OULUN YLIOPISTON
KASVATUSTIETEIDEN TIEDEKUNNAN
ELEKTRONISIA JULKAISUJA 1

Sanna Järvelä & Esa Kunelius (eds.)

LEARNING & TECHNOLOGY - DIMENSIONS TO LEARNING PROCESSES IN DIFFERENT LEARNING ENVIRONMENTS

OULUN YLIOPISTON
KASVATUSTIETEIDEN TIEDEKUNNAN
ELEKTRONISIA JULKAISUJA 1

Sanna Järvelä & Esa Kunelius (eds.)

LEARNING & TECHNOLOGY - DIMENSIONS TO LEARNING PROCESSES IN DIFFERENT LEARNING ENVIRONMENTS

Oulun yliopiston kasvatustieteiden tiedekunta

Vastaava toimittaja Leena Syrjälä

URL http://herkules.oulu.fi/issn14558025/
http://herkules.oulu.fi/isbn9514248104/

Learning & Technology - Dimensions to Learning Processes in Different Learning Environments / Sanna Järvelä & Esa Kunelius (eds.). - Oulu : Oulun yliopisto, 1998. - 215 s. : kuv. - (Oulun yliopiston kasvatustieteiden tiedekunnan elektronisia julkaisuja, ISSN 1455-8025 ; 1). -
ISBN 951-42-4810-4

Asiasanat oppiminen, opetusteknologia, tietotekniikka, oppimisymäristö, konstruktivismi

UDK 371.69
371.3

ISBN 951-42-4810-4
ISSN 1455-8025

OULUN YLIOPISTO
Kasvatustieteiden tiedekunta
Oulu 1998

English abstract

This electronic publication is based on the papers and discussions in the symposium "Learning and Technology - dimensions to learning processes in different learning environments" May 19 – 20, 1997 at the Department of Teacher Education, University of Oulu, Finland. The first day focused on discussing learning, especially learning processes in technology-based environments, while on the second day the focus was on the possibilities of technology to create new learning environments. The papers in this electronic publication reflect the variety of approaches that the Learning and Technology symposium brought together. On the one hand, they represent very well the complexity of the phenomena of learning even in the promising new learning environments, but on the other hand, they also reflect the variety of new models and practices for learning facilitated by technology. There are papers both in English and in Finnish.

Keywords *Learning, technology-based learning environments, information technology in education*

Finnish abstract

Tämä elektroninen julkaisu perustuu ”Learning and Technology - dimensions to learning processes in different learning environments” (Oppiminen ja teknologia – oppimisprosessin ulottuvuudet eri oppimisympäristöissä) tutkijasymposiumiin, joka pidettiin Oulun yliopiston opettajankoulutuslaitoksessa toukokuussa 1997. Symposion ensimmäisen päivän aiheen esitykset ja keskustelut kohdistuivat oppimiseen erilaisissa teknologiaperustaisissa ympäristöissä, erityisesti oppimisprosessin näkökulmasta tarkasteltuna. Toisen symposiopäivän esitykset kohdistuivat pohtimaan teknologian mahdollisuuksiin osana oppimisympäristöä. Tämän julkaisun artikkeleissa heijastuvat se ne näkökulmat, joita Learning and Technology-symposiumissa kokoonnuttiin tarkastelemaan. Artikkeleista nousee esille se, että oppiminen on hyvin monimutkainen ilmiö myös uusien teknologiaperustaisten oppimisympäristöjen konteksteissa. On myös nähtävissä se, kuinka tieto- ja viestintätekniikan hyödyntäminen oppimisessa ja opiskelussa mahdollistaa uusia opiskelun käytäntöjä ja oppimisen malleja. Tämä julkaisu sisältää sekä englanninkielisiä, että suomenkielisiä artikkeleita.

Asiasanat *Oppiminen, teknologiaperustaiset oppimisympäristöt, tieto- ja viestintätekniikka koulutuksessa*

Introduction

This electronic publication is based on the papers and discussions in the symposium ”Learning and Technology - dimensions to learning processes in different learning environments” June 19 – 20, 1997 at the Department of Teacher Education, University of Oulu, Finland. The first day focused on discussing learning, especially learning processes in technology-based environments, while on the second day the focus was on the possibilities of technology to create new learning environments.

The symposium gathered together researchers from different fields; from psychology to education to the information sciences. There were researchers representing the whole range from children’s learning to university and adult learning. Consequently, learning and technology is a topical question in many fields. A multidimensional approach to research and development seems to be a force in this area.

The papers in this electronic publication reflect the variety of approaches that the Learning and Technology symposium brought together. On the one hand, they represent very well the complexity of the phenomena of learning even in the promising new learning environments, but on the other hand, they also reflect the variety of new models and practices for learning facilitated by technology. There are papers both in English and in Finnish.

The first section of the electronic papers deals with the dimensions typical of students' learning processes in technology-based learning environments. Sanna Järvelä discusses the possibilities of technology in learning and education in general. Several papers focus on collaboration and social interaction. Curtis Bonk and Kira King's paper considers how technology can offer tools for collaborative writing, thus enhancing the quality of social interaction. Päivi Häkkinen and her colleagues report on a study project searching for the optimum conditions for learning and collaboration in technology-based environments, while Lenni Haapasalo's paper focuses on the construction processes in collaborative learning in the field of mathematics. Hannu Soini and his colleagues' paper presents a model of peer consultation in higher education, while Markku Niemivirta discusses how motivation and self-regulative learning emerge in the new learning environments.

In the second section, the papers examine the different possibilities of technology to assist teaching, learning and studying. Päivi Atjonen presents a model and empirical results on how information technology can enhance the development of teaching practices. Tuula Pyykkö and Eero Ropo describe a research and development project with the purpose of creating new possibilities for adult learning in a World Wide Web - based environment. In Jyrki Pulkkinen and his colleagues' paper project tools for learning (ProTo) are described with the purpose of developing Web-based tools for distance learning and creating an open learning environment. Tahvo Hyötyläinen and his colleagues report on the use and theoretical foundations of hypermedia-based learning materials on the World Wide Web, while Juha Kämäräinen focuses on multidimensionality in hypertext and presents ideas to structure it.

The symposium ”Learning and Technology - dimensions to learning processes in different learning environments” was organized and the contents of this publication were compiled by Sanna Järvelä. Esa Kunelius created many innovative technical solutions during the symposium and in editing this electronic publication. The authors of this publication and the researchers who took part in the symposium all contributed to the interesting and important discussion about ways to support learning in today’s information society. Thank you all!

Oulu, October 1, 1997
Sanna Järvelä

Contents

II Different possibilities of technology to assist teaching, learning and studying

I The dimensions typical of students' learning processes in technology-based learning environments.

What are the possibilities of technology in learning?

Sanna Järvelä
Department of Teacher Education
University of Oulu

Abstract

This article discusses the possibilities of information technology in learning. The arguments are grounded on a recent research on students' learning processes in new technology-based environment. The theoretical basis is derived from educational psychology and constructivist view on learning. The possibilites of technology in learning are considered in terms of motivation, social interaction, abstract understanding, the teacher's role and students'cognitive processes. The conclusion is that new technology may provide interesting and powerful learning opportunities, but these should not taken for granted; teachers and learners need to know how to take advantage of them. Therefore, the theories of learning give us valuable information on how to develop more pedagogically relevant learning environments.

Keywords

Keywords: learning, technology-based learning environments, constructivist learning theory

Introduction

Learning is always a challenge: so interesting, so stimulating, even rewarding - but still so hard and sometimes very confusing. Learning may need even more efforts in today's information society. Some may ask how to cope with all this information available in different media? How to manage the complexity of everyday problems? How to learn the basic skills? Learning still requires efforts by the individual learner, but living in today's information society provides us with much more and richer possibilities to get experiences of learning and understanding (e.g. Scardamalia & Bereiter, 1993; Brown & Campione, 1996). Especially, new information technology seems to provide the individual learner with exceptional potential: it offers tools for thinking, for exploring interesting problems, and for world wide interaction. Still, the possibilities of technology in learning are missed if technology is seen only as a means to contact people or to send notes from one country to an another.

From theories on learning to ideas of new learning environments

The theories on learning give us valuable information on how to develop more pedagogically relevant learning environments. The recent debating, even contradictory, tradition in situated cognition has successfully discussed the many faces of constructivist theory on learning. Discussions by different researchers have developed the theoretical idea of learning environment. Some of them emphasize the cognitive perspective (Anderson, Reder & Simon, 1996), while others put the focus on the situative perspective (Greeno, 1997). As Salomon (1997) suggests, these two approaches should be understood in reciprocal relationship: to see an actively constructing student participating in cultural practices.

The theories of social cognition and social interaction have made an impact on multiple researches in computer supported learning, which leads us to use computers today, surprisingly, as social vehicles (e.g. Harasim, 1993). Furthermore, the theories of self-regulation and motivation inspire us to explore the possibilities the new learning environments may offer to the individual learner in order to support his or her learning goals (Järvelä, Lehtinen & Salonen, 1997). New conceptions about learning have connected with certain educational philosophies, mainly those on constructivism. This approach has led to the conceptualization of novel pedagogical practices. However, as Salomon (1997) puts it, the new ideas need new instructional means for their realization in real classrooms and with real students. This is where new technologies become useful.

Increasing interest and motivation

Recent research has pointed out how information technology can enhance students' interests by offering new opportunities for constructive production of knowledge, social communication and sharing of cognitive achievements (e.g. Koschman, 1994). For example, motivation is enhanced by anchoring instruction in meaningful and authentic problem-solving contexts in technology-based learning environments (Cognition and Technology Group at Vanderbilt, 1993). Furthermore, instructional designs which differ very much from the conventional forms of school learning result in changes in the motivation and coping tendencies of students (Järvelä et al., 1997). Technology-based learning environments may facilitate a tendency toward task-oriented interpretations and working processes among the students (Järvelä, 1997).

Partners in social processes

Computer technology can support collaborative learning, enhance interpersonal relationships and address mutual concerns in learning (Lehtinen & Repo, 1996; Vosniadou, 1994). The utilization of educational technology is based on the idea that computers can become partners by undertaking certain phases of student cognitive processing while supporting other phases upon student need or demand (e.g., Lajoie & Derry, 1993). There is a rising interest in the possibilities of technology to support learning with the help of shared problem solving (Teasley & Roschelle, 1993) and enhanced interpersonal communication with new electronic tools (Bonk, Appleman & Hay, 1996). Recent prominent technologies for computer conferencing bring students close to real-world environments and apprenticeship opportunities. A variety of peer, expert, teacher, learner and tool resources jointly create an instructional environment for apprentice learners into a community of discourse.

Making abstract more concrete

Technology-based learning environments embody symbol systems, such as animated diagrams, maps, graphs, texts and films. The symbol systems used for communication have the crucial properties of simultaneously providing representations of and for reality. Communication using these symbol systems is open to multiple interpretations as to how it expresses representations (Pea, 1992). The participants can point to different properties of the environment, have discussion about them to clarify what is meant, describe how they are connected to other things, and co-construct common objects.

Supporting the teacher's role

In a computer environment teacher-student interaction and communication ”turn towards” the joint task. The computer environment (e.g. simulations of complex phenomena or tracing the student's thinking processes) assists the participants in reaching a joint goal for their discussions. This shared goal helps the students in explaining their difficulties, while providing new opportunities for the teacher to scaffold. Teacher-student interaction episodes in a computer environment may involve newer formats than in traditional classroom interaction.

Facilitating cognitive processes

Based on cognitive studies of expertise, Bereiter and Scardamalia (1992; 1993; 1996) argued that an important prerequisite for the development of higher-level cognitive competencies is that students themselves take the responsibility for all cognitive (e.g., questioning, explaining) and metacognitive (e.g., goal-setting, monitoring and evaluating) aspects of inquiry. By restructuring educational practices according to cognitive theory and relying on technology-based learning environments, schools can be transformed into communities in which teachers and students are working in collaboration to construct and improve shared knowledge objects.

The need for a systematic research on the limitations and conditions of technology in learning

In spite of its potential to facilitate learning and understanding, the effect of the new technology should not be taken for granted. It seems that in order to effectively exploit new technology-based environments and corresponding cognitive practices, more systematic research on the limitations and conditions of successful implementation of the computer- and network-based learning environments should be carried out (Hakkarainen, Järvelä & Lehtinen, 1997; Järvelä, Hakkarainen, Lipponen, Niemivirta & Lehtinen, 1997; Salomon, 1997). Learning depends crucially on the exact character of the activities that learners engage in with a certain computer program or some other environment. It depends on the kinds of tasks learners try to accomplish, and the kinds of intellectual and social activities they become involved in, in interaction with what computing affords (Salomon & Perkins, 1996). New technology may provide interesting and powerful learning opportunities, but these should not be taken for granted; teachers and learners need to know how to make good use of them.

References

Anderson, J.R., Reder, L.M., & Simon, H.A. (1996). Situated learning and education, Educational Researcher, 25 (4), 5-11.

Bereiter, C. & Scardamalia, M. (1989) Intentional learning as a goal of Instruction. In L. B. (Ed.) Knowing, learning, and instruction: Essays in honor of Robert Glaser,(pp. 361-392). Hillsdale, NJ: Lawrence Erlbaum.

Brown, A. L. & Campione, J. C. (1996) Psychological theory and the design of innovative environments: On procedures, principles , and systems. In L. Schauble. & R. Glaser Eds.) Innovations in learning. New environments for education. (pp. 289-325). Mahwah, NJ: Lawrence Erlbaum.

Bonk, C.J., Appleman, R. & Hay, K. E. (1996). Electronic conferencing tools for student apprenticeship and perspective taking. Educational Technology, 36(5), 8-18.

Cognition and Technology Group at Vanderbilt (1993). Anchored instruction and situated cognition revised. Educational Technology, 33, 52-70.

Greeno, J. G. 1997. On claims that answer the wrong questions. Educational Researcher, 26 (1), 5-17.

Hakkarainen, K., Järvelä, S. & Lehtinen, E. (1997). Culture of collaboration in computer supported learning. Manuscript.

Harasim, L.M. (1993). Global networks: Computers and international communication. Cambridge, MA: MIT press.

Järvelä, S. (1997). Cognitive apprenticeship and technology: Extending a learning environment with analyses of students' socioemotional interpretations. Instructional Science, in press.

Järvelä, S., Lehtinen, E. & Salonen, P. (1997). Socioemotional orientation as a mediating variable in teaching learning interaction: implications for instructional design. Submitted.

Koschmann, T.D. (1994). Toward a theory of computer support for collaborative learning. The Journal of the Learning Sciences, 3. 219-225.

Lehtinen, E. & Repo, S. (1996). Activity, social interaction, and reflective abstraction: Learning advanced mathematical concepts in computer environment. In S.Vosniadou, E. De Corte, R. Glaser & H. Mandl (Eds.), International perspectives on the Design of Technology-Supported Learning Environments (pp. 105-128). Hillsdale, NJ: Lawrence Erlbaum.

Salomon, G. (1997). Novel constructivist learning environments and novel technologies: Some issues to be concerned with. Invited Key note Address presented at the Earli conference, Athens, August.

Salomon, G. & Perkins, D. N. (1996). Learning in Wonderland. What do computers really offer education? In S. Kerr (eds.) Technology and the future of schooling in America. The ninety-fifth yearbook of the National Society for the Study of Education, Part II. Chicago Press.

Scardamalia, M., & Bereiter, C. (1992) Text-based and knowledge-based questioning by children. Cognition and Instruction, 9, 177-199.

Scardamalia, M. & Bereiter, C. (1993). Computer-support for knowledge building communities. Journal of the Learning Sciences, 3, 265-283.

Scardamalia, M., & Bereiter, C. (1996) Adaptation and understanding: A case for new cultures of schooling. In S. Vosniadou, E. De Corte, R. Glaser, & H. Mandl (Eds.) International perspectives on the psychological foundations of technology-based learning environments. (pp. 149-163). Mahwah, NJ: Lawrence Erlbaum.

Teasley, S.D., & Roschelle, J. (1993). Constructing a joint problem space: The computer as a tool for sharing knowledge. In S.P. Lajoie & S.J. Derry (Eds.), Computers as cognitive tools (pp. 229-257). Hillsdale, NJ: Lawrence Erlbaum.

Vosniadou, S. (1994). Capturing and modeling the process of conceptual change. Learning and Instruction, 4(1), 45-69.

Computer conferencing and collaborative writing tools: Starting a dialogue about student dialogue

Curtis J. Bonk & Kira S. King
University of Indiana

Abstract

Calls for a more "learner-centered" curriculum is heard from the pulpit of most educational reformers of the 1990's. In response, this paper explores the Collaborative Writing (CW) tools available for different levels of electronic interaction that might be indicators of high quality social interaction. In a series of studies starting in late 1993, a research group at Indiana University began to demonstrate how different CW tools and formats impact social interaction and learning. This paper discusses these efforts in terms of the age level of participants, tool utilized, and instructional strategy or task. CW tools reviewed here are categorized into five levels ranging from electronic messaging to delayed collaboration tools to brainstorming tools to real-time collaborative writing tools to collaborative hypermedia. Though the review of these tools is important, a survey of coding schemes used to analyze electronic transcripts point to the forms of teacher or peer assistance, levels of questioning, degree of perspective taking, status, content talk, peer feedback, and types of scaffolding available over computer-mediated communication. Transcript codings and findings across these electronic social interaction studies point to some commonalities in effective instructional *use of these technologies as well as the means to analyze the salient discourse processes and sharing of meaning.*

Keywords

Keywords: collaborative writing, dialogue, sociocultural theory, computer-mediated communication, computer conferencing.

Introduction

Research in the social context of learning has provided substantial support that traditional teacher-centered instructional approaches must be replaced with more active, learner-centered environments (Alexander & Murphy, 1994). As educators push for more active learning opportunities, Vygotsky's (1986) sociocultural theory of cognitive development is rapidly influencing diverse educational arenas. Vygotsky's tenets about learning and development emphasize the importance of social interaction with adults and more capable peers as a means to guide children to developmental levels they might not independently attain (Brown & Palincsar, 1989). Recent CW studies provide support that students' internalize the scaffolding of more capable peers when collaboratively writing (Daiute & Dalton, 1988) as well as the cognitive supports or prompts provided by computer tools (Salomon, 1988).

Though educators are turning to Vygotskian writings to promote the social context of student learning (Tharp & Gallimore, 1990), researchers have yet to make significant in-roads regarding how cognitive processes displayed on a social plane become internalized by the participants (Wertsch, 1991). Ideas about student zones of proximal development, scaffolding, and internalization remain difficult to implement. Educational researchers continue to struggle with the new focus on activities and event meanings as the unit of analysis. Analyzing electronic social interaction is no different.

Despite these theoretical struggles, CW and computer conferencing tools clearly can help us create these learning environments. As the formats for electronic collaboration proliferate, computer conferencing has great potential for changing the ways students and their instructors interact with each other and organize their learning processes. To make decisions that productively transform learning environments (Schrage, 1990), therefore, research is needed that records how schools, teachers, and students are discovering, employing, and modifying the numerous new CW tasks and tools.

Collaborative Writing Roadblocks

There are a numerous obstacles facing the study of computer conferencing and CW. Researchers, in fact, have just begun to examine the social interaction differences between CW tools such as computer network technologies and traditional writing classrooms (Forman, 1992). Minimal documentation presently exists regarding the differences in communication patterns, teacher roles, or student writing performance across levels of CW tools and tasks. Many questions remain:

Will CW foster new expectations of teaching?

What types of writing collaborations are preferable to teachers and students? And when?

What kinds of CW activities are facilitated by different writing tasks and tools?

How do students assist each other during CW?

These questions unfortunately are often forgotten when viewing ingenious writing technologies or hearing about the exciting, new features for searching and sharing knowledge. Our research group has attempted to overcome these barriers by demonstrating how different CW formats impact social interaction and learning. A Collaborative Writing Taxonomy: Bonk, Medury, and Reynolds (1994) defined CW as groups of two or more people working in concert on a common text project in an environment supportive of their text and idea sharing. In providing that definition, however, we realized that CW tools currently offer a maze of new communication channels among participants (from one-to-one, many-to-one, and many-to-many) and a range of text support (e.g., electronic mail, delayed collaboration, brainstorming, and real-time text collaboration).

After surveying and testing a number of CW tools, Bonk et al. (1994) attempted to clarify this predicament by designing a taxonomy of five levels of CW tools for school learning (i.e., from electronic mail to real-time text document sharing; see Appendix A) as well as a model of the levels and types of nonacademic writing support tools (Bonk, Reynolds, & Medury, in press). Though many similarities are evident, the diversity of activity settings and coding schemes continues to challenge educational researchers and are roadblocks in movements to reform education from a social constructivist framework. The next section provides the specifics of our CW efforts to date.

Researching the CW Levels

From a series of studies, we have discovered that these tools can: (1) change the way students and instructors interact; (2) enhance collaborative learning opportunities; (3) facilitate class discussion, and (4) move writing from solitary to more active, social learning. By examining the CW formats used in schools and universities, our research projects to date reaffirm our taxonomy of CW tools used in schools (see Appendix A) and help us refine and reevaluate our coding schemes for CW dialogue. These results should inform researchers, tool designers, and policy makers of the importance of social interaction and dialogue in various CW tools and tasks.

Level One: Electronic Mail Tools

The first study was conducted in a course that was project oriented and met for three hours, once a week. In this course, two professors interacted with 48 students organized into 12 different teams, each working on separate and unique projects. To maintain contact with each student and track their progress, students were required to complete weekly reports and e-mail them directly to the instructors. The instructors then responded to each student with an individualized e-mail message which was coded during the semester. The interaction categories were based on the six "means of assistance" identified by Tharp and Gallimore (i.e., modeling, contingency management, feeding back, instructing, questioning, cognitive structuring; see Tharp & Gallimore, 1988). E-mail was more prevalent in the beginning of the semester and primarily performed a feedback function.

The second project analyzed involved a two semester graduate course sequence taught by the same instructor (one course was more hands-on/design related (i.e., hypermedia) and the other was more theoretical in nature (i.e., constructivism). The first part of the sequence was a discussion class in which class and e-mail participation was graded, while the second part of the course was project-based. Rich data was obtained from following the e-mail conversation for the entire year in order to determine the role it played in the learning environment, the social interactions that occurred, and how this form of computer mediated communication can best be used to support learning. Coding schemes by Tharp and Gallimore (1988) and Granott (1991) utilized for this analysis indicated that E-mail was more prevalent in the design class; however, in each class, the instructor dominated e-mail discussion.

Level II: Remote/Delayed Collaboration

The first of many delayed collaboration projects involved a common and effective on-line communication tool (i.e., the Internet) (see Harasim, 1990). In this study (Sugar & Bonk, 1994), "telecommunities" and cognitive apprenticeships (Collins, Brown, & Newmann, 1989) provided students the opportunity to have new "pen pals" and fostered common understandings or new perspectives among themselves; what Riel (1993) refers to as a global education. The World Forum, developed by the University of Michigan, is an on-line asynchronous telecommunications project designed to give students from six middle and six high school classrooms the opportunity to interact with each other about critical environmental issues. Throughout these interactions, the student groups are assisted by World Forum mentors who question and guide the student groups' understanding of these environmental issues. Tharp and Gallimore's (1988) six means of assistance (noted earlier), Bloom's (1956) levels of questioning taxonomy, and Selman's (1980) degree of perspective taking developmental scheme were used to map out these interactions. In the World Forum component of the World School, students discussed, questioned, and debated with Arctic explorers, mentors, and peers about environmental issues. Student role taking activities within these environmental discussions (students assumed roles of famous people like Professor Stephen Jay Gould and Mr. Richard Leakey) enhanced the degree of perspective taking in their conversations. This finding was interesting since mentor assistance and scaffolding during these exchanges was minimal.

The second Level II project discussed here involves a distance learning course entitled, Interactive Technologies for Learning, using picture-tel technologies to deliver the course. Here, the instructors at each site utilized electronic conferencing methods to organize, control, and facilitate electronic discussions and meaning negotiation. The analysis here is used to determine whether the instructors successfully assumed the role of student mentor and guide. Each week, students were involved in discussing the articles for the class. "Starters" were used to summarize the articles and begin discussion of the articles and open questions, while "wrappers" were used to summarize the discussion that took place. During the intervening days, students participated at least once on that conversation. Student VaxNotes were analyzed into categories like questions, clarifications, and answers. In addition, the relevancy of the comment to the topic and contribution to the construction of meaning was noted. Instructor VaxNotes were sorted according to instructional planning, commenting, and guiding.

A third Level II project investigated computer conferencing using a new tool, First Class, within a computer network. First Class allowed multiple users to communicate with each other regardless of time or geographical location, thereby fostering discussion threads on any topic of interest.

Level III: Real-Time Brainstorming

In Level III, multiple users can simultaneously brainstorm by sending messages to each other. In the only study noted here, we created several teaching dilemma prompts for preservice teachers to resolve electronically while working in subject matter teams (e.g., science) in either real-time or delayed formats. One class of 30 preservice teachers in an educational psychology class interacted over VAX Notes in the Electronic Classroom (EC) (i.e., the delayed, asynchronous setting), while two other classes interacted using "Connect" (i.e., the real-time, synchronous setting). Naturally, issues of group size, roles or participant structures, and task requirements (e.g., length) are critical to the effect of these tools. Coding of student dialogue transcripts indicated that role assignment was critical to group intermental processing and attitudes. Whereas the use of the synchronous software tool, Connect , increased the range of possible group assignments and interaction patterns, the analyses also illustrated that asynchronous communication (Level II) facilitated more serious and lengthy interactions than those in real-time over a local network (Level III; i.e., synchronous communication). After developing a coding scheme for student-student interaction patterns in CW and electronic mail based on Meloth and Deering (1994), the dialogue transcripts revealed that the delayed collaboration mode resulted in more thoughtful and extended peer interaction patterns.

Level IV: Real-Time Text Collaboration

Real-time collaborative tools allow students to view changes that peers and colleagues make to a document as they are being enacted (see Level V study below and Appendix A for examples).

Level V: Cooperative Hypermedia

This final level involves real-time collaboration on a common text or graphics document. The study reviewed here is of a 10th grade English class studying the Crucible. The teacher incorporates the use of the real-time collaborative writing tool, Aspects, to spur classroom dialogue and discourse. An analysis of low and high participating students indicated that collaborative writing software increased the participation rate of quiet students and, to some extent, equalized student interaction patterns. In this study, students interacted using Aspects in the free-for-all text mode, in the chat box, and in building common graphic concept maps or webs of knowledge about Crucible characters. On-task behaviors and class discussion were extremely high using this tool.

Educational Contribution and Implications:

The purpose of this paper is to increase the knowledge base on the benefits and drawbacks of various CW formats by investigating the student dialogue evident in various electronic learning settings. Across these studies of existing CW practices, it is clear that collaborative advanced technologies are important tools for learning. The results indicate that both synchronous and asynchronous computer conferencing have some advantages over live discussions of cases. CW findings may alter student and teacher ideas about teaching and learning and offer insight into how to use technology as a tool within a learner-centered environment. In effect, our research team has begun to: (1) illustrate how schools and universities are using CW tasks and tools, (2) start a dialogue about student electronic social interaction and dialogue, and (3) catalog and inventory specific social interaction patterns within CW. If social interaction patterns and learner-centered ideas embedded in CW are documented and publicized by this research on CW tools and tasks, we will better comprehend and appreciate the components of this new teaching/learning epistemology.

References

Alexander, P. A., & Murphy, P. K. (1994). The research base for APA's learner-centered psychological principles. Paper presented at the American Educational Research Association annual meeting, New Orleans, LA.

Bloom, B. (1956). Taxonomy of educational objectives; the classification of educational goals, by a committee of college and university examinees. New York: Longmans, Green.

Bonk, C. J., Medury, P. V., & Reynolds, T. H. (1994). Cooperative hypermedia: The marriage of collaborative writing and mediated environments. Computers in the Schools, 10(1/2); 79-124.

Bonk, C. J., Reynolds, T. H., & Medury, P. V., (in press) Technology enhanced workplace writing: A social and cognitive transformation. To appear in A. H. Duin & C. J. Hansen (Eds.), Nonacademic Writing: Social Theory and Technology. Hillsdale, NJ: Erlbaum.

Brown, A. L., & Palincsar, A. S. (1989). Guided, cooperative learning and individual knowledge acquisition. In L. Resnick (Ed.), Cognition and instruction: Issues and agendas (pp. 391-451). Hillsdale, NJ: Erlbaum.

Collins, A., Brown J. S., & Newmann S. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. Resnick, (Ed.), Knowing, learning, and instruction: Essays in honor of Robert Glaser. Hillsdale, NJ: Erlbaum.

Daiute, C., & Dalton, B. (1988). "Let's brighten it up a bit": Communication and cognition in writing. In B. A. Rafoth & D. L. Rubin (Eds.), The social construction of written language (pp. 249-269). Norwood, NJ: Ablex.

Forman, J. (Ed.). (1992). New visions of collaborative writing. Portsmouth, NH: Boynton/Cook.

Granott, Nira. (1991). Play, puzzles, and a dilemma: Patterns of interaction in the co-construction of knowledge. Paper presented at the annual meeting of the AERA annual mtg, Chicago, IL.

Harasim, Linda. (1990). Online education: An environment for collaboration and intellectual amplification. In L. Harasim, (Ed.). Online education: Perspectives on a new environment. NY: Praeger.

Meloth, M., & Deering, P. (1994). Task talk and task awareness under different cooperative learning conditions. American Educational Research Association, 31(1), 138-165.

Riel, M. (1993). Global Education through learning circles. In L. Harasim, (Ed.). Global Networks. Cambridge, MA: MIT Press.

Salomon, G. (1988). AI in reverse: Computer tools that turn cognitive. Journal of Educational Computing Research, 4(2), 123-139.

