eLearning in Higher Education

Presentations from the EUDORA Intensive program ELHE during the summer school in Viljandi, Estonia 2004

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Preface

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This book contains articles written by PhD students and staff members of the EUDORA consortium. All of them attended the summer school e-learning in Higher Education (ELHE), an Erasmus Intensive Programme that was carried out in Viljandi, Estonia between 3-13 July 2004. ELHE is one of the modules within EUDORA curriculum for PhD students specialising in research on teaching and teacher education.

Unbalanced e-learning: between powerful „e“ and neglected dimension of learning

The term „e-learning“ was coined by Jay Cross in 1998 (www.jaycross.com). Initially, e-learning was introduced as a metaphor that pictured the switch from traditional teaching and learning to one that is mediated by electronic communication tools and information systems. Unlike the other e-features from the same trend (e-mail, e-governance, e-commerce), the term „e-learning“ arrived at the conceptual terrain that was already occupied by competing sister terms like Open and Flexible Learning, Networked Learning, Online Learning, Web-Based Training, Internet-Based Training, Computer-Assisted Learning, Computer-Supported Collaborative Learning etc. This competition, together with the fiasco of the first generation e-commerce eroded the popularity of this young term. Yet, the concept succeeded to gain the ground within few years. In the beginning of the new millennium the term „e-learning“ was used actively by policy-makers, training companies, educational administrators, practitioners and in lesser extent, by theorists. In 2001, European Commission launched the eLearning initiative as a part of eEurope Action Plan, aiming to develop infrastructure, training, cooperation, services and content in the fast growing e-learning domain. The central information resource related with the Action Plan, e-learning Europa Web site (www.elearningeurope.info) defines e-learning as „using new multimedia technologies and the Internet to improve the quality of learning by facilitating access to facilities and services as well as remote exchanges and collaboration“. This definition reflects the genealogy of e-learning domain that was born as a result of the convergence of its two „ancestors“: computer-assisted learning and distance learning. This explains why conceptualisation of e-learning is too often biased towards technological focus and individualisation aspects of learning. This bias has caused the trend of losing the ground to another concept – blended learning, that is perceived less radical and threatening by change-resisting academic staff. This trend was pointed out also by ODL Liaison Committee in their policy paper from November 2004 (see http://www.odl-liaison.org), indicating the relative decrease of the impact of e-learning concept among policy-makers between 2000 and 2004. While in 2000 e-learning was rarely used by practitioners and was widely used in policy documents, in 2004 e-learning seem to be „up in practice and down in policy discourse“. Despite the rhetorics of the policy documents and some research papers stressing the expectations related with the new qualities of learning with „e“, both the theory and the practice of e-learning seem to be biased towards the technological side. „E“- (or technological) dimension is more powerful, receiving more money and prestige than „learning“- (or pedagogical) dimension. Most of the resources used for e-learning research are allocated into computer science departments and IT/media companies. On the other hand, the camp of educationists does not often recognize e-learning as an interesting field of research and development. Renowned scientific journals in the field of educational science rarely publish any articles related...
with e-learning. Traditionally, most of the technological developments in the education are ‘imported’ from other domains: chalk, books, visual aids, presentation devices. The rise of e-learning can be seen as a chance for the community of educationists to promote the new pedagogical approaches with the help of new tools and learning environments. This calls for more pro-active role of educational researchers and practitioners in designing and developing of these new tools in order to gain the better balance between technological and pedagogical dimensions of e-learning. This is what ELHE summer school is about: we invite the young researchers from different European countries to study together different aspects of e-learning.

This book consists of three sections. The first section is focusing on the communication and collaboration aspects within e-learning communities. In chapter 1 Brian Hudson, Alison Hudson and Steef Woldinga report on a study into the role of personal and professional development planning in supporting learners in an international online learning community. The context for the study is an international joint Masters programme that is framed within a virtual learning environment. A major focus of attention in the development has been on the promotion of formative peer assessment as a means of supporting learners in online learning communities. A framework for facilitating the process of formative self-assessment was developed to support this through a process of systematic reflection, evaluation and action planning. This development provides the focal point for the paper.

Lars Birch Andreasen discusses the challenges of how to establish contexts in virtual learning environments that support interaction and collaboration between students in chapter 2. This approach is founded on a dialogical perspective inspired by Bakhtin which calls attention to the relationships between utterances and to the importance of supporting students’ awareness of each other in a net-mediated context. The paper focuses on the way in which collaborative tasks are integrated in the flow of a course and also the multiple ways in which students’ awareness of each other may be supported.

The second section of this book contains five case studies reflecting the search for balance between the technological and pedagogical dimensions of e-learning. Fawzi Baroud describes the background and goals introducing the e-learning in a Lebanese higher education institution. Mushrooning of new private universities, accompanied by increasing competition and decline of standards in higher education calls for new approaches. E-learning is seen by decision makers as a means for improving the pedagogical shortcomings in higher education. The empirical study was carried out among undergraduate students of Notre Dame University, seeking to document student attitudes and experiences regarding the use of Blackboard Learning Management System. Results of the survey were encouraging, supplementing teaching and learning with a virtual learning environment seems to be an objective worth striving for.

In considering the role of a virtual course management system for the promotion of constructivist teaching, Ali Rääsk outlines the design procedure of a course with the aim of improving the ICT competences of teachers. The context of this study is the teachers’ pedagogical work at the Viljandi Culture Academy in Estonia. The results of the course evaluation form the basis of a discussion of the teachers’ readiness to adopt a constructivist teaching approach and also of the impact of the course on their ICT competences.

Ahmed el Gamal outlines the development of an integrated teaching and learning environment for Egyptian teachers that is aiming to promote the new, pedagogically meaningful ways of using Internet in schools. The justification and theoretical model for an original Web-based tutoring system is provided along with the description of the cognitive and communication tools included in the system. The analysis of students’ feedback shows their satisfaction with the new learning environment.

Herman Schimmel addresses the role of new technology in non-academic settings, his case study is focusing on the knowledge management aspects of Intranet implementation project in one of the largest newspaper publishing company in the Netherlands. Empirical study is combining the data collected with various instruments: usability tests, questionnaire, individual and group interviews. Analysis of the empirical data concludes with detailed suggestions focusing on the organisation of knowledge teams, stimulation of knowledge sharing and filtering the submitted Intranet content.
Silpa Pöntinen and Päivi Palojoki discuss the role of ICT in home economics education in Finland. Home economics education is focusing on the skills and knowledge needed in everyday life, and ICT is becoming increasingly important in modern homes. Thus, there is a clear need of re-definition of the foundations of classical home economics education that has been traditionally related mainly with manual skills. Two case studies from the University of Helsinki illustrate this new approach to home economics education: DiViLearn project (use of multimedia and videoclips in the initial teacher education) and Teaching Practice project (e-learning integrated with teaching practice). The empirical study provided some conclusions, stressing the importance of integrating ICT in the initial home economics teacher education.

Mart Laanpere, Kaido Kikkas and Hans Põldoja describe the pedagogical foundations of IVA Learning Management System that was developed in the Centre for Educational Technology, Tallinn University. The key aspects in developing this new virtual learning environment were related with the built-in support to social constructivist learning.

The third section is addressing the issues of e-learning content creation. Jože Rugelj presents different aspects of knowledge visualization process as a means that can facilitate creation and communication of knowledge. Beyond the mere transfer of facts, knowledge visualization aims to further transfer insights, experiences, expectations, and opinions by using various complementary visualizations. Application of visualization on four levels of use is employed to present some important concepts and noticeable implementations.

In chapter 2 Alenka Praprotnik, Irena Nančovska Šerbec and Jože Rugelj outline how artificial intelligence methods can be used in Web based learning environments for the interpretation of the results of automated testing. Students are classified according to the results of testing and the system can identify the exercises in the test that crucial for classification. This information is a basis for adaptive automated assesment, where the difficulty of examination is adapted to each individual’s knowledge and capabilities.

Hans Põldoja, Teemu Leinonen, Terje Väljataga, Antti Ellonen and Marjo Priha report on their work-in-progress on the design of learning objects for social constructivist learning, which need to be different from the learning objects used usually. The design is based on the progressive inquiry learning object templates that allow teachers to participate actively in their design and development.

Terje Väljataga explores the suitability of learning objects to support problem based learning in secondary school in cross-curricula topics. Designed prototypes of learning objects are shown in the chapter and some results of evaluation from the technical and pedagogical point of view are presented.

In the last chapter entitled Creating eContents in Teacher Education, Elizabeth Winkelhner describes how traditional lecture notes can be transformed into multimedia web-based modules. She raises some interesting research questions, such as how development of multimedia learning materials influence didactic patterns of teachers, and presents the results from the case study carried out at the State College of Teacher Education in Linz.

On behalf of the staff and participants of ELHE 2004 Intensive Programme, we would like to express our gratitude to Tallinn Pedagogical University and Viljandi Culture Academy for hosting the summer school „E-learning in Higher Education“ in Viljandi during 3-13 July, 2004. We would like to thank also the State College of Teacher Education in Linz for coordinating the Erasmus Intensive Programme ELHE and for taking care of publishing this book. And finally, acknowledgments to European Commission for funding the Intensive Programme and this publication.

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Supporting learners in an international online learning community:

**Supporting learners in an international online learning community:**

Brian Hudson and Alison Hudson, Sheffield Hallam University
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Abstract

The background context for this paper is the development of the international MSc e-Learning Multimedia and Consultancy. The MSc is a collaborative programme between Hogeschool van Arnhem en Nijmegen (HAN University) in the Netherlands and Sheffield Hallam University in the UK. The programme as a whole is framed within a virtual learning environment and involves a “blended approach” through international studies, local studies and independent study. A major focus of our attention in the early stages of development of this project has been on the promotion of formative peer assessment as a means of supporting learners in online learning communities. Subsequently as a result of student and tutor feedback, a framework for facilitating the process of formative self-assessment has become the priority of our current development. This is based on the introduction of a personal and professional development planning process across the programme, in order to support this through a process of systematic reflection, evaluation and action planning. This has also become the focus of attention in terms of our ongoing action research and provides the focal point for this paper.

Introduction

The development of the international MSc e-Learning Multimedia and Consultancy arose from the TRIPLE M Advanced Curriculum Development (CDA) Project which was supported by the European Commission under the SOCRATES programme (1998-2001). Earlier outcomes from the associated ongoing action research have been reported in Hudson, Hudson and Steel (2003) and Hudson, Owen and van Veen (2003). The MSc is a collaborative programme between Hogeschool van Arnhem en Nijmegen (HAN University) in the Netherlands and Sheffield Hallam University in the UK. There are approximately sixty students enrolled across four cohorts at the present time. The programme as a whole is framed within a virtual learning environment (VLE) and involves a “blended approach” through international studies, local studies and independent study. A socio-constructive theoretical framework has informed the programme design as outlined in Hudson, Owen and van Veen (2003) with the aim of facilitating communication, collaboration and interaction. Students work in international groups using the VLE, videoconferencing, email and synchronous discussions. The local studies involve face to face meetings in national groups at local study centres supplemented by video conferencing. In the case of the small number of students working at a distance from the local study centres, alternative means of communication have been established and supplemented by one to one communication via email, video conferencing and telephone.

Research Aims

The aims of our research have been gradually refined over the course of the development of the programme since the first pilot phase in the second semester of 1999-2000 (Hudson et al., 2000). The evaluation of early modules on the programme highlighted the wish from the students for greater international collaboration. This was expressed by one student in particular who argued that collaboration in any environment is about needing each other and with reference to Salomon (1992) drew attention to the fact that collaborative learning requires much and well orchestrated interdependence. In reflecting upon our experience we are confronted with the reality that promoting...
collaboration is both complex and challenging. Accordingly our major aims are to explore the aspects that characterise effective pedagogical practice and student engagement in open and flexible e-learning environments. This point of departure, combined with the outcomes of earlier phases of development, has given rise to several research questions including the following:

1. How best can we facilitate purposeful engagement of autonomous and independent learners in e-learning environments?
2. To what extent is the notion of assessment for learning a key condition for achieving orchestrated interdependence and autonomy in e-learning?

This paper builds on Hudson (2004) and focuses on recent developments that aim to support formative self assessment through a process of personal and professional development planning (PPDP). In doing so the following is taken as starting point for thinking about the term “formative assessment”: “all those activities undertaken by teachers and by their students [that] provide information to be used as feedback to modify the teaching and learning activities in which they are engaged” (Black and Wiliam, 1998, 7).

**Research Methodology**

The overall approach towards this enquiry is set within an ongoing action research framework. In considering the nature of action research it firstly needs to be acknowledged that it is contested and is the result of a number of waves of advocacy over a period of several decades in the English-speaking world (Kemmis, 1993). Each wave has been shaped by the particularities of its time and to some extent reflects specific cultural and historical conditions. It is possible to identify differing traditions with distinguishing characteristics. The approach that we have sought to develop, with both colleagues and students, can be described as “critical” or “emancipatory” action research as advocated by Carr and Kemmis (1985). This approach takes a strong stance on action research as a critical social science, rather than simply as some form of practical reasoning, seeing it as connected to social action and social movement. This connection between social research and social life is intrinsic to research as an activity. An overriding goal is the aim to change the social world for the better. If such change is to be achieved then it will come through improved shared social practices, the shared understandings of these social practices by the community and also the shared situations in which these practices are carried out. Accordingly such research is always critical in the sense that there is a relentless striving to better understand our current situations in order to improve them. However it is also critical in the sense of being “activist” in a professional sense. By this we mean the very processes through which we learn i.e. collaborative learning through joint activity in which communities of learners set out to learn from change through the very process of making changes whilst at the same time studying the process and consequences of these changes. The aim is based on an understanding of ourselves engaged in shared social practices (both students and tutors) as the agents, as well as the products, of history.

Central to the values and vision of the MSc programme team is a belief in the importance of knowledge sharing and collaborative knowledge building in learning communities e.g. between individuals, across subject and professional boundaries, both within and between learning organisations. The aims of the programme place emphasis on developing the profile of the problem solver/team leader at the interface of pedagogical, technological and cultural dimensions of organisational change and development. Several tutors on the programme have worked as students at earlier stages of their own development. A strong emphasis has been placed on collaborative action research and reflective practice within the tutor team from the outset of development. Subsequently this has become conceptualised within an integrative holistic model of design/developmental research that integrates the processes of research, evaluation and dissemination (Hudson, 2005a; Hudson, 2005b). Such an approach draws upon thinking and development around the Integrative Learning Design (ILD) framework, the central goal of which is to both construct propositions about teaching and learning and also to engineer and construct effective learning environments that enable both teachers and learners to make these propositions actionable (Banan-Ritland, 2003). The ILD framework has been developed in order to address questions about methods and processes in complex, naturalistic settings. Specifically it aims
to address the ways in which we might systematically create, test and disseminate teaching and learning interventions that will have maximum impact on practice and that will contribute significantly to theory and also to consider those specific research methodologies or combinations of methods that are most appropriate to particular phases of design research. These phases of design research are consistent with, but extend the reach of, action research involving phases of informed exploration, enactment, evaluation for local impact and evaluation for broader impact.

In relation to the process of the development of the use of information and communications technologies (ICTs) in education, we describe ourselves as adopting the perspective of “socially constructed technology” (Lee, 1999). We advocate that the social shaping of technology is governed by the ways in which users give their own meanings to ICTs and through the adaptation of such products and services to users’ own purposes. Starting points for our research have been the standard approach towards module evaluation through such means as end of module questionnaires to both staff and students. In addition we have adopted an ethnographic approach with the aim of exploring emergent issues as they arise naturally through the process of enquiry. In relation to this aspect we have found the approach of responsive evaluation (Stake, 1973) to be particularly relevant. This approach aims to be responsive to the concerns and issues of the “stakeholders” involved in the evaluation. The context in which this research has been undertaken is one based upon a collaborative approach to teaching, evaluation and action planning within the programme team. Several of these cycles have led to wider dissemination of the outcomes as indicated earlier.

Programme Design and Pedagogical Approach

In designing and planning the programme considerable emphasis has been placed on enabling collaborative activity in multinational teams. In relation to this aspect we share the general perspective offered and the crucial distinction between co-operation and collaboration made by Lehtinen et al (1999). Co-operative work is seen to be accomplished by the division of labour among participants, whereas collaboration involves the mutual engagement of participants in a co-ordinated effort to solve the problem together. We have also been influenced by the thinking around the notion of “powerful learning environments” (Buchberger, 2001; Grabinger, 1996 and Kirschner, 2001) which imply the creation of learning situations that elicit active and constructive processes of knowledge and skill acquisition and ample opportunity for interaction, communication and co-operation. A project based approach towards learning underpins each module of the programme (see Figure 1).

Figure 1: Project based approach

Personal and Professional Development Planning (PPDP) process

A major focus of our attention in the early stages of this development has been on the promotion of formative peer assessment as a means of supporting learners in online learning communities. However as a result of student and tutor feedback, a framework for facilitating the process of formative self assessment has become the priority of our current development. This is based on the introduction of a PPDP process across the programme supported by academic tutoring in order to support formative self assessment through the promotion and facilitation of a process of systematic reflection, evaluation and action planning.

