3 What is the Added Value of Web-based Learning and Teaching? The Case of Tampere University of Technology

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Abstract

The purpose of this paper is to describe added value in web-based learning. The question is how contexts and situations influence added value and what university students think of it. The added value in a given learning context should not be generalized to all contexts.

Keywords: value added, web-based learning and teaching in higher education, transfer of best practices

1. Introduction

The present research has not attempted to study the added value in terms of achievement. Instead, it has concentrated on students` expectations and experiences of web-based learning and teaching processes. The added value of web-based learning will also be evaluated in comparison to conventional learning. For the further development, planning and implementation of web-based teaching and learning it is important to find pedagogically appropriate teaching methods for various teaching situations. The users of web-based learning environments should consider critically how to add value to their teaching and learning by using web-based environments.

Later in this paper we describe the results of the research aimed at exploring the added value of web-based teaching and learning at the Virtual University of TUT (Tampere University of Technology). The findings of this study indicate both the expectations and experiences of added value. To make optimal use of web-based learning environments we need pedagogically validated models and concrete instructions for teaching and learning to be carried out on the net.

2. Categories of added value

The question of added value in web-based teaching and learning has concerned educators, administrators and the public for various reasons (Rogers, 2001). Earlier research suggests a great potential for added value for learning through the use of the web (e.g. Overlock 1995; Whitnall et al. 1994; Jones & Smith 1992; Lamb 1992; Lennon & Maurer 1994; Kappe et al. 1993; Andrewartha & Wilmot 2001; Felix 2001). However, several studies on comparing conventional courses with computer-based or technology-enhanced courses yielded no significant difference in academic achievement (Russell, 1997). In fact, the results of media-comparison studies indicate, that the use of one instructional medium over another will most likely produce no significant difference in achievement (Clark, 1983; 1994a; 1994b; Kozma, 1991; 1994a; 1994b; Jonassen, Campbell & Davidson, 1994; Lockee, Burton, & Cross, 1999, Russell, 1997).

Why is the question of benefits and the added value of web-based learning and teaching so interesting and why are institutions of higher education so hard fighting to secure funding for technology? Because nowadays higher education must respond on many fronts, including workforce training, just-in time learning, shortages of teachers, geographically limited learners, significant changes in part-time and full-time learning and learners with special needs (Adelman, 1999; Dolance & Norris, 1995; Green, 1999; Schneider & Shoenberg, 1999; Rogers, 2001). Therefore the benefits of using various media and teaching methods should be systematically investigated. Teachers and learners should choose the pedagogically most appropriate methods and tools for each learning situation. We assume, like Rogers (2001), that a rich mix of learning, teaching and thinking tools meets the needs of market-driven convenience, affordability, accessibility and opportunity for significant cognitive change.

Bartolic-Zlomislic & Bates (2002) have pointed out that in order for web-based course to be successful, benefits and limitations to the organization and to the student should be appropriately balanced. Focus must be on potential performance and value added must be benefits to both the institution and more importantly to the student.

The aim of this paper is scrutinize the question of added value from the students` perspective in higher education. Forsblom & Silius (2001, 2002) have divided the concept of added value into four categories: flexible organization of learning, improvement of teaching quality, development of learning and communication skills by using web-based learning environments and the innovative use of information and communication technologies in teaching. These categories have also been used in the present study.

2.1. The flexible organization of learning

2.1.1. Understanding time and space

The concepts of time and place become relevant when designing web-based teaching and learning. Web-based learning and teaching need not necessarily be real-time, nevertheless studying always takes place in a physical context (Matikainen 2000; Vahtivuori 2000). In learning all physical and cognitive activities are somehow contextualized. According to Vahtivuori and Masalin (2000) the physical surroundings and cultural context define and change the nature and way of our activity: when the context affects us and changes our activities, our activities produce that context. In web-based learning the physical context is exemplified by a lack of physical presence. This sometimes impacts a feeling that learning is independent of time and space and a feeling of unrealistic easiness in learning. Therefore teachers have to plan interactive activities, and the course structure (e.g. timetable for the course) carefully beforehand. How the interaction between teachers and students will succeed in web-based learning depends to a large extend on the teachers` ability to plan and use pedagogically appropriate methods in teaching, to give guidance and support for collaboration.