Schrage, M. (1990). Shared minds: The technologies of collaboration. New York: Random House.

Selman, R. (1980). The growth of interpersonal understanding: Developmental and clinical analysis. New York: Academic Press.

Sugar, W. A., & Bonk, C. J. (1994). World Forum communications: Analyses of student and mentor interactions. Paper presented at the Mid-Western Educational Research Association annual meeting, Chicago, IL.

Tharp, R., & Gallimore, R. (1988). Rousing minds to life: Teaching, learning, and schooling in a social context. Cambridge, MA: Cambridge University Press.

Wertsch, J. V. (1991). Voices of the mind: A sociocultural approach to mediated action. Cambridge, MA: Harvard.

Vygotsky, L. (1986). Thought and language (rev. ed.). Cambridge, MA: MIT Press.

Appendix A: Taxonomy of Collaborative Writing Tools (Bonk, Medury & Reynolds, 1994).

Note: the tools listed below may vary in options such as: text outlining, concept mapping, teacher coaching, dialogue tracking, and maximum number of participants.

Level 1. Electronic Mail and Delayed Messaging Tools: allow users to directly send messages or files from one computer to another using point-to-point transfer or to a centralized server using a store-and-forward strategy; while the latter may be preferred since users can log on and off without losing messages, the former may be more economical in a writing lab; useful for assignment reminders, scheduling, and providing document feedback.

cc:mail (cc:Mail, Inc.)
DaynaMail (Dayna Communications)
Microsoft Mail (Microsoft; Note: also has Level 3 applications)
QuickMail (CE Software; Note: also has Level 3 applications)

Level 2. Remote Access/Delayed Collaborative Writing Tools : allow users to remotely access, update, and control files stored on other computers or stored on a mainframe computer; remote access often requires security clearance; helpful for revision or review of a document.
Bank Street Writer III (Scholastic Software, Inc.)

Carbon Copy (Microcom, Inc.)
Collaborative Writer (Research Design Associates)
For Comment (Access Technologies)
Instant Update (On Technology)

Mark-Up (Mainstay)
Prep Editor (College of Humanities and Social Sciences at Carnegie Mellon Univ.)
Prose (McGraw-Hill Book Company)
SEEN (CONDUIT; provides remote commenting on ideas not completed text)
Screen Share (White Knight Technology)
Timbuktu (Farallon, Inc.)

Level 3. Realtime Dialoguing and Idea Generation Tools: allow multiple user s to simultaneously brainstorm on a topic by sending messages to each other; typically have two windows: a shared/transcript window consisting of ongoing dialogue and a private screen for creating and editing dialogue; useful for prewriting, idea generation, and postwriting phases of collaborative writing.

Conference Writer (Research Design Associates)
DIScourse (Daedalus Group, Inc)
Group Writer (Sunburst Communications)
Connect (Norton)

Level 4. Realtime Collaborative Writing Tools (Text Only): allow more than one person to work on a document concurrently; changes to a document are immediately visible to all participants; pointing devices allow users to draw attention to particular parts of a shared document while private chat boxes allow for real-time conversation and commenting; useful for text creation and revision.

Live Writer I (Research Design Associates)
Realtime Writer (Realtime Learning Systems; used mainly for Level 3 purposes)

Level 5. Cooperative Hypermedia Tools: most allow document sharing capabilities of Level 4 above but expanded to other features including: hypertext, graphics, video images, music, speech, or animation; typically require sophisticated hardware; useful for most aspects of writing depending on feature.

Aspects (Group Logic)
CSILE (Ontario Institute of Studies in Education)
HyperAuthor (Hypermedia and Cognition Group at Wisconsin)
IRIS Intermedia (Brown University, Institute for Research in Info and Scholarship)
KnowledgeBuilder (Knowledge Builder)
My MediaText Workshop (K-6) or Mediatext (Grades 7 to Adult) (Wingsfor Learning)

Project-based science learning in networked environment: analysing cognitive and social processes in constructing shared knowledge spaces

Päivi Häkkinen, Anneli Eteläpelto & Helena Rasku-Puttonen
University of Jyväskylä

Abstract

Project-based science learning in networked environment: analysing cognitive and social processes in constructing shared knowledge spaces. This study aims to investigate, with the parallel consideration of cognitive and social aspects of learning, what kind of modes of group interaction are present and dominating in networked, project-based environments. Teachers' or mentors' supportive role in promoting learning will also be focused. Interaction processes are analysed in relation to the task structuredness and to students' prior knowledge. The study and the projects will be realised at the secondary school level, in networked environments connecting separate schools of distant areas, both locally, nationally and internationally. Qualitative data on interaction processes from comprehensive schools will be gathered, and for the modelling and *assessment of these processes, interdisciplinary tools based on intelligent methods will be used.*

Keywords

Keywords: collaborative learning, project-enhanced work, technology-supported environments.

Introduction

Approaches to learning and instruction have already for sometime put emphasis on contextual and situational factors as well as on social interaction, co-operation and collaboration among individual learners. On the other hand, advanced research on the nature and qualities of expertise in complex domains has also demonstrated a great variety in the quality of subjects' knowledge structures and prior knowledge. However, we are still in lack of studies of how the different qualities of subjects' prior knowledge are manifested and intertwined in collaborative learning situations where there is a shared goal and a necessity to utilise different knowledge sources

The modes of interaction in technology-based learning environments will be rechallenged by the possibilities to utilise the globally networked contexts of information retrieval and the new tools for collaboration between different kind of situational cultures. However, the enhanced openness of learning environments is also putting new challenges for instructional support and teachers' scaffolding of learning processes in these open environments. Challenged by this, the study aims to investigate, with a parallel consideration of cognitive and social aspects of learning, what kind of modes of group interaction are present and dominating in project-based environments. Our main focus is in the collaborative processes of learning, particularly in specifying and describing factors which have the most important inference for the promotion of successful collaboration.

The study described in this paper is a part of the research project called CATO (Collaboration and Authenticity in Open Technology Enriched Learning Contexts), the aim of which is to promote integration of new technologies in open, authentic and collaborative learning contexts. The practical implications of the project are mainly realised in the co-operating project Pedanet, the aim of which is to facilitate the use of information and communication technologies in the region of Central Finland.

Theoretical background

Research on collaborative learning

There is a substantial body of empirical evidence demonstrating the positive effects of social interaction for individual learning (e.g. Light et al. 1994; Teasley & Roschelle 1993). Collaboration has been analysed as a desire to construct shared meaning about the world through interaction with others, and to produce the joint commitment to shared goals as well as to shared diagnosing and monitoring of activities. Teasley and Roschelle (1993) have defined collaboration as involving engagement of participants in a co-ordinated effort to solve the problem together. The main benefits of collaborative learning are assumed to be of twofold. First, collaborative working helps students to discover, construct and become aware of their own thinking process. Second, this is due to sharing of critical thinking methods that can illustrate students the divergent ways that people can find solutions. For example, elaborating on other people's statements as well as explaining concepts and procedures to oneself and to others has a strong mediating effect on learning. Collaborative learning situations also seem to provide a natural setting for self-explanation and explaining to others as well as other forms of knowledge articulation which have shown to demonstrate positive effects for learning.

Collaborative cognitions are also assumed to promote the use of abstract representations among collaborators more efficiently than individual working on the same problem (e.g. Scwartz 1995). The natural explanation for this is that the collaborative task is putting demands for creating a common ground. This means that in a collaborative learning situations, the collaborators negotiate a common representation that serves as a touchstone for co-ordinating different perspectives on the same problem. Since the representation bridges multiple perspectives of the problem structure and situation, it tends to be in a more abstract level than the representations formed from a single viewpoint.

Social interactions do not always, however, seem to create effective learning processes but peer interactions may vary a lot, and only some learning environments produce ideal learning experiences. For example, collaborative learning situation might cause the splitting up the task among collaborators in a way that denies individual’s experience with all its component parts. Further, one important interaction skill that students often lack in collaborative learning situations, involves asking questions that evoke elaborated explanations (Katz 1995). Therefore, it is important to find out what tends to make some peer interaction successful but not others.

It has been suggested in the recent studies on learning and instruction that reciprocal understanding between collaborators is essential. This mutually shared knowledge means that different individuals possess common knowledge. Therefore, in order to be able to truly collaborate, individuals need to have a profound and mutual understanding of each others' perspectives and shared interpretations of the situation in hand. There are suggestions that negotiation of meaning enables the collaborators to establish a mutual frame of reference for enhancing reciprocity (Nystrand 1986).

Challenges for research on collaborative learning

On the basis of the recent research on collaborative learning, it seems evident that people learn information and patterns of reasoning from one another but for some kinds of shared knowledge, individually rooted processes play a central role. Human cognition is so sensitive to social and cultural context that we must seek after good and elaborated mechanisms by which people actively shape each other's knowledge and reasoning processes (Resnick et al. 1991). The analysis of these questions imply the merging of the social and cognitive, treating them as essential aspects of one another rather than as a background or context for a dominantly cognitive or social science.

Furthermore, another challenge for studying collaborative learning is of methodological nature. Earlier studies on collaborative learning tried to establish parameters or causal links for determining effective collaboration, whereas now the aim is more to understand the role that different parameters play in mediating learning and interaction (Dillenbourg et al. 1995).

Research on project work

From the viewpoint of learning, project-enhanced work has given promises for promoting higher-level learning. This kind of working is assumed to provide students opportunities for "cognitive apprenticeships" in authentic scientific inquiry, using computers for data-collection, analysis and communication (O'Neil & Gomez 1994; Pea 1993). Student teams work on projects with teacher guidance to develop and apply their understanding of concepts and skills e.g. through solving problems and writing. There are also some attempts to build network-based systems for participants, especially novices, by providing a supporting structure for project-enhanced science learning. Furthermore, these tools usually allow shared inquiry and communication with project members through shared workspaces.

Higher-level learning through project work does not, however, happen automatically but support is needed for successful project activities. Without a proper instructional support for the project learning, it can in the worst case create misconceptions and establish 'mis-habits' in constructing the project product. Teachers' support also interacts with the task demands determined by the structuredness/ openness of the task. Interestingly, previous studies have shown that in the case of novel and unstructured situations, teachers tend spontaneously to use instructional models such modelling, scaffolding and coaching which is, furthermore, assumed to lead to more higher-level and deep learning (Järvelä 1995; Renkl et al. 1997). Furthermore, it seems obvious that technologies can provide teachers a possibility to follow e.g. problem solving from phase to phase in order to assess in an adequate way how to scaffold successful learning processes.

Aims

This study aims to analyse different modes of group interaction during project work by describing how the participating classrooms do or do not support collaborative learning. Particularly in relation to the task structuredness and to students' prior knowledge, the supports and barriers for collaboration (including the computer networks, teacher's or mentor's role, classroom norms and expectations, etc.) will be examined.

Subproblems of the study include questions such as:

- How different prior knowledge is integrated in the group work?
- How are the collaboratively shared meanings integrated in individuals' knowledge base?
- How the collaborators can reach a mutual understanding of each other's perspective and context?
- How are individual experiences co-ordinated to create specific group cultures?

- What kind of division of responsibilities is beneficial for promoting individual learning?
- What makes certain kind of peer interaction successful compared to others?
- Are students consistently poor at giving explanations or do they explain some types of knowledge more than other types of knowledge, e.g. contextual knowledge as opposed to conceptual or strategic knowledge?
- How collaborating peers use the various information resources available for them in a learning environment?
- What kind of coaching and how is given by peers? By more experienced peers/ mentors?
- How to include the passive learner in the group processes?
- Should problem selection be assigned or self-initiated?
- What are the social processes that maintain the group activities?

Method

Research design

The influence of the task structudness is analysed using a comparison of different secondary school learning projects which have different degree of structuredness. These differences mainly arise from the goal-setting but also from their novelness for teachers. In the less structured and more novel projects, we assume that teachers have to get involved in spontaneous modelling, thinking and redefinition of the task. In the first phase of the study two different science learning projects are compared. In both of these projects, students' prior domain knowledge will be assessed before they are involved in the project work.

The goal of the first and less structured project ENSI (Environment and School Initiative) is to change ideas of environment protection suggested and gathered from different cultural contexts mainly from different European countries. Students are involved in the decision-making, problem-finding and in the monitoring of the environment. The project also tries to cross the boundaries of primary and secondary levels of comprehensive school as well as to involve parents in a shared and collaborative construction and mediation of local ideas.

The other task environment is related to a broader international science program called GLOBE (Global Learning and Observation to Benefit the Environment) that attempts to promote teaching project-based natural sciences. It aims to follow the scientific inquiry typical to natural sciences including the reliability judgement of experiments and observations as well as making conclusions and interpretations. Each Globe school has its own Globe area and a GPS localisation equipment with which the measurements, experiments and observations are made (rainfall, temperature, cloudiness, water measurements, vegetation definitions). The measurement information is sent to the international Globe database, and different schools around the world can use the information for various comparative studies related to chemistry (ph measurements), biology (effects of seasons on plants), geography (comparisons of climate between topographically low and high places around the world) and so on.

Technology environment

The study and the projects will be realised in networked environments connecting separate schools of distant areas, both locally, nationally and internationally. Particularly the advantages of ATM- (Asynchronous Transfer Mode) technology for the transfer of voice and visual images across long distances, will be utilised in the construction of collaborative learning environments. During the projects, there is a possibility to use technologies such as databases, services of Internet, groupware, conferencing systems, multimedia, simulations, project tools, CSCL tools etc.) to support collaborative working both in face-to-face situations during project work and in computer-mediated situations. Particular interest is on investigating the technology specifically designed to support higher-level learning through collaborative project-based school work (e.g. Pea 1993), especially groupware kind of CSCL tools. The aim of these kinds of tools is to move from the computer as a knowledge presentation device to one that supports a pedagogical focus on communications to support collaborative learning tasks.

Methodological approaches

Empirical data on interaction processes will be gathered by videotaping, on-line registration of log-files, stimulated recall, and theme interviews. Also computer-mediated communications between students and mentors will be automatically recorded. The particular interest is in developing on-line process analysis as well as the methods for modelling and assessment of interaction processes. For developing this branch, we have a separate subproject where methods of neurocomputing are investigated. The particular benefits of neural networks as powerful tools in reduction and visualisation of complex, time-dependent process data will be deployed (Häkkinen & Järvelä 1997).

Conclusions

To conclude, project work has often been argued to trigger critical thinking and higher-order learning. The main benefits of this kind of working and learning environment could be based on impact of the activities that students and teachers get engaged into, such as making explorations and investigations, finding solutions, explaining, argumenting, commenting each other's ideas, making synthesis, using multiple representations, communicating etc. And in collaborative working, stored community knowledge is assumed to help students to consider different perspectives and to organise their own knowledge. However, this does not happen automatically but as we all know, deep learning is hard and laborious process. Collaborative project learning is not always successful. This might be the case, e.g. when leaning too much on division of labour and splitting up the task among collaborators in a way that denies individual's wider experience with all its component parts. Therefore, we need also research on coaching of collaborating peers as they work on problems and critique other students' solutions at various working phases both in face-to-face and computer-mediated situations. Empirical data of the study will be gathered during the term 97-98, and the whole study will be completed by the end of year -99. We hope that this study will lead to better understanding on the nature and conditions of successful collaborative learning project. In addition, it attempts to provide practical tools for teachers to evaluate this kind of learning projects.

References

Dillenbourg, P., Baker, M., Blaye, A. & O'Malley, C. 1995. The evolution of research on collaborative learning. In H. Spada, & P. Reimann (eds.) Learning in Humans and Machines. Pergamon.

Häkkinen, P. & Järvelä, S. 1997. Developing a method for analysing complex on-line data: The dynamics between students' cognitive strategies and situational interpretations. A poster presented at the 7th European Conference for Research on Learning and Instruction, Athens, August 26-30, 1997.

Järvelä, S. 1995. The cognitive apprenticeship model in a technologically rich learning environment: interpreting the learning interaction. Learning and Instruction, 5(3), 237-259.

Katz, S. 1995. Identifying the Support Needed in Computer-Supported Collaborative Learning Systems. Paper presented at the CSCL'95 conference, Indiana University, Bloomington, October 17-20, 1995.

Lehrer, R. 1993. Authors of knowledge: Patterns of hypermedia design. In S.P. Lajoie & S.J. Derry (eds.) Computers as cognitive tools. Hillsdale, NJ: Lawrence Erlbaum Associates.

Light, P., Littleton, K., Messer, D. & Hoiner, R. 1994. Social and communicative processes in computer-based problem solving. European Journal of Psychology of Education, 9 (1) 93- 109.

Nystrand, M. 1986. The structure of written communication: Studies of reciprocity between writers and readers. London: Academic Press.

O'Neill, D.K. & Gomez, L. 1994. The Collaboratory Notebook: A distributed knowledge-building environment for project-enhanced learning. In T. Ottmann & I. Tomek (eds.) Educational Multimedia and Hypermedia, 1994: Proceedings of Ed-Media '94. Charlottesville, VA: AACE.

Pea, R.D. 1993. Learning scientific concepts through material and social activities: Conversational analysis meets conceptual change. Educational Psychologist, 28(3), 265-277.

Renkl, A., Gruber, H. & Mandl, H. 1997. Situated learning in instructional settings: From euphoria to feasibility. In J. Bliss, P. Light & R. Säljö (eds.) Learning Sites: Social and Technological Contexts for Learning. Pergamon.

Resnick, L.B., Levine, J.M. & Teasley, S.D. (eds.) 1991. Perspectives on socially shared cognition. Washington, DC: American Psychological Association.

Salomon, G. 1994. Differences in patterns: Studying computer enhanced learning environments. In S. Vosniadu, E. De Corte & H. Mandl (eds.) Technology-Based Learning Environments: Psychological and Edcuational Foundations. NATO ASI Series F: Computer and System Sciences, Vol. 137. Berlin: Springer.

Schwartz, D.L. 1995. The Emergence of Abstract Representations in Dyad Problem Solving. The Journal of the Learning Sciences, 4(3), 321-354.

Teasley, S.D. & Roschelle, J. 1993. Constructing a joint problem space: The computer as a tool for sharing knowledge. In S.P. Lajoie & S.J. Derry (eds.) Computers as cognitive tools. Hillsdale, NJ: Lawrence Erlbaum Associates.

Planning and assessment of construction processes in collaborative learning

Lenni Haapasalo
University of Jyväskylä
Department of Teacher Education

Contact address:
http://www.jyu.fi/~lenni/
lenni@tukki.jyu.fi

Abstract

Great part of empirical researches, reports, and articles concerning working processes in collaborative learning are mainly just reflections of technical organisation of the learning environments neglecting the importance of problem posing and substance matters. The article tries to point out these aspects by concerning learning processes of mathematics.

Keywords

Keywords: mathematics, knowledge, construction, collaborative learning

Introduction

Constructivist learning accentuates active mental processes of the learner involved in trying to describe "reality" and to test and change conceptions in social interaction with others. But how can we provide the learner (team) with opportunities for these kinds of constructions? It seems to be fashionable to plan very strongly context-oriented learning environments for giving pupils opportunities to obtain adequate mathematical information from everyday situations (Fig. 1). They can, for example, study a leaflet on nutrition and they have to plan a healthy breakfast (problem 1). It is patently obvious that in social interactions pupils can learn some percentages (procedures 1-2), perhaps some attributes for the concept "fraction" (concept 1) etc. The teacher can choose a new problem again and hope that the pupils can construct more mathematical knowledge. But how can the teacher be sure that the pupil learns concepts and structures, not only some context oriented routines?

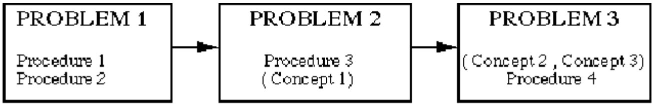


Figure 1. Context-oriented learning of mathematics

It is relevant to ask what kind of constructions pupils can make during these processes. One possibility is to interpret these kinds of learning environments within *radical constructivism* (Glasersfeld 1991) by accepting the possibility that there does not need to exist any objective reality for the pupil. Only relevant interpretation of the situation is made by the pupil. This, however, contradicts the goal that the any education has from the outset: Pupils are hoped to learn “advanced” mathematics that has some sociocultural power. But if this is the case, then we should speak about *weak constructivism*, because pupils’ mental models (concept attributes) should fit together reasonably precisely after the learning period (i.e in global sense of time).

Naturally it is reasonable to accept the possibility that pupils develop certain *social constructions* of their own to be used in communication. But it is difficult to identify the borderline between weak constructivism and radical constructivism.The situation is like a tennis tournament. The external global terms mean that we know when and where the final is going to be played. We can even make assumptions about tactics to be used by the players, if the final is, for example, played on grass. But we never know who are going to play in the final, and how the finalists are going to qualify. Thus, especially locally (in the sense of time), we have to accept very radical changes, tactics, even results. Using this metaphor, the basic philosophy of author’s MODEM-project could be described as a local constructivism that allows pupil to make very radical and individual, even naive and context-oriented mental models in local "right-now-situations" on the way towards more acceptable conceptions, i.e. culturally viable knowledge. Thus, in many cases the final constructions can be interpreted as results of global weak constructions. For solving this contradiction I would like to use a virtual concept local construction.

The idea of local constructivism

Without any possibility for a longer discussion here I would claim that learning situations should be based on more or less pragmatical philosophy. When thinking about the theory of *Peirce*, one of the most famous philosophist of science, we can understand any scientific knowledge as a 'viable knowledge' having born within scientific community through darwinistic processes (Fig. 2). Non viable ideas have been dropped out. The concept of "objective reality" is like an implicit dynamic force pushing the community into discussion and argumentation and leading its belief systems. Quoting Abimbola (1983) and Stenhause (1985) I would like to write: "Every new innovation is like a wild animal, breaking fences now and then .... just in order to come later back into the system as a new part". Theory of 'BigBang' in a nice example how the discussion is going on according to figure 2.

We could make the philosophy of figure 2 work also in any constructivist learning process. Just put 'pupil team' onto the place of 'scientific community' and we have the basic philosophy for an ideal collaborative interaction!

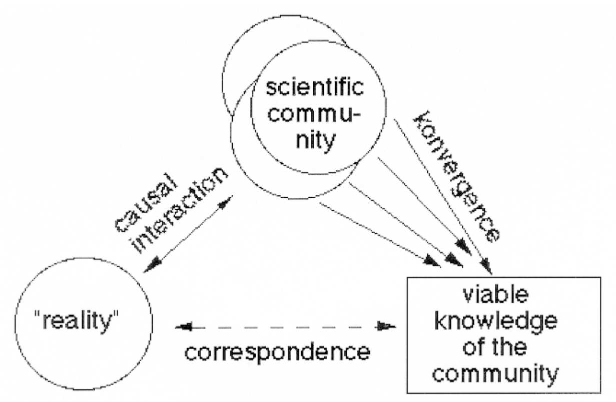


Figure 2. Scientific knowledge as a viable social construction

Let's assume that on the starting point an individ or a team accepts a task as a real problem (which strongly depends on problem posing!) and executes a construction process. Furthermore let's assume that the process is observed and evaluated by the teacher. At the first step the construction can be very *radical*, basicly anything that a team or a pupil thinks to be viable. Just after communicating with other teams and with teacher the viability can be tested by using more "objective" criteria. Usually teacher has possibility to decide how long time will be used for these interactive and successive testings and how to test the viability at the end.

Furthermore, let's assume that after a longer collaborative working period (i.e. after several successive local constructions) a team has constructed knowledge recarding it viable. This can be culturally radical only in the following two cases: The "objectivity" of the knowledge cannot be tested at all (like in case of paintings or poems), or the objectivity can be tested and the result differs from the culturally viable conception about the same situation (like finding a new method for making CD ROMs, as a 15 years old school boy did in Kuopio, Finland). In the most case, however, the knowledge goes with the culturally viable conception (like pupils´ notation 2/5 for "two fifts"). In this case the whole process is not radical but *weak*, and so we are dealing with *weak constructivism*. The most important fact is to notice that the concept constructivism is actually meaningful only in "right-now-situations". What happens during a longer period of time is less important in the learning psychological sense. The same fact was pointed out by Dewey, one of the most famous pragmatists and pedagogues, by the way. I hope the reader would notice how beautifully the philosophy of radical constructivism and weak constructivism can be combined via this virtual concept 'local constructivism'. If the reader agrees with me, he/she will notice that this concept is unnecessary: *An ideal construction situation is both radical and social!*

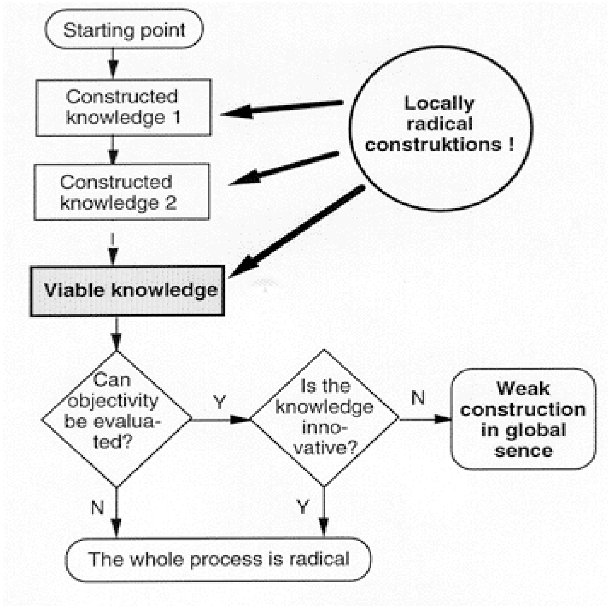


Figure 3. Connecting radical constructivism and weak constructivism through 'local constructivism'

The importance of problem posing and emotions

After have listened more than one hundred conference presentations about problem solving and after now have read more and more articles describing pupils' discussions in (collaborative) learning environments I feel sad. The role of problem posing and emotions has namely been neglected almost totally. If the reader doesn't mind, I will try to lighten this by using first a metaphor and then a simple, nice problem to be solved by the reader himself/herself.

Let's assume that we give a collaborative task for two different groups. They have to go to a city, and after 24 hours they have to write a description of the city. The first group comes from south, seeing at first look nice gardens, tennis courts, hotels, restaurants, theatres. The group spends a nice day and night having a lot of interaction. Of course the description will be positive, but what about the other group? It happens to come by train from north through an ugly suburb, seeing just mis-erableness. Immediately after getting out of train the members are battered badly and they have to spend 24 hours in hospital. What kind of interaction and writing process does an observer notices in this group?

In both cases one can study collaborative working habits and thinking processes and write a report. How-ever, the least what any researcher should do would be to mention these kind of relevant things on the preface! Using this metaphor any topic, any concept to be con-sidered in learning process can be seen as a big city. A poor problem posing by the teacher often means giving the learner just one way ticket from north. It is easy to imagine what kind of impact all this would have on research results.

Let me try to point out more the impact of problem posing, especially negative emotions. Because it is impossible - logically even naiv - to try to describe emo-tions of any other person, I would like to give the reader possibility to monitor his/her emotions by making the following nice tasks.

Task 1: Try to solve the problem below. Alone, without any co-operation and discussion! If You haven't found any solution after about 30 minutes, please stop and try to analyse your feelings and emotions. Then go on with the problem as You like. However, never ask anybody a ready solution. You will find it. It is not question about a trap!

Problem: Andy, Bill, David and Carl have to go over a very weak and dangerous bridge. At most two persons can be simultaneously on the bridge, and because of the darkness it is impossible to take a step without using light all the time. However, they have only one pocket lamp, and the batteries will be exhausted after exactly 12 minutes. How can they all go safely to the other end of the bridge, if each of them needs 5, 4, 2, and 1 minutes, respectively, for going over the bridge in one direction ?

Task 2: Formulate now the same problem by replacing the main question with the following question: "What do you think is the shortest time that the four fellows would need for going to the other end of the bridge?" Try to solve this new problem and monitor Your emotions.

Task 3: Give Your friends the problem by varying the problem posing like above. Analyse the emotions and solving process. Do you recognise any difference?

After making the above tasks the reader might notice that a *dialectic problem* posing is by far the best one because of the following important fact: Unlike *interpolation problems* and *analysis-synthesis problems*, the solver can consider any dialectic problem from subjective point of view (see e.g. Kretschmer 1983, Haapasalo

1994a, and Fig. 6). The problem posing is pleasant, motivating and does not generate negative emotions immediately or maybe at all. Because any problem can be formulated in dialectic form, any concept or topic can be approached "from south" (using the metaphor above). When thinking the philosophy of (radical) constructivism it is relevant to ask: "Do we have right to formulate problems in any other form at all?" Otherwise there is a strong conflict with the basic philosophy of science presented in figure 2. It is a pity that dialectic problems have been so badly underestimated not only in education but even in research of education.

Systematic construction of mathematical knowledge

In the author's *MODEM* project (Model Construction for Didactic and Empirical Problems of Mathematics Education) learning of mathematical concepts has been investigated within "systematic constructivism". This section of the article introduces a model for construction and assessment of mathematical knowledge from this point of view, where the acquisition of mathematics is seem to base on *conceptual knowledge*.The first element of the systematisation consists of separating mathematical knowledge into *concepts, theorems, and procedures*. We try to give the pupil a sufficient number of opportunities to construct concept attributes and procedural knowledge based on them. In order to complement this we have to be ready for a long process of concept building in which we separate the phases of *orientation, definition, identification, production and reinforcement*. This is the second element of systematisation (Fig. 4).