The PPDP process is presented as one possible framework for thinking systematically about personal and professional development, as the basis of the evaluation of ongoing progress and future action planning. It draws on ideas of action research which is seen as providing a framework for thinking systematically about what happens in a social situation, implementing action for change and monitoring and evaluating the effects of the action with a view to continuing the development. The linking of the terms action and
research highlights the essential feature of the method: trying out ideas in practice as a means of improvement and as a means of increasing knowledge about the given situation. Action research is seen to provide a way of working which links theory and practice into one whole: ideas-in-action (Kemmis and McTaggart, 1982).

The cycle of action research can be seen to consist of four moments as outlined below in Figure 2. Accordingly in order to undertake action research, one aims to develop a plan of action, act to implement the plan, observe the effects of action in the context in which it occurs, and reflect on these effects as a basis for further planning, subsequent action and so on, through a succession of cycles.

Figure 2: The moments of action research through a succession of cycles

Attention is drawn to the way in which these ideas have been developed with a greater focus on professional learning i.e. action learning which is described as follows:

Action learning is a continuous process of learning and reflection, supported by colleagues, with an intention of getting things done. Through action learning individuals learn with and from each other by working on real problems and reflecting on their own experience. (McGill and Beaty, 1995: 21)

Comparing this with that of action research earlier we can make a distinction between the individual and the wider social dimensions. As suggested by Kember (2000) research can be seen as a form of learning that is both systematic and rigorous, the outcomes of which are normally made public. In contrast, the outcomes of learning tend to be confined to the individual or fellow members of the learning community.

Furthermore systematic reflection on experience at an individual level may facilitate a link between theory with practice at the wider social or communal level. The process of personal and professional development planning may be seen as a tool for illuminating the interplay between reflection and experience at the individual level and for linking theory with practice at a wider social or communal level (Figure 3).

Figure 3: Interplay between reflection and experience and the interactive relationship between theory and practice

This process is intended to aid reflection on personal and professional development achievements and future needs at a number of stages in the programme and to provide a means of recording the results of student evaluation and action planning in a PPDP e-Portfolio. This self-assessment process is intended to be carried out against a framework of the aims of the MSc programme as a whole and the intended learning outcomes for each module. The mode of recording is not prescribed and is at the discretion of the student. The process is timed to take part at review points in the course of study that coincide with the start and end points for modules and is supported by academic tutors. The role of the academic tutor is to support the process of self-assessment through a process of dialogue by means of one to one meetings which may be face to face, online, by telephone or by any other means of effective communication.
Data collection

The process was first introduced to students on the MSc programme during the first semester of 2003-04. Responses were invited from all students for discussion with their academic tutors at the end of this semester in January 2004. For the purposes of this research, the three authors acted as academic tutors and responses were received from 14 students. Of this group, there were 9 HAN University students comprising 8 male and 1 female and 5 Sheffield Hallam students made up of 3 male and 2 female students. All the students involved submitted written responses as part of the PPDP process and took part in one to one discussions about their contributions. They also agreed to act as participants in this research in response to a statement of research ethics.

Data Analysis and Interpretation

A number of themes emerged from the process of data analysis which reflected the nature of the student response to the PPDP process. These were initially categorised as “making connections”, “taking ownership of the process” and “reflecting of the process of (e-)learning”. Subsequent analysis and dialogue resulted in the first category being expanded to three sub-categories and the addition of a new one giving six in all:

- Making connections within the MSc programme structure
- Making wider connections with the workplace
- Making wider connections and looking
- Taking ownership of the process
- Reflecting of the process of (e-)learning
- Studying and working in new roles

Examples from each category are given in the following section.

Making connections within the MSc programme structure

Joy’s initial response was to produce a “mind map” based upon her questions about the overall structure of the programme (Figure 4). The programme is made up of six units/modules that together make up 90 European Credits (ECTS) which are as follows: Open and Flexible Learning Environments (10 ECTS); Digital Media Applications (10 ECTS); Communication Consultancy and Change (10 ECTS); Research Methodologies (15 ECTS); Project Studies (15 ECTS) and Dissertation or Extended Curriculum Development project (30 ECTS). Her questions at that time are based upon the “what, why and how” of the programme as a whole and how the various parts fit together. In a further response at the beginning of the following semester following a presentation on the PPDP process as part of the induction in September 2004, Joy offered these further reflections:

“I have just revisited the power point and found resonance with the quote from Salomon that you used in the presentation. We are all interdependent and I think that one of the great strengths of a collaborative e-learning community is the sharing of that learning process. I revisited the chart that I submitted as an immediate response to the CCC unit, over a year ago, and read the response and was immediately struck by two things … the first is how different the two responses were … the second … how confused I was! (CCC became a lot clearer by christmas). I am also struck by the length of time reflective learning actually takes. I must admit that it is only now that the real (and/or implicit as opposed to explicit) learning that I undertook in DMA is actually beginning to strike home. My immediate response, once again, at the beginning of another academic year is a happy learning confusion … but I believe that all will eventually become clear again by christmas.”
Supporting learners in an international online learning community:

The following response from Rutger was on the same theme:

“The first weeks up to assignment 1 were good and hard working. I learned to have a good view on what research in education is. I realise how well the modules fit together. I experience what social constructivism is. I think I have a good research proposal now. I realize again not to react too fast and soon. I felt the limitation to express myself in English. I learned to formulate my research question well. I learned that creation of time give space for better ideas.”

Making wider connections with the workplace

This response from Gerry relates his learning on the programme to his workplace and to developments at a national level in his professional context. Gerry is a consultant working for a Local Education Authority on the implementation of the national ICT strategy:

“I think that Brian’s point regarding systematic reflection on individual experience is an important one ... As an educational consultant working in

the field of school improvement ... the question of personal and professional development planning portfolios arises in the MSc course at the same time as the UK Department for Education & Skills, (DfES), are developing their ‘National Standards for School Improvement Professionals’, (NSSIP) ...I feel that the integration of the PPDP competencies into the structure of the NSSIP portfolio would best suit my personal needs.”

This response from Hubert addressed similar issues in a different professional context though without any evidence of a similar approach to or framework for to continuing professional development:

“Next month I have to take decisions on my further learning process. There are three options:
• proceed with my study for my own development
• proceed with my study and focus on subjects that give me direct opportunities for a new job

Making wider connections and looking beyond

Jim was at the final dissertation stage of the programme when he responded and did so with a “mind map” in a similar way to Joy (Figure 5). His mind map reflects on the most memorable aspects of the modules studied on the programme together with some of the key aspects such as the development of the DMA e-portfolio and international video conferencing. Furthermore he looks ahead, beyond the programme, by asking the question: “As a practitioner, what do I do with my skills and knowledge base?”

Norbert’s response reflected similar concerns with regard to the future, both in terms of professional development and job prospects. Furthermore his response also reflected the inherent uncertainty surrounding his decision making:

“Next month I have to take decisions on my further learning process. There are three options:
• proceed with my study for my own development
• proceed with my study and focus on subjects that give me direct opportunities for a new job

The following response from Rutger was on the same theme:

“The first weeks up to assignment 1 were good and hard working. I learned to have a good view on what research in education is. I realise how well the modules fit together. I experience what social constructivism is. I think I have a good research proposal now. I realize again not to react too fast and soon. I felt the limitation to express myself in English. I learned to formulate my research question well. I learned that creation of time give space for better ideas.”

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“I think that Brian’s point regarding systematic reflection on individual experience is an important one ... As an educational consultant working in
Supporting learners in an international online learning community:

- Quit!
  I would like to make closer connection between students in our study and the knowledge circle around our HAN professor in which I take part as well.

Figure 5: Jim’s mind map

Taking ownership of the process

The response from Marcus was seen as an example of taking ownership of the PPDP process and integrating it into his approach to his studies, following his experience on the research methodologies module.

“I strongly feel that two aspects are responsible for the new insights I got within this module. The first one is the way this course was delivered – as an online course. … the second aspect accounting for the very positive experience I had in this first module – the intrinsic motivation for this programme. I will follow an action research approach I have already developed a detailed action plan, including milestones and a preliminary timetable.”

He also established a “PPDPwiki” on his organisation’s web server to track the progress with his dissertation studies.

Peter responded on a similar theme, emphasising the importance of vision and imagination in terms of promoting/motivating personal action:

“To much focused on my personal perspective. Didn’t see all of it. Diagnose-tool is great to widen vision … With regard to the interference of theory and practise: The balance of dream and do: dreams are important for continuing doing, though structure is needed for personal action approach.”

Reflecting of the process of (e-)learning

The following response is a further extract from Marcus’s overall response, which reflected a strong reaction to his experience of studying in an e-learning context in which he highlights some striking characteristics of the experience and compares this with his previous rather traditional academic experience. Once again he is reflecting on his recent experience of the research methodologies module.

“Obviously this deeper level of learning comes at a price, which is the time requirement … The combination of literature study, guided by input from my tutor, with regular online discussions with fellow students, offering new and frequently challenging views of the topic under observation, really stimulated my own learning, leading to a deeper level of understanding. This stands in stark contrast to my previous academic experience, where the learning process mostly used to be a one-way communication from the tutor to the students.”

Julian was at an early stage of his studies when he reflected on his experience following the first module on open and flexible learning environments. Having come from a predominantly technological background, he also raises very relevant questions about his own ability to think critically about such issues without first gaining some command of the pedagogical knowledge base:
Supporting learners in an international online learning community:

Am I able to critically analyse OFLEs from a pedagogical perspective? Yes and no. After completion I feel that I am able to recognize the pedagogical perspective, but I really don’t know if I am able to critically analyse OFLEs. My intuition tells me that for the moment the latter is a bridge too far. Perhaps I underestimate myself, I don’t know. What I do know is that by nature I don’t have a very critical mind: I really have to force myself to be critical when I have to review my peers for instance. But being able to criticize has not only to do with one’s nature, it has also to do with knowledge of course. Perhaps I can be more critical in the future, when I have hopefully gathered more expertise…”

Studying and working in new roles

Many of the students on the programme have found that their roles have changed quite significantly during the course of their studies, often involving promotion within the organisation itself or a complete change of job. Nathalie reflects the interdependence between her studies and the stage of development of her own organisation in her response:

“There is an obvious correlation between the things I learn and the developmental process of my organisation.”

Similarly Richard reflects on his own role as change agent within his organisation:

“In my new experiences I often feel like a Trojan Mouse in my organisation.”

Discussion

Whilst the examples selected do demonstrate an engagement with the PPDP process, not every student found the process to be relevant to their needs. For example, one student who was highly focused from the outset of the programme completed his studies in record time and produced a high quality dissertation without engaging in the process at all. Furthermore Jane questioned the value to her of engaging with the process:

"As I am starting this review near the end of my course, I will begin with the Dissertation module, and perhaps work back later. I’ve decided not to split it into review 1 and review 2 for each Module, but rather where I am now (evaluation), and either evidence of that, if I’m satisfied, or action plan if I’m not.

Given that all our modules have a reflective assignment anyway, I can’t see the value of the PPDP for modules; however it has certainly thrown up a few questions for me about the learning outcomes of the course as a whole.

Just because the programme says has particular aims, doesn’t mean it is realistic to expect all students to achieve all aims. The programme itself may be flawed in delivering those outcomes, and each individual will have different aptitudes for fulfilling these aims.

I do keep all my Masters assignments together. However I can’t see any value in linking to them from this document.”

The latter comment reflects a contrast with the orientation of several students who have developed web based e-portfolios based on the digital portfolio developed in the DMA module. In these they have stored all programme assignments and associated products and artifacts. This may be yet another reflection of the tension identified in the early stages of the programme development (Hudson, Hudson and Steel, 2003) between individual concerns and the sense of obligation and commitment to the community. Whilst this may also be a reflection of individual preferred learning styles there is a further tension between such individual orientations and the aims of the programme as a whole which are based on the promotion of team-based working which are made explicit at the outset.

The PPDP process is still at an early stage of development and progress to date has highlighted a number of issues and raised new questions. One of the key issues has become an action priority for the programme as a whole. This relates to the need to engage all students in the process and furthermore raises the challenge of engaging all staff members in order to embed this in practice. In one of the formative discussions underlying this development the
suggestion was made to aim for all summative assessment to be based on the process and content of the e-portfolio in the longer term. This highlights the issue between the module specific and the generic aspects of the PPDP in its current form. Furthermore it highlights the fact that at present it is not explicitly part of the summative assessment. It also raises the question of the role of the DMA portfolio in its current form, how this might be developed further as a generic programme-wide tool and also the potential implications of such a development for other modules. The dialogue will continue with the aim of improving practices and our shared understandings of those practices as both teachers and students. This paper will serve a constructive role in the dissemination and evaluation of ideas for both local as well as broader impact.

References


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Abstract
The article discusses the challenges of how to establish contexts in virtual learning environments that supports interaction and collaboration between students. Dealing historically with the development from early distance education until today’s combination of physical and virtual spaces, the article argues for a broad understanding of virtual learning environments. Theoretically the discussion builds on a dialogical perspective on communication, inspired by the Russian philosopher Mikhail Bakhtin, which calls attention to the relationships between utterances and to the importance of supporting students’ awareness of each other in a net-mediated context. Empirically the article builds on a case study of a Swedish net-mediated university course, where several attempts were done at facilitating interaction between students. The article discusses the reasons why many of the attempts failed, and concludes among other things that collaborative tasks have to be integrated closely in the flow of a course, and that the students’ awareness of each other may be supported in multiple ways.

Introduction
The integration of virtual learning environments and use of computer-mediated communication in education have contributed to new developments in the relation between students as well as between students and teachers. In relation to distance education, where students earlier had to study each on their own hand, interacting only with the study materials and occasionally a teacher, the use of the internet has extended the individualized perspective and made it possible to establish new ways of collaboration between students. The aim of this article is to draw attention to some of the challenges facing net-mediated education, especially when trying to establish contexts for collaboration between students. Questions to be discussed are: – How does students experience communicating over the net? – What motivates students to interact with each other? – How can we understand the nature of dialogue and interaction in educational settings on the Internet? – How may collaboration be organized in a virtual learning environment?

The article will deal with these questions from a theoretical as well as an empirical perspective. Empirically the article will discuss results from a case study of a net-mediated distance course at a Swedish university. Theoretically the analysis of students’ computer-mediated and written communication is inspired by the Russian philosopher Mikhail Bakhtin, who understands communication as dialogical and polyphonic.

Understanding of “virtual learning environments”
A “virtual learning environment” is often understood as simply being the net-mediated facilities or the specific learning management system (LMS) available at a specific education. From the perspective of this paper, however, a virtual learning environment is more than just a question of technology, and I therefore understand a virtual learning environment as a mutual interplay of three dimensions: One dimension of a virtual learning environment is the participants; the actual students and teachers involved in the education. A second dimension is the different contexts around an education; these could be physical, didactical, organisational or technological. The specific net-based facilities offered at an education are one of these contexts. The third dimension of a virtual learning environment is the actual ways in which the involved participants make use of the different contexts. Depending on how people act and what they choose to...
do and not to do, the specific virtual learning environments will develop differently. With this understanding of a “virtual learning environment” I want to emphasize that the participants and their actual use of the different technological and other possibilities have important impacts on how a specific virtual learning environment will develop. A learning environment is therefore not a given entity, but is continually co-constructed through the actions of the teachers and the students engaged in it.

A historical perspective

The development of virtual learning environments as we know them today owes a lot to the history of distance education. As originally stated by D.R. Garrison (Garrison, 1985: 235), the development of distance education can be seen as passing through three “generations”, building on different theoretical understandings (see also Keegan, 1996).

The first generation of distance education can be described as the “correspondence school”. This kind of education was made possible through infrastructure like the mail and the railway system, through which study materials were delivered to students who could be living in remote areas. The theoretical understanding of distance education had a focus on the autonomy of the student and the individual independence of time and space.

The second generation can be described as “multimedia-based distance education” delivered by large educational institutions specializing in distance education. The development of broadcast media was necessary for this generation to evolve. The understanding of distance education in this generation has a focus on the industrialisation of the education and the effective delivery of standardized courses to a large quantity of students.

The third generation can be described as “computer-mediated distance education”, using the communicative possibilities of computers to make interaction between the participating students possible. The theoretical focus in this generation is on communication and collaboration between students and on support of social learning processes. Computer-mediated interaction between students was a radically new step compared to earlier forms of distance education.

The development of “generations” has not been a simply linear development, where previous generations have been replaced by new ones; and the different understandings of distance education are therefore all present in the field today. With the development of the third generation of distance education and the integration of computers in education generally, the boundaries between “on-campus” and “distance” or “on-line” education are getting somewhat blurred. In many cases there can be seen a tendency towards merging or integrating the two formerly distinct areas. The history of distance education can therefore be seen as part of the development of virtual learning environments, and with the concept of virtual learning environments we can draw attention to the contexts, participants and their actions in specific educational settings.