2.1.2. Interdisciplinary and vertical study opportunities

Web-based study open up opportunities for both interdisciplinary and vertical studies. Interdisciplinary and vertical studies bring teachers and students from different fields together to observe the same phenomenon. Such crossing of institutional borders over different education levels, fields and organizations increases sharing of knowledge and know-how (Eteläpelto & Tynjälä 1999). The flexible organization of learning via the net diversifies the course supply in small units. Web-based course supply also gives students an opportunity to choose from a wider selection of courses, even from international markets.

2.1.3. Access to digital materials

Students should be informed about appropriate materials available electronically. Efficient and effective systems that support students` access to electronic material could be provided e.g. through full text databases and electronic journals together with flexible borrowing systems (Lefoe et al., 2001).

2.2. The improvement of teaching quality

2.2.1. The design of learning environments and course structures

In web-based learning the work of the teacher is partly changing into designing learning environments. The role of the teacher is to know the tools and the characteristics of the learning environments they use well enough to make pedagogically reasonable choices and solutions in the planning of teaching. Carefully designed and appropriately selected tools of the learning environments support students` learning processes and enable teachers to concentrate on the essential contents of the substance. In line with Uljens (1997) and Vahtivuori & Masalin (2000) we see the carefully designed and pedagogically appropriate learning environment essentially as a community of learners where communal learning and culture and the active process of the learner may become real.

Some earlier teaching experiments (Hämäläinen 1999; Hämäläinen & Muhonen 1999; Forsblom 2001; Pohjolainen et al. 2001) carried out by the Hypermedia Laboratory of TUT show that the properties available in the learning environments were not fully exploited. Pohjolainen et al. (2001) consider that in the teaching experiment in mathematics the tools that did not provide direct support for the learning were not utilized. The results of the teaching experiments using the "Russian on the Net" learning environment indicate the same (Forsblom, 2001; Forsblom & Silius 2001; Forsblom 2002).

Pohjolainen et al. (2001) consider that it is not necessary or beneficial to use all possible methods and tools in every context and situation, even if the methods and tools as such are useful. In their opinion the excessive cognitive load may inhibit goal-oriented learning, e.g. by undermining students` motivation to study. We agree partially with this argument. On the other hand, we note that it is also possible that the tools of the learning environments are not used appropriately, because in some cases teachers and students do not know how web-based learning environments could be used in a pedagogically appropriate way.

2.2.2. The quality of teaching materials

We assume that teaching materials can be produced and updated easily in web-based environments. The new research knowledge can be transferred quickly to teaching via the net. Web-based teaching and learning improves the quality of teaching materials provided that the designers take a great responsibility to produce high quality material in these more open environments. Network-based environments offer various ways to illustrate teaching materials by simulation, modeling and visualization.

In learning it is not essential to memorize things; the ultimate objective of learning is to restructure and enhance the knowledge of a student. Therefore learning should be closely connected to real life situations. Lambert Gardiner (1993) argues that hypermedia-based teaching material is educationally superior, because it simulates the real life situation and students deal with information from many sources. When planning web-based courses teachers should consider how they could connect teaching e.g. to situations in working life.

2.3. The development of learning and communication skills using web-based learning environments

There are many studies presenting the clear advantages of cooperative and collaborative learning over more individual and competitive formats (Johnson & Johnson, 1975; Slavin, 1991). According to Bonk and Reynolds (1997) many collaborative pedagogical strategies also have relevance in web-based learning. Interactive and distributed technologies enable learners and instructors to participate in an incredible array of information, resources, and instructional experiences (Bonk & Cunningham, 1998).

2.3.1. Collaborative web-based learning

Collaborative web-based learning tools, like tools for student collaborative inquiry, problem-based learning, articulation and dialogue, debate and personal reflection, offer various ways for learners, instructors, and experts to interact (Bonk & King 1998; Cummings et al.; 2000; Oliver & McLoughlin, 1999; Oliver et al., 1998). Web-based courses that are based on the theory of collaborative learning give students an opportunity to learn sharing information and argumentation in a multidisciplinary way. Students learn to use scientific terms and concepts by explaining their meanings to each other. According to Bonk (2001), to create a learning community, the system must bring people together for some initial common interest or quest (e.g. sharing, problem solving etc.) Members of the online groups also need ways to become informed about events of the learning community (Duffy et al., 1998).