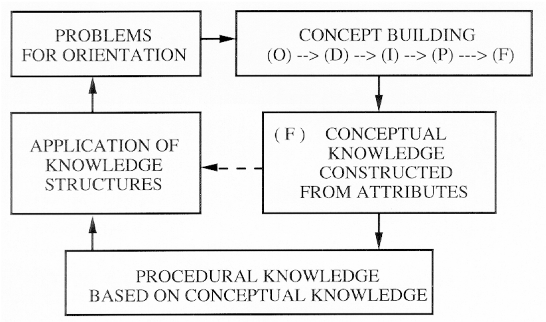


Figure 4. Systematic construction of mathematical structures

In order to give a short description of the philosophy of the systematic constructivism I will choose an interesting concept from school mathematics: Gradient of a straight line (Fig. 5)

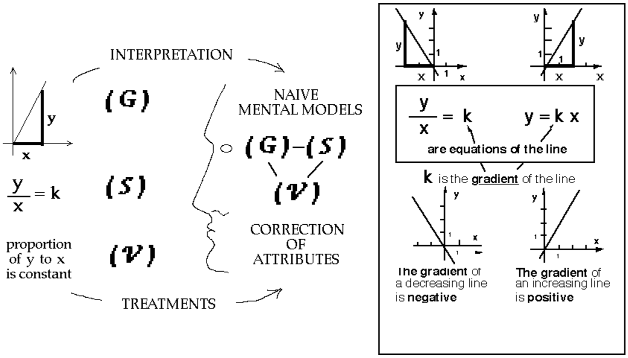


Figure 5. Construction of relevant attributes of the concept "gradient"

It is not easy to see that the above figure contains about 2 years school mathematics. This is the case because replacing the verbal representation V in figure 5 by V´: "y is proportional to x" or V´´: "y depends linearly on x" one notices that it is a question about a big *concept field:* ´Proportionality´ - ´Linear dependence. Construction of this conceptual knowledge means constructing of verbal, graphic and symbolic attributes of the same concept!

The process of systematic concept building will be presented by taking examples from author's WINDOWS-based learning program LINE (Haapasalo et al. 1994). In this each phase of concept building is programmed as an independent module and can also be used as a stand-alone program. The main menu (Fig. 6) allows one to choose any module or an alternative in which the program automatically takes care of all five modules. The order of the modules and tasks in each module can be changed for carrying out a study of the meaning of each subphase. For a more detailed description the reader can download the program from http://www.jyu.fi/~lenni/programs.html.

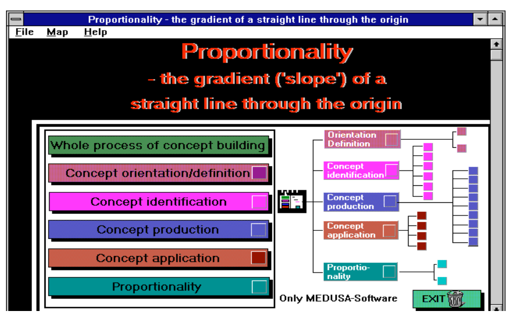


Figure 6. The main menu of the learning program LINE

Because in constructivism the pupil is considered to be a subject who is actively forming, processing and retaining information, it requires us to see acquiring knowledge as a dynamic process which is executed in a situation that is meaningful for the pupil. Contextual problems which the pupil can interpretate through his mental models can be used for *concept orientation*. Roofs of houses, for example, offer an interesting geometric viewpoint for understanding and constructing the idea of the slope of a straight line without using any mathematical symbolism, and dialectic problem posing provokes pupil to interpret the situation with his own mental models (Fig. 7).These are, especially at first, the only relevant interpretations of the situation for pupil, so that the local learning environment is based on the idea of radical constructivism.

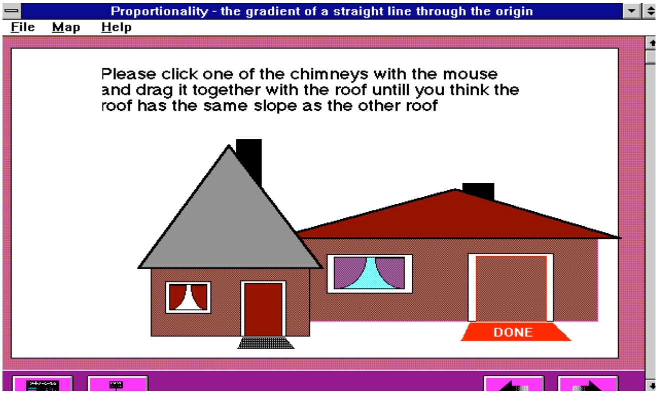


Figure 7. A dialectic problem for orientation to the concept ´gradient´

Finding a *definition* for the concept should mainly be *a process of social construction*, where pupils try to fix the relevant determiners of the concept (Fig. 5). In the phases of orientation and definition, creative thinking and productive working by the pupil is needed.

In the phase of *identification* we give for pupil possibilities to identify concept attributes in verbal (V), symbolic (S) and graphic (G) forms. For this we need six kind of identification tasks (I): IVV, IVG, IVS, IGG, IGS and ISS. During the learning process the teacher must be ready, if necessary, to begin with tasks that require distinguishing between only two elements (Fig. 8) before going to identification of several elements (Fig. 9).

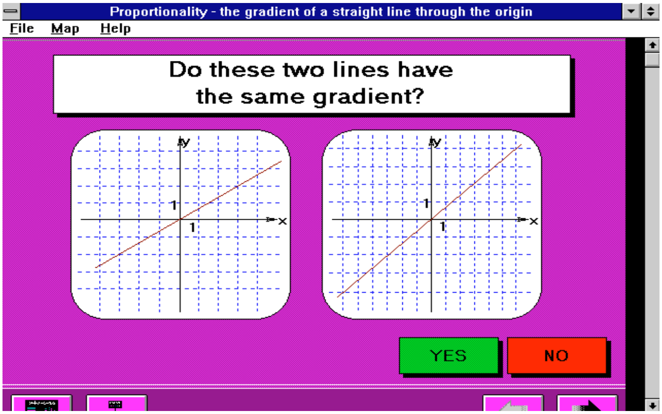


Figure 8. Simple identification task (IGG)

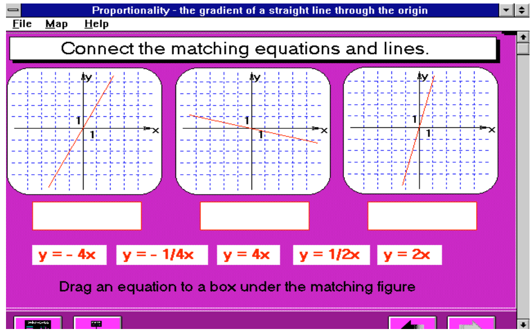


Figure 9. More complicated identification task (IGS)

In the phase of concept *production* we have to give pupils possibilities to produce from a given presentation of the concept another representation in a different form. The development of production (P) requires nine combinations: PVV, PGV, PSV, PVG, PGG, PSG, PVS, PGS and PSS (Fig. 10). The tasks of identification and production must be achievable without any complicated processing of information on the student's part.

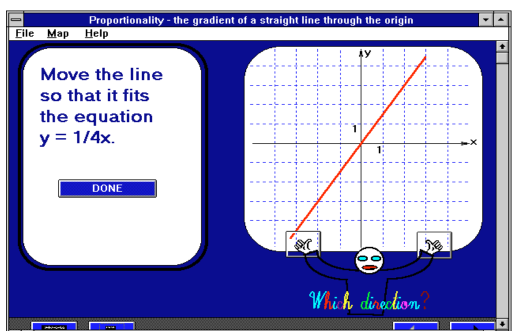


Figure 10. A production task PSG

In the phase of reinforcement the goal is to train concept attributes and to develop procedural knowledge to be used in problem solving and applications. When assessing the learning results, the same type of tasks are called either application tasks or mechanical tasks (Fig. 11).

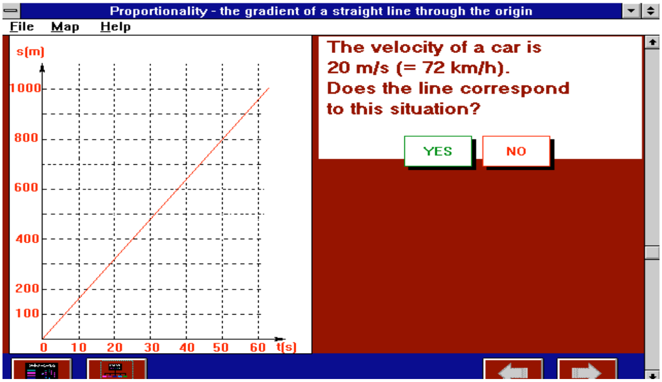


Figure 11. Starting page of a reinforcement task

Summary of most important results of the empirical researches

In the MODEM 1 the learning of the gradient of a straight line was studied by means of the learning program mentioned above (Haapasalo 1991). The pupils in 8th grade learned in two hours assisted by the computer alone. For subgroups a certain module was skipped.

In the MODEM 2-3 (Haapasalo 1992, 1993) the experimental group in the 4th grade learned fractions (resp. decimals in the 5th grade), and the comparison group was taught in conventional way.

The assessment was planned so as to measure all combinations of identification and of production, the role of different forms of representation, the importance of different phases of concept building, and the ability to use concept in simple applications.

The investigations confirmed that the process of concept building is for most of the pupils a long process in which the above subphases are systematically involved. They also form a good framework for assessment. The identification phase plays a central role in concept building, and seems to give the pupils the best and most pleasant learning environment for the forming of concept attributes. Skipping it, or even moving it into a wrong place after the production, caused a lot of difficulties in concept building. Pupils' cognitive results were significantly poorer and their opinions of the learning significantly more negative than those who learned with identification. However, skipping the production did not cause any statistically significant differences in the cognitive test, but had a positive effect in the pupils' opinions of the learning!

Concept understanding is measured most reliably by the production tasks, but unreliably as well by mechanical and application tasks. Production tasks are also difficult for the pupils . The tasks containing verbal representation are systematically difficult and have high reliabilities by measuring of concept understanding. A production within the same representation form is significantly more difficult than a production between different kinds of representation. The same did not hold for identification. Mechanical tasks had a poor correlation with each other and with other tasks. In MODEM 2 every application task had a corresponding mechanical task at the end of the test requiring the same arithmetic operation. Fig 12 shows that, in spite of the large number of mechanical tasks in textbooks, the performance of the comparison group on such tasks was poorer than the performance of the MODEM-group, which did not have any drilling at all. The learning within systematic constructivism not only lead to significantly better results, but the pupils (especially the boys) also like this kinds of learning environments. The teachers confirmed the fact that perseverance and consistency in pupils' work clearly improved also in other subjects.

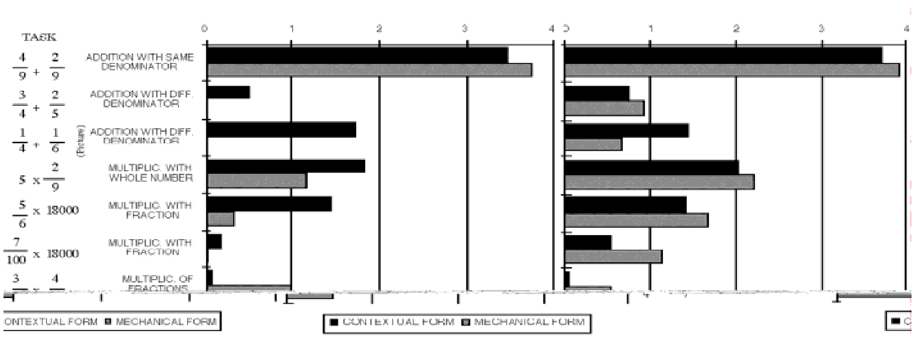


Figure 12. Pupils' performance in mechanical and corresponding application tasks with fractions. (left: comparison group, right: MODEM -group)

Using computer for integrated learning environments

A microcomputer, equipped with a measuring interface and supporting software, is a versatile tool in experimental concept building process (Redish & Risley 1990). It offers good opportunities not only for science teaching but also for the learning of mathematical concepts in an effective way. In the subproject MODEM 8 (see Haapasalo 1994b) the construction of the concept 'linear dependence' (i.e 'slope'!) was studied by gathering the data about the dependence of distance and time when an object was moving with a constant velocity through light gates. The data was gathered and handled by an IBM-compatible computer equipped with the Dutch UIA-interface board and IP-COACH software (Rahkonen 1994). In the workshop some examples were given how this kind of computer program can visualise a physical phenomena making the depence of the variables to develop step by step on the screen. It was noticed, that even pupils in the fourth grade could construct relevant attributes for the concept 'slope' without using any symbolic forms. However, although a computer is able to support these kinds of experimental approaches, a successful use of this versatile tool requires a careful formulation of problems as well as practical experiences of using new educational technology in teaching situation.

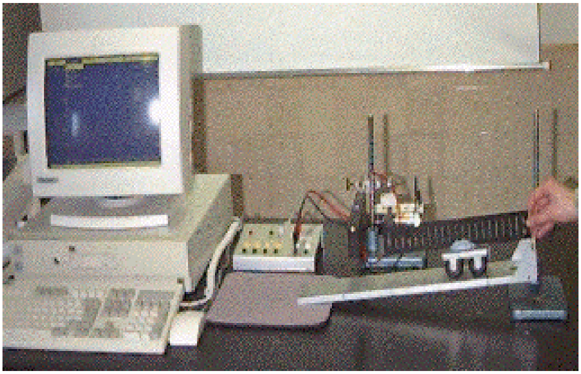


Figure 13. Computer based modelling of velocity as slope of a straight line

Computer based geometric ideas from the history of mathematics

This section introduces Stowasser's innovations to use multimedia for visualising big mathematical ideas which have been important in the evolutionary development of mathematics. The reader can get a more detailed description from http://matserver.math.jyu.fi/TUBerlin/home.html by downloading demodisks.

Not long ago, envelopes of curves, involutes, caustics, and parallels were standard topics for freshmen. The rich concept 'curve' served as an assembler of the isolated parts of school mathematics: Geometry, Algebra, Trigonometry, Analytical Geometry, Calculus. As a result of moves towards generalisation and rigour, especially in math education, the 'special curves' and most of the 'vital geometric spark which has ignited so many minds in the past', have been cancelled (Baumann 1979, Brieskorn et. al. 1981, 1986). At school, even hyperbolas and parabolas are not objects of geometric or kinematic interest. Their study has degenerated into treating them as graphs of functions. Analysis courses at school or university maintain such an unsatisfactory view with even non-obligatory courses such as Differential Geometry using 'special curves' for illustrative purposes only. As a result mathematics teachers are not aware of the educational potency of special curves as a fruitful field for exploration with geometric, kinematic, algebraic and other precalculus tools. Therefore little is thought of anyone who can only draw cardioids and some other beautiful curves using compasses and ruler. Certainly fascinating shapes showing the very essence of a curve are usually not brought out by paper and pencil work. Beauty does not show up either with rough sketches or by plotting points in a Cartesian co-ordinate system.

Today's computer technology allows efficient revitalising of geometric and analytic problem solving (model building) and makes a new kind of visual communication possible in contrast to the common verbal problem posing found in the textbooks (Bruce et. al. 1990). Computers have made available the extensive drawing tools which are necessary from an aesthetic appreciation of curves. And most importantly: the very dynamic nature becomes manifest when step by step geometric or kinematic generation of the curve takes place on the computer screen. Because of the availability of computer graphics and animations geometrical methods, particularly precalculus methods of the 17th century, neglected today, will gain new educational importance. The rich material on curves in Newton's Lucasian Lectures on Algebra, or the problems in the Calculus books of J. Bernoulli can in fact be exploited properly using kinematic representations (Stowasser 1976-1979, 1979a, 1994, Stowasser & Mohry 1978, Haapasalo & Stowasser 1993, 1994).

In contrast to ready-made sets of exercises the demodisks presents a rich field of activity to engage the curiosity of 'open-eyed minds'. It is an invitation to ask questions and to look around for answers making use of available sources such as 'Mathematica', 'Maple', Dictionaries,.... common sense and friends. Even first year university training should be started with new aims from some genuinely unifying points of view. Demodisks offer examples of the art of visual communication as a by-product of a European joint project *New Approaches* *to the Teaching of Engineering Mathematics* (1991-1994) which Stowasser has been engaged in:

'Curve': the Paradigm of Time Dependent Processes
- Algebraic curves from rotating straight lines (J. Steiner)
- Envelopes from coupled circular motions (J. Steiner)
- Orbits in central fields (Newton, ...)

Conics and the Astroid
- Conics as Lissajous curves
- Conics in the frame of Apollonius' famous contact problem
- Astroid and evolutes of conics

Cardioid and Cycloid - a Kinematic Approach
- Cardioid: seven different generations
- Circles of momentaneous rotation and of curvature
- (using Euler's theorem about moving rigid bodies)
- Cycloid: Roberval's and Huygens' ingenious ideas

Orbits of Difference Equations
- Trajectory of a cannon ball (Galilean Parabola)
- Circular motion around a sink (Archimedean Spiral)
- With constant angle by candlelight (Cartesian Spiral)

References

Abinbola, I. O. 1983. The Relevance of the “New” Philosophy of Science for the Science Curriculum. School Science and Mathematics 83 (3), 181-192.

Baumann, R. 1979. Das Lüneburger Projekt zur praxisnahen Entwicklung von Materialien zu problemorientiertem Analysisunterricht. In: R. Stowasser (ed.) Der Mathematikunterricht. Heft 2, Stuttgart: Klett.

Brieskorn, E. & Knörrer, H. 1981. Ebene algebraische Kurven. Boston: Birkhäuser.

Brieskorn, E. & Knörrer, H. 1986. Plane Algebraic Curves, Boston: Birkhäuser.

Bruce, J. W., Giblin, P. J. & Rippon, P. J. 1990. Microcomputers and Mathematics. Cambridge University Press.

von Glasersfeld, E. 1991. Radical constructivism in mathematics education. Mathematics Education Library, vol. 7. Dordrecht: Kluwer.

Haapasalo, L. 1991. Konstruktivismi matemaattisen käsitteenmuodostuksen ohjaamisessa ja analysoimisessa. Jyväskylän yliopisto: Kasvatustieteiden tutkimuslaitoksenjulkaisusarja A. Tutkimuksia 43. (Constructivism in the guidance and analysis of mathematical concept building. University of Jyväskylä. Institute for Educational Research. Publication series A. Research report 43). (http://www.jyu.fi/~lenni/modem1e.html)

Haapasalo, L. 1992. Murtolukukäsitteen konstruktivistinen oppiminen. Jyväskylän yliopisto: Kasvatustieteiden julkaisusarja A. Tutkimuksia 51. (Constructivist learning of fractions. University of

Jyväskylä. Institute for Educational Research. Publication series A. Research report. 51). (http://www.jyu.fi/~lenni/modem2e.html)

Haapasalo, L. 1992. Desimaalilukujen ja yksikönmuunnosten konstruktivistinen oppiminen. Kasvatustieteiden julkaisusarja A. Tutkimuksia 55. (Constructivist learning of decimals. Univ. of Jyväskylä. Institute for Educational Research. Publication series A. Research report. 55). (http://www.jyu.fi/~lenni/modem3e.html)

Haapasalo, L. 1993. Systematic Constructivism in Mathematical Concept Building. In: P. Kupari & L. Haapasalo (eds.) Constructivist and Curriculular Issues in the Finnish School Mathematics Education. Mathematics Education Research in Finland. Yearbook 1992-1993. University of Jyväskylä. Institute for Educational Research. Publication Series B, Theory and Practice 82. Jyväskylä: University of Jyväskylä & The Finnish Association of Mathematics and Science Education Research, 9-22.

Haapasalo, L. 1994a. Oppiminen, tieto & ongelmanratkaisu. Vaajakoski: MEDUSA-Software. (http://www.jyu.fi/~lenni/otoeng.html)

Haapasalo, L. 1994b. Matematiikan ja luonnontieteiden integroiduista oppimisympäristöistä. In: J. Enkenberg & K. Sormunen (eds.) Uudet menetelmät ja mahdollisuudet matemaattis-luonnontieteellisten aineiden oppimisessa. Joensuun yliopisto: Kasvatustieteiden tiedekunta. Aineenopettajan ja oppilaanohjaajan koulutuslinja. Koulutus ja ohjaus, 48-52.

Haapasalo L. & Stowasser R. J. K. 1993. Organizing Ideas from the History of

Mathematics Drawn from the History. In: P. Kupari & L. Haapasalo (eds.) Constructivist and Curriculular Issues in the Finnish School Mathematics Education (eds. P. Kupari & L. Haapasalo). Mathematics Education Research in Finland, Yearbook 1992-1993. University of Jyväskylä. Institute for Educational Research. Publication Series B, Theory and Practice 82. Jyväskylä: University of Jyväskylä & The Finnish Association of Mathematics and Science Education Research, 95-107.

Haapasalo, L. & Stowasser, R. J. K. 1994. Computeranimationen - Wiederbelebung der Geometrie. Mathematik Lehren, Heft 65. Seelze: Erhard Friedrich Verlag.

Haapasalo, L., Selkama, P. & Simola, H. 1995. Constructivist learning program for the concept field Linear dependence-Proportionality. Vaajakoski: MEDUSA-Software (http://www.jyu.fi/~lenni/programs.html).

Hiebert, J. (ed.).1986. Conceptual and procedural knowledge: the case of mathematics. Hillsdale, N. J.: Erlbaum.

Kretschmer, I. F. 1983. Problemlösendes Denken im Unterricht. Frankfurt a. M.:Peter Lang.

Rahkonen, V. 1994. Computer-Based Approach to the Study of a Capacitor. In: L. Haapasalo (ed.) Experimental and Curricular Issues in School Science Education. Science Education Research in Finland:

Yearbook 1992-1993. University of Jyväskylä. Department of Teacher Education. The Principles and Practice of Teaching 12, 47-52.

Redish, E. F. & Risley, J. S. (eds.) 1990. Proceedings of The Conference on Computers in Physics Instruction. Addison-Wesley.

Stenhouse, D. 1985. Active Philosophy in Education and Science. Boston, Ma.: Allen & Unwin.

Stowasser, R. J .K. 1976-1979. Materialien zum problemorientierten Unterricht. In: R. Stowasser (ed.) Der Mathematikunterricht Heft 3 (1976), Heft 1 (1977), Heft 6 (1978), Heft 2 (1979). Stuttgart: Klett.

Stowasser, R.J.K. 1979a. Zur Wechselbeziehung zwischen Problem und Theorie am Beispielfall der Analysis - Prospekt eines neuzugeschnittenen Analysisunterrichts. In: R. Stowasser (ed.) Der Mathematikunterricht. Heft 2. Stuttgart: Klett.

Stowasser, R. J. K. 1994. Unifying Ideas for the Mathematics Curriculum under Control of Aesthetics. In: Beiträge zum Mathematikunterricht. Bad Salzdetfurth: Franzbecker.

Stowasser, R. & Mohry, B. 1978. Rekursive Verfahren. Ein problemorientierter Eingangkurs. Hannover: Schroedel.

Peer collaboration in higher education - Peer consultation as a method for promoting students' self-regulation and small group learning

Hannu Soini, Sari Koivula, Leena Ropponen & Mari-anne Tensing
Department of Behavioural Sciences
University of Oulu

Abstract

The aim of the study is to introduce and discuss about the theoretical basis and practical solutions of methods based on consultation and students small group working. One of the main problems in the research of collaborative learning is to develop such kind of study methods which are not in contradiction with the main principles of its theoretical basis. This presupposes that working methods should support and emphasise collaborative, reflective and self-regulated nature of the learning process. It is easy to accept the importance of these factors but in practical teaching situations the teacher is frequently stopped in his or her tracks when the students will not set their own targets or they remain unaware of them. This is often seen as the student's problem, but the main point of this study is to point out the role of the working methods so that it changes its own ways of working to correspond to the demands which it sets for its students. From the point of view *of group behaviour a good teacher will above all help students to learn for themselves and to accept more responsibility for their own learning. Consultative method is part of a new learning culture, which has been developed on the department of Behavioural sciences at the university of Oulu.*

Keywords

Keywords: collaborative learning, higher education, peer consultation, group dynamics

Introduction

One of the main problems in the research of collaborative learning is to develop such kind of study methods which are not in contradiction to the main principles of its theoretical basis. Psychological research of collaborative learning has been understood also in co-operative settings as an individual process. Social structures or culture in general have been reduced as additional background variables which can be take into account as a part of primarily individual learning process. (Dillenbourg & al, 1996;Wertch, 1991.)

How should we study collaborative learning to make justice to the concept of collaboration? One problem is that we have different concepts to describe collaborative learning. The term co-operation has usually been defined as the division of labour among participants. It is an activity where each person is responsible for a portion of the task. Collaboration on the other hand can be understand as a process which involves the mutual engagement of students in a co-ordinated effort to solve the problem together. (Dillenbourg & al., 1996;Rochelle & Teasley, 1996)

The concept of collaborative learning is problematic also for the psychological theories of learning. Järvilehto (1994) criticizes the ontological basis of learning theories of separating organism and environment from each other. This basic distinction misleads also the learning research to understand learning as a special cognitive activity where knowledge is transmitted from environment to the head of the learner. According to Järvilehto man and his environment should be seen as a one system and learning as a continuing reorganisation of this system.

Theories of situated learning (Lave, 1991; Greeno,1989) question alike basic assumptions of mainstream cognitive learning research. Situated theories of learning has its main focus on the everyday interaction between people and its historically and culturally constituted nature. Learning should be seen as a process in which cooperation between learners becomes deeper and improvement in this interaction as an essential part of the learning situation. Learning is a process in which learner becomes gradually a more responsible participant of the ”community of practice”. Learning is not just a change in knowledgeable skills but change as a person, in identity (Lave, 1991).

Modern learning theory emphasizes the active participation of the individual in the learning event, self-regulation, the setting of one's own learning targets and the adoption of the role of subject in the process. It is easy to accept the importance of these factors but in practical teaching situations the teacher is frequently stopped in his or her tracks when the students will not set their own targets or they remain unaware of them. This is often seen as the student's problem, but the main point of this study is to point out the role of the teaching organisation so that it changes its own ways of working to correspond to the demands which it sets for its students. From the point of view of group behavior a good teacher will above all help students to learn for themselves and to accept more responsibility for their own learning.

A consultative method is part of a new learning culture, in which learning is seen as a complex social process and where students mutual cooperation i utilised during the learning process. Earlier research has shown that the most beneficial small group interactions are those in which students are giving or receiving help from each others (Peterson & Janicki, 1979 Webb, 1982). Our earlier research (Soini & Kronqvist, 1994) showed that university students evaluate their studying also in collaborative settings from the individual point of view. On the other hand students have difficulties in understanding the influence of organisational factors or group dynamics to their mutual co-operation.

Consultative method is based on contextuality, reflectivity and dialogue between small groups of students. Contextuality means that students are encouraged to study the actual ”everyday” problems they have in their small group studying. It is also assumed that the dialogue about study problems with other peers helps students to see their own behaviour in learning situations from different perspectives. Feedback from peers is believed to help students to take more responsibility of their own working. One of the main purposes in peer consultation is to create a situation where learning problems can be examined in a safe and confidential atmosphere. It aims to minimise competition between students and to help students to discuss about theoretical and practical problems of psychological research.. Finally the focus is on examining students activities in a broader perspective, paying attention also to the hidden factors in individuals and organisations that prevent learning (Kumpula, 1994; Soini & Kronqvist, 1994).

The aim of this study is to examine peer consultation from the point of view of students' self-regulation and collaboration and to study typical problems students address in small group working in higher education. The goal of the peer consultation method is also to promote students small group studying and help them to finish their research project in psychology. The importance of students involvement and participation in the everyday practice of their university studying is especially stressed.

Methods

Subjects

In this study 46 students were involved in small group work (12 groups) during their studies of psychology. Each group had a research project that lasted one academic year, 96/97.

Procedure

Before the consultation started students worked in small groups about one month and planned research project of psychology from a topic of their own chosen. In a consultation session three small groups worked together (Figure 1.). Each small group has a special task during one session. The sessions were organised and conducted by supervisor (teacher).

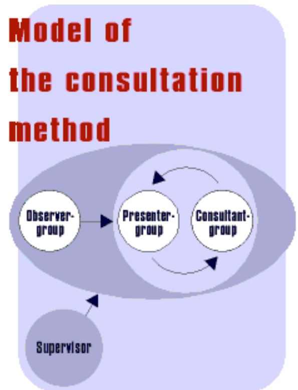
During the consultation session students' small groups worked in the following roles: as a presenter-group, as a consultant-group and as an observer-group.

In the *presenter-group* students task was to describe any kind of problems and difficulties which they entered in small group when working with research themes and issues. They were also encouraged to describe problems in organising their mutual co-operation in small groups.

The aim of the *consultant-group* was to help the presenter-group to identify their way of action and help them to analyse and examine further their problems. The role of the consultant-group was not to give direct advises or solutions but to help presenter-group to see their problems from different point of view.

The task of the *observer-group* was to evaluate and give feedback of the co-operation between the presenter-group and the consultant-group.

The task of the supervisor was to make the students to stay in the given role during the consultation process an help students to continue on difficult situations.



Data collection

Data was gathered during the consultation process in the following ways:

Questionnaire 1.

At the beginning of consultation students were asked to answer to open-ended question: Describe as concrete as possible the current problems of your small group studying and difficulties in research work.

Consultation diary

Students of the presenter-group were asked to keep diary about themes and topics of their consultation. Presenter-group were asked to describe dialogue between consultation-group and especially how topics of discussions were changed during consultation.

Questionnaire 2.

At the end of consultation students were asked to evaluate the consultation process by answering open ended questions concerning the whole consultation process.

Results

Results of this paper are preliminary and they are based on the content analysis of data from questionnaire 1 and the students diaries. Themes of discussions in consultation settings and students descriptions (questionnaire 1) showed that typical problems in small group studying could be divided in two main categories. The first category consisted of the problems of organising the small group studying and mutual co-operation between students. The second category was included problems considering the theoretical and methodological questions of psychological research.