The first whole education to be offered in a virtual learning environment, through computer conferences, is dated by the American philosopher Andrew Feenberg to have taken place in 1982 (Feenberg, 1989: 39). Experiences from the organizing of this education point especially at changes in the role of the teacher: In the early sessions of this education the teachers offered elaborate presentations to the students, almost like ‘written lectures’, but this reduced the participation of the students almost to silence, as there was not much for them to add. After this experience, other teachers tried with non-directive techniques and short questions, but none of the students dared ‘breaking the ice’, as they were insecure of how to participate and with how much.

The third approach from the teachers was to lay out a well-defined ground for the interaction by giving introductory comments with explicit rules for discussion, and then asking questions based on specific examples. This last approach finally showed successful in order to achieve student activity and contributions to the computer conference (Feenberg, 1993: 191).

Even today computers are to many students still regarded as a new medium to use for educational purposes, and compared with face-to-face communication in classrooms many students do not have the
same kind of implicit knowledge on the net of when to say something, how to say it, and how to be aware of the other participants. As pointed out by John Benseman, students’ familiarity with the medium is important for the degree of their participation (Benseman, 1999: 148).

**A dialogical perspective on communication**

The theoretical point of departure for this article is inspired by the Russian philosopher Mikhail Bakhtin (1895-1975) and his dialogical perspective on communication (Bakhtin, 1981). In Bakhtin’s view communication can be seen not as the transmission of meaning from a sender to a receiver, but as a polyphony of different voices interacting with each other in a dialogical relationship. According to Bakhtin understanding in communication takes place neither at the ‘sender’ nor the ‘receiver’ of a given message, but instead in a shared third place in a mutual relationship between the participants in the communication. The one who talks and the one who listens are both actively contributing to the construction of meaning of what is uttered. Therefore words and utterances can be seen as social phenomena, and must be understood in relation to their contexts: In a specific context, words can have different meanings depending on who the utterer is, in what situation the utterance takes place, and what other words and utterances they appear in relation to (Bakhtin, 1986: 87). In a general context, words can be seen as affected by the social situation as well as by the historical dimension, since there are traces in every word of the persons and situations, where they have been used before. Every word contains therefore different voices, and according to Bakhtin the utterer must form his or her own voice through relating to these voices:

“The word in language is half someone else’s. It becomes ‘ones own’ only when the speaker populates it with his own intention, his own accent, when he appropriates the word (...). Prior to this moment of appropriation, the word (...) exists in other people’s mouths, in other people’s contexts,


serving other people’s intentions: it is from there that one must take the word, and make it one’s own.” (Bakhtin, 1981: 293-94)

This aspect of Bakhtin’s understanding of communication – that there are complex relationships between an utterance and former utterances – is supplemented by another aspect, that takes the relationship between utterances even further – that there are also relationships between an utterance and what can be anticipated as future utterances:

“The word in living conversation is directly, bluntly, oriented toward a future answer-word: it provokes an answer, anticipates it and structures itself in the answer’s direction.” (Bakhtin, 1981: 280)

This means that the utterer’s consciousness of who the reader or listener might be, is actively co-constituting the utterance that is being made. In your ‘inner ear’ you can almost hear the possible answers that may come; and the expectation you have regarding the reactions of others, are influencing what you are about to express. In relation to net-mediated communication, this means that the participants’ understanding – or their awareness – of their communication partners are influencing what kind of contributions they may produce. A practical implication of this may be that in order to facilitate the communication process it is important to support the participants’ awareness of each other.

In this view of communication we cannot point out one centre, but many different centres of the communication. Bakhtin underlines the inherent polyphony of voices in every utterance, which implies that there can be different understandings from different points of view of the same communication. Seeing learning in a dialogical perspective stresses the importance of difference or even asymmetry between participants in a communication. Through different perspectives in interaction with each other and through the relations that emerge between ‘oneself’ and ‘the other’, participants can be challenged to view things from the perspective of ‘the other’ and thereby possibly develop new under-
standings. In this way, learning does not happen as just copying or adopting the other’s perspective, but instead as actively ‘appropriating’ the other’s perspective from one’s own point of view (Bakhtin, 1981: 293). Following Timothy Koschmann’s discussion of Bakhtin (Koschmann, 1999: 310), this also means that learning does not happen just through participation, as well as it does not happen just through direct transfer of knowledge. Instead, learning can be said to happen through transaction, which is a process where the participants and their contexts interact and where both are changed after the experience.

Analysis of the case study
As pointed out earlier this article explores challenges of establishing net-mediated collaboration between students. The following discussions will deal with this question empirically, through results from a case study of a net-mediated distance education course at a Swedish university (Birch Andreasen, 2003). The studied case was an introductory course in Sociology, which lasted half a year and had forty students. The course took place entirely on-line and had no face-to-face meetings. The web design of the course was simple and easy to use, consisting of web pages with descriptions of the content, the activities and the progress of the course combined with a number of asynchronous, non-threaded group discussions boards as a means for communication between the students. The course activities consisted of a number of individual assignments and two periods of group assignments.

Method of the study
The case study builds on two main sources of empirical data. One is observation of the net-mediated communication between the students as it developed through their written contributions on the electronic discussion boards of the course. The other main source of empirical data are qualitative interviews with selected students concerning their experiences with studying and collaborating through the internet. These two main sources were supplemented by other types of data, e.g. information from the course web pages.

The empirical data have been analysed through a combination of methods: The number of written contributions were analysed in relation to the students’ patterns of participation. The content of the net-mediated communication between students were analysed in relation to the development of collaboration. The interviews were transcribed and analysed in relation to the students’ experiences of the net-mediated collaboration. The case analysis is constructed in a combination of these methods.

The course participants
The students of the course had an average age on 31 years, which is quite a high age for first year university students. This is apparently due to the fact that when studying through the internet with its higher degree of flexibility, it is possible being a student and combining this with having work, family or children. Therefore this way of studying is more accessible for people at a later stage of life, who often have more obligations.

Among the course participants in the specific case there were more women than men, and the male students were generally younger than the female students. The interviews from the case study suggest that there may be different strategies among the course participants, so that the female students – who generally were older – more often chose to combine work, family and children with their university studies, whereas the male students – who generally were younger – more often combined the net-mediated course with other full time on-campus courses in order to be able to complete their education faster. However, this can only be a hypothesis based on this specific case, and may not be generalised without further studies being made.

Attempts at establishing interaction
The design of the course aimed at facilitating the development of interaction between the participating students, in order to support their active learning through communicating with each other and reflecting on each others’ work. One example on the attempts to facilitate interaction took place in the beginning of the course, where short self-presentations from each student were used to introduce
the course participants to each other. These presentations were a way of helping the students getting used to write through net-mediated communication, and also a way of supporting the students’ awareness of each other, thereby getting a ‘consciousness of the reader’ of their utterances, as seen from Bakhtin’s perspective. However, the case study showed that it was mainly in the beginning of the course the presentations worked as this kind of support of awareness, as they were not continually updated during the course.

Another attempt at facilitating the students’ interaction took place by making their essays and assignments available on an internal website, with the intention of helping the students read each other’s texts. Twice during the course, the students were asked – after finishing their own essay – to write comments on other students’ essays and post their comments on the group discussion boards. The students were also encouraged to follow-up on these comments in order to develop discussions with each other on the discussion boards. However, the analysis of the case study shows that only the obligatory comments to other students’ papers were posted, and with only one exception no further interactions took place. Therefore, this activity did not develop the interaction between the students, as it was meant to do.

In the interviews from the case study, some of the students expressed that they would have preferred the interaction to have taken place during their work on the essay, and not after their essay was posted. The students felt that in that case they would have been more motivated to engage themselves in discussions, as they would have been able to use ideas from the discussions in finishing their essays. If the activity had been organized this way, it would probably have had more chance of establishing interaction between the students.

Another reason for the lack of interaction was apparently that the students needed more time than they were given to develop their discussions: In the period of time when the students should comment and discuss each other’s papers, the course at the same time moved on to its next period with new topics and new tasks to solve. Therefore the students laid their effort in solving these new tasks, and not in discussing their essays from the earlier period of the course.

It seems therefore necessary to make such tasks with student interaction more integrated in the course design, for example by making the interaction a central activity of the course in a given period of time, and not just a voluntary one, parallel to other activities.

**Group work: Collaboration or division of labour?**

After two weeks of the course the students had their first group assignment, which consisted of a number of questions to be answered, all related to a specific book. A student explains how his group worked on the assignment:

**Interviewer:** “The first group work; can you describe, how your group collaborated?”

**Student:** “Quite simply! The assignment was split into questions about the different chapters, and each person took a chapter. … So there was actually no discussion, just each wrote about his or her chapter, and one gathered it all in one document. And then we delivered it as a group assignment.”

Most of the groups actually organized their work on this first group assignment this way by delegating one or two questions to each member, and just collecting each answer in a single file without having discussed the content of their writings. Therefore this first group work did not bring about further interaction between the students. A group work with this kind of division of labour can be described as what Pierre Dillenbourg calls a “vertical collaboration”, where participants are responsible for their own autonomous contribution, as opposed to a “horizontal collaboration”, where participants share the responsibility for the different contributions (Dillenbourg, 1999: 11).

The lessons to be learned from this is that if the group assignment instead of being made up of separate questions that could be delegated to each student, had consisted of tasks where it was necessary for the group members to discuss, negotiate meanings, and reach a shared solution, it would probably to a higher degree have been able to facilitate the communicative and collaborative dimensions of the group assignment. It is not enough just making the technology for
communicating on the net available; the activities must also make it relevant or necessary for the students to communicate and interact.

The meaning of words

The case study showed that the task of splitting up questions between the students in the first group assignment could cause problems due to the understanding of single words. In one of the groups a student proposed on the discussion board that each participant should just one-by-one ‘grab’ a question, and the first to grab one could keep it. Afterwards another student expressed in an interview that the notion of ‘grabbing’ a question had reminded her of a kindergarten where each child clings to his or her possessions and does not want to share. She felt the notion of ‘grabbing’ immature, and thought that it differed from her idea of how to collaborate. But she didn’t raise this question on the group discussion board; instead she used the question to reflect on how words and utterances can obtain different meanings for different people in different contexts.

She reflected that maybe the expression was not meant by the other student to begin a ‘kindergarten competition’, but could just be an expression he had randomly chosen when he wrote his short message on the discussion board. She also reflected on how some messages she herself had earlier written might have been understood differently by other participants. This lead her to conclude that in net-mediated communication it may be necessary to write in a rather explicit and clear manner, compared to other contexts, in order not to be misunderstood. The discussion of ‘grabbing’ a question shows how words and utterances in a Bakhtinian sense cannot be understood out of context, but may obtain different meanings in different contexts. Every word is full of meanings from situations where it has previously been used, and the word carries these meanings with itself, whenever it is used (Bakhtin, 1986). In a dialogical understanding of learning, in which meaning is seen as constituted in a ‘shared third place’, the student’s reaction can be seen as an example that interacting with others may lead the involved participants to reflect on themselves from an outside perspective, thereby eventually creating new knowledge.

Dualities in the students’ understandings

The students’ experiences with the use of net-mediated communication were characterized by a number of dualities, the interviews of the case study showed. Some students felt that net-mediated communication could be experienced as a more difficult way of communicating than face-to-face communication, and that net-mediated communication sometimes led to ‘sharper’ expressions or more conflicting interaction. They felt that misunderstandings could arise, due to the fact that on the asynchronous electronic discussion board they communicated only through the written word, with no tone of voice or other phatic signs, and with a probable delay in sometimes a couple of days before getting a response to one’s utterances. Other students had different experiences. They felt that through the asynchronous net-mediated communication they had more room for reflecting on their contributions to the discussion and for thinking through more balanced expressions than they would have in a face-to-face situation. Therefore these students felt that the discussions actually happened in a ‘smoother’ way in the net-mediated context.

A different duality was grounded in the fact that on an electronic discussion board every utterance is kept visible throughout the length of the course. In some situations this made participants feel vulnerable about writing to the discussion boards, and therefore they kept themselves from participating and contributing as much as they may otherwise had done. In other situations, however, they could use the discussion boards as a shared memory, being able to read through and remember earlier postings, re-activating the dialogue they were part of.

Dualities like the above mentioned were characteristic for the students’ experiences with the use of net-mediated communication. This emphasizes again the need of supporting the students’ awareness of each other through net-mediated communication. The more confidence they have towards each other, and the more trust they have that what they write will be accepted and discussed, but not ‘flamed’ or attacked, the more they will dare involving themselves and contributing to the development of a shared understanding. One of the students wrote on the discussion board that he had often made up imaginary faces of his group members when he wrote messages to their discussion board. This had helped him in his writing,
and it appears that Bakhtin’s emphasis on the “consciousness of the other” is of great importance to students’ way of participating, both when reading other students’ writings and when writing new messages themselves.

Another situation that underlined the need of supporting the students’ awareness of each other happened in a group work, where one participant was absent in a couple of days, and this made his group think that he had quitted the group work; when he joined the groups’ discussion board again some days later, he found the group preparing to go on without him. This event also shows that there is a need to explicit the expectations in a group or in a class about how to work and communicate, how often you read or write to the discussion board, etc.

The discussions emphasize the need for establishing quite explicit ‘rules’ for communication as guidance for the students in how to act when trying to communicate and collaborate on the net. This was also pointed out by Feenberg in his discussion of the lessons from the first online education (Feenberg, 1993: 191).

Another thing to be pointed out is the importance of having a moderator in net-mediated discussions. A moderator’s role can be to focus a discussion, maintain a friendly tone, provide feedback and eventually summarize the ongoing discussion (Flate Paulsen, 1995). The moderator does not have to be a teacher, but can as well be a participant, and the participants may take turns in being moderator. As Michel Campos points out, without a moderator in electronic discussions the risk is bigger that discussions will not evolve, or that misunderstandings and conflicts may occur, ending up in an ‘online clash’ instead of an ‘online class’ (Campos, 2002). It may therefore be fruitful to integrate in the organization of a course that the students are introduced to ways of communicating through the net, to different roles that may be used in net-mediated discussions, and to make each other’s expectations to the communication explicit.

Conclusion

Even though ICT is increasingly used in educational settings at various levels, students, teachers and designers of net-mediated education are met by a number of challenges, some of which have been discussed in this article. An understanding of “virtual learning environments” was presented, that places technology as just one of many contexts of an educational setting. What is therefore important in the design of learning environments is the pedagogical understanding of the teachers and designers. With an emphasis on how to establish conditions for collaboration between students, the article points out some important challenges that must be faced:

First of all, the participants’ understandings of the context are important. The richer the context is represented, the bigger the chance for the students to develop shared understandings. There will however always be an element of uncertainty, as words and utterances can always be understood differently, and one of the interviewed students concludes that in virtual environments it is even more important to express oneself explicit and clear.

Supporting the students’ awareness of the other participants contributes to establishing their feelings of confidence and trust, and thus facilitates their participation and interaction. However, the case also shows that awareness support like presentations of participants must be updated regularly in order to continue having a supportive function.

Establishing a frame and some explicit ‘rules’ for the net-mediated communication can be a way for the teacher to be present and visible on the net, and may at the same time act as a support for participants in search of how to communicate and collaborate.

Finally, if group assignments are to support collaboration, it is necessary that the participants have to interact, discuss and negotiate with each other, and not just split the work in independent parts that can be finished alone. And generally, interactive activities must be integrated as central parts of the flow of a course, the discussion of the presented case study concludes.

References


**Keywords**

Virtual learning environments; e-learning; dialogical learning theory; project-oriented work; collaboration.

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**EARLY EXPERIENCE IN DEVELOPING AN E-LEARNING ENVIRONMENT: The case of a Lebanese higher educational institution**

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**Abstract**

This paper describes the development of a virtual learning environment (VLE) in a Lebanese higher educational institution where e-learning is still in its formation period. In particular, it looks into the inception of the VLE at the university, the extent to which faculty members embed it in their teaching as a supplementary teaching tool and finally how students perceive its use in terms of availability of facilities, teacher support, course design and learning experiences. Analyses of current practices show that the use of the VLE in teaching and learning at the university is growing steadily though slowly. In addition, questionnaire results, which sought to document student experiences concerning the use of the VLE, yielded favorable results regarding facilities, teacher support as well as satisfaction with the course content and delivery. The paper concludes by identifying some of the obstacles to change and with recommendations for the wider use of e-learning in the university curriculum as a supporting tool for a vibrant pedagogical experience.