2.3.2. Individualized self-directive web-based learning

Web-based learning environments are affected by the actions of the user (Tucker 1990). Students are able to actively choose program components in whatever desired order, which develops self-directive skills (Barker & Tucker 1990; Bonk & King, 1998). According to Weston and Barker (2001) student control is especially desirable for lessons that cover a wide range of difficulty so that students can choose an appropriate difficulty level. In this case instructors must relinquish some control of students learning, because some students` have neither the discipline nor the inclination to work independently (Weston & Barker (2001).

It should be remembered that we do not have to choose between collaborative and individualized teaching and learning methods in one separate web-based course. It is possible to use both so that teachers and students consider which method is pedagogically appropriate in each context.

2.4. The innovative use of information and communication technologies in teaching

New functional and pedagogically appropriate teaching methods can be found by testing the technological innovations. When planning the course structure, teachers should carefully consider the possibilities for learning provided by the environments. The use of environments` tools should be closely connected to the course objectives and the teaching methods on the courses. After the experiments, researchers, teachers and students should evaluate whether the selected tools brought added value to teaching and learning.

In some cases the technological improvements, e.g. the quality of photos on the web, have caused changes in teaching methods. Technological improvements have essentially changed teaching methods e.g. in medicine. Nowadays medical students learn to make diagnoses by comparing laboratory photos on the net. (Forsblom & Silius 2001; Forsblom, 2002).

3. Students` expectations of added value in web-based teaching

Expectations of added value were investigated at the Tampere University of Technology. The research was carried out before and after web-based courses. The data comprise of 400 responses before the web-based courses and 160 responses after the experiments. Empirical material was collected by web-questionnaire in autumn 2001 (Silius et al. 2002).

The students` background information was also researched. Majority of the students were at the beginning of their studies and usually they did not have any experiences of web-based learning. In their opinion they had been succeeded quite well in earlier studies. They live near the campus and they were going to study a web-based course at home or in computer classroom at the University of Technology. Of these students 40% were working while studying and 30% of them studied during the working day at their workplace. Students reported that they could use word processing software, helps, email, web-browser and install plug-ins but they did not know news and chat as well (Silius et al. 2002).

Students were allowed to mention all value added as they expected. After experiences they were also allowed to mention all the value added which had been realized.

From the students` perspective the most considerable added value in web-based teaching was the flexible organisation of education.

Expectations	(%)
Flexible participation	56%
Access to course material	37%
Flexible learning environment	24%
Automation of teaching routines	22%
Crossing of institutional borders	14%

Table 1: Students` expectations of added value/flexible organisation of education.

Those students who were working while studying were in special need of flexibility in their study schedules. They mentioned that participation in courses organised only on campus were inconvenient for the most of them. For those students the opportunity to study via the web was the value added. In the situations where course schedules overlapped or courses were full the web-based teaching and learning were reported to be value added.

Access to course material was also mentioned as an added value. Students expected to get all the course material via the web and they thought that the sources of web-based teaching materials will be better marked. In their opinion using the web in learning and teaching students are able to automate their everyday routines and routine tasks (like the delivery of teaching materials, enrolment in exercise groups or to courses etc.).

The results of the study indicate that "*The improvement of teaching quality*" was considered as value added.

Expectations	(%)
Better quality of course material	26%
Flexible feedback and support practices	19%
Individualized teaching	12%
Multidisciplinary courses	11%
Course material produced by specialists	10%
Support to personal contacts	9%

Table 2: Students` expectations of added value/improvement of teaching quality.

Students expected that web-based teaching and learning would improve the quality of teaching materials. They hoped that teaching materials would be illustrated, for example, by simulation, modelling and visualization. The students expected that they would get more just-on-time feedback and support for their studies in web-based teaching.

The students` expectations of added value in web-based learning in the category "*The development of learning and communication skills using web-based learning environments*" are as follows:

Expectations	(%)
Practice in self-direction skills	36%
Practice in learning to learn skills	18%
Practice in collaborative learning skills	6%

Table 3: Students` expectations of added value/development of learning and communication skills using web-based learning environments

The students expected that their learning to learn skills and self-direction skills would improve in web-based learning and also that open learning environment and tutoring practices would support the development of those skills.

The innovative use of tools was mentioned as an added value in the category "*The innovative use of information and communication technologies in education*".

Expectations	(%)
Innovative use of tools	16%

Table 4: Students` expectations of added value /innovative use of information and communication technologies in education.

From the students point of view new kinds of web-based tools could bring added value to teaching and learning. The technological improvements, e.g. the illustrated hyperlink mind maps, improve students` skills in knowledge construction and the tools for creating team consciousness improve motivation to study.

