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Does Optional Web-Based Seminar Support Better (Constructivist) Learning in the Basics of Informatics?

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ABSTRACT

This paper describes the use of the web as a complementary addition to conventional lectures in the learning of the basics of informatics. We utilize a slideshow with links, search engines on the web, and the Web CT environment. The solution enables a web-based seminar supporting learning in various ways. First, in our approach the students compose a coursework report focusing on the main concepts of the subject area. This occurs by using the slideshow with links and search engines on the web. Second, in the web-based seminar students can familiarize themselves with the coursework reports of other students. We claim that in this way learning can be promoted in the spirit of both cognitive and social constructivism.

At the beginning and end of the course we analyzed how useful and interesting the students regarded six course themes. In addition, the students were expected to analyze their own development of computer use skills, Internet use skills, and their knowledge of basic concepts in informatics. The study found that optional WWW-based seminar affects both external and internal motivation equally. The effect on the knowledge of basic concepts in informatics was beneficial.

INTRODUCTION

The WWW provides both the possibility to organize information in a strict form (e.g. using trails and guided tours) and also opportunities for free "surfing" with its advantages and disadvantages. To realize the benefits of the WWW we have used a three-layer learning solution. These layers are (a) the support of guided tours as a slideshow on the WWW, (b) the support of appropriate links, and (c) the support of search engines and directories. Based on these layers we have organized a coursework in which students were expected to enter their findings in their personal diaries. This approach provides a real basis for successful WWW-based coursework and research results show that our three-layer learning solution is beneficial [8, 9].

In the spirit of the social constructivist learning theory for improving the benefits of our WWW-based coursework we suggest the use of a virtual learning environment (Web CT) and its presentation feature. This feature of the Web CT enables the demonstration of the idea of shared workspaces in practice. During the process of seminar work students can familiarize themselves with shared workspaces. This occurs by publishing and presenting seminar work; by commenting on seminar works created by other students (or groups) and by reading comments expressed by other students.

This paper introduces our approach to carry out a web-based coursework and seminar. It has two purposes. First, it introduces our WWW-based coursework as a way to apply the WWW in the learning of basic concepts in informatics. Second, it includes an evaluation of how dedicated the students who completed the optional WWW-based coursework were while learning different areas of informatics. Additionally, the paper contains an evaluation of how three different main areas, which are (1) skills in using computers, (2) skills in using the Internet, and (3) knowing the basic concepts, were developed during the course. We made all the evaluations by comparing the students who completed the coursework to the students who did not participate in the coursework.

Before discussing the study itself, we first provide the theoretical background of the study.

ENGAGEMENT AND MOTIVATION

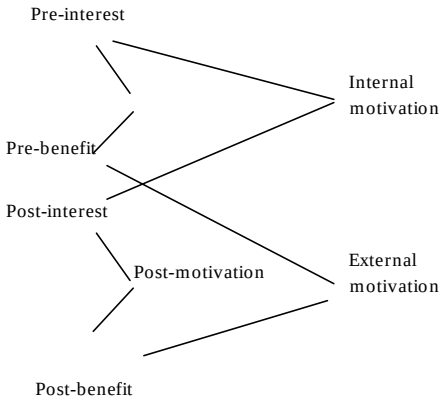
Our research deals with the learning of textual material. Most commonly in learning from text, motivation is understood both internally and externally [2, 3, 5, 7]. Internal motivation reflects a student's own interest in regard to espousing new knowledge. It is associated with a human's high-level needs such as self-actualization. External motivation reflects the need to reach goals set by others. This is connected to a human's low-level needs such as security and survival.

Motivation in learning from text can be evaluated as shown in figure 1 (see next page). Pre-motivation is the sum of pre-interest and pre-benefit. Post-motivation is the sum of post-interest and post-benefit. Internal motivation is the sum of pre-interest and post-interest. External motivation is the sum of pre-benefit and post-benefit.