**Introduction**

The recent mushrooming of universities in Lebanon invites speculations as to what makes one university distinguishable from the other in terms of providing quality education. Recent statistics published by the Center for Educational Research and Development (CERD) showed that in 2002 Lebanon had 42 officially licensed private universities which housed around 76,000 students enrolled in the fields of humanities, sciences, engineering, medicine and fine arts. Surely the rapidly increasing number of higher educational institutions in Lebanon is influenced by three factors: (i) the sharp decline of the academic standards of the non-fee paying Lebanese University as a result of severe shortage of funding meshed with administrative decay (Al Ameen, 2001); (ii) the tendency of parents to place their youngsters in ‘private’ educational hands (Abouchedid, 1997); (iii) the rising of the ‘corporate education’ culture in which commercial universities seek profit by taking advantage of the growing number of high school graduates moving into higher education. Since university revenues are based on the recruitment and retention of students, many universities are seeking to improve and up-date their educational programs in order to find a niche in Lebanon’s competitive higher educational market. In this context, one of the tasks ahead of universities in Lebanon is concerned with the promotion of problem-solving and interactive pedagogical collaborative styles in the classroom and to redress students’ lack of motivation and participation in classroom discussions and projects. This paper seeks to share the experience of Notre Dame University in Lebanon in encouraging intellectual activity through adopting the Virtual Learning Environment VLE as a potential catalyst for quality teaching. The paper is based on the premise that the VLE potentially provides a means to improving on the pedagogical shortcomings in higher education institutions. Although the Web has become the modern tool of communication and information resource all over the world and the advanced technology it uses offers distinct advantages both to educators and students (Bento & Bento, 2000), research on the educational benefits of VLE has yielded mixed results as the e-learning trend has both outspoken proponents and critics. Carl (1991), for instance, has detailed the positives of e-learning. In his view, e-courses can be monitored more easily than the traditional classroom, off-campus students can use electronic mail to have the same quality of communication with faculty members that on-campus students have, and e-learning may result in cost savings. By the same token, Dwyer et al. (1995) explained the educational advantages that arise...
when supplementing a course with Web-based tools including student-to-student and faculty-to-student communication, enabling student-centered teaching approaches, providing 24 hours-a-day accessibility to course materials, and providing just-in-time methods to assess and evaluate student progress. Other studies (e.g., Gifford, 1998; Kincannon, 2002) downplayed the effectiveness of e-learning in the light of the evidence that a higher percentage of students participating in online courses tended to drop out before the course was completed compared to students in a conventional classroom. Despite the presence of some skeptical views regarding the pedagogical benefits of e-learning in meeting students’ learning needs, there is evidence that a VLE is a potential means for making education more effective, flexible, efficient and immediate (Riley & Gallo, 2000). Recent scholarship showed that positives of e-learning outweigh those of its negatives. In a comparison of two groups of students who completed a course online and in class, for instance, Redding & Rotzien (2001) found that online instruction was more effective than classroom instruction as course examinations revealed the online group performed better than their classroom counterparts. However, in an investigation of time spent to complete a course, Gifford found online learning requires more time than traditional classroom learning. In a further comparison of Web-based and classroom learning in higher education institutions, Hofman (2002) reported that Web-based learning courses enabled students to understand the course content more effectively than when delivered through traditional classroom instruction due to a better collaborative learning environment provided by the Web as a learning tool and resource. With reported pedagogical advantages of e-learning at play, there are a number of limitations that hinder the integration of e-learning tools into teaching in educational institutions in Lebanon. For instance, educational decision-makers may fear that e-learning would unexpectedly shift traditional education into a new pedagogical undertaking where teachers and policymakers are not adequately familiarized with its objectives, content and learning outcomes (Nasser & Abouchchedid, 2001). Secondly, many decision-makers consider that the implementation of e-learning in educational institutions may result in an abrupt change in both content and styles of pedagogy which educational decision-makers cannot currently accommodate due to the near absence of plans for a smooth transition from traditional education to e-learning. Third, many decision-makers also contend that Virtual Learning Environments might stamp out the platform from which a deliberate academic discourse takes place (Mathews, 1999) fearing that universities will become ‘no lecture’ institutions. Therefore, in addressing Lebanese university students’ passivity and lack of receptivity to course content and material in the traditional classroom, one must consider a proactive awareness initiative at universities. This would provide evidence of students’ convenience or inconvenience of learning in VLE, particularly in light of the dichotomous stance of educational policymakers; one denouncing the traditional classroom teaching process while the other fearing to endorse e-learning as an alternative to the traditional classroom.

This paper is part of a VLE championing initiative at a private university in Lebanon where the educational process is predominantly traditional. The aim is to encourage the university to utilize the VLE in creating new learning environments that provide learning opportunities outside the classrooms as well as facilitating student-student and student-teacher communication. Its main assumption is that the VLE provides all-time access to learning at anytime and from any location, is cost effective and has wide reach (Michau, Gentil & Barrault, 2001), besides providing enormous pedagogical benefits including constructivist learning that helps promote, among other things, critical thinking and mastery learning; two much needed cognitive domains in Lebanon’s higher educational system. First, the paper will present the historical development of the VLE at Notre Dame University in Lebanon and will document the experiences of a sample of undergraduate students at the university who have taken courses using a Virtual Learning Environment, VLE.

**The Development of VLE at Notre Dame University**

The development of the VLE at Notre Dame University is relatively fresh since the University itself was established in 1987. The University structure is based on the American-credit system of education and has six Faculties. These are: Humanities, Sciences, Engineering, Architecture Art and Design, Political Sciences and Business Admin-
istration. In 1988 the University accommodated 350 students who were mostly enrolled in undergraduate majors. Since the 1990s, the University has witnessed a growth in the number of students; a matter which encouraged the University administration to branch out to other regions in Lebanon in order to provide higher education to rural populations. At present, the university houses 4215 students who are mostly enrolled in undergraduate majors with the majority registered in the Faculty of Business Administration and Economics. With the tremendous expansion of the student body at the university and its need to take advantage of the recent technological advances in education, the university administration has decided to enhance its learning and teaching processes through supplying the current curriculum with a VLE.

In practice, in the year 2000 the university has formed committees drawn from the six Faculties to conduct a feasibility study on using the VLE in teaching. A working group was formed to start the selection of faculty members in order to study together the implementation of e-learning at the university. The group comprised key administrators and Information Technology (IT) staff and specialists and was chaired by the director of the Division of Computing Services. The group conducted vendor demonstrations and lengthy evaluation processes of the IT infrastructure of the university. The group also conducted assessment of current styles of pedagogy used in the learning/teaching process at the university. After lengthy discussions, the group selected Blackboard as a tool to support the teaching and learning process in traditional classrooms. Blackboard was used to supplement and not replace the long-established classroom teaching and learning styles at the university. In addition, Blackboard was divided into different sections that include course content (e.g., course documents, book listings, course information, and assignments), communication tools (e.g., e-mail, virtual chat, discussion forum, document transfer, and calendar), assessment (online assessment, grade book) and administrative control for the instructor.

The Fall of 2001 marked the official inception of the VLE at the University; the objective was to provide a flexible learning environment to students and to support learning at the University. With the inception of the VLE at the University, faculty members and students have been increasingly attracted to the learning opportunities provided by computer technology. One of the opportunities provided was to offer training to both students and faculty members on the use of technology for the purpose of learning and teaching. As a result, specialists from the Division of Computing Services at the University trained 100 out of 210 full time faculty members. In addition, the majority of students at the University received training. The training focused on the use of Blackboard to support the teaching and learning process in traditional classrooms. By “traditional classroom” I mean conventional face-to-face classroom learning. At present, about 36% of faculty members use Blackboard in teaching while the rest are hesitant to use it due to their reluctance to post material on-line, particularly examinations, due to what they report as confidentiality and security issues.

After three years of the use of the Blackboard at the University, the present study seeks to document student attitudes and experiences regarding the use of Blackboard. The aim is not to gauge students’ endorsement or opposition to the Virtual Learning Environment, but to assess the reasons for these attitudes and thereby consider the likelihood for further implementation of e-learning at the University.

Method
Sample
A sample of 29 undergraduate students enrolled in Advanced Software Packages and Accounting Information System courses were recruited for the study. The sample comprised 20 males (69%) and 9 females (31%) who were between 20-29 years of age. The majority of respondents reported that they took courses through the Blackboard. In addition, 79% of respondents reported that they connect to the on-line environment 1 to 10 times per week.

Questionnaire
The questionnaire was laid out in three parts. Part A sought to generate background information about students such as gender, age, course type, frequency of taking courses via Blackboard and frequency of connecting to the online environment. Part B of the
questionnaire requested students to rate 17 question-items dealing with the use of Blackboard along a Likert scale ranging from 1 as very high to 7 as very low with 4 as the neutral response. The scale was continuous and was allowed to obtain a great variance in the data. The questionnaire items aimed to measure student attitudes towards the instructor’s competency and help in delivering the course via Blackboard, the utility of Blackboard in learning, the degree of technical support provided by the university, access to information and communication with peers and the course instructor. The third part of the questionnaire had four open-ended questions on the prerequisites that should be established to effectively participate in an online course, how the learning material wins the learner’s interest, advantages and disadvantages of using Blackboard in students current course, and a fourth blank question for additional comments. The internal consistency measured through Cronbach alpha (Cronbach, 1994) of the items was .85. Two items appeared to have a low reliability; these being item 4 (The university provided me with support in cases of unexpected Blackboard technical problems) and 5 (the course instructor provided timely feedback of my assignments). Removing these items from the questionnaire led to a $\alpha = 0.87$.

Procedure

The questionnaire was administered to 29 students at Notre Dame University in two classrooms where the course instructors used Blackboard to post course materials such as syllabus, calendar/schedule, lecture notes, handouts, reserved readings and links. Students found the questionnaire items easy and straightforward.

Findings and discussion

Prima facie evidence from descriptive statistics shows student contentment with the way the courses were delivered, course content, suitability of documentation to the nature of the course, immediate feedback from their instructor and competence of the instructor in managing the course. In addition, the majority of students reported that they were happy with the way the course was delivered and registered as well their satisfaction with easy accessibility to posted material. Above all, 78% of students reported that the course was high or moderately high in meeting their learning needs (See appendix for full results).

Open-ended responses coalesced with students’ positive evaluation of their learning experience reported in the questionnaire. To the first question on the prerequisite for effectively participating in an online course, the majority of students recorded teamwork, learning applications, and computer literacy. As for the material needed to win the learner’s interest, students reported that it was very easy to put the whole data needed on a floppy or CD and read it later at their own pace. This encouraged students to browse the Web pages particularly in the advanced software package course. In addition, students reported that Blackboard reduces paperwork, saves time, and motivates students to check course material and announcements online. In terms of advantages, students reported that Blackboard facilitates communication with their instructor, as a student put it “the Blackboard helped me communicate with my instructor with no need to visit him to communicate with him”. Students also reported that the way the course was delivered helped them become aware of updates and new information in their respective fields of study. As for the disadvantages of using Blackboard: “is being accessible only through the intranet”, and not from the Internet as many students reported.

The survey responses further indicated that being able to communicate easily with their instructors had a positive impact on student attitudes towards the courses and their related pedagogical activities. Students’ positive attitudes towards Blackboard reveal that technology plays a role in meeting students’ learning needs. Students’ positive experiences of taking a course in a virtual environment were beyond what I expected as all students participated fully and actively in the courses offered via Blackboard.

Despite students’ positive views of Blackboard there are certain limitations that impede its use on a large scale at the university. These limitations are administrative and technical. At the administrative level, i.e., the decision-making process at the University, no decisive decision has been taken so far by the University Council, a decision-making body in universities which follow the American system of higher education to integrate e-learning into the university curriculum. Hence, the use of Blackboard is limited to faculty members who believe in its numerous pedagogical benefits. In terms of tech-
nical limitations, Blackboard’s potential as a teaching tool is largely contingent upon the hardware and technology “know-how” of its users. In this context, not all faculty members at the university have the technical “know how” to utilize Blackboard in the learning and teaching process. Furthermore, and as reported by many students surveyed, Blackboard is not a practical teaching tool for students without Internet connectivity.

Despite these limitations, students’ positive experience in getting engaged in a vibrant virtual learning environment has truly reflected the concept of flexible delivery i.e., being flexible in access, time and place in a manner similar to the approach of Baron (1995), provided students with increased responsibility and control over their own learning.

As a student said:

“We need to accept the fact that the machine is helpful to enhance our learning provided that we direct the machine to meet our needs so that we have control over our learning not the machine controlling us.”

Based on the results of the present study, the following recommendations were developed for the future integration of e-learning at the university under-investigation.

1. One of the crucial steps for facilitating the implementation of e-learning is to seek cooperation from the faculty members and decision-makers at the university. Deploying any online learning tool requires cooperation by departments, faculties, instructional technologists, instructional designers, computing lab coordinators, computing support specialists, library administration and staff.

2. Working groups will help maintain and develop the e-learning initiative at the university. These groups should also include decision makers who can determine long-range courses of action and the power and flexibility to see them enacted.

3. A direct result of the working group should be an evolving set of policy and procedure statements in the By-laws encompassing everything such as how the university intends to implement and monitor the development of e-learning.

4. All faculty members and administrative units at the university should be asked to receive training. For instance, faculty members need to know that the university intends to support their efforts in using the Web to teach with explanations of what type of support will be offered by the administration.

5. Faculty members should be offered training in how to teach in an online environment and what best practices can meet their course educational objectives.

Judging from what students reported in the survey, supplementing teaching and learning with Virtual Learning Environment is an objective worth striving for.

References


### Appendix

**Student Questionnaire Results**

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Frequency of taking college courses through Blackboard.
Early experience in developing an e-learning environment:

### Frequency of connecting online

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- **Missing**: 3

**System Total**: 29

The documentation given to me by the university for accessing Bb. was suitable for the course requirements:

- very high: 15 (57.7%)
- high: 6 (23.1%)
- moderately high: 1 (3.8%)
- neutral: 4 (15.4%)
- Total: 26 (100.0%)

**Missing**: 3

The course instructor was available via Bb.:

- very high: 12 (42.9%)
- high: 5 (17.9%)
- moderately high: 4 (14.3%)
- neutral: 4 (14.3%)
- low: 2 (7.1%)
- very low: 1 (3.6%)
- Total: 28 (100.0%)

**Missing**: 2

**System Total**: 30

The instructor showed skill and competence in helping me with Bb.:

- very high: 18 (62.1%)
- high: 7 (24.1%)
- moderately high: 2 (6.9%)
- neutral: 2 (6.9%)
- Total: 29 (100.0%)

The university provided me with support in cases of unexpected Bb. technical problems:

- very high: 6 (22.2%)
- high: 3 (11.1%)
- moderately high: 4 (14.8%)
- neutral: 11 (40.7%)
- low: 1 (3.7%)
- moderately low: 2 (7.4%)
- Total: 27 (100.0%)

**Missing**: 2

**System Total**: 30
Early experience in developing an e-learning environment:

**The course instructor provided timely feedback of my assignments**

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**Bb. helps me manage and have control over my own learning development**

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**Bb. helped fulfil the course objectives**

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**Through Bb the course was helpful in meeting my learning needs**

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**System**

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Early experience in developing an e-learning environment:

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### I was satisfied with the way Bb covered the course content

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### I was satisfied with the way the course was delivered through Bb

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### Bb provided a constructive learning environment

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### Bb. facilitated learning activities (theory, practical, group work)

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Early experience in developing an e-learning environment:

### Bb. facilitated my communication with classmates

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<thead>
<tr>
<th>Level</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>very high</td>
<td>6</td>
<td>20.7</td>
</tr>
<tr>
<td>high</td>
<td>2</td>
<td>6.9</td>
</tr>
<tr>
<td>moderately high</td>
<td>7</td>
<td>24.1</td>
</tr>
<tr>
<td>neutral</td>
<td>9</td>
<td>31.0</td>
</tr>
<tr>
<td>low</td>
<td>2</td>
<td>6.9</td>
</tr>
<tr>
<td>very low</td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### Bb. helped me communicate with the course instructor

<table>
<thead>
<tr>
<th>Level</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
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<td>11</td>
<td>37.9</td>
</tr>
<tr>
<td>high</td>
<td>6</td>
<td>20.7</td>
</tr>
<tr>
<td>moderately high</td>
<td>5</td>
<td>17.2</td>
</tr>
<tr>
<td>neutral</td>
<td>2</td>
<td>6.9</td>
</tr>
<tr>
<td>low</td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td>very low</td>
<td>2</td>
<td>6.9</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### I would recommend other students to use Bb. courses

<table>
<thead>
<tr>
<th>Level</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>very high</td>
<td>13</td>
<td>44.8</td>
</tr>
<tr>
<td>high</td>
<td>9</td>
<td>31.0</td>
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<tr>
<td>moderately high</td>
<td>4</td>
<td>13.8</td>
</tr>
<tr>
<td>neutral</td>
<td>2</td>
<td>6.9</td>
</tr>
<tr>
<td>very low</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes on the author:

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Key Words:

Virtual Learning Environment, Lebanon, E-learning, Blackboard, Collaborative Learning, Information Technology, Critical Thinking
Constructivist teaching using the IVA course management system

Constructivist teaching using the IVA course management system

Abstract

The article aims to identify necessary ICT competences of teachers, which facilitate their teaching practice and the students learning process. The article describes the design procedure of a course for teachers to increase their ICT competences for the pedagogical context at Viljandi Culture Academy, in Estonia. In addition, the results of the evaluation of the course will be presented, including an evaluation on the teachers’ readiness to use constructivist teaching, the teachers’ feedback on the course and finally the results of the evaluation impact, which aims to identify, the impact of the course on teachers’ ICT competences.


A course management system for applying principles of constructivism.