1. Problems of Students co-operation in small groups

1.1. Difficulties in organising and directing small group work

Compared to their studying before, students had a lot of freedom to decide about their own studying. Students felt they had a lot of difficulties in planning own study process.

“in our group our relations got strained now and then and the group was seeking for its shape”

1.2. Lack of time

The new way of studying took more time than their were used to and they felt that they did not have enough time for this kind of working. Students felt that the lack of time and the small group work was not a very good combination

1.3. Different opinions about the goal of the study

Different people with different interests produced difficulties to make a schedule within the group.

” group dynamics was a crucial question in our consultation process. All four of us had their own opinions about everything and that predicted problems in the future...”

” we need more negotiation skills in our group”

2. Problems concerning the content of the study area

2.1. Difficulties in choosing and restricting the research area.

In the beginning of the term students task was to choose a research theme they were interested in. They found out that the research area they had chosen appeared to be larger than expected and on the other hand they felt that the concentration on a narrow field of study was not satisfying.

” we should discuss together about a smaller research area which would come close to everybody’s interest, then we should read more literature”

2.2. Difficulties to choose the theoretical frame of reference

Also, because of their short experience they had difficulties to choose the theoretical frame of reference and a relevant methodical approach.

”we were unsure about the difference between quantitative and qualitative research and also what means reliability.”

2.3. Difficulties in understanding theoretical concepts of Psychology

This problem in connected with the problem of handling theoretical and methodical aspects of research area. Because of the complicated scientifical text they had difficulties in reading and understanding psychological literature.

” We had difficulties to find literature in Finnish, this is too difficult in English.”

Finally, they found out that there are large variation and contradiction of psychological concepts in different paradigms.

3. How problems changed during consultation

The results concerning the change of students ideas of problematic issues in small group working are preliminary and the final results will be presented later after the closer analysis of questionnaire two. According to the diaries students consultation sessions helped them to understand better the problems of their mutual cooperation. Typically students felt it as a great relief to found out that their peers have same kind of problems in small group studying as they have. Discussions with peers directed them to see their commitment to the collaboration more realistic. Students admitted their commitment to the studying was not always very high and they acknowledged self-regulative learning as rather demanding working method.

Conclusions

The results showed that peer consultation is a promising method when we try to increase students self-regulation and commitment to their studies in higher education. Self-regulated studying in small groups also showed to be a rather demanding for students. Even students were highly motivated to study topics of their own chosen they need and are able to get a lot of support and help from each others. At the beginning students waited for help unilaterally from teachers and did not trust so much to their peers. Gradually the situation changed and peer consultation helped them to understand typical learning strategies they used in small group studying and problems in students mutual co-operation. Some students felt that peer consultation had opened their eyes to see their own role in shirking their responsibilities

Working in different roles was seen to be fruitful. It offered a possibility for perceptive taking and to see problematic issues and learning process from different point of views. Surprisingly the most useful role in that sense was participation in an observer-group. Peer consultation seemed to be rather demanding method for some students. Obviously a confidential group climate for honest dialogue develops slowly.

References

Dillenbourg. P., Baker, M., Blaye, A., and O'Malley, C. (1996) The Evolution on Collaborative Learning. In Reiman, P., and Spada, H. (eds.) Learning in humans and machines. Towards an Interdisciplinary Learning Science.Oxford: Elsevier Science.

Järvilehto, T. (1994) Learning as formation of man-environment system. In Proc. Int. Workshop on CLCE, ed. by Levonen, J. and Tukiainen, M., p. 7-8.

Kumpula, H. (1994). Joku vastaa kaikesta ?- Yliopiston tiedostamattomien rakenteiden jäljillä. Oulun yliopiston opintotoimiston julkaisuja.

Lave, J.(1991). Situating learning in communities of practice. In Resnick,L.B., Levine,J.M. and Teasley, S.D (eds.) Perspectives on socially shared cognition.63-84. American Psychological Association, Washington.

Moust, J, Scmidt, H.,Volder, M., Belien, J. and Grave, W.S.(1987) Effects of verbal participation in small group discussion. In Richardson, J, Eysenck. M.W. (eds.) Student learning. Research in education and cognitive psychology.SHRE,Open Univeristy Press, Stradford.

Peterson,P., Janicki,T.C. (1979) Individual Characteristics and children's learning in large -group and small group approaches. Journal of Educational Psychology 77, 219 - 312

Rochelle,J.,Teasley,S. (1996) The construction of shared knowledge in collaborative problem solving. In O' Malley, C.O (Ed.), Computer - supported collaborative learning. Heidelberg: Springer-Verlag.

Soini, H.,. Kronqvist, E-L. (1994). The significance of group dynamics in peer tutoring in higher education. In Foot, H., Howe C.J., Anderson,A., Tolmie,A.K., & Warden, D.A.(Eds.) Group and Interactive learning. Computational Mechanics Publication, Southampton, pp. 470-482.

Webb, N.M. (1982) Group composition, group interaction and achievement in cooperative small groups. Journal of Educational Psychology 74, 475 - 484.

Wertch, (1991) A Sociocultural Approach to Socially Shared Cognition. In Resnick,L.B., Levine,J.M. and Teasley, S.D (eds.) Perspectives on socially shared cognition. American Psychological Association, Washington.

Dynamics in Self-Regulated Learning Implications for studying person x situation -transactions

Markku Niemivirta
University of Helsinki

Abstract

This presentation examines the dynamics and contextuality of individual self-regulation in learning. The study suggests that the interaction of a classroom environment and students motivational tendencies affect the way students act in an actual learning situation, and therefore also the quality and form of — either individual and/or collaborative — knowledge construction and learning. The beliefs students hold about themselves and their learning environment provide guidance for the course of actions they prepare to carry out in certain situations. It is therefore important to realize that individual self-regulation always stems from personal responses to environmental and situational demands. Self-regulatory actions are not be understood only as some effective forms of engagement, but as various forms of socially and cognitively adaptive activity. Theoretical and practical implications for designing new learning environments are discussed.

Keywords

Keywords: Self-regulation in learning, situational motivation, learning modes

There has been some major changes in the aims and goals of education during the last years. Instead of focusing on increasing mear fact knowledge, the emphasis is now on developing higher level thinking skills and a capability to learn and adapt to changing demands (Scardamalia & Bereiter , 1997). This shift in emphasis has its' roots in changing conceptions and understanding of learning. From a historical perspective (see Mayer, 1997), these changes can be summarized as in the following illustration (Table 1).

Table 1. *Metaphors of Learning (adapted from Mayer, 1996)*

Learning	**Major era**	**Research base**	**Teacher's role**	**Student's role**	**Typical instructional method**
Response strengthen-ing	1900s-1950s	Lab animals on artificial tasks	Dispenser of rewards and punishments	Recipient of rewards and punish-ments	Drill and prac-tice on basic skills
Information processing	1960s-1970s	Humans on artificial tasks	Dispenser of information	Recipient of information	Textbooks and lecturing
Knowledge constructing	1980s-1990s	Humans on realistic tasks	Guide for exploring academic tasks	Sense maker	Discussion, guided discov-ery, supervised participation in academic tasks

Accordingly, recent conceptualizations have empha-sized the active and constructive nature of learning. This view rests on few basic principles advocated by cognitively oriented constructivism (von Glasersfeld, 1989; Savery & Duffy, 1995):

1. Understanding is in our interaction with the environment.

We can not talk what is learned separately from how it is learned, as if a variety of experiences all lead to the same understanding. Rather, what we understand is a function of content, the context, the activity of the learner, and most importantly, the goals of the learner.

2. Nature of what is Cognitive conflict is the stimulus for learning and determines the organization and learned.

When we are in a learning environment, there is some stimulus or goal for learning activities - the learner has a purpose for being there. That goal is not only the stimulus for learning, but it is a primary factor in determining what the learner attends to, what prior experience the learner brings to bear in constructing an understanding, and basically, what understanding is eventually constructed.

The practical argument following these principles is often something like “students all have different knowledge, different skills and abilities, and different experiences. Although a teacher is nominally in charge of the students' progress, a more constructivist approach encourages the students themselves to take control of their own.“ This kind of vision views students as strategic (i.e., they actively develop repertoires of thinking and learning strategies) and responsible for their own learning. In other words, students are considered to be (or to become) self-regulated learners. But what actually is self-regulated learning?

Early approaches to SRL were very person-centered and focused mainly on the cognitive tuning of learning processes. For example, Corno and Mandinach (1983) defined SRL as “an effort put forth by students to deepen and manipulate the associative network in content area, and to monitor and improve that deepening process” (p.95). And even though more recent approaches have increasingly emphasized the motivational nature of SRL, the focus have still been on an individual student. These conceptualizations have consistently treated self-regulation of learning as something of a “deliberate, judgmental, and adaptive aptitude of expert proportion” (Winne, 1995; p. 173). Only recently have some researchers pointed out the potentially limited account of this approach (e.g., Boekaerts, 1996; Garcia, 1995). It has been argued that defining regulation in SRL as individual’s effective regulation of cognitive and metacognitive resources does not fully describe the complexity and versatility of regulatory activities students employ in natural learning situations. The rationale for this argument is based on the fact that students do not direct their activities only towards learning goals, but towards other personal goals as well (Ames, 1992; Boekaerts, 1993; Nicholls et al, 1989). Furthermore, goals do not always need not to be oriented around *attaining* something, they can also be oriented around *avoiding* something...An example: Consider a student whose learning history is based on frequent failure experiences in various achievement situations. S/he may have “learned” not to possess any control over actions and subsequent learning outcomes, and therefore, in order to avoid situations in which failing could be attributed to lack of abilities, s/he might employ a variety of strategies or other ways (e.g., not trying at all) to protect her sense of self-worth (cf. Covington, 1992). This kind of activity in learning situations is by all means self-regulatory — it is just the *criteria* for its' effectiveness that varies. Thus, besides cognitive regulation, SRL also includes various forms of motivational and emotional regulation, and social adaptation.This notion brings us closer to the issue of differentiating individual and contextual or situational factors related to students' engagement in self-regulatory learning activities.

I will use the concept of *learning mode* to illustrate students' situationally induced self-regulatory activities (see Niemivirta, 1996). A learning mode refers to an organic whole embodying personal belief structures, situational interpretations, motivational orientations, and strategy use...in a situation. This conceptualizing stresses the idea of cognitive-affective personality system in which individuals are characterized in terms of "(a) the cognitions and affects that are available and accessible, and (b) the distinctive organization of the interrelations among them and psychological features of situations" (Mischel & Shoda, 1995, p. 254). Thus, the term "mode" is used to indicate both the dynamic aspect of self-regulatory learning activity and its situational fluctuations, and the stability of situation-behavior variability. A schematic, highly simplified description of self-regulatory activity in a learning situation is seen in Figure 1. It illustrates different factors and types of mediating processes that produce certain motivational-cognitive patterns and behavioral outcomes. From this point of view, different learning modes could be understood as distinctive forms of activity that students initiate in specific situations. It is assumed that the activation of specific cognitions, affects, and behaviors are guided and constrained by the organization of available cognitive-affective units — i.e., network of knowledge structures that represent individual preconceptions, beliefs, and dispositional tendencies (Higgins, 1990; Mischel & Shoda, 1995).

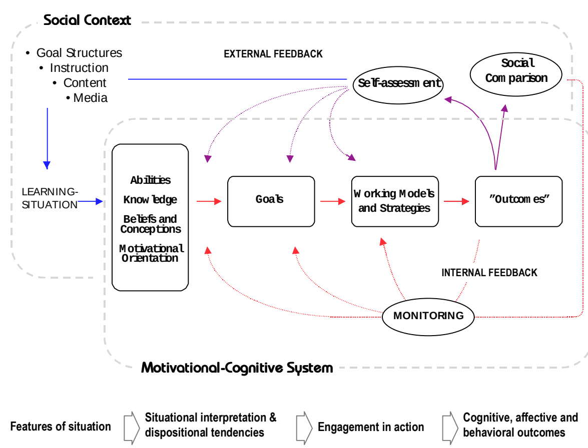


Figure 1. A simplified process-model of self-regulated learning (modified after Butler & Winne, 1995).

Based on prior research it is possible to construe various hypotethical motivational-cognitive patterns of SRL that partially represents individual tendencies to engage in various forms of action (see Table 2).

- An *intentional learning mode*, for example, is characterized by an intrinsically motivated and task-oriented learning activity that has its goals in personal knowledge construction. A student employing this mode is likely to have high self-confidence, seeks challenge, and attributes progress in learning to effort (Pintrich & DeGroot, 1990; Zimmerman & Martinez-Pons, 1990). Obstacles or difficulties associated with the task (or situation) are interpreted as positive challenges, and the subsequent progress in the pursuit of reducing task-related uncertainty forms the basis for self-appraisals (Lehtinen et al., 1995; Strube, 1990).
- An *adaptive learning mode*, in contrast, can be understood as two separate forms of activity depending on the adaptive function of the activity itself. It can be described as *self-enhancing*, when the basic motive for self-regulation is to promote personal well-being by trying to demonstrate competence, and *self-protective*, when the motive is to protect the self against esteem-threatening situations (Baumeister et al., 1989). This differentiation stems mainly from the work on self-presentational strategies (for a review, see Banaji & Prentice, 1994) and is based on individual differences in self-esteem; the self-protective form of adaptive self-regulatory activity is grounded on avoiding potential negative outcomes. It arouses processes that interfere with optimal and constructive task engagement. Sensitivity to failure-relevant information and preoccupation with ability rather than task

concerns lead easily to helpless patterns of behavior (Dweck & Leggett , 1988).

Table 2. *Learning Modes and The Patterning of Personal Dispositions (from Niemivirta, 1997)*

	LEARNING MODES		
Qualities of activity	**Intentional**	**Self-enhancing**	**Self-protective**
Form	Approach	Approach	Avoidance
Focus	Task	Ability	Ability
Agency	Internal, dynamic	Internal, static	External
Purpose	To increase competence	To demonstrate competence	To avoid signs of incompetence
Self-evaluation	Internal, own progress	External, social comparison	External, social comparison
Personal dispositions			
Self-esteem	High	Mid	Low
Means-ends beliefs	Effort	Abilities	External
Control beliefs	High	Mid	Low
Goal orientation	Learning	Performance	Avoidance
Strategy use	Deep processing	Surface processing	Surface processing

These forms of activity are therefore assumed to be a function of both personal or individual attributes and the psychological setting. When facing a task or any other learning situation, students try to construe what the task is. This occurs both through data- and theory-driven processes, and through context-driven processes (see Higgins, 1990). That is, student's representation of a situation is based on both the situational cues perceived and the pre-existing knowledge structures guiding the interpretation. Furthermore, based on this situational interpretation, students also create representations of both possible means (i.e., tactics, strategies, or other operations) they have available for approaching the situation, and their accessibility to these means (cf. Winne, 1996).

So, if we accept the assumption, that students -- based on their prior experiences -- perceive learning situations in different ways, we can also assume that the structure of that environment have a different impact on different students. Some studies have demonstrated, that classrooms' goal structures already guide students approaches to studying and learning. A competitive classroom, for example, induces performance and outcome focused engagement, whereas a collaborative classroom supports more task-focused engagement (Ames, 1984). Furthermore, there is also evidence (Graham & Golan, 1991) that shows how situationally induced goals have an effect on the quality of students performance and even on the level of their information processing: students in an ego-involving (i.e., outcome focused) setting showed more surface level processing than students in a task-involving setting. However, these studies have not considered the effects of the situation or the environment on different students. And by "different", I refer to students with different kinds of motivational orientations and personal beliefs about learning or themselves.

In our own recent study we tried to examine how these motivational factors were related to students' preferences for various learning activities and environments. I'll give a brief description of the procedure and materials utilized (so far) in the study:

1. First, students responded to a self-report questionnaire, which tapped various motivational constructs (for example; goal orientation, control beliefs, self-perceptions, preferred strategy use, etc.; see Niemivirta, 1996). Following this students were categorized on the basis of their goal patterns. That is, on the basis of their relative value profiles on goal orientations (cf. Niemivirta, 1997). The "validity" ...so to say... of this solution was examined by examining the profiles of "external" variables in either groups. As can be seen in Figure 2, these results seemed fairly consistent and meaningful.

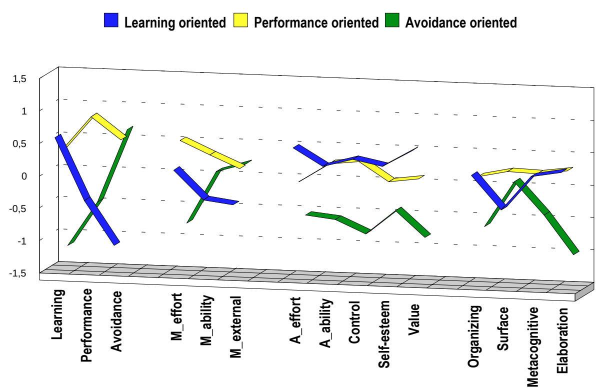


Figure 2. Students' motivational-cognitive profiles.

2. Next, students preferences for and perceptions of their learning activities and environment were examined. Again, students responded to questionnaire, which tapped items related to various dimensions (Niemivirta & Järvelä, 1997). If these results are now examined according to the typology of students with differing motivational orientation, we can see that also their preferences for certain kinds of learning activities differ (see Figure 3). For example, learning oriented students preferred more open communications and collaborative activities than avoidance oriented students, who, in contrast, significantly more preferred teacher-directed activities. (A similar patterning of results was also obtained from a variable-oriented -- i.e., correlative -- approach.)

3. Furthermore, we also wanted to examine how this framework could be integrated (or compared, or validated) with a more dynamic and process-oriented approach. We therefore have collected on-line data concerning both actual activities in the classroom and students own interpretations of various learning settings (Järvelä, Hakkarainen, Lipponen, Niemivirta & Lehtinen, 1997). Unfortunately, for the purpose of this presentation, I only have some limited data available. These descriptive results presented here are only to exemplify some of our aims and efforts in the ongoing study.

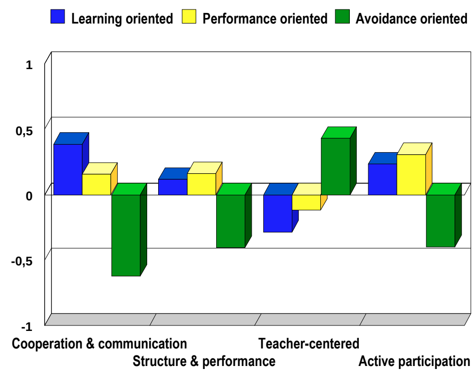


Figure 3. Students' preferences for different learning activities

4. A coding scheme for describing and analyzing students activities in the classroom was created. The contentual structure was based on our theoretical framework concerning students' motivational orientations, situational interpretations, and cognitive activities. Basically, it consisted of various categories within fours different domains: (1) students' goals and general orientation; (2) the quality and strategies of learning activities; (3) self-related motives and functions; and (4) social interaction and relations to peers and teachers. These domains were furthermore related to three different motivational orientations; learning, performance, and avoidance orientation, respectively. Additionally,

students were also interviewed using a stimulated-recall interview technique (see Järvelä, 1995), and their own interpretations of different learning situations and their own behavior in them were examined. Although these analyses are not yet fully conducted, some preliminary results concerning the analysis of students' classroom behavior will be illustrated next.

5. An independent observer examined the video tapes and coded students activities according to the structure described earlier. Here, only descriptive examples of three different students who previously were categorized as either learning, performance, or avoidance oriented students are presented. As can be seen in Figures 4, 5, and 6, the activity profiles of these students (during one class) match the typology fairly well. (However, due to the fact that most details are excluded from these illustrative profiles, the richness of student descriptions is not fully captured.)

What then can we conclude on the basis of these results? First of all:

- It is fairly reasonable to argue, that students have different kinds of -- more or less general -- approaches or tendencies towards learning;
- They also prefer different forms of learning activities -- ranging from collaborative vs. individual, active vs. passive, teacher vs. self-directed activity structures;
- And thirdly, and most importantly, these two differential dimensions are clearly related to each other.

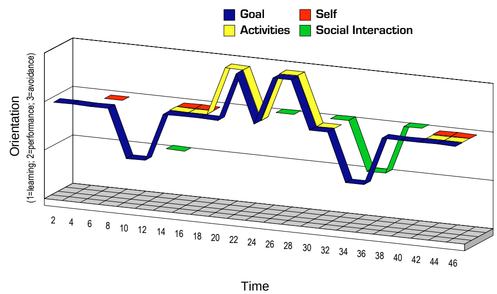


Figure 4. An activity profile for a learning oriented student.

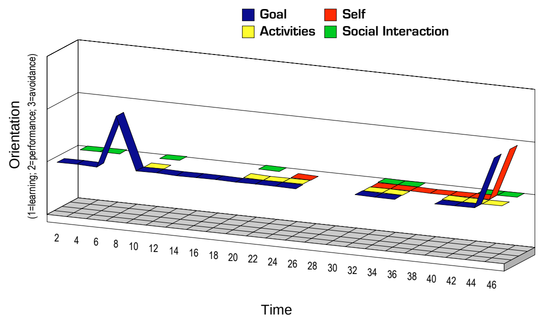


Figure 5. An activity profile for a performance oriented student.

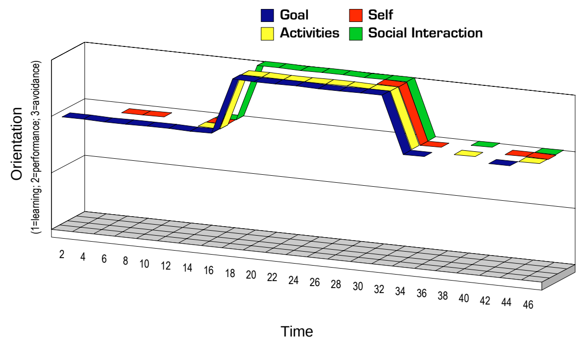


Figure 6. An activity profile for an avoidance oriented student.

These results also support the view, that the interaction of a classroom environment and students motivational tendencies affect the way students act in an actual learning situation, and therefore also the quality and form of -- either individual and/or collaborative -- knowledge construction and learning. To realize the "epistemological" consequences of these conclusions, and to further examine the practical implications of this view, another "constructivist" principle must be added to our understanding: If engaged learning is to be viewed as an activity of meaning-making (Bruner, 1990), and if meaning itself is to be rooted in individual experience, the context of that experience will as well be a part of the meaning. Even simple cognitive processes may have entirely different meanings and consequences depending on students' intentions, the social setting in which the process takes place, or the cultural affordances available to the individual at the time (cf. Salomon, 1991).

Accordingly, we can state that:

Knowledge evolves through social negotiation and through the evaluation of the viability of individual understanding. The social environment is critical to the development of our individual understanding as well as to the development of the body of propositions we can call knowledge (Savery & Duffy, 1995).

What then does this perspective on students self-regulatory learning activities and their individual and contextual determinants add to our understanding concerning the design and evaluation of powerful learning environments? One general conclusion should at least be drawn: Students predispositions to various forms of self-regulatory activity have solid grounds in the interdependent nature of individual (e.g., motivational orientations) and situational (activity setting in a classroom) factors. That is, the beliefs students hold provide a guidance for the course of actions they prepare to carry out in certain situations. It is therefore important to realize that individual self-regulation always stems from personal responses to environmental and situational demands. Self-regulatory actions are not be understood only as some effective forms of engagement, but as various forms of socially and cognitively adaptive activity (cf. Niemivirta, 1997). Thus, when designing new environments, two issues concerning individual differences need to be taken into account: (1) students approach learning situations in different ways, and (2) they also prefer different kinds of activities in those situations.

Acknowledgements:

I would like to express my gratitude to Sanna Järvelä for her valuable cooperation concerning the empirical part of this study.

References

Ames, C. (1992). Classrooms: Goals, Structures, and Student Motivation. *Journal of Educational Psychology*, 84, 261-271.

Ames, C. (1984). Competetive, cooperative, and individualistic goal structures: A motivational analysis. In R. Ames & C. Ames (eds) *Research on Motivation and Education, Vol I. Student Motivation*. Academic Press, Inc.

Banaji, M. R. & Prentice, D. A. (1994). The Self in Social Contexts. *Annual Review of Psychology*, 45, 297-332.

Baumeister, R. F., Tice, D. M., & Hutton, D. G. (1989). Self-presentational motivation and personality differences in self-esteem. *Journal of Personality*, 57, 547-579.

Boekaerts, M. (1996). Self-regulated learning at the junction of cognition and motivation. *European Psychologist*, 1, 100-112.

Boekaerts, M. (1993). Being Concerned With Well-Being and With Learning. *Educational Psychologist*, 28, 149-167.

Corno, L. & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist*, 18, 88-108.

Covington, M. V. (1992). *Making the grade. A self-worth perspective on motivation and school reform*. Cambridge University Press.

Dweck, C. S. & Leggett, E. L. (1988). A Social-Cognitive Approach to Motivation and Personality. *Psychological Review*, 95, 256-273.

Garcia, T. (1995). The role of motivational strategies in self-regulated learning. Teoksessa P. R. Pintrich (eds.) *Understanding self-regulated learning*. San Francisco: Jossey-Bass Publishers.

Graham, S. & Golan, S. (1991). Motivational influences on cognition: Task involvement, ego involvement and depth of information processing. *Journal of Educational Psychology*, 83, 187-194.

Higgins, E. T. (1990). Personality, social psychology, and person-situation relations: Standards, and knowledge activation as a common language. In Pervin, L. A. (ed.) *Handbook of Personality. Theory and Research*. New York: The Guilford Press.

Järvelä, S. (1995). The cognitive apprenticeship model in a technologically rich learning environment: Interpreting the learning interaction. *Learning and Instruction*, 5, 237-259.

Järvelä, S., Hakkarainen, K., Lipponen, L., Niemivirta, M. & Lehtinen, E. (1997). *The interaction of students' motivational orientation and cognitive processes in Csile- based learning projects*. A paper presented at the 7th Earli conference, Athens, August.

Lehtinen, E., Vauras, M., Salonen, P., Olkinuora, E., & Kinnunen, R. (1995). Long-term development of learning activity: Motivational, cognitive and social interaction. *Educational Psychologist*, 30, 21-35.

Mayer, R. E. (1996). Learners as information processors: Legacies and limitations of educational psychology's second metaphor. *Educational Psychologist*, 3/4, 151-163.

Mischel, W. & Shoda, Y. (1995). A Cognitive-Affective System Theory of Personality: Reconceptualizing Situations, Dispositions, Dynamics, and Invariance in Personality Structure. *Psychological Review*, 102(2), 246-268.

Nicholls, J. G., Cheung, P. C., Lauer, J. & Patashnick, M. (1989). Individual differences in academic motivation: Perceived ability, goals, beliefs, and values. *Learning and Individual differences*, 1, 63-84.

Niemivirta, M. J. (1997). *Individual differences in motivational and cognitive factors affecting self-regulated learning — A pattern-oriented approach*. Arvioitavana.

Niemivirta, M. J. (1996, September). *Intentional and Adaptive Learning Modes — The Self at Stake*. Paper presented at the 2nd European Conference on Educational Research. Sevilla, Spain.

Niemivirta, M. J. & Järvelä, S. (1997). *Students' motivation and preferneces for learning activities*. In prep.

Pintrich, P. & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82, 33-40.

Savery, J. R. & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology*, 5, 31-39.

Scardamalia, M. & Bereiter, C. (in press). Adaptation and Understanding: A Case for New Cultures of Schooling. Teoksessa Vosniadou, E., De Corte, E., Glaser, R. & Mandl, H. (Eds.) *International perspectives on the psychological foundations of technology-based learning environments*.

Strube, M. J. (1990). In search of self: balancing the good and the truth. *Personality and Social Psychology Bulletin*, 16, 699-704.

von Glasersfeldt, E. (1989). Constructivism in education. Teoksessa T. Husén & T. L. Postlethwaite (eds.) *The international encyclopedia of education* (supplement, 11-12). Oxford, England: Pergamon.

Winne, P. H. (1995). Inherent Details in Self-Regulated Learning. *Educational Psychologist*, 30, 173-187.

Zimmerman, B. J. & Martinez-Pons, M. (1990). Student Differences in Self-Regulated Learning: Relating Grade, Sex, and Giftedness to Self-Efficacy and Strategy Use. *Journal of Educational Psychology*, 82, 51-59.

II Different possibilities of technology to assist teaching, learning and studying

Information technology in the development of teaching practice

Päivi Atjonen
Kajaani Teacher Training Department
University of Oulu

Abstract

The main purpose of this work was to develop a feedback and mentor system based on modern information technology for use in teaching practice. A constructivistic theoretical framework was adopted, in that unlike microteaching, it placed emphasis on the student teacher's responsibility for constructing personal pedagogical meanings. Six experimental phases were accomplished during the years 1994–1997, involving 78 student teachers and their 32 mentors. Three lessons per student were videotaped using three cameras (split-screen technique) and observed by two persons through the medium of a specially developed computer program. Both the videotapes and observation files carried a real-time code for comparing information from different sources. Each student teacher analysed his/her own feedback material in collaboration with a peer student, filled in a self-assessment form and participated in a feedback session held by a mentor. The main results indicate that information technology can provide useful material for deeper discussion of novice teachers' own styles of teaching and can broaden their consciousness of pedagogical decision-making. They were able to assume the role of outside observers, and in that way to develop their pedagogical thinking (self-confrontation) and their ability to assess different desirable alternatives when organising instruction. They fully realised

the need for pedagogical differentiation when they saw the AV-ADP material involving actual pupils. The results can be applied broadly to the development of teacher education, especially teaching practice.