CONSTRUCTIVISM

In education we can teach concepts in a teacher-centered way or we can use student-centered educational methods. Behaviorism, as a teacher-centered way, is interested in a student's behavior in relation to teaching while its opposite, constructivism, is interested in the mental processes which affect the behavior of a student [11]. A traditional lecture is

Figure 1. Motivation of Learning from Text



mainly based on the behaviorist approach while coursework and projects are typical of constructivist learning.

Constructivism asserts that learners construct knowledge by making sense of experiences in terms of what is already known [4]. In the constructivist approach learning is comprehended as the development of mental models. Brandt [4] emphasizes that constructivism is an essential basis when applying the WWW for teaching and learning. It provides the teacher with a structure for teaching. By focusing on concepts and connecting them to mental models, teachers can gain both confidence and control over the amount of material they cover in the small blocks of time usually allotted to teaching and training. Integrated with experiences that learners use to alter and strengthen mental models, the constructivist approach to teaching information retrieval also gives users the structure needed to get the most out of the Internet.

THE WWW IN LEARNING IN OUR CONTEXT

The problems inherent in any information system such as disorientation, navigation inefficiency and cognitive overload are multiplied on the Internet [4]. However, these problems can be overcome using a suitable pedagogical approach and/or appropriate tools. The WWW and its hypermedia nature enable learning by constructing knowledge in the sprit of the cognitive school of constructivism. Cognitive constructivism emphasizes that learning occurs through many channels: reading, listening, exploring and experiencing his or her environment [10]. Furthermore, the WWW and web-based learning environments support learning based on social constructivism by providing different ways of communication. Social constructivist theory emphasizes the influences of cultural and social contexts in learning [12].

One way to organize a presentation on the WWW is to provide trails and guided tours. Trails connect a chain of links through information spaces [1]. These can include multiple "recommended" trails through a network. Guided tours restrict users to the trail, prohibiting detours. While trails lower the cognitive overhead (or overload) by recommending the next logical link to proceed, guided tours reduce the overhead further by removing all other choices. Thus, they can also prevent the phenomenon of 'lost-in-hyperspace'.

In the case of coursework one approach may be by seeing Internet tools as cognitive tools, in other words, tools for knowledge construction. Cognitive tools actively engage learners in the creation of knowledge that reflects their comprehension and conception of the information rather than focusing on the presentation of objective knowledge [6]. In the same way, web-based tools, like Web CT, can be seen in an active context. The students can use Web CT and its presentation feature for introducing their ideas, receiving feedback, and managing coursework. In this way a web-based learning environment may support learning in the spirit of both cognitive and social constructivism.

Based on the above it is important to comprehend views of learning while outlining courses as well as comprehending ways of using the WWW in learning. We stress three issues. First, we must discuss what the right amount of traditional (behaviorist) teaching is. Second, we must analyze what the right way to use the WWW is.

A SOLUTION FOR WWW-BASED LEARNING: COURSEWORK AND ITS EVALUATION

Because constructivism is the leading approach to learning of our time, we evaluate learning based on this approach. Our main focus is to show how successful the learning process has been. We conducted this evaluation principally on the basis of two views:

1. the meaningfulness of learning,
2. understanding of the basic concepts.

Secondarily, we are interested in use skills, because these indirectly show how the concepts are learned.

We pursued a study concerning WWW coursework based on the idea of trails and guided tours supported by the use of search engines and directories. This idea was supported by the use of web workspaces on the Web CT environment. In this section we describe our experiment, sample, measures and tests, followed by the results of our study.

Experiment

At the University of Jyväskylä the themes of an introductory course in automatic data processing are (1) introduction (including such themes as the meaning of automatic data processing, the information society and problems in utilizing computers), (2) presentation of data in the PC environment, (3) computer software, (4) hardware technology, (5) data communications, and (6) the meaning of information technology in business. The course usually lasts 10 weeks including lectures (8 hours), compulsory practical exercises in basic skills with personal computers and the Internet (18 hours) as well as a final examination. The course given in spring 2003 also lasted for this length of time and included the above-mentioned activities and in addition material and activities on the WWW to support the lectures in the constructivist fashion.