4. Realization of added value

To obtain more information about good web-based learning practices in technical sciences eleven teaching experiments were evaluated (http://www.virtuaaliyliopisto.tut.fi/verkkopakki).

The evaluation process consists of pedagogical and usability sections (see Albion 1999; Leinonen et al. 2002; Quinn 1996; Soloway et al. 1996; Squires 1997; Squires & Preece 1999; Tergan 1998). The researchers paid attention to how the learning context and pedagogical appropriateness were taken into account in user interface, tools, tasks, quizzes and in planning, designing and implementation of content production. The needs of learners such as growth, diversity and motivation should be supported in software learning environments. Special the attention was paid to how software supports those needs (see Soloway et al. 1996).

The data indicates that course web sites were composed of html pages with information about lectures, course structures and so on. Usually there were links to course material. The pages also included the option to register for the exercise groups or to return seminar papers or exercises to the teacher via the web. Interactive drills, web-lectures and simulations for testing comprehension of course materials were used in the teaching experiments. Activating and motivating tasks for reading comprehension concerning course materials were also used. Teaching methods like learning diaries and porfolios were used only on few courses.

The table illustrates the added value realized better then expected.

Realized vs. expected added value (%)		
	Realized	Expected
Flexible participation	60%	56%
Practice in self-direction skills	56%	36%
Better quality of teaching material	27%	26%
Practice in collaborative learning skills	13%	6%

Table 5: Realized vs. expected added value from the students` perspective.

The table below illustrates the added value realized less than expected.

Realized vs. expected added value (%)		
	Realized	Expected
Access to course material	35%	37%
Flexible learning environments	23%	24%
Automation of teaching routines	19%	22%
Practice in learning to learn skills	13%	18%
Flexible feedback and support practices	12%	19%
Individualized teaching	11%	12%
Crossing of institutional borders	7%	14%
Multidisciplinary courses	7%	11%
Support for personal contacts	6%	9%
Material produced by specialists	5%	10%

Table 6: Realized vs. expected added value from the students` perspective.

5. Discussion and conclusions

The results of the study showed problems in design and implementation of web-based courses (see also e.g. Hara & Kling 1999; Noble 1997, 1998a, 1998b). This is the reason why added value was not perceived as useful.

According to the data the educational benefits and the appropriateness of web-based courses were sometimes forgotten. In courseware design it must be remembered that there is no pedagogical benefit arising from simply hypertextualising existing course material. It is not advisable to use the web to replace of books or television. The web is a new kind of media, which is also often forgotten. The benefits and the power of that new media should be understood and exploited in well-proved ways.

The roles of students and teachers were perceived to be similar as in conventional education. No attention was paid to the change needed in web-based learning environments. Only a few experiments took account of the fact that teachers are no longer mere information sources for students. In web-based teaching they guide the entire learning process. According to Kook (1997) the teacher's new role in network-based teaching is like a consultant who searches for information, teaching materials and guides students in their learning processes. Kook sees the teacher as an assistant in the learning team. Teachers will also help each other in planning teaching schedules, sharing new ideas, helping each other with education challenges etc. Both institutional and individual borders will become invisible when teachers together develop web-based tools for instructing students.

Unfortunately the need for experienced tutors was often forgotten. The tutoring system, like all the other support systems, should be planned carefully beforehand, because the reactions to problems that arise during the ongoing courses are always slow. Usually in theory the teacher is seen as a tutor. To achieve good learning results the change in the students' role has to be reflected in the students' conception of his/her own learning and in learning theory which supports the learning environment.

Some web-course designers concentrate not on the instructional design or teaching support aspects required for teaching and learning via the web but on the technical tools and design of web pages themselves. The pedagogical issues and solutions have not always been thought out. Too often conventional education methods have been used on web courses and too often the creative use of new learning theories has been neglected.

The transfer of added value to various contexts requires more information from experiments. The quality of learning does not improve by using computers if one does not know how to use them appropriately. The potential of the web-based learning

environments in comparison with the more traditional learning environments needs investigation. When defining added value e.g. content, learning culture, goals and the level of education should be considered. The results of some studies show that there is some useful added value in different contexts, but it is difficult to transfer the best practices of those studies to new learning situations. Background information is needed when transferring one successful added value to another quite similar teaching context. The background information includes factors like structure of the course, planned learning methods, students` learning histories and demographic information on students, the roles of teachers and students and the level of formality.