Key words

Key words: pedagogical thinking, reflection, self-assessment, information technology, teaching practice

The theoretical background

Is it possible to learn to teach in the laboratory? Can we get relevant information about a human being by machines? Is the behaviour of a student teacher abnormal in the crossfire of video cameras or in front of computers? What on earth are the future teachers going to do with this experience when they are working in small countryside schools? I have been faced with questions of this kind many times when working as a teacher educator and researcher in a learning environment equipped with special information technology. I will try in this paper to give some answers to them from the perspective of teaching practice.

Teaching practice has been carried out differently depending on the main aims and character of teacher education. Some years ago particular value was attached to practical activities rooted in the everyday routines of instruction (the apprenticeship model), and teacher educators could not even dream of using video cameras, for example, as tools for improving teaching performance – not to mention any of the other equipment created by modern information technology. As far as academic teacher education today is concerned, the emphasis in on theoretical studies and the enrichment of pedagogical thinking abilities, and discussions about notebook computers, hypermedia, Internet, CD-rom or DVD are by no means rare in this context.

The thinking teacher – A challenging aim for teacher education

In my opinion the main aim of teacher education is the development of pedagogical thinking in the prospective teachers. By that I mean the desire to consider both positively and critically one's own concept of education and growth and the ability to see different alternatives for planning and implementing instruction (McNamara 1990). I mean especially *thinking focused on teaching-learning events*, not the general reasoning of a personal character that prevails in the teaching profession or the sociological and philosophic context of teaching.

Kubler-LaBoskey (1993) has described *development from an alert novice to a pedagogical thinker*. The pedagogical thinker is able to restructure teaching and learning processes in a professional and rational way, including the intuitive and perhaps irrational aspects of know-how. A pedagogically alert student teacher understands that teacher-pupil interaction during teaching-learning processes is a very complex matter. Paradoxically, *the realisation of this complexity is the main prerequisite for becoming a good teacher*. One has to understand that there are many ways of achieving a proper learning outcome, i.e. the same result can be attained in many ways. I call this a paradox because it would be reasonable to expect professional education to make the job clearer by offering information that describes and explains the process involved. Should a teacher be "less certain" at the end of the teacher education course than at the beginning? The answer may be 'yes', in many respects.

As difficult as the development of thinking and the verifiability of this development may be, the challenge must be faced in teacher education. Otherwise we leave (prospective) teachers imprisoned by the restricted everyday life of schools, if we do not sharpen their mental tools to analyse their own teaching experiences. I agree with Kansanen (1986, 21), who points out that some teaching skills can be learned by certain techniques but broader thinking abilities can be achieved only by practising thinking. This requires concrete material, which can be found in teaching practice.

Research results suggest that inexperienced observers of pedagogical processes tend to pay attention to critical issues (Clark & Peterson 1986, 263), or on the other hand, have difficulties in specifying why a certain teaching-learning event was successful (Brown 1990, 120). The human observation capacity can be overloaded because too much is going on simultaneously, and it has been estimated that teachers make interactive decisions every other minute (Clark & Peterson 1986, 268–273). In fact, the whole problem can be summarised in the words of Sotto (1994, 29): "It makes no sense to decide how one is going to teach, before one has made some study of how people learn."

So novice teachers need time and i*nstruments to stop or slow down the flow of teaching and learning events* in order to understand what really happens. They should perhaps first consider the situation from the teacher's perspective, and then they will be capable of looking more carefully at what the pupils' reactions were. One useful way to support and help this kind of restructuring is to make videotapes of classroom events on which the voices have been recorded in the proper way, although sometimes this is not enough and the interpretations have to be filled out with a short interview with a teacher, for example.

Research into teacher thinking has been focused on three themes (see Atjonen 1996a). The research efforts have been directed at teachers' *preinteractive* planning processes (e.g. Clark 1989), *implicit theories* (e.g. Clark & Peterson 1986; Onosko 1990) and *interactive decision-making* (e.g. Berliner 1989; Borko et al. 1988). These aspects can well be studied during periods of teaching practice, as they involve a student and his/her mentor who are in the middle of an active process in which the former is making important decisions about planning and instruction that are inevitably coloured by his/her hidden assumptions. The teaching practice should not be destroyed by running through the teaching experiences quickly and superficially.

The students should be made to stop and carefully rethink their detailed experiences. There should be a lot of discussion during the mentoring sessions on what *personal pedagogical activities a student should be more conscious of*. One may well question critically the 'myth of experience', which expects that the more experience you have, the better teacher you automatically become (Johnston 1994, 199; Mungby & Russell 1994, 88). This also helps us to realise that it is necessary to guide pupils' learning processes in a professional way (Marland & Osborne 1990) and that it is a naive attitude to count on mere intuition.

'Reflection' has been the key concept in recent years when discussing pedagogical thinking, being defined as meaning the interactive consideration of one's own teaching practice and teaching theories. It is typical of reflective thinking to keep putting off one's decision-making, to adopt a wondering attitude and to try to find new viewpoints on everyday routines. (see Calderhead 1993; Michell & Marland 1989; Ojanen 1996; Schön 1987.) In the midst of the popular trend of reflection, the warnings expressed by Moon (1995), for example, should be taken seriously. He thinks that the concept of reflection has lost its meaning at the expense of the interest which should be focused on the substance of pedagogical processes. Liston and Zeichner (1990, 38) give the name *'wishy-washy reflection'* to the belief that all kinds of thinking activities, despite of their content, can lead to a better teaching profession. This entails the danger that reflection is reduced to mere verbalism (thinking without action) or activism (action without thinking), which are not able to promote any genuine professional development (Gingsburg & Clift 1990, 454).

Although I accept many of the "soft" mental processes – which can be called 'reflection' – as an important part of teaching practice, I prefer to speak of *pedagogical thinking*. This requires some "hard data" on teaching and learning processes but enables teachers to adopt self-directed and self-regulated critical attitudes towards their own decisions. It also accepts emotions, fears, expectations and values as very important reflection material supporting interpretations based on the facts. Copeland (1989) might use a concept of ‘clinical reasoning’ in this sense.

Video cameras and computers as tools for teaching practice

Everyday teaching practice is typically loaded with hurry, differing opinions from mentors' and strict concentration on subjects and individual lessons. Sometimes only the student teachers are fully aware of the contradictory expectations, when trying to survive in the midst of the mess. According to traditional habits, an experienced teacher educator is sitting at the back of the classroom making some unstructured notes of what is seen or heard during the lesson. The more pupil-centred the methods are, the less you can see or hear the questions or learning difficulties that emerge among the pupils and what the answers given by the student teacher were. Even if you could see and hear clearly, the selective human memory and the restricted ability to make clear perceptions can play tricks at the expense of the student or mentor. The consequence may be that their interpretations differ dramatically.

Against this background it is amazing that video cameras are so seldom used systematically in teaching practice. A few decades ago it was understandable because of the high cost and clumsy, heavy structure of video cameras, but nowadays the situation is totally different. The main reason can perhaps be found in the behaviourist character of microteaching, which was especially popular in the 1960's (McGarvey & Swallow 1986; Perlberg 1989; Vare 1994; Wilkinson 1996). In today's constructivist fashion, "Proper Teacher Educator" will not want to risk being labelled as a behaviourist!

In this "behaviourism phobia" many important *constructivist interpretations* of the effectiveness of videotapes have been ignored. A video can capture a huge amount of rich, exact material on the course of classroom events, the elements connected with it, verbal and non-verbal interaction between the teacher and pupils, individual reactions to learning tasks etc. It can help one to look at one's own activities from the perspective of an outsider, i.e. a subject can become an object. This change in roles makes it possible to become aware of the difference between the ideal and real self. (see e.g. Baker 1970, 16–17.) If the difference is of some size, it can motivate a change. This is described in the literature with the concept of 'self confrontation' (McAleese 1984), and its effectiveness has also been admitted in many other areas of personal relationships as well as the teaching profession.

The video itself is not important, but the important thing is the character and quality of the thought processes catalysed by it. An authentic tape provides a common basis for mentoring discussions, because it is powerful in stimulating vivid recall of even quite detailed thoughts which the teacher had during classroom events (see the technique of stimulated recall interview: Marland 1984). Videotapes can be analysed many times over, if necessary, in order to specify the relationship between causes and effects, and it cannot make the feedback look any better than the true situation. At the same time, tapes used in an unskilled way can be a very hard tool to operate with, so that collaborative work with a peer student and/or mentor is definitely needed during the playback session.

The task of a *mentor* is to put good questions and to function *as an inquirer*, focuser and facilitator (McGarvey & Swallow 1986, 51–58; Perlberg 1989; Glickman & Bey 1990, 558–559). While the video provides the confrontation, a mentor is responsible for the other side of a process, namely the caring. The most important thing is to induce students to think aloud about their emotions, decisions, and thoughts regarding the teaching experiences including the grounds and alternatives for decisions made during the lesson. Mentors are not evaluators or judges as in traditional teaching practice (see Broeckmans 1989; Krokfors 1997) or in microteaching, but *should help the student teachers to conceptualise their experiences and balance out their interpretations*. The responsibility for self-assessment is transferred to a significant degree to the student teachers, who, in the spirit of constructivism, are expected actively to restructure their experiences.

Used together with videotapes, a free or semistructured *observation* can serve as a catalyst and a focuser (Borich 1990; Freiberg & Waxman 1990, 120–123). One should again recall the problem mentioned at the beginning of this paper, that an inexperienced teacher has difficulties in recognising the essentials of teaching-learning processes during unstructured observation. On the other hand, a videotape of one's own teaching behaviour is without exception emotionally very poignant: practically no one can watch a videotape of him/herself with indifference! But watching the video alone can tempt one to fix on ‘cosmetic’ issues (e.g. voice control, expressions, gestures or dress) and consciously or unconsciously reject the pedagogically significant messages (Fuller & Manning 1974; Hildebrand 1996; Wilkinson 1996). Without focusing, the playing of videotapes is apt to reward and maintain the present behaviour and does not stimulate a change.

Also, the results of the observation process (printed out from a computer program) are meant to serve merely as common material for reflection, providing fixed points for discussing the course of the teaching-learning processes and the guiding of these processes. They do not normally have any life of their own without the videotape and without a personal knowledge of the pupils. *The computer does not make perceptions or interpretations on behalf of a human being*. It is just a digital notebook in which observations are in real time.

In the following two chapters I will describe a research and development project that has been conducted at the Kajaani Department of Teacher since 1994 in which I have tried to combine the "hard" video and observation technology and the "soft" constructivist and intentional processing described above in a purposeful manner in a specially equipped learning environment.

Procedures in the project

The research and development project called 'Information Technology in the Development of Teaching Practice' (abbr. ITTP) consisted of six *experimental phases* during the years 1994–1997. It involved 78 student teachers (prospective primary school teachers), 23 males and 55 females, of whom five participated in the pilot phase in the autumn of 1994. 19 teachers at Kajaani Teacher Training School and 13 subject teacher educators at the Kajaani Department of Teacher Education were responsible for mentoring. Each experimental phase has been included in the student's ordinary teaching practice at the Teacher Training School.

The students in the 2nd, 3rd and 4th years of their studies worked together with pupils of grades 0–6 (6–12 years old). Lessons representing subjects taught at primary school (except physical education) were videotaped and observed. All the lessons were ordinary ones in the sense that we did not scale down the size of the class or the teaching time, not did we expect the student teachers to reteach their lessons. The student teachers had been guided to prefer pupil-centred teaching and learning methods (openly defined) because they need a proper arena in which to practise these demanding processes during the initial stages of teacher education.

The teaching and learning situations were videotaped and observed in a special research unit which also functions as an ordinary learning environment. *This pedagogical process laboratory* (abbr. PPL) is equipped with modern information technology (Figure 1) and is centred on a classroom/studio (120 m2 in area) where the pupils and teachers can work normally. The fittings can be changed as required, e.g. the room can be divided into smaller parts with movable screens or be used as one large, open learning environment. It can be a computer classroom, a lecture hall, a metal workshop, an arts studio or an ordinary classroom with chairs and desks.

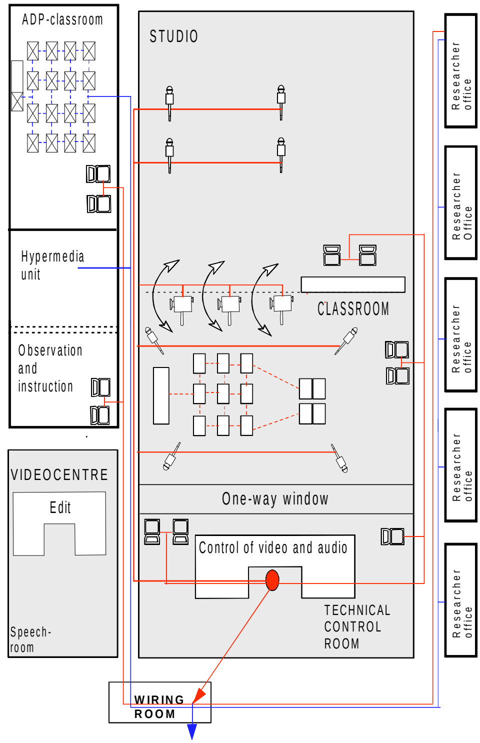


Figure 1. Floor Plan of the Pedagogigal Process Laboratory

The main equipment for gathering the data for research purposes consisted of three high-quality video cameras (remote controlled), several sensitive microphones and 2–4 notebook computers with a special program for observing the lessons. The voice of the teacher is recorded by a special wireless microphone, which gives very rich material for monitoring conversations. The technical control room contains all the facilities for controlling both the sound and lighting and the video cameras. (see also Atjonen 1995a, 9–21.)

A horizontal split-screen technique was used to combine pictures of the teacher and a group/pair of pupils on the videotapes, so that the student teachers would be effectively guided to consider their own activities together with their pupils' reactions. One important technical advantage of the PPL is the real-time code, which is saved both on the videotapes and in the observation files and enables the course of events to be followed as a function of time. Since the voices of the teacher and the pupils are recorded on separate audio tracks, it is possible to ensure that the verbal interaction is reproduced clearly enough.

Three lessons per student were videotaped at intervals of approximately one to two weeks. While a student teacher was working with the pupils in the classroom/studio, the mentor and peer student keyed in their observations on the notebook computers in the technical control room. The observations were saved through the medium of a *computer progra*m specially developed for this purpose at the Kajaani Department. The observation data were printed out in hard copy in the form a raw matrix and a few graphs for the use of the mentor and the student, enabling the student to follow up the ratings of the observers as a function of real-time.

After each lesson the student teacher was expected to look at the videotape and interpret the observation data together with the peer student. The next stage was to fill in the self-assessment form, which included certain tasks and open questions formulated from the perspective of the pupil-centred method and the teacher's self-confrontation ideas. Once the student teacher felt ready or mature enough, a mentoring session was held. This whole procedure was in principle gone through before the next recording in the PPL.

The idea was to use the digital and analogue material for heuristic discussions in the spirit constructivist principles. I wanted to have some "hard data" available (like a positivist) to be actively processed mentally and reflected on (like a cognitivist) in order to help the student teachers to adapt to various learning environments now and in the future. We have not mechanically compared the input and output of the pedagogical processes but have regarded the process phase between them as extremely important. Thus the focus has been on the novice teachers' intentions in relation to the context.

Main results of the project

Student Teachers' Progress in the Main Objectives

The two main objectives of the project were 1) to promote an inquiry orientation in the student teachers towards their own teaching performance and 2) to make them more conscious of the way in which they make their personal pedagogical decisions. These objectives were evaluated by both the mentors and the student teachers themselves on a 5-point Likert scale (1= attained insufficiently.... 5= attained well). The results are shown in Table 1:

Table 1. Progress in the Main Objectives, as Assessed by the Mentors and Students (group means)

Objective	Students' Self-assessment	Mentors' Assessment
Inquiry Orientation	4.18	4.18
Conscious Pedagogical Decisions	4.34	4.14

The table indicates that the novice teachers made significant progress, since the overall mean score was 4.21. An even more important result as far as the individual cases are concerned was that the evaluations of the mentors and student teachers were very similar, and were in fact identical in 55 cases out of a total of 146 (=2 objectives x 73 students). The difference was two points in only 16 cases, and in five cases it was three points (e.g. the mentor had assessed the progress as 5 and the student as 2). The students were slightly more optimistic than their mentors (mean 4.26 vs. 4.16), but the difference was not significant, being similar to those reported in many other countries.

A typical example of the latest experimental phase is given in Figure 2, which shows the results of 13 individual student teachers (identified with the letters A–M).

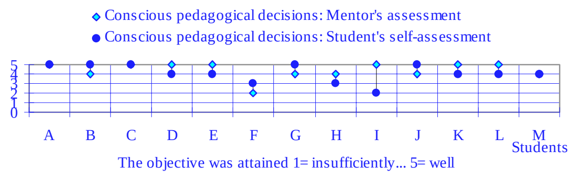


Figure 2. Students' Progress in One of the Main Objectives (from February to April, 1997)

The student teachers whose progress is described in Figure 2 were working in the PPL during their final period of teaching practice, and therefore many of them were very well qualified in teaching, although others still had to concentrate on basic teaching skills with the help of videos and observation files.

Main positive learning experiences

The student teachers described their personal, individual learning experiences in both the interviews and the open questions of the questionnaires. A content analysis of the positive opinions is summarised in Figure 3.

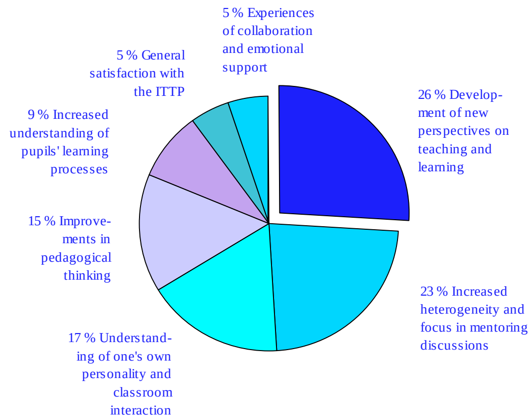


Figure 3. Positive Learning Experiences of the Student Teachers in 1995–1997 (number of utterances 413)

One fourth of the expressions indicated satisfaction that *many new perspectives* had been opened up on teaching and learning. Not only the videotapes but also the observation files and discussions with a peer student and a mentor had contributed to a better personal understanding of teaching-learning processes and their various possible interpretations. A further fourth of the positive utterances involved the *mentoring sessions*, which the student teachers had found to be *more objective, focused and versatile*. The main reason lay in the common, concrete material available for both students and mentors. If necessary, it was possible to check from a videotape whether the mentor's perception of three questions one after another, obscure instructions given to pupils or supervision of the work of only two groups of children were valid at all. Both categories illustrate clearly the main advantages of the system as could be predicted on the basis of the literature.

Many novices had felt it extremely revealing to look at themselves like outside observers in relation to their *personal interaction with the pupils* (17 %): Am I really approaching the children in that way? Is it typical of me to put questions in this way? Are my non-verbal cues and gestures really like that? Can any other people see my relationship to the pupils as warm/reserved, as I see it? It had sometimes been difficult to accept at first sight the real self which they confronted on the TV screen, but when the first emotional confusion had disappeared, they were able to recall through the videotape even quite detailed thoughts, problems and their solutions experienced during the interactive phase of the lesson. Afterwards they had time to analyse the material both on their own and together with their co-learners (reflection-on-action; Schön 1987).

I have defined a separate group of utterances as *deepening the pedagogical thinking* (15 %) which is intensively connected with all the categories analysed above. The novices described how they had started to think of the relationship between causes and effects more carefully. They had tried to specify the teacher's and pupils' roles from various points of view, and had asked critically what are the crucial characteristics of 'genuine' learning and what is really meant by child-centred methods. They became worried about children's learning difficulties which were clearly to be seen with the help of the special technological facilities, and they were forced to compare the planning and implementation processes more precisely. They had to admit that it was impossible in this system to ignore either positive or negative experiences with a shrug of the shoulders, as one had to stop for a while and think carefully what had happened. All these findings support the theoretical ideas of 'advanced pedagogical thinking' described in the first chapter.

Although the number of expressions in Figure 3 concerned with the increase in *thinking of the pupils' point of view* is only 9 %, this perspective was included indirectly in all the other categories as well. This category as such contains only just those utterances in which the student teachers mentioned directly that their knowledge of the pupils as individual learners had improved, that they had felt confused in the face of the pupils' learning difficulties, or that they had been able to delve to the bottom of the pupils' world and thoughts. The lower part of the TV screen (when the split-screen technique was used), which revealed the activities and discussions of the pupils, proved to communicate a great deal to the novices.

Changes in attitudes towards the project

As can been seen in Figure 4, first opinions and expectations had changed radically during the project.

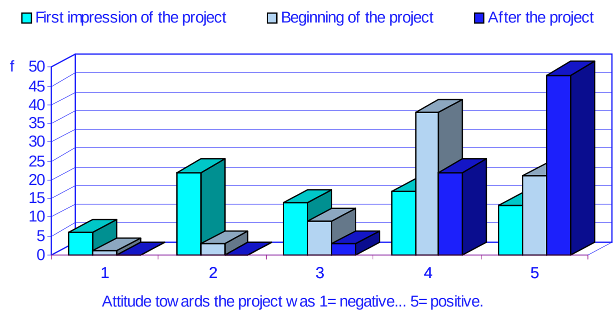


Figure 4. Changes in the Attitudes of the 73 Students

The first impression of belonging to the experimental group had typically been negative. This was the case especially in the first two phases of the project in 1994 and 1995 (Atjonen 1995b, 194; Atjonen 1996b, 88) because for a number of practical reasons, I did not have enough opportunity to discuss it with the students and give them detailed information on it. In this respect, the situation has improved significantly during the last two years. On the other hand, I have come to the conclusion that it is not possible to explain what the ITTP is about rationally and exhaustively in advance: the project just has to be experienced!

Figure 4 shows clearly that when the action phase of the project was reached, the suspicions started to disappear (changes in means: 3.13 _ 4.04 _ 4.62), and *by the end of the project* there were many *extremely satisfied novices*. It had not been nice and easy all the time, but it had been worth experiencing without any doubt!

All 78 were of the opinion that every student teacher should be given the possibility to participate in the ITTP, and this recommendation has already been taken seriously in the Kajaani Department. About five students were not completely sure whether such a system should be voluntary or obligatory, but it is my opinion that the students who really need videos and observations to improve their instruction are the ones who will not participate on a voluntary basis.

Discussion

To become conscious of one's pedagogical decision-making is a process of a lifetime, lasting the whole of one's teaching career, for which only the "starter's orders" can ge given during the initial teacher education. The parts of these "starter's orders" can be "effective" in different ways, if we assess them by external criteria, for example, or in relation to time. Modern information technology can open up some promising options for versatile processing of human information, and can lead to a better overall picture of learning and its guidance and promote a deeper understanding of the multidimensionality of instruction. The best characteristic of a true professional is not thinking or acting in black-and-white: *being confused* from time to time is an essential prerequisite and a manifestation of professionally valuable humility.

One aspect of the effectiveness of the ITTP, for example, can be illustrated aptly by two quotations from student teachers: "I learned more during those three videotaped lessons than during all the other 17 lessons which I had in the Teacher Training School" or "I personally feel that video has helped me to develop my teaching and guiding more than a hundred mentoring discussions". Not all the experiences were so dramatic, nor do they need to be, but they illustrate a lot of the main principles I have tried to put into practice as a teacher educator, researcher and project leader.

The ITTP – like many other projects carried out in laboratory-like surroundings – has succeeded in proving that the "naturalness" of a learning context cannot be defined unambiguously. For example, the pupils and student teachers who worked in the PPL found it a very pleasant, peaceful room where teaching and learning could take place without outside disturbance. I hope my paper has already made it clear that the aim of this project was not to give a "realistic picture" of a teacher's work. I have tried to provide my students with *some transferable mental tools for understanding pupils' learning processes in as exact and comprehensive a way as possible*. Having said this, it is unnecessary to answer separately the question of what the students are going to do with this experience after starting to work as a qualified teacher in a small countryside school.

References

Atjonen, P. 1995a. Opetustapahtuman kuvaaminen didaktisessa prosessilaboratoriossa. Osa 1. Tutkimusyksikön toimintaperiaatteiden teoreettisia perusteita opettajankoulutuksen näkökulmasta. *[Describing the teaching and learning processes in the didactic process laboratory. Part 1. Functional principles of the research unit from the perspective of teacher education].* Oulun yliopisto. Kajaanin opettajankoulutuslaitoksen tutkimuksia A 7.

Atjonen, P. 1995b. Opetustapahtuman kuvaaminen didaktisessa prosessilaboratoriossa. Osa 2. Opettajan didaktisten ajattelu- ja toimintavalmiuksien kehittäminen. Oulun yliopisto. *[Describing the teaching and learning processes in the didactic process laboratory. Part 2. Development of a teacher's pedagogical thinking and activities].* Kajaanin opettajankoulutuslaitoksen tutkimuksia A 8.

Atjonen, P. 1996a. Opettaja didaktisena ajattelijana ja toimijana. *[Teacher as a pedagogical thinker and actor]*. Teoksessa Heikkinen, R. & Oikarinen, L. (toim.) Kasvatuksen ja koulutuksen vainioilta. Professori Juhani Suorttin juhlakirja hänen täyttäessään 50 vuotta 19.9.1996. Kajaani: Koti-Kajaani, 37–58.

Atjonen, P. 1996b. Opetustapahtuman kuvaaminen didaktisessa prosessilaboratoriossa. Osa 3. Opetustapahtumaa koskevan didaktisen tietoisuuden ja omaehtoisen analysoinnin edistäminen opetusharjoittelussa. *[Describing the teaching and learning processes in the didactic process laboratory. Part*

3. Promoting pedagogical sonsciousness and inquiry-oriented attitude towards the teaching-learning events during teaching practice]. Oulun yliopisto. Kajaanin opettajankoulutuslaitoksen tutkimuksia A 12.

Baker, H. 1970. Film and video tape feedback: A review of the literature. University of Texas. The research and development center for teacher education. Report series n:o 53.

Berliner, D. 1989. The place of process-product research in developing the agenda for research on teacher thinking. In Lowyck, J. & Clark, C. (eds.) Teacher thinking and professional action. Leuwen university. Studia paedagogica 9, 3–21.

Borich, G. 1990. Observation skills for effective teaching. Ohio: Merrill.

Borko, H. & Livingston, C. & McCaleb, J. & Mauro, L. 1988. Student teachers' planning and post-lesson reflections: Patterns and implications for teacher preparation. In Calderhead, J. (ed.) Teachers' professional learning. London: Falmer, 65–83.

Broeckmans, J. 1989. Supervision conferences and student teachers’ thinking and behavior. In Lowyck, J. & Clark, C. (eds.) Teacher thinking and professional action. Leuwen university. Studia paedagogiga 9, 345–359.

Brown, S. 1990. Student teachers learning from experienced teachers. In Bone, T. & McCall, J. (eds.) Teacher education in Europe: Challenges ahead. Glasgow: Jordanhill College, 120–126.

Calderhead, J. 1993. The contribution of research on teachers' thinking to the professional development of teachers. In Day, C. & Calderhead, J. & Denicolo, P. (eds.) Research on teacher thinking: Understanding professional development. London: Falmer, 11–18.

Copeland, W. 1989. Technology-mediated laboratory experiences and the development of clinical reasoning in novice teachers. Journal of teacher education XXXX(4), 10–18.

Clark, C. 1989. Asking the right questions about teacher preparation: Contributions of research on teacher thinking. In Lowyck, J. & Clark, C. (eds.) Teacher thinking and professional action. Leuwen university. Studia paedagogica 9, 305–323.

Clark, C. & Peterson, P. 1986. Teachers' thought processes. In Wittrock, M. (ed.) Handbook of research on teaching. 3rd ed. New York: Macmillan, 255–296.

Freiberg, J. & Waxman, H. 1990. Reflection and the acquisition of technical teaching skills. In Clift, R. & Houston, R. & Pugach, M. (eds.) Encouraging reflective practice in education. New York: Teachers College, 119–138.

Fuller, F. & Manning, B. 1974. Self-confrontation reviewed: A conceptualization for video playback in teacher education. Review of educational research 43(4), 469–528.

Gingsburg, M. & Clift, R. 1990. The hidden curriculum of preservice teacher education. In Houston, R. (ed.)

Handbook of research on teacher education. New York: Macmillan, 450–465.

Glickman, C. & Bey, T. 1990. Supervision. In Houston, R. (ed.) Handbook of research on teacher education. New York: Macmillan, 514–534.

Hildebrand, J. 1995. Learning through supervision. A systemic approach. In Yelloly, M. & Henkel, M. (eds.) Learning and teaching in social work. Towards reflective practice. London: Jessica Kingsley, 172–188.

Johnston, S. 1994. Experience is the best teacher; Or is it? An analysis of the role of experience in learning to teach. Journal of teacher education 45(3), 199–208.

Kansanen, P. 1986. Antaako didaktiikka opettajalle välineet? *[Does pedagogy give a teacher the necessary tools?]* Kasvatus 17(1), 12–22.

Krokfors, L. 1997. Ohjauskeskustelu. Opetusharjoittelun ohjauskeskustelun toimintamallien tarkastelua. Helsingin yliopisto. [*Supervisory discource. Models of action in pre-service supervisory discource]*. Opettajankoulutuslaitoksen tutkimuksia 171 *(academic dissertation)*.

Kubler-LaBoskey, V. 1993. A conceptual framework for reflection in preservice education. In Calderhead, J. & Gates, P. (eds.) Conceptualizing reflection in teacher development. London: Falmer, 23–38.

Liston, D. & Zeichner, K. 1990. Teacher education and the social conditions of schooling. London: Routledge.