Introduction

According to an Estonian national survey, computers are only occasionally used in schools in Estonia despite the fact that schools are sufficiently equipped with up-to-date computers and network connections (found on Laanpere et. al, 2002). This can be caused by a lack of educational software, which meet the needs of the teachers, or by a lack of know how of the teachers to use the hardware and software available. This paper addresses the latter as being the main concern when implementing ICT in a higher educational institution. According to Singer (2000), the effort required by teachers to master new technologies is underestimated. He states that one of the reasons why technology innovations fail to take hold in schools is because teachers do not have proper guidance on how to make use of them. In addition, another important issue which isn’t taken into consideration when teachers implement ICT, concerns how teachers can stimulate the learning process of students when using ICT. According to Shulman (1987) teacher trainings, which teach how to use technology, is not the same as knowing how to use technology to improve student learning. What teachers need in order to help students learn with technology is specific pedagogical content knowledge and strategies to help teach content using particular methodologies and tools (Margerum-Leys & Marx, 2000).

The focus of this research is to develop teachers’ ICT competences at Viljandi Culture Academy in Estonia. Viljandi Culture Academy is a state owned applied higher educational institution, which provides courses in fields such as theatrical art, dance, music, national handicraft, youth work as well as library and information sciences. Besides theoretical knowledge, graduates obtain practical experience in the particular fields. An additional priority of the curricula of the academy is to develop the pedagogical skills of the students.

For so far, the use of ICT tools for teaching and learning has been minimal. Some teachers have experimented with different ICT tools, but, until now there has not been a clear policy on ICT implementa-
tion for the whole academy. This study aims to address the following research questions in order to facilitate the implementation of ICT for the Academy:

1. Which ICT competences are needed for teachers?
2. Which setup should the learning session have? 3. What kind of impact did the learning session have on teachers ICT competences?

Defining ICT competences for teachers

ICT competences of teachers will not be thoroughly analysed, they will be defined based on a literature review. According to several researches, (Veen, 1993; Dillems et. al, 1998; Watson and Tinsley 1995; Watson, 2001) introducing ICT tools at schools should not have a techno-centric focus but rather present teachers with knowledge on how they can use ICT tools for their own teaching and how it will benefit students. Fullan (1991) points out that in order to implement innovations at schools, teachers should participate in skill-training workshops, where they can learn new skills, and discuss possible change with colleagues. Another issue that is raised in order to solve problems faced when implementing ICT in the curriculum is that ICT needs to provide consistency. Fishman et al. (2001) emphasize that beside a clear pedagogical approach when using ICT, there is also a need for consistency when using forms of technology. He points out that there are too many forms of technologies for teachers to learn. Instead of this fragmented use, teachers should be provided with a technological tool which supports the whole curriculum. This can be realised when using a Learning Management System (LMS). De Boer (2004) defines a learning management system as a Web-based database-driven system that enables or supports learning.

As a first result of these findings, it can be concluded that necessary ICT competences for teachers are related to carrying out teaching activities and facilitating the students’ learning process. Therefore effective ICT implementation should take into consideration a modern pedagogical context in accordance with teaching and learning methods. Teachers should be informed and become aware of how the use of new technology will support a certain pedagogical approach. Secondly, teachers should be introduced to a learning management system, which provides teachers with a usable framework for the whole curriculum. These two principles can be integrated, by introducing a learning management system, which facilitates a modern pedagogical context. A learning management system called IVA is developed to advocate constructivist teaching and learning, which is a learner centred pedagogical approach aiming to activate and motivate students to construct their own knowledge and develop their pedagogical thinking skills (Laanpere et al, 2003).

Important ICT competences for teachers can therefore be seen as competences to carry out constructivist teaching when using the tools, which are provided in the IVA learning management system. In order to carry out the implementation of constructivist teaching using the IVA learning management system at Viljandi Culture Academy the following sections will elaborate on the definition of constructivism and its principles (Section 3.3.1.) and introduce the IVA learning management system (Section 3.3.2).

Constructivism

In order to introduce the main idea behind the constructivist teaching and learning, the ideas presented by Funderstanding about constructivist learning, constructivism is defined as: “a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us generates our own “rules” and “mental models”, which we use to make sense of our experiences. Learning therefore, is simply the process of adjusting our mental models to accommodate new experiences” (Funderstanding, 2001, Constructivism section, ¶1).

In order for teachers to learn practical applications of the constructivism in teaching and learning, ten principles of constructivism were defined based on several authors (Terwel, 1999; Jonassen, 1997; Reeves, 2004; Arts in Education Institute, 2004.; South Educational Developmental Laboratory (SEDL), 1995; Funderstanding, 2001). These principles are active learning, student’s own construction of knowledge, learning is contextual, complex tasks for learning, collaboration and conversation in learning, reflection of learning, formative evaluation and response in learning, highly motivated
students, sufficient time for learning, and mother tongue learning and students overall cultural context.

These principles of constructivism will be the subject matter for the course for teachers at Viljandi Culture Academy. In order to make decisions about the order of the principles, which will be used for teaching, the principles are organized into clusters.

Cluster 1: Language, culture attitude, context and complex task
Language and culture attitude principles should be introduced together with the principle of the authentic context. Both are concerned with the context and materials for learning. The complex task principle is also related to the learning context, more specifically, in order to carry out constructivist teaching a complex task should be related to the authentic learning context.

Cluster 2: Activity, motivation and construction
These principles are all related to the learning subject, this is the reason why these principles are presented in one cluster. Activity is not an independent aspect. Students should be active in constructing knowledge. These aspects are also connected to motivation and goal orientation.

Cluster 3: Collaboration, conversation and time
This cluster was organised according to the social aspect of learning, from a teachers’ perspective. A large part of the learning takes place through social activities rather than an isolated context. Learning through a social context requires a sufficient amount of time. This is the link which teachers are familiar with and that is the reason why the time principle, which more generally influences all of the other principles, is presented together with the collaboration and conversation principle.

Cluster 4: Reflection, formal evaluation and response
These principles consist of elements of evaluating the learning process and its outcomes. In order to carry out an adequate reflection of the learning process, formative evaluation from the teacher is needed. Its aim is developmental for the learner and its outcome meaningful for composing personal reflection. Genuine response carries the same purpose.

In brief, the first cluster is related to the learning context. The second cluster to the subject of learning, its core element being construct-

ing the knowledge. The third cluster is related to collaboration and conversation in learning. The final cluster is related to the process and outcome evaluation. This categorizing is useful when dividing the subject matter of the course into four separate sections for four course sessions.

As stated earlier, teachers’ ICT competences are related to knowledge and skills about using constructivist teaching with the support of the IVA learning management system at Viljandi Culture Academy. In order to obtain sufficient information about the subject matter for the course, the next chapter gives an overview of the IVA learning management system and its applications.

IVA learning management system
IVA is a Web-based learning management system, which is developed by the Centre for Educational Technology and Department of Computer Science at the Tallinn Pedagogical University in order to advocate constructivist approaches and practices in e-learning.

The structure and functionalities of the IVA system advocate constructivist approaches to learning and teaching. The three most important conceptual pillars for designing a truly constructivist learning environment are the three C-s:

• Tools, support, time and space for personal knowledge Construction
• Meaningful and authentic Context for learning
• Support for Collaboration and group reflection and production.

Referring to these three pillars, the IVA user interface is designed in three sections (Laanpere et al 2003):

• WebTop, a section which contains tools that assist personal knowledge construction and reflection.
• BookShelf, a section which contains tools that provide context for meaningful learning.
• WorkShops, a section which contains tools that assist student collaboration and group communication.
An additional section in IVA is the Management section; it contains tools that will aid teachers to manage the course. Students of the course do not have access to this section.

Based on the findings presented in the last two subheadings, a course was designed for teachers. The aim of the course was to introduce principles of constructivism and their applications in the IVA learning management system. The main objectives of the course were: teachers will be able to understand the principles of constructivism, and teachers will know how to use IVA to implement these principles. The following subheading gives an overview of the learning sessions (Section 3.2.3).

Learning Sessions
The learning sessions consisted of an introductory session and four workshops. The aim of the introductory session was to introduce to the participants the goals of the workshops, give an overview of the activities, and to inform teachers about the activities, which they have to arrange before the workshops.

The four workshops concentrated on principles of constructivism and their applications in the IVA learning management system. The workshops were designed according to different constructivist principles. The first workshop concentrated on the aspects related to the learning context and tasks. The second workshop dealt with the learning subject. The third workshop focused on collaboration and time related aspects. The fourth workshop highlighted the evaluation. In all sessions PowerPoint presentations, group-works, discussions and practical activities with IVA learning management system were used (see table 1).

Table 1: Setup of the workshop sessions

<table>
<thead>
<tr>
<th>Learning activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PowerPoint presentations will be used in order to provide teachers with informa-</td>
</tr>
<tr>
<td>tion about the principles of constructivism and examples of their applications.</td>
</tr>
<tr>
<td>2. Group assignments will be used for making reflections about the participants'</td>
</tr>
<tr>
<td>previous experiences.</td>
</tr>
</tbody>
</table>

3. Group-work activities will be used in order to activate teachers to think about their personal experiences in using constructivist principles.
4. Discussions will be used to offer teachers the opportunity to share their previous gained experiences with these principles and to use good applications for their teaching practices from their colleagues.
5. Practical assignments in the IVA course management system will give the participant the opportunity to apply the principles using the tools in the IVA course management system. Practical assignments will be related to teachers' actual teaching activities. The aim of the activities is to create in IVA course management system a course which they could use for teaching their regular lessons.

Results
Respondents
The evaluation data was collected before the course (pre test of teachers' readiness) from eight teachers at Viliandi Culture Academy, who applied for the course of the IVA learning management system using constructivist teaching. The course participants had different working positions, and were from different departments at Viliandi Culture Academy. Only one regular teacher took part of the course, the other seven participants teach courses and are also engaged with administrative tasks. After the course, the participants were asked to fill in a post-test of their readiness to use the principles of constructivist teaching and a general feedback questionnaire to evaluate the course. To demonstrate the learning outcomes, teachers were asked to create courses in the IVA learning management system. These courses were evaluated from the perspective of the use of the constructivist principles using a checklist for impact evaluation.

Results on teachers' readiness to use principles of constructivist teaching
In order to measure teachers' readiness to use constructivist teaching in a learning management system a questionnaire was used. The questionnaire concentrates on Reeves (2004) eight opposite dimensions of a learning environment, where one side represents a traditional teaching approach and the other side represents ideas of constructivist teaching, such as, Task-oriented, Challenging, Collaborative, Constructionist, Conversational, Responsive, Reflective, and Formative. These dimensions represent features of teaching and learning.
For the readiness evaluation a pre- and a post-test was used. Participants of the course had to fill in a questionnaire consisting of eight questions on a ten-point scale about their readiness to use constructivist teaching. The left side of the scale (1-5) the principle of traditional teaching are presented and on the other side the scale (6-10) the principles of constructivist teaching are presented. Teachers were asked to choose a number that indicates their personal ideas about the use of the principles. The numbers one to five indicate a more traditional approach to teaching and the numbers six to ten a more constructivist approach to teaching.

The same questionnaire was filled in after the course. This procedure helped to identify the change in attitude of the teachers, thus their change in readiness to start to use constructivist teaching. If teachers’ answers are presented on the right side of the scale, then it can be assumed that they are ready to use constructivist teaching in IVA learning management system.

In the following table (Table 2) the frequencies among readiness pre and post-test scores are presented.

### Table 2: Frequencies among readiness pre and post-test scores

<table>
<thead>
<tr>
<th>Dimensions of constructivism</th>
<th>Pre-test Mean (standard deviation)</th>
<th>Post-test Mean (standard deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Authentic learning context</td>
<td>7.3 (0.9)</td>
<td>6.8 (1.6)</td>
</tr>
<tr>
<td>2. Complex task</td>
<td>7 (1.6)</td>
<td>6.9 (1.6)</td>
</tr>
<tr>
<td>3. Integral collaboration</td>
<td>5.6 (2.5)</td>
<td>5.6 (1.8)</td>
</tr>
<tr>
<td>4. Original construction of knowledge</td>
<td>7.6 (0.9)</td>
<td>7.6 (1.3)</td>
</tr>
<tr>
<td>5. Multi-faceted conversation</td>
<td>7.4 (1.9)</td>
<td>7.5 (1.3)</td>
</tr>
<tr>
<td>6. Genuine response</td>
<td>6.9 (1.8)</td>
<td>7 (1.3)</td>
</tr>
<tr>
<td>7. Deep reflection</td>
<td>7.6 (1.8)</td>
<td>7.6 (1.2)</td>
</tr>
<tr>
<td>8. Formative evaluation</td>
<td>7.3 (1.6)</td>
<td>8.1 (1.6)</td>
</tr>
</tbody>
</table>

As the statistical analysis showed, there was a significant difference for the formative evaluation principles between the readiness pre- and post-test scores. Before the course the teachers’ readiness towards formative evaluation principle was significantly lower than after the course ($t=2.198$, df=7, $p=0.032$). Between the other seven principles no statistical differences were found. However, as presented in table 2, in both the pre- and the post-test, readiness of teachers to use constructivism is present. All the principles tested received a mean score of 5.6 or more, which indicates a readiness to use constructivist teaching in a web based learning environment. Three aspects of constructivism (integral collaboration, original construction of knowledge and deep reflection) the pre- and post-test showed exactly the same results.

The main reason for only one principle being significantly different between the pre- and post-test can be attributed to the fact that the pre-test, which was given before the course, already indicated a readiness to use constructivism. The scores which were given to the principles were unexpectedly high for the pre-test items. Six principles out of eight: authentic learning context, complex task, original construction of knowledge, multi-faceted conversation, deep reflection, formative evaluation were rated with seven and above (out of ten).

### Teachers’ feedback on the course

In order to gain the teachers’ feedback of the course, a questionnaire with 21 items was designed. 19 structured questions were to be evaluated on a five point Likert scale and 2 open-ended questions to be filled in. In the following table (Table 3) the mean scores of the results on 19 structured questions are presented on a five point Likert scale.

### Table 3: Frequencies among utility and usability

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean (standard deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Were the goals of the course clearly presented?</td>
<td>4.5 (0.5)</td>
</tr>
<tr>
<td>2. Was the scheduling of the course sufficient with respect to the planned contents and tasks?</td>
<td>4.3 (1.4)</td>
</tr>
<tr>
<td>3. Was the workload well spread over the course?</td>
<td>4.1 (0.6)</td>
</tr>
<tr>
<td>4. How would you rate the value of descriptions of constructivism principles?</td>
<td>3.9 (1.5)</td>
</tr>
<tr>
<td>5. How would you rate the value of examples of constructivism principles?</td>
<td>3.0 (1.5)</td>
</tr>
<tr>
<td>6. How would you rate the complexity of constructivism principles?</td>
<td>3.2 (1.5)</td>
</tr>
<tr>
<td>7. How would you rate the value of practical activities in the IVA course management system?</td>
<td>3.0 (1.5)</td>
</tr>
</tbody>
</table>
8. Is the course in general good and relevant to the teaching practice?
9. Were the individual and group work well balanced during the course?
10. Was the course sufficiently practically oriented?
11. Was there enough technical equipment for the course?
12. To what extent do you think this course can help the instructor making a constructivist course?
13. To what extent do you think this course will help the instructor to use IVA course management system in the future?
14. Have your goals been met after the course?
15. Was it easy to follow the trainer’s explanation?
16. Was it interesting to follow the trainer’s explanations?
17. How would you rate the approach used for the course?
18. How difficult or easy was it to work with support materials (handouts)?
19. What is your opinion about the support materials (handouts)?

Overall average of the questions: 4.5 (0.3)

Note: All the structured questions were rated using a five point scale, where 1 represents very low and 5 very high.

The highest score of questions was given to the role of practical assignments in the course (Question 7). This item received the total maximum mean score 5.0. This indicates, that the design aspect: to use practical assignments throughout the course, achieved very positive responses from all the participants. Only one question was rated below four, and the rest of the questions were rated four and above.

As mentioned above, the questionnaire also consisted of 2 open-ended questions. The first open-ended question was aiming to find out, what kinds of additional activities the participants would like to see added to the course. The main suggestion which was given concerned practical issues. Participants suggested adding more practical assignments on how to work with the course management system in the workshops. Suggestions were also given to leave more time for group discussions and provide teachers with additional materials about constructivist teaching.

The second open ended question, was aiming to find out what personal goals the participants had for this course. Most of the participants set as their personal aims for the workshops to learn about the IVA learning management system and its applications for their teaching. Two participants had more general aims; they entered the course in order to make decisions about implementing IVA on a larger scale, for one participant the larger scale was the whole school and for another the department.

In brief, both structured and unstructured questions indicate that the most valuable aspect of the course for the participants was its practical orientation and mainly for learning how to use the IVA learning management system. This was also shown by the unstructured question about the personal aims for attending the course. All the participants’ answers were related to learning how to use the IVA learning management system.

As indicated, constructivist teaching also achieved high rating but still lower than using the IVA learning management system. This could have been influenced by the fact that teachers were actually quite familiar with constructivist teaching. This could have made them less interested in the examples of how to use constructivist teaching.

Learning task and impact evaluation

The learning task for the participants was to create a web based version of a course. In order to evaluate these courses in terms of using constructivist principles, an impact evaluation was used. The impact evaluation indicates which constructivist principles are used in these courses created by the participants. The impact evaluation was carried out by three educational experts who are familiar with methods of constructivism in education.