We have found that the added value in the defined context cannot be generalized as useful in all contexts. It is clear that we need more information about the methods which work in web-based learning environments. The evaluation group of the Hypermedia Laboratory and the Virtual University of TUT is making an effort to clarify the conception of added value by investigating the advantages and disadvantages of web-based learning in various contexts. The data will be collected in the pilots of the Hypermedia Laboratory and the Virtual University of TUT for many years. The paper presented some results of the teaching experiments carried out last year. We hope that the findings of future teaching experiments will facilitate even more the transfer of added value to new web-based learning situations.

References

Adelman, C. (1999). Crosscurrents and riptides: Asking about the capacity of the higher education system. Change, 31(1), (pp. 21-27).

Albion, P.R. (1999). Heuristic evaluation of educational multimedia: from theory to practice. http://www.usq.edu.au/users/albion/papers/ascilite99.html (checked up 2.7.2002)

Andrewartha, G. & Wilmot, S. (2001). Can multimedia meet tertiary educational needs better than the conventional lecture? A case study. Australian Journal of Educational Technology 2001, 17(1), (pp.1-20).

Barker, J. & Tucker, R. N. (Eds) (1990). The Interactive learning revolution: Multimedia in education and Training: New York: Nichols.

Bartolic-Zlomislic. S. & Bates, A.W. (2002). Investing in Online Learning: Potential Benefits and Limitations. http://bates.cstudies.ubc.ca/investing.html (checked up 2.7.2002)

Bonk, C.J. (2001). Online Teaching in an Online World. Bloomington, IN:CourseShare.com.

Bonk, C.J. & Cunningham, D.J. (1998). Searching for learner-centered, constructivist, and sociocultural components of collaborative educational learning tools. In C.J. Bonk, & K.S. King (Eds.), Electronic collaborators: Learner-Centered technologies for literacy, apprenticeship, and discourse (pp. 25-50). Mahwah, NJ:Lawrence Erlbaum Associates.

Bonk, C.J., & King, K.S. (1998). Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse. Mahwah, NJ:Lawrence Erlbaum Associates.

Bonk, C.J. & Reynolds, T. (1997). Learner-Centered Web Instruction for Higher-Order Thinking, Teamwork, and Apprenticeship. In B. Khan (ed.) Web-Based Instruction. New Jersey: Englewood Cliffs, (pp.167-177).

Clark, R.E. (1983). Reconsidering research on learning from media. Review of Educational Research, 53(4), (pp. 445-459).

Clark, R.E. (1994a). Media and method. Educational Technology, Research and Development (ETR&D), 42(3). (pp. 21-29).

Clark, R.E. (1994b). Media will never influence learning. Educational Technology, Research and Development (ETR&D), 42(2), (pp. 7-10).

Cummings, J. A., Bonk, C.J., & Jacobs, F.R. (2000). Twenty-first century syllabi: Dynamic tools for promoting interactivity. Manuscript submitted for publication.

Dolence, M.G. & Norris, D.M. (1995). Transforming higher education: A vision for learning in the 21st century. Ann Arbor, MI: Society for Collage and University planning (SCUP).

Duffy, T., McMullen, M., Barab, S., & Keating, T. (1998). Professional development in the 21st century: Preparing for the future. A strategic plan for research and development. Unpublished manuscript, Indiana University of Bloomington.

Eteläpelto, A. & Tynjälä, P. (1999). Oppiminen ja asiantuntijuus. Työelämän ja koulutuksen näkökulma. WSOY, Porvoo.(In Finnish)

Felix, U. (2001) A multivariate analysis of students´ experience of web-base learning. Australian Journal of Educational Technology 2001, 17(1), (pp.21-36).

Forsblom, N. (2001). Intercultural foreign language studies in the Russian on the Net Learning Environment. In EDMedia 2001. World Conference on Educational Multimedia, Hypermedia & Telecommunications. June, 2001 Tampere, (forthcoming).

Forsblom, N. (2002). What is the Added Value of Web-based foreign language learning ?. In V. Kohonen & P.Kaikkonen (eds.) Quo vadis, foreign language education /Fremdsprachenunterricht? Publications of the Department of Teacher Education, University of Tampere (in print).

Forsblom. N. & Silius, K. (2002). Value added on Web-based Learning Environments. In E. Pantzar (ed.), Perspectives on the age of the information society. Tampere: Tampere University Press, (pp. 103-113).