Our approach to using the WWW for teaching and learning on this course was to combine

- the idea of trails and guided tours on the WWW, and
- both behaviorist teaching/learning and constructivist learning

The constructivist approach is the commonly accepted principle for learning. Since the structural form of knowledge (or knowledge structures) is typical for the basic concepts of informatics, it is also natural to approach the learning and teaching of it from the perspective of constructivism. However, in our context, in the basics of informatics, students may need guidance at the beginning of learning. Thus, the traditional learning methods in the behaviorist manner must be accepted as a part of teaching and learning methods. The students were introduced to our approach and the pre-questionnaire administered at the beginning of the course.

We organized our basic course lectures on the basis of the above-mentioned approach. Thus, the lectures consisted of

- printed lecture notes, which all students obtained at the beginning of the course,
- conventional lectures (9 hours),
- lecture notes on the WWW including links to supporting sites, and
- optional coursework using the WWW in regard to lecture notes on the WWW.

Due to our context, we claim that conventional lectures and printed lecture notes are needed as a behaviorist part of the course, but lecture notes on the WWW provide an opportunity for a constructivist approach. The lecture notes on the WWW were organized in the form of a slideshow using Microsoft Powerpoint 2002 and its Internet assistant. These tools permit the slides in each lecture to be organized in the strict form of a guided tour on the WWW providing support for a student who is at the beginning of learning in informatics and not familiar with computers and the WWW. Each slide in the slideshow may include a set of links to interesting WWW sites and in this manner a slideshow can also be comprehended as a trail. Our slides included links concerning the critical concepts to the appropriate link pages, which were evaluated as supporting the learning of these concepts best. The selection of the links on the slides was based on the list of critical concepts for learning produced by a group of teachers (n=12) of informatics at our university. Since the slides are on the WWW, a student can also support his or her learning using search engines and directories. Thus, the form of a lecture is flexible and it can be seen as a trail or a guided tour depending on the situation and information needs. This allows different views and brings a real constructivist way of learning, since the role of instructional media shifts from one which seeks to maximize the communication of fixed content and/or skills to one in which students engage in the knowledge construction process: construct-

ing interpretations, appreciating multiple perspectives, developing and defending their own positions while recognizing other views, and becoming aware of and able to manipulate the knowledge construction process itself.

To realize the benefit of the lecture notes on the WWW we organized a coursework in which students were expected to enter their findings in their personal diaries. These findings included their opinion about (a) the general form of presentation, (b) the links provided by the teacher, and (c) the links found by the students themselves using search engines and directories. Additionally, the students were expected to give various examples of what they had learned during the coursework. To promote the students' participation in the optional coursework, the students got credits by completing the coursework for the final examination. Although the coursework is a constructivist part of the course, the teacher's office hours were available as an additional resource to promote their work. The students had six and a half weeks for the coursework before the final examination. The work was expected to be conducted as an individual task or in groups of two or three students.

The groups placed the presentations in their own web-based workspaces. Other groups were expected to familiarize themselves with these presentations. All the groups had permission to upload files to all workspaces. Thus, it was possible to upload comments regarding the work of other groups to any workspace. For authoring the coursework, the groups had six weeks. After these six weeks the groups were expected to comment on at three other coursework presentations. These comments were placed in the Web CT workspaces. The students had one week for this.

The workspaces were created before the course using the presentation feature of the Web CT. All the groups, involved with the Web CT-based coursework, got permission to upload, download, and view material in any workspace. Thus, communication was possible between the groups, enabling the web-based seminar.

Sample

One hundred and forty students, 109 females and 31 males, whose mean age was 24 years (range 19-52 years), entered the course and completed both pre- and post-treatments. All the students were familiar with university lecturing. They familiarized themselves with the use of a WWW browser and basic search engines and directories (i. e. Google, Altavista and Yahoo) before the introduction of the optional coursework. All the students studied informatics as a minor. During the course they were required to participate in practical exercises concerning the use of personal computers and the Internet (18 hours) and all the students had the same exercises concerning these matters. Participating in the lectures (9 hours) and the coursework was optional.