Marland, P. 1984. Stimulated recall from video: Its use in research on the thought processes of classroom participants. In Zuber-Skerritt, O. (ed.) Video in higher education. London: Kogan Page, 123–135.

Marland, P. & Osborne, B. 1990. Classroom theory, thinking and action. Teaching & teacher education 6(3), 93–109.

McAleese, R. 1984. Video self-confrontation as microteaching in staff development and teacher training. In Zuber-Skerritt, O. (ed.) Video in higher education. London: Kogan Page, 123–135.

McGarvey, B. & Swallow, D. 1986. Microteaching in teacher education & training. London: Croom Helm.

McNamara, D. 1990. Research on teachers thinking: Its contribution to educating student teachers to think critically. Journal of education for teaching 16(2), 147–160.

Mitchell, J. & Marland, P. 1989. Research on teacher thinking: the next phase. Teaching & teacher education 5(2), 115–128.

Moon, B. 1995. Practical experiences in teacher education: Charting a European agenda. Background paper prepared for Association of teacher education in Europe. European Union sponsored conference, Gargano, Italy. June 28.6.–1.7.1995.

Mungby, H. & Russell, T. 1994. The authority of experience in learning to teach: Messages from physics method class. Journal of teacher education 45(2), 86–95.

Ojanen, S. 1996. Reflektion käsite opettajankoulutuksessa. Muotihulluus vai kasvatusreformin kulmakivi? *[The concept of reflection in teacher education. A craze or a cornerstone of educational reform?]* Teoksessa Ojanen, S. (toim.) Tutkiva opettaja 2. Tampere: Tammer-Paino, 51–61.

Onosko, J. 1990. Comparing teachers' instruction to promote students' thinking. Journal of curriculum studies 22(5), 443–461.

Perlberg, A. 1989. Conceptual and theoretical bases of microteaching. In Eraut, M. (ed.) The encyclopedia of educational technology. Oxford: Pergamon, 205–209.

Schön, D. 1987. Educating the reflective practioner. London: Jossey-Bass.

Sotto, E. 1994. When teaching becomes learning. A theory and practice of teaching. London: Cassell.

Vare, J. 1994. Partnership contrasts: Microteaching activity as two apprenticeships in thinking. Journal of teacher education 45(3), 209–217.

Wilkinson, E. 1996. Enhancing microteaching through additional feedback from preservice administrators. Teaching & teacher education 12(2), 211–221.

Aikuisten oppiminen ja opiskelu tietokoneita hyödyntävissä oppimisympäristöissä: Alustavia tutkimustuloksia suomalaisista aikuisoppilaitoksista

Tuula Pyykkö, Eero Ropo
Tampereen yliopisto

English abstract

Adult Learning in Computer Facilitated Learning Environments: Initial Experiences From Finnish Adult Education Centers. *English abstract. The project is initiated and funded by the National Board of Education (NBE) for three years 1996-98. The purpose is to develop computer supported and facilitated learning environments for adult vocational education. This is done by supporting networking and cooperation among the institutions, departments, and individual teachers and by facilitating and subsidizing the introduction of technological innovations in the implementation of teaching and studying. Fifteen vocational institutions participate the project from all over the country. The research related to the project focuses on investigating the process, problems and solutions in the development of learning environments in individual institutions* *and vocational programs. The research project has so far collected and initially analyzed data on teachers' and students' experiences on the use of computer facilitate distance education in teaching and studying in different degree programs. The results show that teachers are optimistic of the potential and benefits of networking and innovative teaching methods in vocational education. However, there are lot of variance in the skills and knowledge of adopting the technology in the practical level. The student interviews show that vocational students are heterogeneous in respect to using computers in their studying. One distinction is between men and women; men having more of earlier experience in using computers and internet. Another difference is related to the area of studies. For instance, business administration students seemed to have more experience and skills to apply computer environments in their studying. All the students expressed a need for support and tutoring both in using the technology and in studying the subject matter contents. It seems to us that applying new media in teaching requires changes in the basic strategies of instruction towards student-centered and individualized tutoring.*

Keywords

Key words: learning environment, vocational education, computers in education

Tutkimusprojektin (OpinNet) taustaa ja tavoitteita

Opetushallitus julisti tammikuussa 1996 haettavaksi “Suomi tietoyhteiskunnaksi koulutus tiedon valtatielle”-liittyvän opetusmenetelmien ja materiaalien kehittämisohjelman. Aikuiskoulutuksen alueelle oli tarkoituksena perustaa hanke verkkojen ja oppimisympäristöjen kehittämiseksi aikuistutkintoihin. Hankkeeseen voivat hakeutua tutkintotavoitteista aikuiskoulutusta antavat oppilaitokset. Tutkintotavoitteinen aikuiskoulutus tarkoittaa, että koulutuksen yhteydessä opiskelija osoittaa ammattitaitonsa näyttökokeessa, minkä perusteella hänelle annetaan tutkintotodistus. Opetushallitus rahoittaa koko hankkeen, eli siis sekä hankkeeseen liittyvien oppilaitosten OpinNet:iin liittyvät kustannukset että Tampereen yliopistolta tilatun tutkimuksen. Projekti aloitettiin syksyllä 1996 ja sen on määrä jatkua aina vuosituhannen vaihteeseen saakka.

Projektin keskeisenä tavoitteena on kehittää aikuiskoulutuksen oppimisympäristöjä avoimiksi, joustaviksi ja uutta teknologiaa hyödyntäviksi. Tämä mahdollistaa aikuisopiskelijoiden osallistumisen ammattitutkintoihin valmentavaan koulutukseen joustavasti, mahdollisimman riippumattomina koulutuksen ajasta ja paikasta. Koulutuksen yhteydessä opiskelijoille annetaan myös mahdollisuus omaksua tietoyhteiskunnan edellyttämät tietotekniset taidot. Tämä tapahtuu sisällyttämällä tutkintoon opiskelua, joka toteutetaan uusia tietoteknisiä ja pedagogisia menetelmiä soveltaen.

Oppilaitoksille projekti on haaste, jolla pyritään uusien ratkaisujen ja menetelmien sekä työtapojen kokeiluun ja käyttöönottoon. Avoimissa oppimisympäristöissä tapahtuva opetus ja opiskelu edellyttää oppilaitosten kehittävän ja kokeilevan uusia opiskelijoiden ohjaus- ja tukimuotoja, opetusmateriaaleja sekä muita pedagogisia sovellutuksia. Aikuiskoulutuskeskusten toiminta on liiketoimintaa, jossa myydään tutkintoja. Tutkinto on tuote ja niiden kehittämiseen myös OpinNet -projekti pyrkii tarjoamaanresursseja sekä henkistä ja materiaalista tukea. Projektista lienee hyötyä myös opettajien jatko- ja täydennyskoulutuksennäkökulmasta. Yhteistyö niin oppilaitoksen sisällä kuin oppilaitosten välillä helpottanee opettajien omien tietoteknisten valmiuksien kehittämistä ja kehittymistä.

Mukana olevat oppilaitokset ja tutkinnot

OpinNet:ssa on tällä hetkellä mukana 16 oppilaitosta, joista 14 on ammatillisia aikuiskoulutuskeskuksia. Kaksi oppilaitosta on ammatillista (aikuis)koulutusta antavia oppilaitoksia. Tutkintoja on mukana 12: liiketalouden perustutkinto, yrittäjän ammattitutkinto, maaseutuyrittäjän perustutkinto, tietokoneasentajan ammattitutkinto, kokin ammattitutkinto, leipurin ammattitutkinto, hotellipalvelun ammattitutkinto, koti-, laitostalous- ja puhdistuspalvelualan perustutkinto, laitoshuoltajan ammattitutkinto, siivoustyönohjaajan erikoisammattitutkinto, kiinteistönhoitajan ammattitutkinto, sähkölaitosasentajien ammattitutkinto. Tutkintojen ja oppilaitostenlukumäärä vaihtelee, sillä projektiin on mahdollista liittyä mukaan ja jättäytyä pois projektin edetessä.

OpinNet:n organisoituminen verkostoiksi

Projekti organisoituu käytännössä verkostomaisesti siten, että valtakunnallisen kehittämisverkoston osina toimivattutkinnoittain muodostetut verkostot ja oppilaitoskohtaisesti muodostetut verkostot. Valtakunnalliseen kehittämisverkostoon kuuluvat kaikki OpinNet -oppilaitokset, tutkintokohtaisiin verkostoihin taas kunkin ammattialan oppilaitokset.

Oppilaitokset raportoivat toiminnastaan kuukausittain valtakunnallisessa verkostossa sähköposti-ilmoitustaululla. Raportoinnin tarkoituksena on toimia informaation lähteenä niin oppilaitoksille kuin Opetushallitukselleki n sekä herättää lukijoissa keskustelua avoimen oppimisympäristön kehittämiseen liittyvistä asioista. kuukausiraportointi ei ole kuitenkaan täysin vastannut ennakko-odotuksia, sillä raportit ovat usein varsin yleisiä eikä niitä kirjoiteta toivotuin aikavälein. Yleinen keskustelu valtakunnallisessa verkostossa on toistaiseksi rajoittunut lähinnä käytännön asioiden tiedottamiseen eikä siitä ole vielämuodostunut luontevaa kommunikointikanavaa projektin varsinaiseen sisällölliseen työhön. OpinNet:läiset kokoontuvat myös kaksi kertaa vuodessa kasvotusten pohtimaan projektin kehittämistä.

Keskustelu on ollut vilkkaampaa tutkintokohtaisissa verkostoissa, missä saman ammattialan ihmisten yhteydenpito on muodostunut luontevaksi ja henkilökohtaiseksi. Tutkintokohtaisissa sähköisissä keskustelufoorumeissa tavoitteena on kehittää oman ammattialan koulutusta avoimessa oppimisympäristössä tapahtuvaksi. Foorumit voivat myös risteytyä, jos joillakin ammattialoilla on yhteisiäkehittämiskohteita. Yhteistyön puitteissa on tähän asti kehitetty ja kokeiltu erilaisia tietoteknisiä (esim. Net-Meeting, ristiinopetus) ja pedagogisia sovellutuksia (esim. portfolio) sekä tuotettu verkkomateriaalia yhteiseen opetuskäyttöön. Tutkintokohtaisilla keskustelukanavilla käydään ajoittain vilkastakin keskustelua useilla ammattialoilla (mm. liiketalous, koti-, laitostalous- ja puhdistuspalveluala, ravintola-ala), mutta joillakin ammattialoilla yhteistyö hakee vielä muotoaan.

Oppilaitoskohtaisissa verkostoissa kukin oppilaitos kehittää OpinNet-ammattialoja yhteistyössä toistensa kanssa. Oppilaitospalavereja on toistaiseksi pidetty vaihtelevasti, riippuen mm. oppilaitoksen koosta ja opettajien aikaresursseista.

Tutkimuksen tavoitteet ja ongelmat

Tutkimuksen tavoitteena on seurata ja kuvata hankkeeseen osallistuvien oppilaitosten toimintaprosesseja, ongelmia ja ongelmien ratkaisuprosesseja, joita avoimen oppimisympäristön suunnittelussa ja toteutuksessa ilmenee. Pyrkimyksenä on analysoida uuden teknologian soveltamisen tuomia ongelmia ja etuja ammatilliseen aikuiskoulutukseen sekä laatia suosituksia koulutuksen kehittämiseksi.

Tämänhetkiset tutkimusongelmat voidaan kiteyttää seuraaviin osa-alueisiin:

a) Opettajien kokemukset avoimen oppimisympäristön suunnittelusta, toteutuksesta ja uuden teknologian vaikutuksistaopettajantyöhön

b) Opiskelijoiden kokemukset (uutta teknologiaa hyödyntävästä) opiskeluprosessista avoimessa oppimisympäristössä

c) Avointen oppimisympäristöjen opetuskulttuuri

Alustavia tuloksia

Opettajien näkemyksiä avoimen oppimisympäristön suunnittelusta ja toteutuksesta sekä uuden teknologian vaikutuksesta opettajantyöhön: Kyselytutkimus ja yhteenveto oppilaitosten kuukausiraporteista

Kyselynä toteutetun tutkimuksen tarkoituksena oli selvittää, miten projekti oli lähtenyt liikkeelle, mitä ongelmia suunnittelussa on ilmennyt sekä millaisena opettajat näkevät avoimen oppimisympäristön ja sen tuomat muutokset opettajantyöhön. Kyselylomakeaineisto kerättiin tammi-helmikuussa 1997. Avoimia kysymyksiä sisältävän kyselylomakkeen vastausprosentti oli 81%. Oppilaitosten laatimat kuukausiraportit analysoitiin myös syksyn 1996 ja kevään 1997 osalta. Näistä raporteista ilmenee kunkin oppilaitoksen/ammattialan eteneminen projektin osalta.

OpinNet-projekti on lähtenyt liikkeelle vaihtelevasti eri oppilaitoksissa ja ammattialoilla, sillä atk-taidot ja valmiudet ovat eri asteisia eri oppilaitoksissa ja ammattialoilla. Ei-teknisillä ammattialoilla opettajien ja opiskelijoiden atk-taidot ovat vähäisiä ja tekniset resurssit niukkoja, kun taas teknisesti orientoituneilla ammattialoilla on panostettu jo ennen OpinNet:ä teknisiin resursseihin ja valmiuksiin.

Useimmat oppilaitokset ja ammattialat ovat keskittyneet avoimen oppimisympäristön kehittelyssä teknisiin sovellutuksiin (Net-Meeting, videoneuvottelu, www-sivut, www-materiaali tehtävineen), mutta myös pedagogisia kokeiluja ja oppimisen ja osaamisen arviointitapoja on kehitelty (portfolio, projektioppiminen). Projektin keskittyminen teknisiin sovellutuksiin selittynee mm. opettajien kiinnostuksella tietotekniikkaan ja konkreettisten tuotosten aikaansaamiseen. Yhteistyö on lisääntynyt vuoden 1997 kuluessa ja erityisesti se on koettu mielekkäänä opetusmateriaalin vaihdon, tutkinnon tuotteistamisen, teknisten- ja pedagogisten kokeiluiden sekä kokemusten vaihdon osalta. Yhteistyöhalukkuuteen vaikuttaa myös oppilaitoksen ja opettajien toimintakulttuuri (onko totuttu jakamaan tuotoksia, tekemään yhteistyötä) ja toimintaympäristön erilaisuus (paikalliset eroavaisuudet) sekä opettajien työmäärä (opetus, muut samanaikaiset projektit). Myös työelämäyhteydet ovat lisääntyneet useissa oppilaitoksissaprojektin kehityshankkeiden myötä (mm. portfolio, näyttökoe). Materiaalia tehtävineen on testattu opiskelijoilla vielä suhteellisen vähän. Syksyllä 1997 myös opiskelijat, projektin keskeisin osa, pääsevät kokeilemaan ja antamaan palautetta kokeiluista useissa oppilaitoksissa. Tähän mennessä opiskelijoille on lähinnä annettu atk-opetusta ja joillakin ammattialoilla he ovat myös opiskelleet pieniä osuuksia uusilla pedagogisilla- ja teknisillä sovellutuksilla.

Opettajilta saatujen vastausten mukaan opiskelu avoimessaoppimisympäristössä tarjoaa opiskelijoille teknisten välineiden opiskelumahdollisuutta, mahdollisuutta opiskella (osittain) ajasta ja paikasta riippumattomina sekä yksilöllisyyttä. Itsenäinen opiskelu tosin vaatii opiskelijoilta oppimaan oppimisen taitoja sekä itseohjautuvuusvalmiuksia, kuten itsenäistä otetta työskentelyyn, suunnitelmallisuutta, tavoitteellisuutta, pitkäjänteisyyttä, kykyä omaksua tietoa eri lähteistä sekä ryhmätyötaitoja. Myös teknisten työvälineiden hallinta tai halu niiden käytön oppimiseen on joidenkin opettajien mielestä edellytys opiskelulle avoimissa oppimisympäristöissä.

Opettaminen avoimessa oppimisympäristössä edellyttää opettajien mielestä opettajilta teknistä osaamista, pedagogistentaitojen kehittämistä sekä opiskelijoiden ohjaustaitoja. Joidenkin opettajien mielestä opettajilta vaaditaan myös yhteistyötä työyhteisön, oman ammattialan työnantajien sekä kouluttajien kanssa.

Opiskelijoiden kokemukset (uutta teknologiaa hyödyntävästä) opiskeluprosessista avoimessa oppimisympäristössä

Opiskelijahaastattelut

Tutkimusta tarkennettiin valitsemalla kolme OpinNet:iin kuuluvaatutkintotavoitteista ammattialaa eri oppilaitoksista opettaja- ja opiskelijahaastatteluihin. Tässä yhteydessä käsitellään opiskelijahaastatteluja. Ammattialat edustivat erilaisia aloja ja niidenkehittämiskohteet eroavat toinen toisistaan. Ammattialat ovat: koti-, laitostalous- ja puhdistuspalvelualan perustutkinto (KOLAPU),kiinteistönhoitajan ammattitutkinto ja liiketalouden perustutkinto. Haastattelut olivat vapaamuotoisia teemahaastatteluita, joissa pyrittiin kartoittamaan opiskelijoiden opiskelukokemuksia avoimessaoppimisympäristössä. Opiskelijahaastattelut olivat ryhmähaastatteluita, joissa opiskelijoita oli mukana neljästä seitsemään. Opiskelijat tulivat haastatteluun vapaavalintaisesti. Opiskelijat edustivat kohderyhmiään hyvin, paitsi liiketaloudentutkinnon osalta, missä vinoumaa korjattiin yhdelläyksilöhaastattelulla. Haastattelut olivat kestoltaan 45-60 minuuttia ja ne suoritettiin opiskelijoiden lähijaksolla/opiskelupäivänyhteydessä.

KOLAPU-tutkinnon opiskelijat ovat kaikki naisia, heidän ikäjakaumansa on 25-45-vuotta ja he opiskelevat lähiopetuspainotteisesti. Opiskelijat ovat työttömiä monelta eri alalta ja joiltakin puuttuu ammatillinen koulutus kokonaan. Koulutus on työllistämiskoulutusta ja se kestää 1v. 3kk. Koulutus on alkanut vuoden 1997 alussa ja haastatteluhetkellä opiskelijoita oli koulutuksessa 18. Haastattelu tehtiin maaliskuun puolivälissä 1997.

Kiinteistönhoitajan tutkinnon opiskelijoista valtaosa on miehiä, mutta naisiakin on mukana. Ikäjakauma on noin 18-50-vuotta. Opiskelijat ovat työttömiä, alanvaihtajia, alasta kiinnostuneita. Koulutus on omaehtoista[1]. Koulutuksessa etä- ja lähijaksot vuorottelevat suhteellisen tiheästi ja säännöllisesti. Koulutus kestää noin vuoden ja se on alkanut lokakuussa 1996. Haastatteluhetkellä opiskelijoita oli koulutuksessa 18. Haastattelu tehtiin maaliskuun lopussa 1997.

Liiketalouden tutkinnon opiskelijoista miehiä on kolmannes. Ikäjakauma on 20-50-vuotta. Opiskelijat ovat ammatinvaihtajia, ammattitaidottomia, työelämässä mukana olevia(lisäkoulutusta hankkivia), työttömiä, vammaisia. Koulutus on omaehtoinen ja etäopetuspainotteinen. Koulutus kestää kaksi vuotta ja se alkoi syksyllä 1996. Haastateltavat olivat kaikki miehiä, mutta vinoutumaa kompensoitiin yhden naisen yksilöhaastattelulla. Haastatteluhetkellä opiskelijoita oli 16. Haastattelu tehtiin toukokuun lopussa 1997.

---

1. Omaehtoisuus tarkoittaa tässä yhteydessä vapaaehtoista hakeutumista koulutukseen.

Opiskelutuen tarve

Kaikki opiskelijat kaipaavat ohjausta ja tukea jossain määrin, etenkin tekniikkaan, tietokoneen käyttöön liittyen. Tietokoneenaikaisempi käyttö on ollut kaikilla ammattialoilla suhteellisenvähäistä. Opiskelijat kaipaavat hyvää suunnittelua, (atk)ohjausta ja tukea nimenomaan opiskelun alussa. Myös nopea palautetehtävistä sekä apu ongelmissa koetaan tärkeänä.

KOLAPU-opiskelijoilla ja kiinteistönhoidon opiskelijoilla koetaan paitsi opettaja, niin myös toiset opiskelijat tärkeiksi tukijoiksi ja voimavaroiksi. KOLAPU-opiskelijoilla painottuu toisten opiskelijoidenhenkinen tuki, “vapaa ilmapiiri”, kun taas kiinteistönhoidonopiskelijoilla myös substanssiosaaminen koetaan tärkeäksi.

Kyl meiän ryhmä on hirveen hyvä.

Samansorttisii ihmisii.

Melkein kuin kotiin tulis ku aamulla tulee ja oma porukka on siinä. On sillai...

Ollaan huolissaan, jos joku on poissa. Et saako se monisteet ja....

(KOLAPU-tutkinnon opiskelijoiden ryhmähaastattelu 13.3.1997)

Tai siihen me ollaan pyritty, että toisiltamme kysellään, koska aina löytyy joku, joka tietää jostain asiasta enemmänkuin toinen. Pyöritetään sisäpiirihommana sitä(haastattelijan huomio: viittaa lähijaksoon).

(Kiinteistöhoitajan tutkinnon opiskelijoiden ryhmähaastattelu26.3.1997)

Kiinteistönhoitoa opiskelevat opiskelijat ovat saaneet riittävästi ohjausta, mutta KOLAPU-opiskelijat kaipaavat lisäätukea ja opastusta mm. tietotekniikkaan. Tekniikka koetaan haasteellisena, mutta osaamisen kehittäminen vaatii aktiivista harjoitusta.

- Se oli kivaa aikaa kun puolet luokasta oli keittiössä ja puolet atk:ssa, siinä oppi eniten.

Sama myös keittiössä vastaavasti.

- Eli ohjausta alussa tarvitaan paljon? Kyllä, melkein “suusta suuhun”- opetusta.

- Toisaalta se on hyvä, että käy niitä vahinkoja, koska niist sit taas oppii.

(KOLAPU-tutkinnon opiskelijoiden ryhmähaastattelu 13.3.1997)

Liiketalouden tutkintoa opiskelevat opiskelijat ovat tyytymättömiä koulutuksen suunnitteluun ja organisointiin. Koulutukseen kaivataan koordinoivaa opettajaa, joka huolehtisi opiskelukokonaisuudesta ja antaisi tukea tarvittaessa. Yhteistyötä muiden opiskelijoiden kanssa ei ole eikä sitä kaivatakaan.

- Ja se, minkä mä taas koen pahimpana on se, että kun ei, niin ku kansakoulussakin, et kummiskin jokaisella luokalla on jonkinlainen luokanvalvoja. Eli tässä nyt puuttuu se varsinainenvastuuopettaja, joka ois meihin oppilaisiin yhteydessä, joka hoitas näitä meiän asioita. Joka tavallaan hoitas, ettei tulis näitä katkoksia.

(Liiketalouden tutkinnon opiskelijoiden ryhmähaastattelu 27.5.1997)

- Ja niinku sanoin, yks asia mikä aikuiskoulutuksessa tietyst on, se vastuunottaminen itestään. Niin ehkä siin tuli pikkanen yllätys se, että sitä ajatteli, että se ohjaus olis kuitenkin pikkasen aktiivisempaa mitä se on täällä ollut...

(Liiketalouden tutkinnon opiskelijoiden ryhmähaastattelu 27.5.1997)

- Tähänhän lähettiinkin just ettei tarvitse(haastattelijan huomio: viittaa yhteistyöhön).

- Ei, se on rasite.

- Se on paremminkin rasite.

- Se on ihan totta.

- Siitä tulee kauhee stressi vaan, että millä mä saan kaikki kasaan....

- Se, että jos sut on määrätty joihinkin ryhmään, sulla tulee painetta siitä, että sä joudut ajattelemaan muita.

- Se on just se aikataulutus, se on aika vaikee sopia yhteen, jos siinä on monta tyyppiä samassa porukassa, niin toinen tekee eritahtiin kuin toinen.

(Liiketalouden tutkinnon opiskelijoiden ryhmähaastattelu 27.5.1997)

- No, kyllähän meillä varmasti ois jos me haluttaisiin olla yhteydessä. Meillähän on toistemme sähköpostiosoitteet. Mutta em mä tiedä, en mä ehkä kaipaa sellasta. Se on ihan, mulla on ihan tarpeeksi tekemistä noiden läksyjen kanssa, että ei oo semmosta. Kyllä jos mä kysyisin neuvoa, niin kyllä mä varmastikaan. Mutta ei vaan...se on ihan tämmönen persoonakysymys. Et ei heissä ole mitään semmosta, että mä en haluaisi olla tekemistä. Ei ole tarvetta.

(Liiketalouden tutkinnon opiskelijan yksilöhaastattelu 27.5.1997)

Kokemukset monimuoto-opetuksesta sekä etä- ja lähiopetuksesta

Monimuoto-opetusta pidetään ainoana mahdollisena opiskelumuotona liiketalouden- ja kiinteistönhoitajan tutkintoa suoritettavien opiskelijoiden keskuudessa. Opiskelu sähköisesti on ollut vielä melko vähäistä etäopetuspainotteisessakin opiskelussa. Opiskelijoiden ajan on vienyt suurelta osin koneen käytön opiskelu ja opettajien ajan taas materiaalin ja tehtävien valmistelu.

Liiketalouden perustutkinto, joka pohjautuu pääsääntöisesti etäopiskeluun, on ollut monelle opiskelijalle liian epämääräinen. Koulutus ja koneenkäyttö ei ole hahmottunut opiskelun alussa ja opiskelurytmiin kiinni pääseminen on vienyt jopa yhden lukukauden.

- ...Elikä sillon kun puhutaan esimerkiksi ATK:n, mikrotietokoneenhallinnasta, mikä oli monille vielä aika lapsenkengissä, et oli ihan aakkosista aloitettava, niin se oli liian vähäistä se koulutus. Et siinä mielessä monella varmaan meni ensimmäinenlukukausi siinä, että sai koneen auki...

(Liiketalouden tutkinnon opiskelijoiden ryhmähaastattelu 27.5.1997)

- ...Mikä on mun mielestä hyvä, ettei kaikkea tuoda valmiiksipureskeltuna. Saa tietynlaista rutiinia, mitä tarvitsee muuallakin elämässä. Ja mikä on huonoa, on vaan ihan se, että tästä syystä, että se on näin hahmotonta tai elävää tää opiskelumuoto, niin se tekee sen, että pitäs olla hirveentarkka kirjanpito siitä mitä tekee. Ettei käy niin kuin mulle etten välillä tiedä mikä tentti pitäisi suorittaa ja mikä ei...

(Liiketalouden tutkinnon opiskelijan yksilöhaastattelu 27.5.1997)

Kiinteistönhoitoalaa opiskeleville opiskelijoille nykyinen opiskelumuoto on näyttänyt soveltuvan hyvin. Opiskelu on rytmittynyt hyvin etä- ja lähijaksoihin ja yhteistyö opiskelijoiden ja opettajan kanssa pelaa hyvin.

- Et kyl tää sopii paremmin kuin peruskoulu. Ei oo pakkoo.

- Loppujen lopuks, meil on hirveen hyvä henki kyllä tässä meidän ryhmässä.

- Turhat stressaamiset pois.

- Onhan siinä opettajallakin merkitystä.

- Opettaja on hyvä... ettei olla siellä ja ihmetellä, että mitä tänä aamuna tapahtuu. On suunniteltu.

- Niin ja etäpaketit kun puretaan tuolla pienryhmissä, mikä on mun mielestä hyvä, että ...

- Eli te keskenään puratte tehtävät?

- Joo, omat tehtävät. Opettaja kommentoi ja korjaa tarvittaessa. Me keskenään lähijaksolla puretaan.

- Et kovasti kun on etätehtäväpaketit himassa, niin teet sä mitä tahansa, niin se on aina hyödyks. Vaikka ei sitä- välttämättä kaikkee tarviikaan mitä lukee.

(Kiinteistönhoitajan tutkinnon opiskelijoiden ryhmähaastattelu27.5.1997)

Koti-, laitostalous- ja puhdistuspalvelualan tutkinnon opiskelijat ovat myös suhteellisen tyytyväisiä opiskeluunsa. He pitävät lähiopetuksesta ja sen tuomasta säännöllisyydestä. Etäopetuspäiviin suhtaudutaan myönteisesti, mikäli opetus liittyy tietokoneen opiskeluun. Tämä tosin edellyttäisi koneiden hankkimista kotiin.

- Kyl sitä kun on jo kolme vuotta kotona ollut, niin kyllä sitä nyt haluaa nähdä muita kuin torilla jotain mummuja.

- On se kiva lähteä aamulla johonkin, täytyy herätä ja lähteä...

- Kyl me niist etäpäivist sentään vähän tykätään, jos se etäpäivä olis koton, et näpyttelis sitä (haastattelijan huomio: viittaa koneeseen).

- Se on tietenkin, et joskus ois sillai, niin sillai se on ihanpiristys sille, että kun täällä käy joka päivä.

- Mut samanlainen se vois olla se tietokonepäivä kotona.

- Niin, tietokonepäivä, jos ois tietokone oikeen kotona.