Green, K.C. (1999, March April). When wishes come true. Colleges and the convergence of access, lifelong learning, and technology. Change, 31(2), (pp. 11-15).

Hara, N. & Kling, R. (1999). Students´ frustrations with a web-based distance education course. First Monday, 4(12). /verified 16 Mar 2001/ http://firstmonday.org/issues/issue4_12/hara/

Hämäläinen, M. (1999). Russian on the Net. Intelligent Computer and Communications Technology: Teaching & Learning for the 21st Century. PEG99. Proceedings of the Ninth International PEG Conference 10-12 July 1999, (pp.1.13). University of Exeter, England.

Hämäläinen, M., & Muhonen, J. (1999). Venäjää verkossa. In H. Ruokamo & S. Pohjolainen (eds.), Etäopetus multimediaverkoissa : Kansallisen multimediaohjelman ETÄKAMU -hanke (pp. 251-265). Helsinki: Paino-Center Oy. (In Finnish)

Johnson, D.W., & Johnson, R.T. (1975). Learning together and more: Cooperation, competition, and individualization. Englewood Cliffs, NJ: Prentice Hall.

Jonassen, D.H., Cambell, J.P. & Davidson, M.E. (1994). Learning with media: Restructuring the debate. Educational Technology, Research and Development (ETR&D), 42(3), (pp.31-39).

Jones, L. J. & Smith, S.G.(1992). Can multimedia instruction meet our expectations? EDUCOM Review, Jan-Feb, (pp. 39-43).

Kappe, F., Maurer, H.& Sherbakov, N. (1993). Hyper-G. A universal hypermedia system. Journal of Educational Multimedia and Hypermedia, 2(1),(pp. 36-66).

Kook, J-K. (1997). Computers and Communication Networks in Educational Settings in the Twenty-First Century: Preparation for Educators' New Roles.

Educational Technology 37 (2), (pp.56-60).

Kozma, R.B. (1991). Learning with media. Review of Educational Research, 61(2). (pp. 170-211).

Kozma, R.B. (1994a). A reply: Media and methods. Educational Technology, Research and Development (ETR&D), 42(3), (pp. 11-13).

Kozma, R.B. (1994b). Will media influence learning? Reframing the debate. Educational Technology, Research and Development (ETR&D), 42(2), (pp.7-19).

Lamb, A.C. (1992). Multimedia and the teaching learning process in higher education. In Teaching in the information age: The role of educational Technology. New Directions for Teaching and Learning Number 51. The Joddey Bass Higher and Adult Education Series. San Francisco: Jossey-Bass Publishers.

Lambert Gardiner, W. (1993). Using hypermedia to turn university teaching inside out. In N. Metallinos (Ed), Verbo-visual literacy: Understanding and applying new educational communication media technologies. Selected Readings from a Symposium of the International Visual Association, June 25-29, Delphi, Greece (pp. 65-72).

Lefoe, G., Albury, R., Littler, C. & Trivett, N. (2001). Collaborative partnerships: Changing roles for academic and support staff in new learning environments. In J.G. Hedberg (Ed), Online Learning Environments: Research and Teaching. RILE Monograph. Wollongong: Faculty of Education, University of Wollongong.

Leinonen, T. (2002). Collaborative discovering of key ideas in knowledge building. Computer Support for Collaborative Learning (CSCL 2002) Conference. Boulder, Colorado, USA, January 7-11, 2002.

Lennon, J. & Maurer, H. (1994). Lecturing Technology. A future with hypermedia. Educational Technology, April, (pp.5-14).

Lockee, B.B., Burton, J.K., & Cross, L.H. (1999). No comparison: Distance education finds a new use for 'No significant difference'. Educational Technology, Research and Development (ETR&D), 47(3), (pp.33-42).

Matikainen, J. & Manninen, J. (2000). Aikuiskoulutus verkossa. Verkkopohjaisten oppimisympäristöjen teoriaa ja käytäntöä. Helsingin yliopiston Lahden tutkimus- ja koulutuskeskus. Tampere: Tammer-Paino. (In Finnish)

Noble, D.F. (1997). Digital Diploma Mills, Part I, The automation of higher education. /verified 16 March 2001/ http://communication.ucsd.edu/dl/ddm1.html

Noble, D. F. (1998a). Digital Diploma Mills, part II, The coming battle over online instruction. /verified 16 March 2001/ http://communication.uscd.edu/dl/ddm2.html

Noble, D.F. (1998b). Digital Diploma Mills, Part III, The bloom is of the rose. /verified 16 March 2001/ http://communication.uscd.edu/dl/ddm3.html

Oliver,R., Omari, A., & Herrington, J. (1998). Exploring student interactions in collaborative World Wide Web computer-based learning environments. Journal of Educational Multimedia and Hypermedia, 7 (2/3), (pp. 263-287).