In order to carry out the impact evaluation, an expert-review checklist was created. The checklist evaluated the presence of constructivist principles in the courses that were made by the teachers taking part of the course. All the evaluators were asked to rate the presence of the principles on a three point scale, where zero indicates that the
principle is not used, one indicates that principle is used to some extent, and two indicates that principle is used. Due to the fact that not all the participants had time to finish their actual courses in IVA, three courses (which were to be developed by the participants) out of eight were not evaluated. The final target group for the impact evaluation consisted of five teachers. Their courses in IVA were evaluated by three educational experts.

In three courses (Religious Studies, History of Textile Technology, and Presentation Culture) out of five, which were evaluated, all the measured constructivist principles were present or to some extent present according to all evaluators. The most constructivist course was History of Textile Technology. The least constructive course according to the evaluators was History of Latvia and Lithuania. In order to indicate, which principles were used most and which least, the average of all the measured principles were calculated. Most often, a preference to the principle of using the mother tongue was given; it obtained a mean score 2. The second highest rated principle was that of collaboration. The least used principle, indicated by the evaluators, was the principle of genuine response. In brief, the courses which were made by the participants made use of most of the constructivist principles, especially language and collaboration. The constructivist principles that were least presented in the courses was related to evaluation. It could have been influenced by the design of the course management system. In the IVA learning management system evaluation tools are integrated in different sections. Tools for evaluation: Quizzes and homework assignment can be created in the management section. Created quizzes and homework assignments are placed in different sections in IVA (WebTop and Workshops). This could lead to a situation where teachers will loose their attention applying these principles. The principles presented by most participants are simply applied in the course management system, such as language selection, workshop section with tools for collaboration and group work, and adding materials for authentic learning.

Discussion

The first research question of this study aims to identify the ICT competences of teachers. Literature review showed that needed ICT competences for teachers are directly linked with the pedagogical context in accord with the teaching and learning methods. In the current study, the pedagogical context was constructivist teaching and therefore ICT competences were identified as supportive applications in the IVA learning management system, which advocate constructivist teaching. The principles of constructivism set high requirements for the learning subject, objects, context and process. Necessary conditions for carrying out this kind of teaching and learning might not be present in each learning situation. For example, teachers might have large courses, containing 60-100 students, by these conditions; it can be difficult to use formative evaluation and to provide genuine response to all participants. This argument should be taken into consideration when making a decision about using constructivist teaching for a certain topic. This means that constructivist teaching may not be suitable in all learning situations, and as ICT competences for teachers should be related to the teaching context, the concrete ICT competences can be different than identified in this study.

The second research question was aiming to identify the setup of the learning session for teaching how to apply constructivist teaching with the use of the IVA learning management system. The learning sessions were organized according to four clusters of constructivist principles. In each session principles of a cluster were introduced to teachers and showed how these principles can be applied with the help of the IVA learning management system. According to teachers’ feedback, the most valuable aspect of the course was its practical orientation. However, the other items in the questionnaire, which aimed to receive feedback on the course, were also rated with relatively high scores. This sets doubts on the method, which was used to receive feedback. The results of rating items on the Likert scale did not show remarkable differences between items. It can be suggested that the values of the scales were not clearly defined and that the respondents tended to give higher values to the items rather than lower, due to a personal relationship with the evaluator, not wanting to disappoint the trainer of the course. Considering the size of the target group it should be suggested to use a qualitative method to evaluate the course setup and content of the course in similar studies.

The third research question was aiming to identify the impact of the learning session to teachers’ ICT competences. As stated above,
constructivist teaching was chosen for the pedagogical context of the ICT competences. Therefore the preliminary test to evaluate the use of ICT competences was measuring the teachers’ readiness to use the principles of constructivist teaching. Testing had a pre and post test design, to identify the differences in ideas of constructivism before and after the course. The results showed that there was only one statistically significant difference. The main reason for this can be the fact that the learning sessions took place in four consecutive days, which is too short a time to change attitudes. Another reason for this finding can be that the theoretical model, which was used for creating the questionnaire, does not provide suitable bases for this evaluation. Readiness evaluation should not concentrate only testing the general ideas, but also on the behavioural aspects and implications of ideas of respondents.

The actual impact on teachers’ ICT competences was evaluated in terms of how the constructivist principles, which were discussed in the course, were applied to the courses, which participants created in the IVA learning management system. Modest evidence showed that compared to the use of other principles of constructivism, relatively less use of the principles was made, which fall under the defined evaluation cluster. My interpretation of this finding is related to the design of IVA learning management system, where for all the other clusters there is a concrete section, where these principles can be applied. These principles, which are related to evaluation, need to be applied in different sections in IVA. This fact could cause the loss of attention, while implementing the principles related to evaluation. This finding needs however further research because of the following problems with impact evaluation. As mentioned above, the learning session took place in four consecutive days, teachers were working on their courses in these days with the help of the trainers of the course and had two extra weeks to finish the courses by themselves in their own time and place. The fact that only five teachers out of eight finished their courses in IVA indicates that the work load of the course was not sufficiently divided. Another problem with the impact evaluation appeared with the evaluation method, three experts indicated the use of constructivist principles differently, in some cases experts did not agree, is the principle applied or not. This makes it impossible to trust the method, which was used for impact evaluation.

Conclusion

The first research question of this study was to identify the ICT competences for teachers at Viljandi Culture Academy. As a result of the literature review it was identified that the teachers’ ICT competences are directly related to the pedagogical context and methods for teaching and learning. In this study the pedagogical context was constructivist teaching and learning. The ICT competences were identified as the use of applications in the IVA learning management system to facilitate the constructivist teaching and learning. The second research questions aimed to identify the suitable setup of the learning session for teaching how to apply constructivist teaching using the IVA learning management system. In this study each session introduced a cluster of constructivist teaching and learning principles. The finding indicated that learning sessions should not take place in consecutive days. There should be more time between the sessions in order for students to familiarize themselves how to apply the teaching principles with the use of a learning management system.

The third research questions aimed to evaluate the impact of the course to the teachers’ ICT competences. As a main finding it appeared that principles related to evaluation were applied relatively less than other principles of constructivist teaching and learning. Further research is needed to test this evidence and its reasons. Many evaluation methods, which were used in this study, did not function as their set purpose, this evidence can be used as suggestions for further research to avoid problems with evaluation, which appeared in this current study.

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Constructivism, Learning Management System, teacher training
Abstract
This article outlines the development of an integrated teaching and learning environment (ITLE) that aims to enable Egyptian teachers to use the Internet in education effectively. Within the Egyptian education context, it describes the development of an Internet curriculum and a Web-based learning environment. The Web design principles and guidelines are discussed in the light of constructivist design principles in order to emphasise their implications for the design of the learning environment. The paper focuses on illuminating the various phases that are seen to be necessary for designing an ITLE. Subsequently, the major issues associated with this design are considered. Finally, students feedback on the learning environment is considered and a model for a holistic relational approach is outlined.

Study Rational and an Overview
Egypt is considered to be one of the largest countries in the Middle East and in Africa with an increasing population of over 65 million people who are living in less than 4% of its landscape, which is about 1 million square kilometres. As a consequence, most inhabited areas in Egypt are considered to be highly residential which led to a number of problems that influenced the economical, social and educational systems. The educational system, for instance, is facing several key difficulties such as the increasing number of students who require basic education, the need for more qualified teachers, lack of resources, facilities and infrastructure etc. In the last two decades, the Egyptian Ministry of Education developed a reform policy in order to solve these problems. For example, it built new schools to accommodate the increasing numbers of students.

In line with the development in the infrastructure for education in Egypt, the Ministry of Education established the Technological Development Centre (TDC) which launched a technological development project in 1995. This project aims to develop, integrate and use information and communication technologies in education in Egypt. Within this project, the TDC designs multimedia programmes for several subjects and it connected large numbers of schools in Egypt to the Internet. The main goal of the TDC is to enhance teaching and learning using ICT. However, the majority of teachers do not use the Internet because they do not have the necessary skills and knowledge for using it. This is seen as a result of the lack of training on the use of the Internet for both in-service and pre-service teachers. By looking into the relevant literature, it becomes clear that this case is not only in Egypt but also in other developing countries such as Malaysia (Mohaiadin, 1997) and Macao (Shezhang, 1998). These studies found that there is a lack of knowledge and skills in using the Internet among teachers, and the use of the Internet has been typically learned through friends rather than through formal curriculum or instruction.

An added dimension of the Egyptian context is the predominance of a behaviouristic approach to teaching and learning. As a result, the main teaching method that is used in Egyptian schools is the ‘lecture’ approach. Consequently, the teacher’s role is mainly seen to be as a ‘dispenser’ of information while the learner role is mainly seen to be as a ‘receiver’. These roles neither give the learners the opportunity to actively engage in the learning process nor support the development of their higher cognitive abilities such as analysing, synthesising and integrating knowledge in new situations.

As a result, this case study research aims to develop an Internet curriculum for Egyptian teachers and to design an integrated teaching and learning environment (ITLE) in which this curriculum is implemented. Both the process of developing the Internet curriculum...
and the process of designing the ITLE took into consideration the Egyptian educational and cultural settings. A critical analysis of the pedagogical and epistemological assumptions of the constructivist models, especially those developed by Jonassen (1997), Spiro et al. (1991), Mayer (1999) and Hannafin et al. (1999), also influenced the development of the Internet curriculum and the design of the integrated Web-based learning environment.

**Internet Curriculum Development**

In order to develop an Internet curriculum, a content analysis approach was used to analyse the content of the documents that are related to the use of the Internet such as Internet users' and teachers' guides (El-Gamal & Hudson, 2001). In addition, a Web-based questionnaire was designed to help inform the development of the main objectives of the new Internet curriculum. The structure of this curriculum includes five main units.

The first unit (Introduction to the Internet) is considered to be well-structured because it contains the basic skills and knowledge for using the Internet. The second unit (Searching the Internet for information) aims to develop the skills for selecting and exploring the information on the Internet. The third unit (Internet communication utilities) includes semi-structured content, because it is based on communication utilities on the Internet e.g. email, videoconference etc. Therefore, peer support and discussions are used in order to interpret the content to enhance the development of the students' communication skills using the Internet. The fourth unit (Transferring files from the Internet) provides the students with the necessary knowledge and skills for transferring files using the Internet such as the use of FTP (File Transfer Protocol). The fifth unit (Designing Web pages) is considered to be an advanced unit in this curriculum because it is ill-structured and it aims to provide the students with an increased level of complexity in the content. As a consequence, this unit aims to promote student autonomy in acquiring the knowledge and skills required for designing Web pages.

The concept of using three content structures (well-structured, semi-structured and ill-structured contents) is developed in the light of the Egyptian educational context. These content structures are integrated in order to enable the learners to gradually change their cognitive perception about the teaching and learning process from receivers of information to become cognitively active participants in a community of learning. Consequently, three types of control over the learning process can be distinguished; teacher control, teacher-learner control and learner control (El-Gamal & Hudson, ibid.). The technology plays a key role in facilitating the share of control over the learning process between the teacher and the learner. This technology is developed in the form of a Web-based learning environment namely “Internet Tutoring System” in order to implement this curriculum.

**Characteristics of the Web and Web-Based teaching and learning**

The characteristics of the Web and its potential benefits for teaching and learning have led to the development of the Web-based learning environment. Accordingly, the Web has been used in this research in order to facilitate and support the teaching and learning process concerning the use of the Internet.

Within the framework of the constructivist learning theory, the Web can be referred to as a cognitive tool. According to Jonassen's (1999) model, cognitive tools are seen to be generalisable computer tools that are intended to engage and facilitate cognitive processing. Cognitive tools are also both mental and computational devices that support, guide, and extend the thinking processes of their users.

They are also knowledge construction and facilitation tools that can be applied to a variety of subject matter domains (Jonassen, 1994a). Reeves (1999) also defines cognitive tools as technologies that enhance the students' cognitive powers during thinking, problem-solving and learning.

Harper (1997) states that cognitive tools can help learners organise restructure and represent what they know. Therefore, a series of cognitive tools should be developed to support the perceived needs of the learners and incorporated during the design processes. Jonassen and Reeves (1996) summarise the theoretical foundations for using cognitive tools as follows:

- “Cognitive tools are most effective when they are applied within constructivist learning environments.”
• Cognitive tools empower learners to design their own representations of knowledge rather than absorbing the representations preconceived by others.
• Cognitive tools can promote the deep reflective thinking that is necessary for meaningful learning.
• Cognitive tools enable mindful, challenging learning rather than the effortless learning promised but rarely realized by other instructional technologies.
• Cognitive tools should be applied to tasks or problems defined by learners with the support of their teachers.
• Cognitive tool use for education should be situated in realistic contexts with results that are personally meaningful for learners.” p.698

Reeves (1999) also notes that the Web can be considered to be a cognitive tool. Accordingly, he highlights some common uses that teachers are making of the Web. These uses include enriching access to course materials; documenting course discussions; posting student writing, art, projects, etc. for critique; providing tutorials, simulations, and drills and facilitating group work. Additionally, Berge (1999) highlights some salient characteristics of the Web such as permitting students or instructors to give presentations, to use the Web system for various forms of communication and allowing linkage to other presentations. The Web also enables both asynchronous and synchronous communication among participants and it provides for individual, small group and mass communication.

Starr (1997) highlights three key educational values of the Web which are important to the instructional designer. Firstly it is hypertext which enables the user to easily access information; secondly it is the delivery of multimedia which provide text, audio and video to the user and thirdly true interactivity which enables information exchange between the user and the server.

Hackbarth (1997) also emphasises some characteristics of the Web, which he summarises in the following:
- “It provides economical access to people and multimedia information in ways unmatched by any other combination of media.

Web design principles and guidelines

The principles for constructivist teaching and learning outlined by Jonassen (1993), Merrill (1991) and Runlee and Daley (1998) influenced the design of the Web-based learning environment. Moreover, the overall design was also influenced by the different models of constructivist teaching and learning by Spiro et al. (1991), Hannafin et al. (1999), Mayer (1999) and Jonassen (1999). Accordingly, the Web-based learning environment was designed to provide collaboration and conversation tools; information resources etc.

Jonassen (1994b) identifies a number of constructivist principles for the design of learning environments. These principles include the following:
1. “Provide multiple representations of reality;
2. Represent the natural complexity of the real world;
3. Focus on knowledge construction, not reproduction;
4. Present authentic tasks (contextualizing rather than abstracting instruction);
5. Provide real-world, case-based learning environments, rather than pre-determined instructional sequences;
6. Foster reflective practice;
7. Enable context and content dependent knowledge construction;
8. Support collaborative construction of knowledge through social negotiation.” p.35
Shih and Chen (2000) also identify some guidelines for constructivist instructional system design. These guidelines emphasise that the learning environment should be capable of supporting processes for knowledge construction and circumstances for forming learning groups; and be an easy to use environment for dynamically exploring information and cooperative learning. Based on these guidelines, they recognise the Internet as a suitable tool for developing constructivist learning environments. Accordingly, in this research, the Web-based learning environment was designed in the light of such principles and guidelines.

Furthermore Ruffini (2000) provides some basic guidelines for designing and creating websites. He identifies some elements of the instructional design process in developing effective Web pages. These elements include: target audience, objectives, home page and contents, site navigation structure, page design, text and graphics and the selection of a Web authoring program. Although these guidelines are for designing a faculty Website, they have influenced the design of the Web-based learning environment in this research in terms of identifying the different design elements, in different phases. Most of these phases are influenced by the different steps for developing Web-based learning which are identified by Jolliffe et al. (2001). These include, for example, developing a storyboard, designing the graphical user interface, selecting learning resources etc.

Integrated Teaching and Learning Environments (ITLE)

Kirschner (2001) defines an integrated electronic learning environment as a learning environment that makes use of modern synchronous and asynchronous information and communication technologies to connect the different subsystems of education to each other. These subsystems are seen to consist of five discrete, but interacting, systems or environments, which are a task environment, a study environment, a group or project environment, an administrative environment and a technical environment. The assumption for the design process is that these five systems should be functionally compatible and interrelated. Furthermore, Okamoto et al. (2001) draw attention to the need to integrate different pedagogical strategies in order to adapt to the students’ needs. They note that offering adapted activities, producing appropriate feedback, favouring communication between students and offering assistance are crucial. Therefore, the students’ values, learning styles and preferences should be taken into account. Passerini and Granger (2000) also illuminate that traditional system approaches to education need to be reviewed to integrate strategies appropriate to the new tools. They propose a developmental approach generated by the opportunities for student-instructor interaction and media delivery on the Web. They also stress the need for the identification of an integrated design model to support distance education initiatives. They conclude that traditional instructional design models need to be integrated with developmental approaches taking into consideration new characteristics. These characteristics include: the variety of needs and learning strengths of the students in the virtual classrooms, the inclusion of supplemental information/content resources, the elaboration of most appropriate content (with a variety of media) and communication strategies (from discussion areas, bulletin boards, chat-rooms, workgroups, whiteboards and others).