(KOLAPU-tutkinnon opiskelijoiden ryhmähaastattelu 13.3.1997)

Lopuksi

Tähänastisten tutkimustulosten valossa voidaan todeta, että avoimen oppimisympäristön mukainen opiskelu vaatii uusia valmiuksia niin opiskelijoilta kuin opettajiltakin. Opiskelijat tarvitsevat monenlaista ja monitasoista tukea opiskelunsa tueksi, sillä opiskelija-aines on opiskelu- ja atk-taidoiltaan heterogeenista. Itseohjautuvuusvalmiudet varioivat opiskelijoiden ammattialan, aikaisempien(opiskelu)kokemusten mukaan ja niiden huomioiminen ja kehittäminen on ensiarvoisen tärkeää opiskelun onnistumiselle. Opettajien tuleekin paneutua paitsi opiskelijoiden ohjaukseen, niin myös avoimen oppimisympäristön laaja-alaiseen kehittämiseen. Avoin oppimisympäristö pitää sisällään paitsi teknologisiakokeiluja, niin myös pedagogisia sovellutuksia. Oppimisympäristön kehittämisessä tulisikin huomioida niin ammattialan luonne, opiskelijat kuin työympäristökin. Tavoitteenahan on opiskelijoiden ja työelämän tarpeiden kohtaaminen eikä koulutuksen kehittäminen sinällään, itseisarvona. Eräs opettaja kiteytti asian opettajahaastattelussa näin:

“Ja sit jotenkin musta tuntuu, et se ois hyvä, että siellä olis aina jotain muitakin ihmisii, niit semmosii, et tässäkin kaikki on jotain atk-ihmisii, mitkä vetää, niin sit sielt niinku puutuu se semmonen järkevä, joka kysyy niitä yksinkertasia kysymyksiä, mitkä on yleensä tärkeitä kysymyksiä mihin se koko homma sit kaatuu loppujen lopuks. Ja sit se, et näitä tehään näitä projekteja vähän sillai, tai tätä OpinNet:iäkin, että sitä tehään sitä juttuu, mut ei oo opiskelijoita. Ja mä en oikein ymmärrä miks sitä tehään, siin opiskelijoitahan varten me täällä ollaan. Ja jos meil ei oo opiskelijoita niin mitä me sit tehään. Et mä en niinku ymmärrä sitä että niitä tehään ilman että on mietitty et kelle tehään, miks tehään ja miks käytetään tämmöstä muotoo. Kun nyt me ollaan vähän siinä pointissa et me vaan tehään”.

Lisätietoa OpinNet -projektista löytyy seuraavista osoitteista:

URL: http://www.oph.fi/opinnet

Tavoitteet -> http://opinnet.kuakk.fi/opinnet/tavoite.htm
Tutkinnot -> http://opinnet.kuakk.fi/opinnet/tutkinnot.htm
Aikuiskoulutuskeskukset -> http://opinnet.kuakk.fi/opinnet/oppilaitokset.htm
Tutkimus -> http://opinnet.kuakk.fi/opinnet/tutkimus.htm
Lisätiedot -> http://www.oph.fi/opinnet/lisainfo.html

URL: http://www.oph.fi/opinnet/lisainfo.html

Project Tools for Learning (ProTo) Project

Jyrki Pulkkinen, Esa Niemi & Antti Peltonen, University of Oulu

Abstract

Web-based education is gaining increasing attention as a potential medium for the delivery of high quality educational materials and learning environments to a diverse audience. This project is developing and producing the ProTo learning environment based on Web technology for, among other purposes, corporate in-service training through distance education and distance learning while at work. Preliminary versions of the ProTo environment have been used successfully in the university's distance education projects for several years. It has already been used to educate more than 1500 students in a variety of national and international education projects. ProTo project is funded by Finnish Ministry of Education and ESF (ESR).

Keywords

Keywords: Project learning, open learning environment, learning tools, Internet, WWW

Introduction

A challenge facing the development of educational programs in the Web has been to establish the relations between the learning environment, the contents, and the learning method. (Pulkkinen, Niemi 1996) This model of thinking has traditions which date back to the remote past. John Dewey thought that study meant problem-solving that would be most successful through practical research activities. Today these principles have re-emerged as educational challenges thanks to the so-called constructive psychology, in which the basic idea is that the student must construct his knowledge and skills through his own experiences. Collaboration adds new potentials to the learning process. For example, according to Gokhale (1995), collaborative learning methods foster the development of critical thinking through discussion, clarification of ideas, and evaluation of others' ideas.

As with any other instructional products, the pedagogical design of the learning environment is one of the most important steps in the overall process. As many teachers and instructors have adopted the constructivist and collaborative methods in teaching, we should question if the traditional instructional design models are suitable for designing Web based environments. The problem in Web based course designs has been the lack of functional, practical models and tools for the construction of the students' own knowledge. Reading alone does not open the contents of courses, as the participants need to be allowed to do things and produce knowledge themselves and compare it with other students. In our development work, an effort has been made to construct a new kind of open learning environment on the Web that enables distance learning at work or home, adds the social dimension to study and helps the student to develop further his thinking and self-awareness (Järvilehto 1994, Pulkkinen 1996).

Pedagogical principles and tools of the Proto learning environment

The fundamental idea of the constructivist psychology of learning is that the student must construct his knowledge and skills by himself through his own experiences. This takes place best in situations and learning environments arranged for the purpose, putting an emphasis on the process goals and making sure that sufficient support and guidance is available for learning. (e.g. Järvelä 1996.) According to Cennamo et al. (1996), complex technology-based learning environments should take into account the fact that the learners have previous experiences about the things to be learned and that they can concentrate on different things in their studies. Learning is a social process.

Learning through one's own experience and reflection emphasises the student's own activity to a great extent. The guiding principle in our ProTo environment is that the studies proceed as a project from the student's point of view. Project learning situations can arise from different inputs: practical or theoretical problems related to student's own learning goals, earlier experiences or related learning materials.

Project learning means that the student's first task is to get oriented towards the field of topics to be learned, and to *determine a goal* for his studies which is sensible and challenging from his own viewpoint. The goal is reached gradually through *project work* supported by different *learning materials* and joint discussions. In this practico-theoretical project work, students can put together all the knowledge that they have experienced meaningful in the learning materials and discussions.

One of the tools for project learning in ProTo consists of a remote editor for project pages. The remote editor system enables the students to produce their project pages easily on the Web, even without any knowledge of how to use the HTML language. The students can also paste HTML page scripts made in another editor. To achieve system security, students can only edit their own pages, but they can also read the pages of all other students. The tutors and administrators have access to edit all the pages. In that way they can, for example, more easily help the students in their work.

In learning theoretical or practical skills, experience adds to the student's knowledge level but is not, however, sufficient to reach the level of higher learning processes. This would presuppose so-called reflection, which can be described as a general term for those intellectual and affective actions with which an individual handles his experiences in search of a new kind of understanding and evaluation. As far as reflection is concerned, it should be remembered that although an individual himself controls the reflection process, he also needs social interaction to reflect and compare his own ideas with those of others. An individual learner can process his own experiences and link new ideas and insights into the cognitive schemes of other people. It is the teacher's role to assist and support this process.

To reflect on problems, the students can use the questions presented in the learning materials or personal bookmarks as a starting-point. Special tools for reflective discussions have been created for this purpose in our ProTo environment. Reflective discussions in the social context are very important to make the students feel that they belong to the group which has come together to try and learn, to find a deeper understanding of the matter that they are learning about.

Learning is a process. Because the project work will be finished slowly as students proceed in their studies, it has been useful to develop so-called "portfolio study" for organisation and joint evaluation of knowledge. The students must gather any thoughts directly provoked by each section of the learning materials to the relevant pages which are indexed by ProTo automatically. On this basis it is possible to enter into a discussion with the other students and with the tutor. Through this reflective and social activity on the Web, the students are able to finish their project papers trying to improve their designs and expertise.

Proto learning environment technology

In the new learning environments, the technical operating environment becomes an active part of the whole (Tessmer, Richey 1997), and the technical implementation cannot be separated from the rest of the planning process. However, traditional instructional design and the CAL software implementing schemes based on it cannot be applied in the creation of a computer-based open learning environment. Therefore it has been necessary in the ProTo project to consider technological alternatives and technical implementations on the basis of new pedagogical thoughts and functional elements based on them.

The construction of new learning environments is always R&D by nature. Therefore the technology that is chosen needs to be flexible and easy to manage. In this way it is possible to produce genuine and fast interaction in the entire development team, and there is not any gap between the basic ideas and technical implementation. The development of ProTo has been taken part in by people with different backgrounds, and it has been possible to test the functioning of alternative approaches in the courses that have already been arranged.

The ProTo technology is scaleable in such a way that the same technology can be used both in the development work and in the true course environment. The use of separate production and R&D environments makes it more difficult to understand the phenomena caused by the technology and delays the solving of related problems.

The backbone for the ProTo learning environment is provided by the study server on which information systems have been constructed to support the studies, especially project study. This server (http://edtech.oulu.fi) is an active Web server that enables "real-time" bi-directional communication. At the same time the server platform also makes it possible to use networked multimedia and hypermedia in the ProTo environment.

The linking of various different functions and areas to each other was the main reason why the ProTo environment was implemented as a database-based system. The controversial static/dynamic nature of the data content and security issues are also easy to manage in the Web database approach.

Accessibility, ease of use and cost-efficiency spoke in favour of using a standard Web browser to provide the student interface to ProTo. The maintenance and control tools for the teacher/tutor also run on a standard Web browser.

Based on the above-mentioned theoretical starting-points and practical experiences, the use of readily available communication and collaborative work applications was abandoned in the ProTo project, while a fragmented environment consisting of a number of different "standard systems" such as e-mail, Web pages and NetNews does not enable easy management of the learning environment nor full-coverage organisation of the pedagogical activities.

Current experiences in real courses

Currently we use ProTo environment as a essential part of the normal pre-service and in-service courses at the faculty of education and continuing education centre. The implementation of the learning environment aims to open learning possibilities and create study communities irrespective of place or time of the study. In the academic year 1996-1997 we had over 1500 students (pre-service/in-service; domestic/international) studying and using the ProTo environment. The following cases will describe how the ProTo environment enables the distance studies for students in different subjects and different locations.

Case 1. International Web based course for teachers

The Faculty of Education, University of Oulu is a partner in the European Union funded project called T3, Telematics for Teacher Training, led by the University of Exeter, UK. The project is a part of European Union 's 4th framework telematics programme. As a part of the T3 project the Faculty of Education has created a special course for technology teachers implemented by means of WWW technology. The theme of the course is ”The Lego Dacta Construction Kit and Logo Programming Language as a Learning Environment in Technology Education”. The student teachers and teachers from Finland, UK, the Netherlands and Italy took this course in spring 1997.

As a starting point for reflecting the problems dealing with proper pedagogical usage of Lego/Logo kits at the school, students can read the articles published on the Web and experiment with the Lego kit at the ”Lego/Logo laboratory”. Some of the students can have lots of experience of Lego kits, while others have none. This will offer a common starting-point for the heterogeneous group of students.

At the lab learners can control the Lego device in the lab by issuing Logo commands through a Web page. They will see the resulting movements of the Lego device on a Web page through a live video connection. According to our own experiences the Lego lab provides a highly motivating starting-point for the studies. After studying the theory of technology education and robotics, they can thus get in ”touch” with Lego/Logo programming and problem solving in the Lego/Logo environment.

Learning through one's own experience and reflection puts a lot of emphasis on the student's own activity. The guiding principle in our course is that the studies proceed as a project from the student's point of view. Students can write and present the project plans and reports on ProTo environment. In addition to traditional information presentation, it is also possible for the students to take part in discussions on Proto based on their project papers and other learning experiences. The ProTo discussion tools have been developed to support argumentation and reflective discussion. In the ProTo discussion forum, the students can also get assistance in any questions related to the studies or the learning environment.

Case 2. Decentralised study environment model in learning; Continuing teacher training activities in Northern Finland

The Continuing Education Centre of the University of Oulu has organised mass scale teacher training in Northern Finland, related to "Finland towards an Information Society" programme financed by the National Board of Education in Finland. In 1996-1997 over 1000 teachers have participated in this 5 study credit week entity of the programme, which is to be considered a large number compared to the population density and large geographical area of Northern Finland. Furthermore CEC has organised a 15 credit programme in educational technology, in which over 200 teachers have participated. In both of the programmes the same concept of decentralised study environment model has been used.

Training has been implemented in 20 different training locations using telematic applications. CEC has trained a local tutor to guide a group of students in each training location. Lectures are being transferred to each training location via video conferencing facilities, using the vc bridge of the University of Oulu. The back bone of the training concept is a study diary made by each student on www pages with Proto as the tool. In the study diary the student reflects on ideas and questions brought up during lectures or raised by the study material and other sources. The diaries are public materials inside the student group because they are produced in the ProTo environment. The idea is not only to produce own reflections but to read what others have thought about the same matters and converse on these. The feed back from students suggests that the Proto environment where the documents are being produced has been working well. It is easy to use and the student does not have to master a lot of technology in order to be able to work. On the other hand the environment is challenging for the students because a traditional study orientation is not applicable anymore; the idea is not to teach the students but give them tools to learn actively by themselves. It seems that the students are able to start producing their study diaries in a relatively easy way, but the other part of using them i.e. reading what others are producing and especially commenting on their output is difficult, reaching a reflective stage in the process in other words. This presents a challenge for the future processing of Proto, to make communication more obvious in the environment.

References

Boud, D, Keogh, R and Walker, D. (ed).(1987)Reflection: turning experience into learning. London: Kogan Page.

Cennamo, K. S. Abell, S.K. & Chung, M-L 1996. A Layers of “Negotiation” Model for Designing Constructivist Learning Materials. Educational Technology. Vol. 36, No:4.

Gokhale, A. A. 1995. Collaborative Learning Enhances Critical Thinking. Journal of Technology Education. ISSN 1045-1064. Vol. 7, No: 1.

Jonassen, D.H. (1994). Thinking Technology. Toward a Constructivist Design Model. Educational Technology April/1994, 34-37.

Pulkkinen, J. (1996). Technology Changing the Pedagogical Culture. The Thirteenth International Conference on Technology and Education, ICTE, March, 17-20, 1996. New Orleans, USA

Pulkkinen, J. & Niemi, E. (1996). Kohti sisällön ja muodon integraatiota - koulutusteknologia 15 ov. Koulutusteknologia-lehti 1/96, 14-15.

Pulkkinen, J. (ed.). (1996).Introduction to Telematics in Teacher Training: First flexible learning material package of T3.

Sweefers, W. (1994). Multimedia Electronic Tools for Learning. Educational Technology May-June/-94, 47-52

Tessmer M. & Richey R., The Role of Context in Learning and Instructional Design. ETR&D, Vol.45, No 2, 96-98

Tietotekniikan ohjelmistojen perusteet (TOP) - hanke

Tahvo Hyötyläinen, Kati Koivu & Jarmo Viteli,
Hypermedialaboratorio, Tampereen Yliopisto

English abstract

English abstract. *This paper introduces the use and theoretical foundations of hypermedia-based learning material produced by Hypermedialaboratory and Department of Computer Science of University of Tampere. Our goal is to make theoretical ideas as well as cognitive tools to come existence in World Wide Web.*

Keywords

Keywords: World Wide Web, strong interaction, authentic learning.

Abstrakti

Artikkelissa tutustutaan Tampereen yliopiston hypermedialaboratorion ja tietojenkäsittelyopinlaitoksen tuottamaan hypermediaperustaiseen verkko-oppimateriaaliin. Artikkelissa tuodaan esille hankkeen lähtökohdat, oppimateriaalin suunnittelun pedagoginen viitekehys ja materiaalin käytännön toteutus pedagogisesta ja oppimisteoreettisesta näkökulmasta.

Aluksi

Nopeasti tietokoneistunut ja verkottunut korkeakoulumaailma on synnyttänyt korkeakouluopiskelijoille aivan uudentyyppisiä oppimistarpeita, joita muodollisen opetuksen puitteissa ei voida tyydyttää. Tietoverkoista on tullut uusi toiminta- ja oppimisympäristö, jossa tapahtuvaa oppimista voidaan kutsua verkko-oppimiseksi. Moderniin informaatio- ja kommunikaatio-teknologiaan perustuvien oppimisympäristöjen merkitys katsotaan kasvavan ja niissä tapahtuva informaalinen opiskelu hyväksytään osaksi normaalia opiskelua. Tampereen yliopiston hypermedialaboratorio ja tietojenkäsittelyopin laitos ovat tuottamassa opetusministeriön tilauksesta hypermediapohjaista oppimateriaalia tietotekniikan perusteista ja sovellusohjelmistoista verkkoympäristöön. Materiaali on suunnattu sellaisille korkeakoulu- ja yliopisto-opiskelijoille, joilla ei ole entuudestaan kovin paljoa kokemusta tietokoneiden käytöstä yleensä ja erityisesti verkkoympäristössä. Hieman kokeneemmille materiaali tukee uusien sovellusohjelmien haltuunottoa ja käyttöä kompleksisimpiin tehtäviin. Oppimateriaali on vapaassa verkkolevityksessä ja siten kaikkien verkossa liikkuvien hyödynnettävissä lukuvuoden 1997 alusta lähtien.

Koska opintomateriaali on suunnattu opiskelijalle, joka ei ole juuri aiemmin käyttänyt tietokonetta eikä liikkunut tietoverkoissa, materiaalin tarkoituksena on opettaa kahden keskeisen käyttöjärjestelmän perusteet ja molempien käyttöjärjestelmien yleisimpien sovellusohjelmien perusteet. Verkosta löytyy esimerkiksi ohjeet siitä, kuinka käyttää tekstinkäsittelyohjelma kuten Wordia, taulukkolaskentaohjelma, Exeliä tai kuinka piirtää kuvia Paint-ohjelman avulla. Opastusta löytyy sähköpostin lähettämisestä Pinen avulla, uutisryhmien lukemista tinillä ja muokkausohjelma emacsin käytöstä. Tukimateriaalina on käytössä Tampereen yliopiston tietotekniikan peruskurssin luentorunko ja muu kirjallinen materiaali.

TOP-hankkeen pedagoginen viitekehys

Hypermediapohjaisten ja interaktiivisten oppimateriaalien katsotaan tarjoavan perinteistä tekstiperusteista oppimateriaalia rikkaamman oppimisympäristön, korostavan oppijan aktiivista roolia oppimistapahtumassa ja siirtävän painopistettä oppimisen ulkoisesta säätelystä kohti oppimisprosessin sisäiseen säätelyyn. Edelleen niiden katsotaan tukevan käsiitteellistämistä ja tiedon konstruointia. Näin ne samalla tukevat konstruktiivista oppimisnäkemystä, vaikka se ei välttämättä ole ollut hypermediapohjaisten oppimateriaalien suunnittelun oppimisteoreettisena viitekehyksenä.

Sosiaaliseen yhteistyöhön perustuvissa oppimisnäkemyksissä hypermediapohjaisia oppimateriaaleja ja -ohjelmia on arvosteltu siitä, että ne eivät tue dialogia eli opittavan materian työstämistä keskustelun avulla. Hypermediapohjaisten oppimateriaalien siirtäminen tietoverkkoihin katsotaan laajentavan oppimisympäristöä sosiaalisella aspektilla, jolloin oppimisesta tai kognitiosta tulee jaettu - yhdessä opitaan paremmin kuin yksin. Hypermediapohjaisten oppimateriaalien siirtäminen tietoverkkoihin ei sinänsä tee niistä sosiaalisella aspektilla laajennettua oppimisympäristöä. Itse oppimisympäristön käsite on opettamisen teorioissa verraten uusi. Tavallisesti se määritellään oppiaineksesta, ja fyysisestä, sosiaalisesta sekä kultturaalisesta toimintaympäristöstä muodostuvaksi kokonaisuudeksi. Vaikka konstruktivistisen oppimisnäkemyksen mukaan opettajan suora vaikuttaminen oppijaan on mahdotonta ja näin ollen oppimisympäristö nousee keskeiseksi, oppija ja ympäristö nähdään kuitenkin erillisinä; oppiminen on yksilön ominaisuus.

Sekä kontekstuuaalisessa että systeemisen psykologian oppimisnäkemyksessä ihminen ja ympäristö muodostavat yhden toiminnallisen järjestelmän. Kontekstuaalisessa lähestymistavassa, erityisesti Engeströmin ekspansiivisen oppimisen teoriassa (Engeström 1987) oppimisen tarkastelun yksikkö on kehittyvä toimintajärjestelmä. Oppiminen ei ole ainoastaan yksilön sisäistä toimintaa, vaan yhtä lailla yhteisöön ja yhteiskuntaan vaikuttavaa ulkoista toimintaa, jossa kulttuuri ja kognitio tuottavat toinen toisensa (Kauppi 1993, 89). Antropologista tietoa eri kulttuurien oppisopimusjärjestelmistä hyödyntävät oppimiskäsitykset näkevät oppimisen osallistumisena yhteiseen käytäntöön. Oppiminen sijoitetaan yhteisen osallistumisen prosesseihin, eikä oppijan päähän (Hanks 1991).

Viime vuosina on rakennettu myös käsitystä yksilön ominaisuudet ylittävästä asiantuntijuudesta, jossa asiantuntijuus ja osaaminen eivät ole kuvattavissa enää yksilön ominaisuuksina, vaan tiimien ja verkostojen jaettuna tai yhteisöllisenä osaamisena (Engeström 1992). Systeemisen psykologian mukaan kaikki käyttäytyminen toteutuu eliö-ympäristö-järjestelmässä (Järvilehto 1994, 27). Eliön ja ympäristön yhteistyö toteutuu kehämäisten toimintajärjestelmien organisoitumisen kautta (emt. 28). Tieto on eliö-ympäristöjärjestelmän toimintaa mahdollistava organisaatio; olemassaolon muoto (emt. 128). Oppiminen on prosessi, jossa tietoa luodaan riippuen siitä, mitä ihminen ympäristöstään tarvitsee ja minkälaisia tuloksia toiminnan tulee tuottaa (emt. 156). Oppiminen ei siis ole tiedon siirtämistä esimerkiksi opettajalta oppilaalle, vaan oman toimintaympäristön laajentamista (Järvilehto 1995, 171). Kontekstuaaliset ja systeemisen psykologian oppimisnäkemykset antavat mielenkiintoisen näkökulman tietoverkkoihin sijoittuvien toimintaympäristöjen tarkasteluun ja rakentamiseen uusina oppimisympäristöinä.

Uudet oppimisympäristöt ovat vahvasti 'sisäänsulkevia' - immersiiviisiä - ja siksi vuorovaikutuksen luonne niissä on laadullisesti erilaista kuin perinteisissä oppimisympäristöissä. Voidaan puhua vahvasta vuorovaikutuksesta, millä tarkoitamme käyttäjän vuorovaikutuksen siirtymistä satunnaisista tapahtumista harkittuihin tekoihin, jotka liittyvät itse toimintaan. Mitä enemmän vuorovaikutuksessa on luomisen piirteitä, sitä enemmän ympäristö tukee vahvaa vuorovaikutusta Sekä tieto että oppiminen ovat luomistapahtumia. Oppimisympäristö voidaan määritellä sellaisena toimintaympäristönä, joka on organisoitunut tuottamaan oppimista ja johon oppiminen sijoittuu (Hyötyläinen, E & al. 1997). Tästä seuraa, että oppimisympäristöt ovat kohdespesiifejä ja dynaamisia. Edelleen määritelmästä seuraa, että tällaisissa oppimisympäristöissä korostuvat autenttiset tehtävät. Oppimismotivaatio ei rakennu oppijan tarpeille, vaan toimintakäytännöistä nouseville haasteille.

Käytännön toteutus

Pedagogisen ja oppimisteoreettisen viitekehyksen puitteissa TOP-oppimateriaalin suunnittelussa on haluttu erityisesti ottaa huomioon verkkoympäristön luonne ja oppijan tarpeet. Materiaali pyrkii vastaamaan käytännön toiminnasta nouseviin haasteisiin. Oppijaa halutaan rohkaista kokeilemaan ja tekemään, eikä vain selaamaan sivuja. Huomiota on kiinnitetty erityisesti:

- kohderyhmän tarpeisiin ja valmiuksiin
- käyttöliittymän selkeyteen ja johdonmukaisuuteen
- sisällön selkeyteen ja johdonmukaisuuteen
- kokonaistoimintaan ja toiminnan läpinäkyvyyteen
- vahvaan vuorovaikutukseen
- verkkoympäristön mahdollisuuksiin.

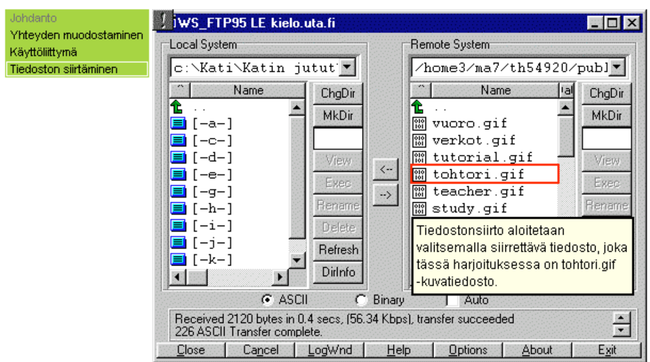
Oppimateriaalia on suunniteltu alusta alkaen yhteistyössä sekä tietotekniikan peruskurssien ohjaajien kanssa että perusteita opiskelevien henkilöiden kanssa. Näin suunnitteluun on voitu paremmin sisällyttää ne vaatimukset, joita kurssin kohderyhmä asettaa.

Useimmissa verkkopohjaisissa oppimateriaaleissa on ongelmana "liiallinen" hyperteksti-ominaisuuksien käyttö. Kaikki mahdollinen on linkitetty, jolloin opiskelija joutuu tarpeettomasti poukkoilemaan materiaalin sisällä saamatta siitä eheää kokonaiskuvaa, osista ei tule kokonaisuuden summa. Opiskelu verkossa jää hyvin helposti surffailuksi aivan kirjaimellisesti. Tällainen surffailu ei tue oppimisprosessia edes käsitteellistämisvaihetta - puhumattakaan tiedon konstruoimisvaiheesta (Hyötyläinen E et al 1997, 174). Sen sijaan, että opiskelija liikkuu irrallisten assosiaatioiden mukaan, TOP-materiaalissa linkit on pyritty muodostamaan oppimisen tuloksellisuuden kannalta mielekkäästi. Oppimateriaalissa siirtymisen tavoitteellisuutta on lisätty esimerkiksi jättämällä sisältötekstistä linkit pois.

Käyttöliittymän suunnittelussa tämä on näkynyt siten, että on pyritty vahvan vuorovaikutuksen lisäämiseen tarjoamalla kokonaiskuvia materiaalin sisällöstä (kuva 1) (TOP-projekti). Näin voidaan vähentää sivujen selailua ja siirtyä yksittäisten osien omaksumisesta kokonaisuuksien ja asiayhteyksien hahmottamiseen. Tätä tukemaan on oppimateriaaliin tehty johdantosivuja, jotka havainnollistavat kyseisen osion rakenteen ja osien laajuudet. Myös haku-toimintoon on jokaiselle hakusanalle tehty kuvaus siitä, missä yhteydessä sana sivulla esiintyy.

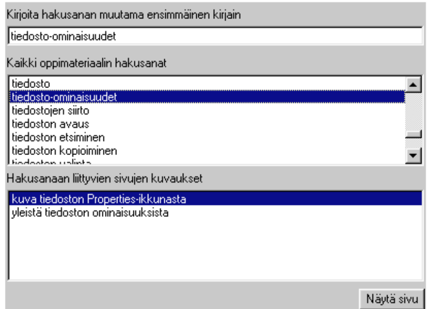
Kuva 1. Netscape -osion johdantokuva

Opiskelijan aikaisempaa osaamista on pyritty hyödyntämään opettamalla sellaisia toimintatapoja, jotka toimivat mahdollisimman monissa ympäristöissä. Esimerkiksi valikoiden käyttöön ja tiedostojen käsittelyyn liittyvät toimenpiteet opetetaan eri osioissa samalla tavalla, jotta oppijalle muodostuisi valmiita toimintamalleja joita tunnistaa ja soveltaa itsenäisesti uusissa toimintaympäristöissä. Tavoitteenamme vuorovaikutteisuuden toteuttamisessa on ollut, että jokainen teko on harkittu ja mielekäs. Oppimateriaalissa oppilasta ohjataan kokeilemaan vuorovaikutteisten kuvasarjojen avulla yksinkertaisia ja autenttisia toimintoja ja samalla tuetaan oppilasta mahdollisissa ongelmatilanteissa (kuva 2) (TOP-projekti). Tällöin oppilas voi testata omia hypoteesejaan turvallisesti, minkä jälkeen hänellä on paremmat valmiudet toimia autenttisessa ympäristössä. Vuorovaikutteisuus on toteutettu Java-kielen avulla, joka on mahdollistanut siirtymisen vahvaan vuorovaikutukseen.



Kuva 2. Tiedoston siirto ftp-ohjelmalla

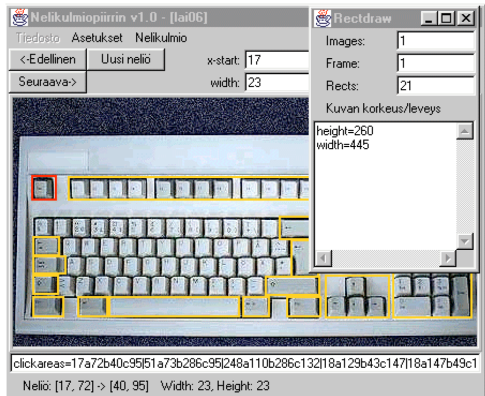
Opiskelija voi kuitenkin halutessaan etsiä tietoa hakutoiminnon ja lisätietojen avulla (kuva 3) (TOP-projekti).



Kuva 3. TOP-materiaalin hakutoiminto.