Twenty-one of the students, 20 females and 1 male, whose mean age was 25 years (range 19-52 years), participated in the optional coursework. 17 of them completed the coursework individually, 23 in groups of two students and 6 in groups of three students. We call this group the WWW group in this paper.

One hundred and nineteen students, 89 females and 30 males, whose mean age was 24 years (range 19-50 years) did not complete the optional coursework. We call this group the non-WWW group in this paper.

Collecting Data

The data for this study was collected by administering a questionnaire both at the beginning and end of the course to both types of groups. The respondents rated each theme of the course with regard to (a) how interesting they considered the themes of the course (where 1=very uninteresting and 5=interesting), and (b) how beneficial they considered the themes of the course (where 1=very useless and 5=very useful).

Additionally, in the questionnaires both at the beginning and the end of the course the respondents were expected to analyze their:

- computer use skills,
- Internet use skills, and
- knowledge of the basic concepts in informatics.

The respondents ranked these skills or knowledge on a 5 point Likert scale (where 1=very poor and 5=very good).

Results

The data based on the motivation-related responses of the students concerning the themes of the course agreed with the normal distribution. Thus, the one-way ANOVA test was appropriate for statistical analysis of the data.

We calculated the scores for pre-motivation and post-motivation of each theme. This was based on the framework presented in section two. The one-way ANOVA test did not show significant differences in pre-motivation between the non-WWW group and the WWW group in regard to any theme of our course (p varying between .344 and .929).

Additionally, the one-way ANOVA test did not show significant differences in post-motivation between the non-WWW group and the WWW group in regard to any theme of our course (p varying between .184 and .914).

Concerning skills and knowledge, and based on the Mann-Whitney test, the study found that the optional WWW-based coursework was useful in the learning of the basic concepts of informatics. However, the coursework did not improve general computer and Internet use skills significantly. Statistical analysis showed that the coursework was most beneficial in the learning of the basic concepts. The difference between the groups was highly equivalent at the beginning and at the end the difference was significant. The results show that WWW-based coursework can help students to learn the basic concepts of informatics. The details of the analysis concerning skills and knowledge are shown in table 1. For this analysis the students were expected to evaluate their skills and knowledge based on a 5-point Likert scale in the questionnaires.

DISCUSSION

The study found that the main effect of our WWW-based coursework is knowledge rather than the skills or the meaningfulness of learning (or motivation). Thus, considering the theoretical discussion the results presented in this paper are contradictory. From the perspective of motivation the WWW coursework does not support constructivist learning. However, the positive result concerning the learning of the basic concepts shows that our coursework supports constructivist learning in the sense of the development of students' mental models. Additionally, the results of our previous papers [8, 9] confirm the results concerning the learning of basic concepts. The results in this paper leave open questions. First, what are the reasons for the success of the WWW-based coursework concerning the development of conceptual knowledge? Second, why does the WWW-based coursework not improve the meaningfulness of learning? Third, what are the meanings of different

Table 1. Analyzing the Students' Skills and Knowledge

	Mean at the beginning of the course			Mean at the end of the course		
	Non-WWW group	WWW group	p	Non-WWW group	WWW group	p
Computer use skill	2.88	2.76	.516	3.44	3.41	.832
Internet use skill	3.36	3.19	.364	3.90	3.88	.913
Knowledge of the basic concepts in informatics	2.29	2.33	.800	2.80	3.24	.022

phases of our coursework (authoring and participating in a web-based seminar)?

Nevertheless, the results contained in this paper show that based on many reasons it is useful to combine behaviorist teaching and constructivist learning utilizing the WWW in our context. The WWW-based coursework, designed in a constructivist manner, especially helped the students who were real beginners (novices) in the field of informatics. In this way everyone had the opportunity to learn.

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