Effective integration of new technology, according to Thomas et al. (1998), requires an understanding of the whole education process and a critical examination of its functions. On the one hand, the innovation needs to be integrated with existing practice. On the other hand, we should seek to improve practice rather than simply translate it. In order to integrate the Web effectively in this research, the learning environment is developed in order to take into consideration the different elements that are involved in the teaching and learning process e.g. the integration of a number of teaching strategies, the accommodation of the students’ preferred learning styles and the integration of new technologies such as the Web with its own tools and resources. According to this perspective, the Web should be viewed as an integrated element in the teaching and learning process rather than as a supplementary one.
Design Phases of Integrated Teaching and Learning Environments

In the light of the models for constructivist learning, an integrated teaching and learning environment (ITLE) “Internet Tutoring System” based on the Web was designed. The basic principles that underpin the design of the Internet Tutoring System can be summarised as:

• Considering the learners’ prerequisite knowledge, needs and learning styles.
• Designing flexible content structures (such as well-structured, semi-structured and ill-structured contents) in the light of the learning objectives.
• Integrating a number of teaching and learning methods such as providing a number of seminars and demonstrations; enabling peer support through discussion; and enabling individual learning through hands-on sessions.
• Designing an easy to use, simple and clear user interface in order to facilitate the students’ interaction with the learning environment.
• Enabling and providing communication tools that facilitate both synchronous (videoconference) and asynchronous (discussion forum) communication. These tools aim to promote and maintain collaboration between the students and support the formation of a learning community.
• Selecting and organising useful and relevant information resources that encourage the students to search for information with the view to integrate both Web information resources and course documents.
• Engaging learners in authentic activities in order to support and maintain their active participation.
• Evaluating learning outcomes using multiple products of learning rather than a single product through the use of digital portfolios.
• Providing technical assistance by using a tutorial and providing possibilities for technical questions to be asked.

Based on these principles, the ITLE was designed through a number of phases. Since these phases are seen to be necessary for any instructional designer whose purpose is to design an integrated teaching and learning environment, they are outlined in the following sections.

Planning of the Learning Environment Structure and Organisation

The main purpose of the learning environment is to enable all the participants to become active and to promote their own learning by maximising the use of a wide range of tools and resources which are available on the Internet. Consequently, the planning of the learning environment aimed to include and integrate some design elements such as synchronous and asynchronous communication tools, information search tools, information resources etc. Moreover, the design integrates a variety of approaches to teaching and learning. For example, there is integration between the use of the Web and the use of the seminars and workshops. Furthermore, there is integration between the various types of learning resources such as Web resources and course documents in order to give the students the opportunity to select the type of resources that accommodate their learning styles. Accrodingly, the suggestions for adapting the design of teaching and learning to the students’ learning styles, outlined by Liu and Ginther (1999), were taken into account during the design of the ITLE. This integration is considered to be a key element in the design of the learning environment in order to facilitate and support the students in having a meaningful learning experience. Furthermore it also takes into account the students who lack prerequisite knowledge and skills particularly at the beginning of the course. As a result seminars and workshops are organised in order to orient the students to the use of the Internet and the learning environment. Furthermore, the design takes into account the cognitive load theory (Sweller, 1988) by reducing the cognitive load that the students might face while learning using an ITLE. Subsequently, some principles for reducing the cognitive load are utilised such as the use of multiple representations by presenting materials using text and pictures (Mayer and Moreno, 2002). Moreover, the guidelines for using simple content, using coherent representations and eliminating redundancy are also considered (Wilson, 1996). The design also aims to relieve short term memory by relying on recognition e.g. providing the user with the necessary
Designing an Integrated Teaching and Learning Environment

links to the different sections on each page rather than overloading the user memory with information about where to find these links. In addition, the information is organised in a simple and coherent structure which aims to reduce the users’ memory cognitive load (Mandel, 1997).

User Interface Design

The graphical user interface contains all the various elements that are seen by learners and with which they will interact as they progress through the learning process (Jolliffe et al., 2001). Marcus (1992) identifies some key components for well-designed user interfaces such as appropriate organisation of data, efficient navigation and quality appearance. These key components were taken into account during the design of the user interface. Consequently, the data and the information given in the learning environment are organised in a coherent way e.g. the colour, font sizes and formats are consistent throughout the design. The quality of appearance is considered in the readability of the text and information throughout the design. Moreover, the navigation was designed in order to enable the students to use the learning environment effectively by providing clear information representation and access in order to facilitate the student’s ability to find and manipulate much of the available information (Harper, 1997).

In terms of the technical support provided, the learning environment was designed to meet the needs of the Egyptian students, who had no previous experience of using a Web-based learning environment. Therefore, the provision of fast and reliable technical support is seen to be a key element. Consequently, a ‘Help’ section for the provision of technical support to the students was designed in order to provide them with the technical information that they might need in relation to the learning environment. Therefore, the ‘Help’ section provides a tutorial for the “ITS”, a technical assistant form and technical contact information.

Selecting and Organising Information Resources

According to Harper (1997), providing access to information in different ways for different types of learners requires developers to employ a variety of devices such as metaphor, cognitive tools and search engines. Consequently, the TITLE was designed to include a wide range of information and learning resources. For example, the learning environment includes links to Web resources and course documents. The selection of information and learning resources which are related to the use of the Internet are based on a set of criteria such as site access and usability, resource identification and documentation, author identification, authority of the author, information structure and design, relevance and scope of content, validity of content, accuracy and balance of content, navigation within the document and quality of the links (Wilkinson et al., 1997).

In addition, a Web search tool was designed to enable the students to search a group of search engines simultaneously (see figure 1). It also gave the students the opportunity to submit their search keywords to a group of search engines on the Internet. Moreover, direct links to the different search engines on the Web were provided in order to give the students the freedom to search each search engine individually according to their own search strategies.

**Fig. 1.** The tool for searching Web resources
The learning environment also provides the students with links to course documents. Subsequently, the students can download these documents, read them offline and print them if necessary.

### Enabling and Providing Communication Tools

A constructivist learning environment should provide access to shared information and shared knowledge-building tools to help learners collaboratively construct socially shared knowledge (Jonassen, 1999). He also emphasises that a constructivist learning environment can support communities of learners. Therefore, when learners collaborate, they share the same goal, requiring shared decision-making, 'consensus' building activities, etc. Two main categories of communication tools can be distinguished, which are synchronous and asynchronous communication tools.

Synchronous communication tools are designed in order to facilitate and support real-time interactions such as student-student interaction and student-teacher interaction. These tools include instant messaging, chatting and computer videoconferencing. Subsequently, a number of tools were incorporated and integrated into the design such as 'MSN Messenger©' and 'NetMeeting©'. In addition to these tools, face to face interactions are integrated particularly during the orientation sessions and workshops in order to support the students’ learning especially those students who lack prerequisite knowledge and skills. Furthermore, in-classroom discussions are also used in order to discuss and highlight the different issues that might emerge from using a Web-based learning environment.

Asynchronous communication tools are also used in order to facilitate the communication between the students. These tools include the use of email and a discussion forum namely 'Discuss©' (see figure 2), which was incorporated into the design.

![Fig. 2. The main discussion areas in the discussion forum 'Discuss©'](image)

This discussion forum enabled the students to discuss a variety of issues and topics that are related to the use of the Internet in education. A big advantage of using a discussion forum is that the messages that are sent by the students and teachers can be kept for future reference and for some students to be able to catch up with the discussion. Furthermore, in-classroom discussions are also used in order to discuss and highlight the different issues that might emerge from using a Web-based learning environment. Guidelines for using the communication tools are given to the students in order to assist them in their use.
Designing Course Activities

Authentic activities are considered to be an essential element in constructivist learning environments. Authentic activities can be identified as activities that have real-world relevance and utility, that integrate those activities across the curriculum, that provide appropriate levels of complexity and that allow students to select appropriate levels of difficulty or involvement (Jonassen, 1991). Each unit in this course includes a number of activities that are related to the unit’s objectives. Therefore, the degree of complexity of the activities is influenced by the degree of complexity and the structure of each unit. Consequently, the degree of complexity of the activities was increased gradually from one unit to another according to progress in the learning process. An example of a simple activity from unit one is ‘Create a new bookmark folder by your name, and add a Web site to it’. Another example of a more complex activity from unit five is ‘Work individually and/or with your peer in order to develop an individual paper prototype for an educational Web page’.

Designing and Enabling the Use of Digital Portfolios

The evaluation of what students learn has both process and product components (Hackbarth, 1997) and therefore, the evaluation of student learning in an ITLE places emphasis on both aspects. Furthermore, it emphasises the evaluation of a portfolio of products rather than a single one. One of the tools that is increasingly used for evaluating students’ learning online is the digital or electronic portfolio. Digital portfolios differ from traditional portfolios in that information is collected, saved and stored in an electronic or digital format. They also allow students to demonstrate problem-solving and critical thinking skills using authentic and performance-based assessment. A special section for digital portfolios was designed in the learning environment. This section was designed to give the students the opportunity to upload their own learning products such as the Web pages that they designed during the course (see figure 3).

Fig. 3. The uploading file screen in the portfolios section

It was also designed to enable them to upload different formats of files such as ‘HTML’ files, document files, images etc. Furthermore, students can link the different files that they already uploaded to the learning environment so that course participants can view and share their own learning products and files with each other.

Evaluation of the Design of the Learning Environment

Both formative and summative evaluations (Kemp and Kemp, 2000) are used in order to test the design and its effectiveness. Formative evaluation included a continuous testing of the learning environment throughout the different design phases, since ‘bugs’ inevitably occur during the process of Web design. Formative evaluation took place with developers at the Sheffield Hallam
University Centre for Multimedia in Education before the initial trial by examining the design against criteria such as ease of use, readability etc. Furthermore, summative evaluation took place in the form of initial trial with a group of 12 ICT students in their first year of Educational Studies course in the School of Education at Sheffield Hallam University. Several issues emerged from the field trial such as the need to develop and integrate a discussion forum especially for the learning environment, as the students in the field trial used the ‘Blackboard’ learning environment as a discussion forum. As a result, the ‘Discuss’ forum was integrated into the design. The main trial was conducted with a group of 18 Instructional Technology students in the Faculty of Specific Education, in Menofia University in Egypt. These students were studying in three different years which are second, third and fourth years. This trial took account of the different aspects related to the learning environment. A particular focus was given to the students’ feedback on the teaching and learning processes using the ITLE. Major issues for evaluation included course organisation; course objectives; teaching methods used to support students’ learning and teacher’s roles; learning process and students’ learning progress; and an evaluation of the characteristics of the learning environment.

Discussion of Results - Students’ Cognitive Load

As highlighted earlier, a number of principles and guidelines for minimising students’ cognitive load (Sweller, 1988) were taken into consideration during the planning phase. Subsequently, in the course evaluation form, a number of questions were given to the students concerning any cognitive overload that they might have experienced during the course. The issue of cognitive overload was investigated by focusing on two main factors. These factors included the students’ feeling of disorientation or “getting lost” during the course and their feeling of being overloaded because of the amount of information they had during the course.

According to the data analysis results, only 11% of the students felt disoriented during the course. Furthermore, 28% of the students were not sure if they felt disoriented or not. On the other hand, 61% of the students did not feel disoriented at any time during the course. Those students who felt disoriented during the course were asked to indicate when they had this feeling. i.e. they were asked whether they have this feeling in the beginning of the course, in the middle or at the end of the course. As a consequence, the 11% of the students who felt disoriented indicated that they had this feeling only at the beginning of the course. For example, Asmaa (a student) commented on her feelings at the beginning of the course saying:

“At the start of the course, although I read some background information about the Internet, I felt some difficulties in following up the amount of information regarding the Internet. Therefore, I felt some frustration and boredom at the beginning of the course. Then, I started to feel relief by having the tutor’s assistance and engaging with the other students in the different years of the course.”

During the focus group at the end of the course, Azza (a student) also commented on her feelings by saying:

“I started this course with only theoretical background. So the beginning was to some extent difficult for me, especially with some students who have already seen the Internet working, which sometimes causes some frustration for me. But this feeling of frustration started to diminish once I started to work on the Internet.”

In her comment, Azza emphasised on the role of the more experienced peers in causing frustration and increasing the sense of cognitive overload for those students who are less experienced. It is important to indicate that these two students were in Year Two during the course which highlights the gap between the students’ existing knowledge and skills. The students’ feeling of frustration and disorientation especially at the beginning of the course was due to many reasons. For instance, some students approached the course with some fears. These fears might influence their own learning especially at the beginning of the course before coping themselves with the associated demands. Furthermore, those students might lack and/or felt lacking competence in using the computer and/or the Internet in comparison with their older peers. Moreover, the amount of information related to the use of the Internet might be great for the students especially at the beginning of the course. Consequently, it was seen to be important to find out whether the students felt overloaded in the course or not. Half of the students (50% of them) did not feel overloaded because of the amount of information in the
course. On the other hand, 17% of the students felt that the course included a large amount of information which caused them to feel overloaded. Moreover, 33% of the students were not sure about their feeling on this aspect. This result indicates the students' unfamiliarity with the vast amount of information resources available on the Internet because they are used to study using text books.

Another factor that led to the students' feeling of frustration and disorientation was the slow Internet connection that the students experienced especially during the first day. This was noticed and highlighted by the observer in the following words:

“When the students were asked to take part in this course, they were keen to work on the Internet. Therefore, when the students found the Internet connection in the Technological Development Centre very slow, a few of them felt frustrated. However, on the second day, when they started on the school computers, the feeling of frustration changed to a feeling of satisfaction. This satisfaction was a result of the improvement that they notice in the Internet connection speed in the school.”

The comparison of the results indicated that not all the students who felt disoriented during the course found that the amount of information caused them the feeling of being overloaded. As a result, the use of the Web-based learning environment did not overload the students. This result is seen to be consistent with the findings of Mayer (1999) and Van Gerven et al. (2002) studies that the use of hypermedia and multimedia in teaching and learning can reduce the cognitive load that the students experience.

**Learning difficulties**

*The limitations of facilities for using the Internet*

The majority of the students who participated in the course in the final trial phase in Egypt commented on the facilities provided for using the Internet. During the focus group they commented on the lack of facilities for the effective use of the Internet. Furthermore, they highlighted these problems in the course evaluation. Azaa commented on this problem saying:

“The computers are major factors for causing some annoying and sometimes frustration for us. Therefore, if the computers and the Internet connection were fast enough, we would achieve much more in this course.”

The problems that are related to the facilities and the infrastructure for information technologies are not only facing Egypt, but also are facing many developing countries. These problems include a lack of resources for developing and maintaining the infrastructure for using information and communication technologies. Grey (1999); Chee (1997) and Wilson (2000) note that the problems that are related to Internet connectivity are considered to be a major barrier in using Web-based learning in developing countries.

*The difficulty of using the English language on the Internet*

The main language of the group of students who participated in this course in Egypt is Arabic. In addition, the students did not study English since they left the secondary school. For all these reasons, a software application called ‘Easylingo’ was used during this course in order to assist the students in translating the difficult words from English to Arabic. However, it was noticed that a few students found difficulty in browsing Websites that use the English language. For example, one of the students (Mostafa) commented on the difficulty to translate some English words into Arabic saying:

“I did not know the translation of some English words into Arabic. I suggest adding part in the Internet Tutoring System in Arabic”

**Students’ Feedback on the ITLE**

The students’ feedbacks on the learning environment were mainly positive. For example, the majority of students, who commented on the different characteristics of the learning environment, found that the ‘Internet Tutoring System’ has a clear user interface; it is easy to use; it has useful links and information resources; and it has well-organised information. One of the students, Mohamed, commented on the user interface follows:

“The user interface is very clear and easy to use. Moreover, the information within the system is very useful and it has relevant information resources.”

Although a large percentage (83%) of the students found that there was enough technical support during the course, a number of technical difficulties were raised. The main technical difficulty that
the students encountered during the course was the lack of facilities required to connect to the Internet and in particular the slow Internet connection speed. This was seen to be a result of the fact that the infrastructure for information and communication technology in Egypt was still under construction at that time, although the government along with the private sector in Egypt is working in partnership and making huge investments in order to develop the communication infrastructure.

Despite the technical difficulties that the students faced during the use of the ‘Internet Tutoring System’, the students and the external observer made very encouraging comments about the system. For example, during the focus group, Hussein (a student) commented on the learning environment by saying:

“The ‘Internet Tutoring System’ for myself is considered to be an ‘electronic educational institution’, because by using it, I can learn individually and in a group which is one of the major advantages of the system.”

The students also felt motivated by using the system and this was seen to be due to the richness of the learning environment and the richness of the Web itself in terms of having different types of resources and tools that they used in their own learning. Furthermore, the students indicated that they neither felt disoriented during the course nor felt overloaded because of the amount of information they were presented with during the course.

**Reflections**

It can be concluded that the current design of an integrated teaching and learning environment (ITLE) namely the ‘Internet Tutoring System’ support students’ learning. This is achieved by providing the students with a range of cognitive tools, information resources and authentic activities. As a consequence, these tools and resources are integrated along with a number of teaching methods in order to encourage the students to play an active role in their learning. This integration is considered to be a key aspect that underpins this study and it aims to accommodate the different learning styles of the students. In this ITLE model, several roles for the teacher emerge such as the roles of mentor, facilitator and orchestrator and these roles are due to the integration of a number of teaching methods alongside the use of the Web-based learning environment (El-Gamal, 2002). These roles are also influenced by the different content structures of the Internet curriculum and the control over the learning process.

