositories:

- ALEA (SD)
- COL Learning Object Repository
- Cumulus
- DILEO (SD)
- easyDB
- EducaNext (SD)
- HCD Suite (SD)
- IAEM
- M-BOX
- Moniviestin (SD)
- Quicktime Streaming Server
- Video Lecturing System ViPS (SD)
- two SD systems were not stated

(Pure) Assessment Tool:

- concorders
- Digital Homework for Students – DHS (SD)
- Forms 5
- prolang
- Questionmark
- Speedwell Question Bank
- survey (SD)
- Webservey
- two SD systems were not stated

(Pure) Collaboration Tool:

- Acollab
- Awki-Wiki (SD)
- Breeze Meeting
- BSWC
- Campus Pack (for Blackboard)
- CGI:IRC Chat
- CommSy
- concert chat
- digalo
- eGroupware
- e-Meeting
- Facilitate Pro
- Flashmeeting
- IBM Lotus Sametime
- Interwise
- Learnloop
- Marratech
- MediaWiki
- MS Messenger
- MS Outlook Web Edition
- Oppimappi (SD)
- phpBB
- PolyCom
- QuickTopic
- Skype
- Smartboard

- Team Spot
- TikiWiki
- VidConference
- Virtual Network Computing – VNC
- VRMS
- XchangeBoard