TOP-materiaalin tuotantovälineet

Laajan materiaalin toteuttaminen vuorovaikutteiseksi ja oppimisteoreettisesti perustelluksi kokonaisuudeksi vaati omien tuotantovälineiden kehittämistä. Tätä varten kehitettiin Generate!-niminen Java-sovellus, joka mahdollistaa laajan materiaalin nopean tuottamisen valmiiden pohjien sekä erityisten työkalujen avulla. Generate!-ohjelma kokoaa yhden oppimateriaali-osion kaikki HTML-sivut useista tietokannoista, jotka sisältävät informaatiota sivujen väreistä jne. sekä "generoi" sivut valmiin pohjan mukaisesti. Generate!-ohjelma myös linkittää sivut dynaamisesti, jolloin sivujen päivitys helpottuu oppimateriaalia päivittäessä (kuva 4) (TOP-projekti).



Kuva 4. Generate!-ohjelman piirtotyökalu, jolla toteutettiin ohjelman vuorovaikutteiset kuvasarjat

TOP-projektin tulevaisuus

TOP-projekti on saavuttanut kehityksensä ensimmäisen vaiheen. Seuraavaksi sitä arvioidaan sekä kvanti- että kvalitatiivisesti suorittamalla sekä sen käyttöön että soveltamiseen samoin kuin saavutettuihin oppimisprosesseihin ja -tuloksiin liittyvää tutkimusta. Näiden tulosten perusteella pyritään voimavarojen puitteissa, kehittämään TOP-oppimisympäristöä yhä paremmin käyttäjien tarpeita tyydyttäviksi. Kehitettäessä uusia verkkopohjaisia oppimisympäristöjä on niiden jatkuva arviointi ja kehitystyö oleellisen tärkeää, jopa tärkeämpää, kuin perinteisillä kursseilla. Verkko-oppimisympäristön käyttäjiä voi helposti olla jopa tuhansia ja näin sen positiiviset ja myös negatiiviset vaikutukset ovat huomattavasti laajemmat kuin perinteisen, suppealle ryhmälle tarjotun koulutuksen.

Uskomme verkon hyväksikäytön oppimisen tukena lisääntyvän hyvin nopeasti. Verkon hyödyllisyys oppimisessa on riippuvainen siitä, miten oppimisympäristön kehittäjät tuntevat ja osaavat soveltaa oppimisen ja opettamisen periaatteetteita verkkoympäristössä. Vaikka paljon jo tiedetään oppimiseen yhteydessä olevista asioista, on edelleen paljon kysymyksiä vailla vastausta. Enemmän tarvitaan systemaattista tutkimus- ja kehittämistyötä, jotta verkon pedagogiset mahdollisuudet tulisivat oppijan kannalta parhaalla mahdollisella tavalla hyödynnetyiksi. TOP-projekti on suunniteltu pitkäjänteiseksi tutkimus- ja kehitteljalustaksi kohti laadukkaampia vuorovaikutteisia verkkopohjaisia oppimisympäristöjä.

Lähteet

Engeström, Y. 1987. Learning by expanding. An activity-theoretical approach to developmental work research. Helsinki: Orienta-Konsultit Oy.

Engeström, Y. 1992. Interactive Expertise. Studies in Distributed Working Intelligence. Research Bulletin 83. Helsinki: University of Helsinki, Department of Education. Helsinki: Orienta-Konsultit Oy.

Hanks, W. F. 1991. Foreword. Teoksessa J. Lave & E. Wenger, Situated learning: Legitimate peripheral participation. Cambridge: Cambridge University Press.

Hyötyläinen, E., Hyötyläinen, T. 1997. Virtuaaliympäristöt oppimisympäristöinä ja oppivina ympäristöinä. Tutkiva opettaja -kokemuksista pedagogiikaksi. Joensuun yliopisto. Savonlinnan opettajainkoulutuslaitos. Kasvatustieteiden tiedekunnan selosteita. N:o 64.

Järvilehto, T. 1994. Ihminen ja ihmisen ympäristö. Systeemisen psykologianperusteet. Oulu: Pohjoinen.

Järvilehto, T. 1995. Mikä ihmistä määrää. Oulu: Pohjoinen.

Kauppi, A. 1993. Mistä nousee oppimisen mieli ? Kontekstuaalisen oppimiskäsityksen perusteita. Teoksessa Kajanto, A. (toim.) Aikuisten oppimisen uudet muodot: Kohti aktiivista oppimista. Vapaan sivistystyön 34. vuosikirja. Jyväskylä: Gummerus, 51-109.

TOP-projekti. Hyötyläinen T., Uotila A., Somero S., Koivu K., Aaltonen A., Levy H., Viteli V., Räihä K., Hietala P., Raisamo R., Hiekkaranta M., Heikkinen M. Tietojenkäsittelyopin laitos/Hypermedialaboratorio. Tampereen Yliopisto. http://www.uta.fi/hyper/top.

Hypertekstin moniulotteisuus - myytistä hyödylliseksi resurssiksi?

Juha Kämäräinen
University of Oulu

The multidimensional nature of hypertext - from a myth towards an useful resource. English abstract. Hyperdocuments can be modelled as multidimensional vector spaces. To develop multidimensional structure is not enough without supporting semantics. That kind of semantics can be build by using facet analysis i.e. semantic factor analysis of the material that will be used in the hyperdocument. The semantic "dimensions" found during facet analysis can be modelled in the hyperdocument by topologies like hypercube and hypertorus so that distinct topics have a kind of coordinates in the structure of hyperdocument. These in turn can be useful helping both the user to navigate and the maintainer to find out the consequences of updating certain parts of hyperdocument. From learning point of view the process of building a multidimensional hyperdocument can be seen as quite a demanding knowledge constructing task. In this article I have introduced some points that should be considered when building hyperdocuments with multidimensional geometry by using procedures based on manual indexing of the source material.

Abstrakti

Hypertekstiin liitetään moniulotteisuuden määre. Tässä artikkelissa kuvataan moniulotteisuuden ilmentymiä ja hallitsemista hypertekstitypologioiden ja dokumenttien sisällönkuvailun avulla. Artikkelissa noudatetaan hypertekstin laatijan näkökulmaa, jonka katsotaan sisältävän myös oppimisen aiheesta hypertekstiä laatimalla. Lineaarinen teksti rinnastetaan luokittamiseen, joka sijoittaa kohteet tiettyyn paikkaan kun taas hyperteksti rinnastetaan indeksointiin, jolla luodaan useita yhteyksiä kohteisiin. Moniulotteisuuden toteuttamiseksi kuvataan hypertekstin solmutyypit, esittävä solmu ja listasolmu, ja esitetään niiden tehtävät hyperdokumenteissa sekä kuvataan polkujen käyttöä käyttäjän ohjaamiseksi hyperdokumentissa.

Hypertekstin moniulotteisuuden myytti

Hypertekstin keskeisiä mainesanoja "epälineaarisuuden" ohella on "moniulotteisuus": Puhutaan siitä, kuinka hyperteksti tarjoaa mahdollisuuksia luoda useita rinnakkaisia organisaatioita ja eri käyttäjille sovitettuja "pääsyteitä tietoon". Kuitenkin, kun tarkastellaan yleisessä käytössä olevia hypertekstijärjestelmien sovelluksia, kuten multimedia-cd-romeja tai World Wide Webin sivujärjestelmiä, havaitaan, että monien näiden sovellusten ainoa yhteys hypertekstiin on, että ne on laadittu hypertekstiominaisuuksia sisältävää työvälinettä käyttäen. Itse sovellukset noudattavat perinteistä kirjaa matkivaa "edellinen sivu / seuraava sivu" -selausperiaatetta. Toinen yleinen näkymä on, että alkujaan lineaarisesti selailtavaksi tehty teksti "koristellaan" enemmän tai vähemmän osuvilla ja vaihtelevasti toimivilla linkeillä "hypertekstivaikutelman" aikaansaamiseksi. Tällaiset ”hypertekstisovellukset” eivät ole käytettävyydeltään edes samanveroisia kuin vastaava teksti paperilla, sillä kuvaruudulta lukeminen voi olla kolmanneksen hitaampaa kuin saman tekstin lukeminen paperilta (Shneiderman 1992). Ymmärretty ja hallitusti hyödynnetty moniulotteisuus voi kuitenkin olla niitä ominaisuuksia, joilla hypertekstidokumentille luodaan se lisäarvo, joka kompensoi käytettävyyteen liittyvät ongelmat ja todella antaa käyttäjälle ”jotakin enemmän”. Toinen, ja nähdäkseni vähemmän käytetty, moniulotteisuuden sovellutus on se ymmärrys, jonka hypertekstin laatija saa sovellusalueen käsitteistä ja niiden välisistä suhteista luodessaan perustellun ja tasapainoisen moniulotteisen hyperdokumentin. Tässä esityksessä noudatetaan laatijan näkökulmaa, mikä vastaa myös konstruktivistisen näkemyksen mukaista oppijan roolia.

Miksi moniulotteisuudesta puhuminen on perusteltua?

Hypertekstin moniulotteisuudesta voidaan puhua aivan perustellusti ja myös hallita sitä, mikä voidaan osoittaa seuraavan analogian kautta: Perinteinen luokitusajattelu lähtee liikkeelle ”sijoittamisesta” — ”on löydettävä paikka kaikelle ja sijoitettava kaikki paikalleen”. Kun tämä lähtökohta asetetaan, kylvetään myös ensimmäisten ongelmien siemenet, sillä luokitettavat oliot ovat tuskin koskaan täysin ”yksipiirteisiä”, jolloin luokitustilanteessa joudutaan aina hylkäämään sekundaarisiksi katsottuja ominaisuuksia, jotta voidaan löytää sijoittamiselle peruste. Taustalla vaikuttaa oletus, että on olemassa yksi ”oikea” maailma, jonka mukaisia perusteita noudattaen päästään luokittelun sopusointuun. Ongelma konkretisoituu dokumentteja luokitettaessa: moniaiheiselle ja -näkökulmaiselle dokumentille ei ”oikeata paikkaa” voida löytää, vaan se tulee aina sijoitetuksi joidenkin aiheidensa ja näkökulmiensa kannalta ”väärin”.

Tämä ongelma on toki tiedostettu ja luokittamisen rinnalle tai jopa korvaajaksi on kirjastoympäristössä nousemassa *indeksointi*. Indeksointiprosessin kuluessa dokumentille annetaan yleensä useita sen sisältöä kuvaavia termejä, jotka valitaan erityisen sanaston (thesaurus) avulla tai käytetään samoja termejä, joita dokumentissa itsessään on eri aiheille ja näkökulmille valittu. Jos luokituksen metaforana on ”sijoittaminen”, indeksointia vastaa nähdäkseni ”ripustamisen” metafora: dokumentti ikään kuin ripustetaan kiinni niihin aiheisiin, joista se kertoo ja näiden ripustusten lukumäärää ei periaatteessa ole lainkaan rajoitettu.

Voidaan sanoa, että perinteinen ”lineaarinen” teksti ja hyperteksti suhtautuvat toisiinsa kuten luokitus ja indeksointi. Jos ajatellaan lineaarisen tekstin kappaleen ja hypertekstin solmun vastaavan toisiaan, kappale sijoitetaan edeltäjänsä ja seuraajansa väliin. Viittausten avulla voidaan toki luoda muitakin yhteyksiä, mutta ne ovat väistämättä edellä mainittuihin nähden toissijaisia eikä teksti ole rakenteena ”aidosti” verkkomaista. Indeksointiin vertautuvassa hypertekstissä tarkasteltava solmu vastaavasti ripustetaan linkeillä kiinni sellaisiin solmuihin, joihin sillä on relevantti suhde sijainnista riippumatta.

Hypertekstin moniulotteisuudesta voidaan siis puhua perustellusti silloin, kun dokumentin laatija on tietoinen siitä, että solmuilla voi olla relevantteja yhteyksiä useisiin muihin solmuihin ja hyödyntää tätä ajatusta alusta pitäen.

Eikö indeksointi tai ”ripustaminen” sitten merkitse sitä, että hypertekstin laatiminen osoittautuu liian monimutkaiseksi, että mahdollisuuksia on liikaa ja niitä on säänneltävä tai rajoitettava? Tähän voidaan vastata toteamalla, että indeksoinnin tarkoitus on saattaa käyttäjä dokumentin luo ja päinvastoin — aivan kuin luokituksenkin. Indeksointi vain lähtee ajatuksesta, että käytettävissä on apuneuvoja, joilla pääsy dokumenttiin ja dokumentin sisältö erotetaan sen fyysisestä sijainnista. Indeksoinnin ”vapaus” ei merkitse periaatteiden puuttumista, vaan erityyppisen käsitenäkemyksen soveltamista.

Medin ja Smith (1984) erottavat kolme näkemystä käsitteistä, nimittäin klassisen, probabilistisen ja ilmentymiin perustuvan (exemplar) näkemyksen. Klassinen käsitenäkemys edellyttää, että käsitteen kaikki ilmentymät jakavat saman piirrejoukon, joka määrittää käsitteen. Probabilistisessa näkemyksessä käsitteellä ei ole yksiselitteisen määrittäviä, vaan ainoastaan tyypillisiä (characteristic) tai todennäköisiä (probable) piirteitä. Ilmentymiin perustuva käsitenäkemys kieltää määrittävien piirteiden olemassaolon ja esittää, että käsite itse määrittyy ilmentymiensä kautta eikä päinvastoin, ts. käsite koostuu joukosta ilmentymiä.

Voidaan sanoa, että tavallinen teksti kieltää ja hyperteksti tunnustaa sen, ettei käsitteitä (eikä myöskään tekstien sisältöjä) voida määritellä yksiselitteisesti. Medinin ja Smithin jaottelussa tavallinen teksti siis seuraa klassista käsitemäärittelyä, kun taas hypertekstissä voidaan nähdä probabilistisen ja ilmentymiin perustuvan käsitemäärittelyn aineksia. Yhteys dokumentin geometriaan syntyy siitä, että klassinen käsitemäärittely tuottaa puurakenteita, mutta probabilistinen ja ilmentymiin perustuva määrittely tuottavat verkkomaisia (syklisiä) rakenteita.

Moniulotteisuus ja hypertekstin geometriat

H.Van Dyke Parunak (1989) erottaa 6 hyperdokumentin geometriaa. Nämä ovat: lineaarinen rakenne ja sen erikoistyyppi rengasrakenne; hierarkkinen rakenne; hyperkuutio ja hypervannike (hypertorus) sekä suunnattu asyklinen rakenne.

Lineaarinen ja rengasrakenne ovat rakenneratkaisuista yksinkertaisimmat. Lineaarinen rakenne, jolla on alku ja loppu ja kullakin välijäsenellä edeltäjä ja seuraaja, toteutuu tavallisessa tekstissä ja siitä suoraan muunnetussa hypertekstissä. Rengasrakenne syntyy, kun solmujonon viimeinen ja ensimmäinen jäsen yhdistetään toisiinsa. Nämä rakenteet ovat World Wide Web-dokumenteissa varsin yleisiä sekä yhden tiedoston sisäisillä linkeillä toteutettuina että useasta tiedostosta koottuina ratkaisuina.

Hierarkkinen rakenne eli perinteinen puu on myös esimerkiksi tekstinkäsittelyohjelman dokumenteista muunnettujen hyperdokumenttien perusrakenteita, joka synnyttää klassisen käsitemäärittelyn illuusion: solmu on ”oikealla paikallaan” hierarkiassa samalla kun suorat yhteydet esimerkiksi saman hierarkiatason muihin jäseniin jäävät hierarkiassa toteuttamatta. Myös puurakennetta näkee World Wide Webissä paljon. HTML-kielen valmiit otsikkotasot ja sisäkkäiset listarakenteet osaltaan ohjaavat siihen. Hypertekstijärjestelmässä puhdas hierarkkinen rakenne on kuitenkin tarjolla olevien mahdollisuuksien vajaakäyttöä: jatkuva liike hierarkiassa edestakaisin rasittaa käyttäjää tarpeettomasti, joskin voi synnyttää myös turvallisuuden tunnetta.

Suunnattu asyklinen rakenne on ”puu, jonka juuret voivat kiinnittyä toisiinsa”. Rakenteeseen muodostuu vaihtoehtoisia polkuja, jotka kuitenkin voivat päätyä samaan pisteeseen, mikä ei hierarkkisessa rakenteessa ole mahdollista. Se, että linkit ovat suunnattuja, saa osaltaan aikaan eron aiemmin mainittuihin rengasrakenteisiin (vrt. asyklinen): samaa linkkiä käyttäen ei voi palata takaisin lähtökohtaan. On toki mahdollista, että samassa solmuryhmässä olisi päällekkäin kaksi suunnattua asyklistä linkkirakennetta, joista toinen luo ”eteenpäin” ja toinen ”taaksepäin” johtavan reitin.

Hyperkuutiolla ja -vannikkeella voidaan hallita eri ulottuvuuksiin virittyvät yhteydet. Vannike muodostuu ”ristissä olevista renkaista” eli vannike syntyy, kun hyperkuution ulottuvuuksien viimeiset ja ensimmäiset jäsenet yhdistetään toisiinsa. Tämä on Van Dyke Parunakin esittelemistä topologioista monimutkaisin.

Moniulotteisuus hallintaan fasettianalyysin avulla

Edellä esitellyt topologiat tarjoavat työkalut moniulotteisten rakenteiden määrittelyyn, mutta millä tavoin esimerkiksi hypervannikkeen kaltainen rakenne voidaan pitää laatimisen ja ylläpidon aikana hallinnassa ja tehdä käyttäjälle ymmärrettäväksi? Pohtiessaan edellä lyhyesti kuvattuja perinteisen luokituksen ongelmia, intialainen S.R. Ranganathan päätyi ajatukseen, jota hän on luonnehtinut mm. ns. mekano-analogian kautta (Ranganathan 1967). Mekano (Meccano) on metalli- ja muoviosia sisältävä rakentelusarja, jonka osat liitetään toisiinsa ruuvien ja mutterien avulla (Meccano Home

Page 1997). Näistä osista voidaan luoda lukuisia erilaisia rakenteita ohjeiden mukaan tai oman mielikuvituksen varassa. Samalla tavoin tulisi sisällönkuvailujärjestelmän rakentua vähälukuisista monikäyttöisistä osista sen sijaan, että kokonaisuus muodostuisi staattisista, valmiista rakenteista, jotka heijastavat laatijansa ja laadinta-ajankohtansa jähmettyneitä näkemyksiä.

Toinen Ranganathanin käyttämä analogia on hänen näkemyksensä aiheesta timanttina, jossa on lukuisia hiottuja pintoja (facet), jotka edustavat eri näkökulmia aiheeseen. Näiden näkökulmien löytämistä ja systemaattista kuvaamista kutsutaan fasettianalyysiksi. Kielitieteen termein voidaan sanoa, että fasetti on semanttinen piirre, joka on aiheessa mahdollinen. Piirteen ilmenemistä konkreettisessa aiheessa Ranganathan kutsuu polttopisteeksi eli fokukseksi, kyse on siis pisteestä, johon ”tietystä kulmasta suunnattu katse tarkentuu”. Jos käsittelisimme aihepiirinämme viestintää, siinä esiintyvän ”toiminnot”-fasetin yksi fokus voisi olla ”soittaminen” ja vastaavasti ”välineet”-fasetin yhtenä fokuksena ”GSM-puhelin”.

Fasettianalyysin prosessia voidaan karkeasti kuvata seuraavasti (Meriläisen 1984 mukaan) — esimerkkiaiheena ”soittaminen palvelunumeroihin GSM-puhelimella”.

1. Poimitaan aineistosta erilliset käsitteet eli isolaatit. (soittaminen/palvelunumero/GSM-puhelin)

2. Lajitellaan isolaatit niissä ilmenevän näkökulman mukaan fasetteihin. (toiminnot: soittaminen, kohteet: palvelunumero, välineet: GSM-puhelin)
3. Järjestetään fasetteihin sijoitetut isolaatit eli fokukset fasettien sisällä (järjestys voi olla esimerkiksi konkreettisesta abstraktimpaan, vanhasta uudempaan jne.).
4. Päätetään, missä järjestyksessä fasetit mainitaan aihetta kuvattaessa.

Fasettianalyysin prosessin tuloksena on siis joukko näkökulmia ja niiden ilmentymiä. On huomattava, että ”sama” käsite saattaa kuulua useaankin näkökulmaan, voidaan esimerkiksi tarkastella GSM-puhelimen käyttöä sosiaalisena tapahtumana, teknisenä suorituksena tai opiskeltavana asiana. On vaikea kysymys, onko tällöin kyseessä sama käsite vai ei. Oma näkemykseni on, että ”käsitettä itsessään” ei voi tavoittaa, vaan käsitteet havaitaan aina jostakin näkökulmasta, jolloin ne ovat käytöltään erilaisia mutta kuitenkin suhteessa toisiinsa, mahdollisesti tämän tavoittamattoman ”käsitteen itsessään” välityksellä.

Moniulotteisuuden ilmentäminen hyperdokumenteissa

Kuvaillun periaatteen mukaisesti voimme tunnistaa kustakin hyperdokumentin solmusta (tai oikeammin solmuksi aiotusta aiheesta) näkökulmat, joiden kannalta se on relevantti (edellinen esimerkki liittyy yhtä lailla GSM-puhelimiin, soittamiseen kuin palvelunumeroihinkin, palvellen kussakin erilaista tiedontarvetta). Näkökulmat antavat merkityksen edellä kuvatulle hyperdokumenttien geometrialle: näkökulma vastaa hyperkuution tai hypervannikkeen yhtä ulottuvuutta ja yksittäinen solmu liittyy useaan ulottuvuuteen yhtä aikaa. Solmussa mainittu näkökulman ilmentymä (esim. ”GSM-puhelin”) edustaa yhtä pistettä asianomaisella (esim. välineiden) ulottuvuudella, johon aihe ”ripustetaan” tämän näkökulman suhteen.

Moniulotteisuuden toteuttamiseksi käytännön hyperdokumenteissa voimme määritellä kaksi tehtävältään erilaista solmutyyppiä, nimittäin esittävän solmun ja listasolmun. (Käsitteiden aikaisemmasta kehittelystä katso Kämäräinen 1995.):

Esittävä solmu on hypertekstikirjallisuudessa usein esitetyn solmun (node) määritelmän mukaisesti lyhyehkö itsenäisesti ymmärrettävissä oleva teksti tai kuva. Solmun määritelmään liitetään usein myös ajatus, että sen tulisi kertoa yhdestä teemasta. Tämä rajoitus implikoi ajatuksen, että kukin solmu kuuluisi yhden kokonaisuuden alle ja tavallaan tekisi siis hypertekstin ajatuksen tyhjäksi, joten se on hylättävä. Esittävät solmut ovat hyperdokumentin ”liha”, joka ei kuitenkaan pysyisi koossa ilman luurankoa, joka muodostuu listasolmuista. Esittävät solmut ripustetaan niiden sisällön kannalta relevantteihin listasolmuihin.

Listasolmun tarkoituksena on luoda yhteyksiä solmujen kesken, toimia usean solmun välisen suhteen (näkökulman) ilmentäjänä, kokoavana rakenteena. Listasolmuun itseensä liittyy vähemmän ”omaa tietoa” kuin esittävään solmuun, mutta solmutyyppien välinen jako ei välttämättä ole selkeärajainen. Olennaista on, että solmujen funktiot, tiedon esittäminen ja yhteyksien luominen, ovat hyperdokumentissa tasapainossa. Näin ei ole useimpien World Wide Web-sivujärjestelmien laita tällä hetkellä, vaan ne ovat suurelta osin painottuneet nimenomaan linkkien luettelemiseen eli ne toimivat listasolmuina. Riittääkö syyksi se, että on helpompi virittää linkkejä kuin tuottaa itse uutta sisältöä? (Tietenkin voidaan kysyä, eivätkö ainakin ainutlaatuiset linkkikokoelmat ole hakukoneista huolimatta myös sisällöllinen kontribuutio.)

Helpottavia rakenteita polkujen avulla?

Hypertekstin käytön ongelmina mainitaan usein käyttäjien eksyminen linkkien ja solmujen muodostamaan ”hyperavaruuteen” (lost in hyperspace) ja toisaalta se, että runsaat valinnat ja monimutkaiset rakenteet kuormittavat käyttäjää henkisesti (cognitive overhead). Kumpaakin näistä ongelmista on pyritty ratkaisemaan ns. polkujen (path) luomisella hyperdokumentteihin.

Zellwegerin (1989) mukaan polku on hypertekstidokumenttiin linkkien avulla järjestetty reitti. Zellweger erottelee sarjana etenevän (sequential), haarautuvan (branching) ja ehdollisen (conditional) polkutyypin. Ensimmäinen tuottaa yksiselitteisen reitin, toinen tarjoaa käyttäjälle valintamahdollisuuden ja ehdollisessa polkutyypissä valinnan tekee hypertekstijärjestelmä käyttäjän aikaisempien valintojen perusteella. Nykyisellään kaikki nämä voidaan jo toteuttaa World Wide Webissäkin, joskin ehdollisen polun toteuttaminen vaatinee käytännössä vielä jonkin verran ohjelmointia esimerkiksi Javan avulla. Haarautuva polku voidaan toteuttaa yksinkertaisesti esittämällä linkkivaihtoehdot, jotka johtavat erilaisille reiteille. Vaihtoehtojen seurausten kuvailemiseen on syytä kiinnittää huomiota, jotta vältettäisiin käyttäjän turhautuminen. Niin haarautuvan kuin ehdollisenkin polkutyypin toimintatapa ja merkitys ovat siis hyperdokumentin laatijan valintoja. Erityisesti ehdollisen polkutyypin osalta on tätä on syytä painottaa, ettei syntyisi illuusiota ”tietokoneesta, joka määrää mitä polkuja käyttäjä kulkee”.

Kun hyperdokumentin perusrakenne on luotu vaikkapa fasettianalyysia soveltaen ja siirrytään polkujen suunnitteluun, päädytään samalla vahvasti arvovalintoihin. Varsinaisen hyperdokumentin perusrakenteen suunnittelussa on voitu ajatella katettavan jokin aihepiiri tasapuolisesti — vaikka tämäkin lienee illuusio — mutta polkujen tarkoituksena on nimenomaan ohjailla ja painottaa asioita. Polut tehdään hyperdokumentin muun rakenteen päälle, kattamaan osa siitä, tarkoituksenmukaiseksi rajaukseksi. Itsepetosta olisi laatia vain yhden vaihtoehdon sisältä lineaarinen dokumentti ja jälkeenpäin väittää sitä polutetuksi hyperdokumentiksi.

Yhteenveto

Olen edellä tarkastellut hypertekstidokumenttien moniulotteisuuden perusteita ja eräitä keinoja toteuttaa ja hallita moniulotteisia rakenteita. Tarkoitukseni on näin tarjota oppimisen ja opetuksen asiantuntijoille hypertekstiin näkymä, josta ehkä voidaan hyötyä. Millaisessa tilanteessa tässä esitettyjä ajatuksia voidaan soveltaa, millaisia etuja kenties voidaan saavuttaa ja millä hinnalla, on soveltajan tai soveltamista harkitsevan tilannekohtaisesti päätettävä.

Hyperteksti on eräs menetelmä, jolla voidaan antaa aiheessa ja materiaalissa esiintyvän rakenteen ilmetä samalla tavoin kuin ”perinteinen” lineaaris-hierarkkinen tekstirakennekin. Monesta nykyisestä hypertekstidokumentista voi havaita ilmiön, jota luonnehtii sanonta: ”Kun sinulla on vain vasara, koko maailma näyttää naulalta.” Kun hypertekstiä sovelletaan, sen tulisi tapahtua aiheen ja ennen kaikkea käyttäjän ehdoilla, ei välineen viemänä.

Lähteet

Ranganathan S.R. 1967. Prolegomena to library classification. 3rd ed. London: Asia Publ. House.

Shneiderman, Ben 1992. Designing the user interface : strategies for effective human-computer interaction. 2nd ed. Reading (Mass.): Addison-Wesley.

Kämäräinen Juha 1995. Hyperdokumenttien laatiminen sisällönkuvailuprosessina. Informaatiotutkimuksen pro gradu -tutkielma. Oulun yliopisto: Informaatiotutkimuksen ja sosiologian laitos. URL: http://wwwedu.oulu.fi/homepage/JUKAMARA/gradu/

Meccano Home Page (MeccanoNet) 1997. URL: http://www.freenet.edmonton.ab.ca/meccano/index.html

Meriläinen Outi 1984. Perustiedot kirjastoluokitusten ymmärtämiseksi. Helsinki: Kirjastopalvelu.

Van Dyke Parunak H. 1989. Hypermedia Topologies and User Navigation. Hypertext ‘89 Proceedings, November 5-8, 1989. Pittsburgh, Pennsylvania. Pp. 43-50.

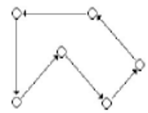
Kuvaluettelo

Kuvaluettelo artikkeliin “Hypertekstin moniulotteisuus - myytistä hyödylliseksi resurssiksi”

Lineaarinen rakenne

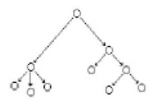
Kuva1. Lineaarinen rakenne (van Dyke Parunak 1989,45.)

Rengasrakenne



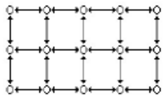
Kuva2. Rengasrakenne (van Dyke Parunak 1989,45.)

Puurakenne



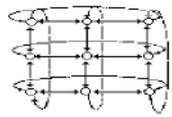
Kuva3. Puurakenne (van Dyke Parunak 1989,46.)

Hyperkuutio



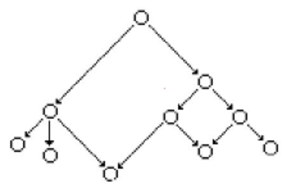
Kuva4. Hyperkuutio (van Dyke Parunak 1989,46.)

Hypervannike



Kuva5. Hypervannike (van Dyke Parunak 1989,45.)

Suunnattu asyklinen rakenne



Kuva6. Suunnattu asyklinen rakenne (van Dyke Parunak 1989,47.)