Overlock, T.H. Sr. (1995). Development of a multi-year plan for the integration of multimedia technology into the learning environment at Northern Maine Technical College. EdD Dissertation. US, Maine: Nova Southeastern University, (pp. 55-73).

Pohjolainen, S., Hautakangas, S., Ranta, P., Levasma, J. & Pesonen, K. (2001). A Learning Experiment in

Mathematics using A&O-Learning Environment. Intelligent Computer and Communications Technology - Learning in On-Line Communities. PEG 2001 23 rd- 26th June 2001, Tampere, Finland, (pp. 30-35).

Quinn, C. N. 1996. Pragmatic Evaluation: Lessons from Usability. http://www.ascilite.org.au/conferences/adelaide96/ papers/18.html

Rogers, P.L. (2001). Traditions to Transformations: The Forced Evolution of Higher Education. Educational Technology Review. Vol. 9 No. 1, 2001 (online). Available:http://www.aace.org/pubs/etr/rogers.cfm

Russel1, T. (1997). The " No significant difference" phenomenon as reported in 248 research reports, summaries & papers. North Carolina State University (on-line).

Schneider, C.G., & Shoenberg, R. (1999, March/April)). Habits hard to break: How persistent features of campus life frustrate curricular reform. Change, 31(2), (pp. 30-35).

Silius, K., Tervakari, A-M. & Kaartokallio, H. (2002). http://www.virtuaaliyliopisto.tut.fi/verkkopakki/ (checked up 2.7.2002)

Slavin, R.E. (1991). Synthesis of research on cooperative learning. Educational Leadership, 48(5), 71-82.

Soloway, E.(1996). Learning theories in Practice: case Studies of Learned-Centered Design. Computer-Human Interaction. CHI'96. Electronic proceedings. http://info.acm.org/sigchi/chi96/proceedings/papers/Soloway/ es-txt.htm (checked up 2.7.2002).

Squires, D. (1997). An heuristic approach to the evaluation of educational multimedia software. Computer Assisted Learning Conference, University of Exeter. http://www.media.uwe.ac.uk/masoud/cal-97/papers/squires.htm (checked up 2.7.2002).

Squires, D. & Preece, J. (1999). Predicting Quality in Educational Software: Evaluating for learning, usability and synenergy between them.http://www.ifsm.umbc.edu/communities/Heur2.html (checked up 2.7.2002).

Tergan, S-O. (1998). Checklists for the evaluation of educational software. Critical review and prospects. Innovations in Education and Training International, 35 (1), 9-20.

Tucker, R.N. (1990). On interactivity and open learning. In J. Barker & R. N. Tucker (eds.), The interactive learning revolution: Multimedia in education and training. New York; Nichols.

Uljens, M. (1997). School didactics and learning. Hove, East Sussex: Psychology Press.

Vahtivuori, S. (2000) Kohti yhteisöllisen ja kokemuksellisen verkko-opetuksen suunnittelua - käyttäjät suunnittelun polttopisteessä. In S. Tella, O.Nurminen & S. Vahtivuori (eds.) Verkko-opetuksen teoriaa ja käytäntöä. Studia Paedagogica 25. Publications of the Department of Teacher Education, University of Helsinki. (In Finnish).

Vahtivuori, S. & Masalin, T.(2000). Designing Communal Web-based Learning Environments: Case GLOBE Project. In S. Tella (ed.) Media Education Publications 9. Media, Mediation, Time and Communication Emphases in Network-Based Media Education. Publications of the Department of Teacher Education, University of Helsinki.

Weston, T.J. & Barker, L. (2001). Designing, implementing, and Evaluating Web-Based Learning Modules for University Students. Educational Technology, 41(4), (pp.15-22).

Witnall, R., Fernandes, E., Almassizadeh, F., Love, J., Dugan, B., Sawrey, B.& Wilson, K.(1994). Multimedia chemistry lectures. Journal of Chemical Education, 71(9), (pp. 721-725).