This study highlighted the ways in which the “effective” integration of web-based technology in teaching and learning needs to take into account the essential relations between the teacher, student, content and technology. These aspects, including technology which should not be regarded simply as a supplementary one, are all seen to be vital considerations in the teaching and learning process. In particular the relations between these aspects are seen to be crucial and also recognised as being very complex.

Accordingly a model has been developed arising from the outcomes of this study which aims to capture this set of complex relationships. Building on the use of the Didaktik triangle as a tool for the analysis of the complex relations between teacher, student and content in the teaching/studying/learning process (Kansanen and Meri, 1999) as highlighted in Hudson (2002) a model for integrated teaching and learning environments (ITLE) was developed. This model takes the basic assumptions of the “didaktik” tradition, with its holistic relational emphasis, and applies this to a complex technologically-based learning context. This is illustrated in Figure 4:
Accordingly, this model emphasises the use of technology as an important and necessary integrated element in the teaching/studying/learning process. The starting point is seen as the design relation between the content and the technology and the way in which the teacher guides this relation. The technology is designed in the light of the cultural and educational context by designing a technology that mediates this context. The teacher integrates the different tools and resources offered by the technology in his/her pedagogical practices with the students. In the Egyptian educational culture, the teacher acts as a model that reflects the students' cultural values. In some situations, he/she uses his/her cultural understanding to remodel unacceptable behaviours in the society. The teacher also guides, mentors and facilitates the interaction relation between the student and the technology and also guides the students' learning in relation to the content through the didaktik relation.

What this model aims to reveal is the additional relationships, over and above the pedagogical and didactical, that need to be considered when design complex technologically-mediated learning environments. In particular they highlight those processes of design, representation, modelling and integration and how these relate to the different aspects of this very complex whole.

References


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Abstract
This paper reports on a study that was conducted during the implementation of an Intranet in one of the largest newspaper publishing companies in the Netherlands. The study aimed to research the perceptions of the employees in the use of this new intranet and the use of other intranets within the company. A literature review was carried out data was collected by means of a usability test, individual and group interviews and an online questionnaire.

The results showed that the employees should be involved more in the sharing of knowledge within the organisation. There is much willingness to share knowledge and willingness to be active with Intranet. The majority (88%) believes that people should have an opportunity to publish important content knowledge on this intranet. Over half of the respondents underlined the importance of project orientated environments within the intranet.

Context
Wegener, located in Apeldoorn, The Netherlands, is a company in media and marketing that is quoted on the Amsterdam Stock Exchange. Every day, Wegener delivers 1.2 million newspapers to its readers in a sizeable area of the Netherlands. Each week, Wegener turns out more than 7 million newspapers and free door-to-door papers. The department of Business Development introduced a new Intranet for all the newspapers in 2004.

Objectives for the Intranet
The main purpose of this Intranet is to offer information to all staff about the progress and results of the various Integration programs and to create a place were people can find documents, presentations and news articles, mainly about the new programs and project organisations.

Secondly, the Intranet will offer a platform for the exchange of knowledge within the company. Dynamic information: topics of discussions, external information resources, possibilities for publications and the exchange of success-stories, plans, tips and ideas.

One of the main purposes of the research was to investigate in which way the new Intranet was valued by the employees and if it was used. Secondly the company wanted to test the usability of the site and have recommendations on improvements to the site.

The main research questions were:
What information do people need to perform better in their work?
What knowledge do people want to share with others?
How do people think they can benefit from it in their work?
How should the content be organised?

Findings

Literature Review
Collison and Parcell (2001) introduced the holistic model in knowledge management in the BP Company. This model is built around the idea that people learn before, during and after everything they do.

According to Weggeman (2000) learning is the process in which existing knowledge is enriched and new knowledge is created. But what is knowledge and how do you manage it?
There are a lot of definitions of and approaches to Knowledge Management (KM). From a whole range of definitions most make it clear that knowledge management is not really concerned with managing knowledge as such. They deal with designing and managing organisations and work processes in such a way that they make best use of knowledge (Owen 2003).

So the effective use of knowledge is the key theme in knowledge management. In modern organisations, knowledge is a part of daily work. In managing the knowledge you grow from an organisation were people have unconscious incompetence, to an organisation were people have unconscious competence. Between these two stages, your employees become aware that they are failing – conscious incompetence and the company provides tools and resources to improve the knowledge, conscious competence. (Collison and Parcell, 2001).

There may be some difficulties in the management of knowledge in firms. One of the main causes is the lack of a clear definition of KM. Dominguez et al, (2003), mention the lack of qualified personnel to design and transmit the good values of KM. Knowledge Management aims to improve the creation and use of collective knowledge by facilitating the exchange, sharing and utilization of knowledge and information (Abell et al, 2001).

One of the objectives for knowledge management is to reduce organisational slack. When you reduce organisational slack, you replicate new knowledge and put it to use in new projects and departments in your company (Szulanski 2003).

What difficulties are there in sharing knowledge? People may find it difficult to ask for help in a situation in which they need more skills or knowledge. This might be one of the main barriers in knowledge sharing. Szulanski (2003) gives some reasons why knowledge sharing can be sticky: e.g. absence of proof of the usefulness of knowledge; the source is not motivated to share knowledge or the lack of credibility of the source. The most effective way of encouraging individual sharing appears to be through appraisal systems where individuals are asked to assess their own knowledge-sharing behaviours and consider their colleagues’ view of their sharing performance. But it is generally accepted that ‘intrinsic motivation’ is the only real motivator for knowledge sharing (Abell et al, 2001). Apart from digital media applications that are used for knowledge sharing, the Intranet is one of the most used media for KM (Twinstra, 2002).

But also another new organisational form is rising in learning, change and KM. It is called community of practice. A short definition of a Community of Practice (CoP) is: “groups that are formed to share what they know and to learn from one another regarding some aspects of their work” (Nickols 2003). Wenger (2000) gives a good comparison between Communities of Practice and formal workgroups and project teams. The most striking difference is that a CoP is held together by passion, commitment and that projects are held together by milestones and goals. Hezemans and Ritsen (2004), in their article “Communities of Practice in de DU” state that there are three steps in the development of a CoP; exchange experiences, knowledge sharing and knowledge development. In the same article
of Hezemans and Ritzen (2004) a summary is made of the desirable functionality’s for a CoP in a digital environment (an Intranet). In each phase different functionality’s are used.

Data collection

Usability test
The first test consisted of 7 tasks. All tasks were written on paper and were performed by respondents without intervention of the researcher. As a result of this first usability test a list of recommendations was made to the project leader to improve the new Intranet. The main recommendations were: There was too much text on the pages, too many different fonts and there are too few illustrations and pictures on the site and the sitemap and the navigation should be improved. As a result of this test, the site was improved. The launch of the official first release of the site was on the 15th of March 2004. In a period of one week at the end of March 2004, 5 people took part in a second test. Compared with the first test the scores about layout and readability had gone up to 7.1 and 7.3.

Questionnaire
The main function of the Intranet is considered to be the news function, according to 66% of the respondents, followed at a great distance by “search for colleagues’ telephone numbers” (24%). More than 10% of the respondents believe that the search for information (documents, handbooks, presentations etc) is an important function.

Of all respondents, employees of De Gelderlander use the Intranet most (90.9%). On the question: “Do you sometimes surf on the Intranet of the Holding Company or an Intranet of one of the other Wegener companies?”, only 27% of the respondents do so regularly; 30% look “now and then” and 43% of the respondents hardly ever surfs to one of the other Intranets. The information people are looking for when they do so, are telephone numbers and E-mail addresses of colleagues and sometimes conditions of employment. The research showed that 77% of the respondents are looking for up to date company news and 72% are looking for information about colleagues and internal telephone numbers. 53% of the respondents were interested in information about projects.

Interviews
In the interviews all respondents were asked to give their opinion on matters such as content management, responsibility for KM and knowledge sharing.
In the external, as in the internal, interviews most respondents agree about the way knowledge management is organised; from the top management. Overall, the respondents showed a need for structuring the information in a way that it is clear to find and to have it presented in a user-friendly way. Most respondents mentioned the benefit it must have for the employee to share his or her knowledge. As soon as people are aware of this benefit, they are much more motivated to do so. There is more motivation to do so if people work on the same level in the organisation. One of the most common remarks in the interview was that the new Intranet must be very attractive to draw people to it and to make them visit the site regularly. People displayed that feeling in different ways such as: ‘an attractive publication function’ or ‘a trigger application’, ‘eyeballs’, ‘people should find there something they want to have’.

Group interviews
The group interviews were held to get more qualitative data in addition to the findings from the questionnaire and the interviews. All respondents worked in the advertising department. The general impression in the groups was that the site was clear and well
ordered but also very boring, “not flashy” and difficult to search in. In all three groups the employees mainly use their own Intranet for general announcements and the search of telephone numbers. This does not mean that there is no need for more information. In the advertising department the employees want to know how other newspapers market their products and they want to find examples of special pages and issues.

Conclusions and recommendations

The conclusions and recommendations from this research mainly discuss three points of attention: organisation, knowledge (sharing) and content.

Organisation

There is willingness to share knowledge and willingness to be active with Intranet. This involvement and willingness can be enhanced by the implementation of knowledge teams of knowledge managers in every newspaper and in every department. These persons must be stimulated to present documents, reports and presentation from their own discipline. This content must be screened and filtered in the department of Business Development before it is uploaded on the Intranet.

Knowledge (sharing)

The managers play an important role in this future state of the organisation. On the one hand their role will be to involve others to develop a culture of knowledge sharing and creation. On the other hand their role is to implement this change. You have to begin with document management and document access, to optimise the library function of the Intranet. Only after this phase, can the exchange, sharing and creation of knowledge take place. It is therefore necessary to make an inventory of all the knowledge that is available in the organisation.

In this second phase the search for early adopters can enhance the awareness of knowledge sharing. It is necessary that these pilot teams provide the organisation with practical knowledge and content that can be used in the daily work of the employees. One

the goals for these groups should be to create branch and customer information in a so called ‘knowledge community’. One of the general outcomes of the questionnaire and interviews was that there is hardly any special knowledge available about branches, products and target groups. On the advertising market the most leading branches are ‘employment’, ‘cars’ and ‘real estate’. These branches have a substantial share in the turnover and there are special sales teams in a lot of the Wegener publishing companies for these branches. The creation of these CoP’s is also a strategy for Wegener to get experience in changing the company into a knowledge sharing organisation and making the evaluation and learning within Wegener a part of daily practice. On the advertising market the improvement of knowledge about the different markets and customers can increase sales. Furthermore a better understanding of what readers want can maintain or even increase the circulation.

Content

In the interviews, the employees stated that the content on the new Intranet should be easy to find and usable for daily work. More than one respondent spoke about ‘trigger-applications’ or eyeballs. It need not directly be something that has to do with their own work but it should be attractive or ‘flashy’. In all companies, more than 72% of the people stated to make intensive use of the “who is who”, e-mail databases and addresses. In the interviews, it was frequently stated that this information is far from complete. Direct action on this issue is recommended to persuade the people themselves to complete this information and keep it up to date.

One of the most common issues in the group interviews was the need to have knowledge of researches, specials, pages and supplements of the publishers. More than 77% of the respondents think that the latest news of projects in the company is the most important function of the Intranet. It is recommended to draw the attention to this Intranet and its content by means of a regular “E-zine” or an E-mail alert. The knowledge communities, as mentioned above, can contribute to this.

For Wegener, the use and sharing of knowledge will be one of the key success factors to keep a competitive advantage to other publishers.
Further research is needed to see in what way the use of the Intranet improves the internal communication and contributes to the development of best practises in the company.

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**Byways or highways - where is home economics education going?**

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**Abstract**

In this article we discuss the role of information- and communication technology (ICT) in home economics education and research in Finland. What is the role of ICT, and especially web-based materials, in the learning of practical skills? Nowadays and perhaps even more in the future, practical skills will be learnt through and within different networks. Practical skills and hand-made artefacts are becoming more and more important in today’s information society where few people see any practical results from their work. Practical skills and hand-made products are not only evaluated by standards, such as economy, ergonomics or efficiency. Making by hand can also contribute to ‘learning to be’, in which the process itself is more important than the exactness of the end product. Since our department educates subject-teachers, we focus here on the role of ICT in home economics teacher training. As examples of subject-relevant projects, we describe two developmental projects we were involved with in 2001-2002, which applied ICT as a part of learning to be a teacher.

**Introduction**

All teachers in the contemporary world need good skills in information and communication technology (ICT). Teachers who focus on pupils’ everyday needs, such as home economics teachers or teachers in consumer education, are no exception to this rule. In Finland ICT skills are highly valued pedagogical tools at the different levels of the Finnish school system. Regarding the ICT skills, teachers not only teach pupils, but can also learn ICT skills from pupils. ICT can equalize the relationship between teachers and pupils, since many youngsters are very skilled in ICT. On the other hand, teachers bring pedagogical expertise and life experience, which helps pupils to learn to be critical. Pupils should understand what is important in the contents they learn with the help of ICT. And what is even more important, they should learn WHY certain issues are more important than others. At its best, teaching and learning can be reciprocal: all can learn new facts and skills and develop as learners.

We define the term information and communication technology (ICT) as the tools and methods with which data is processed and which are used for communicating, e.g. computers, mobile phones, digital cameras, networks and software. ICT can be used to support learning in both the face-to-face and net-based learning situations. The term net-based learning refers to teaching, learning or studying which is supported by the materials and services that can be accessed via networks, especially through the Internet (Tella et al. 2001, 21).
In net-based learning some of the communication can be mediated through mobile devices (e.g. PDA or mobile phone).

From the viewpoint of home economics, it is important to learn the skills and knowledge needed in everyday life. In contemporary homes, ICT is an increasingly important part of living and making choices. We live in a midst of ‘a digital everyday life’. Marja-Liisa Viherä (2000) has discussed the qualities of communication in this kind of society. She wants the electronic services designed for ordinary people to be far more user friendly than they are today. This means that information and guidelines to help solve everyday practical problems should be easy to find on the Internet and easy to apply. She argues that help desks should be available to everybody, and that face-to-face contacts with educated ICT-experts would support citizens in finding the information they need. Digital everyday life is not possible without appropriate technology and support. Regarding home economics education, surviving in a digital society and a digital everyday life is increasingly important as an educational aim. Citizens should be active agents and not passive recipients. How should these challenges be addressed in teacher education and in developing new pedagogical methods for schools?

In this article we discuss the role of information- and communication technology (ICT) in home economics education and research in Finland. What is the role of ICT, and especially web-based materials, in the learning of practical skills? Nowadays and perhaps even more in the future practical skills will be learnt through and within different networks. Practical skills and hand-made artefacts are becoming more and more important in today’s information society where few people see any practical results from their work.

Teacher education and ICT

ICT is a broad term, including various technologies from the use of the Internet and mobile communication devices to versatile ‘intelligent’ tools and appliances used at home. For most people, it is easiest and cheapest to use broadband connections and seek information from the Internet. Sjöberg (1999) has found that for many Scandinavian youngsters new technology is not ‘new’, it has become a natural part of daily life, where they encounter significant problems in seeking and selecting information. Not all information from the Internet meets the criteria of truthfulness and trustworthiness. The message and the quality of the message depends very much of the sender and his/her interests, which may not always be entirely altruistic.

From this viewpoint, those who represent ‘real’ expert organizations, for example regarding issues on food and consumer safety or quality, should carefully ensure that their websites are those loaded first by search-programs, or that their pages should otherwise be easy to find. A single keyword may generate thousands of ‘hits’ and then a critical attitude becomes essential: what is important, and what is trustworthy in all this information? We argue that one of our greatest responsibilities as teacher educators is to cultivate the critical attitude of our teacher students. In turn, they pass this attitude to their pupils, with the motto ‘do not believe without testing’. This is crucial given that the Internet’s information (over)load is uncontrolled. It is the user who must apply critical skills. Interestingly, if comparing information found on the Internet with that from libraries, the two sources are quite different. Literature in libraries has always been selected by someone expert in using public money for library purposes. However, a critical attitude is useful in libraries, too.

Supporting a critical attitude towards the Internet and literary sources supports the development of pupils’ critical thinking. Regarding home economics education, critical thinking skills are of great value when discussing issues related to consumption, the environment and healthy nutrition. It is important to consider any bias in the message, and interests, which may be visible or hidden in text. Have contrary viewpoints been deliberately omitted? Is only one aspect of a complex issue is presented? Information, and sometimes propaganda too, is conveyed by different media: newspapers, TV, radio, and from the Internet. And it is a very basic issue in communication that the message sender always has a motive – but is this motive pure and good from the viewpoint of the receiver, the consumer? Kotilainen and Kivikuru (1999) emphasize that one essential aim of media education is the cultivation of critical attitude, together with understanding of the media. This same aim is important in Finnish home economics education and consumer education.
However, Tuominen (1999) claims that problems of media education have been the lack of time, lack of relevant study materials, and problems of integrating media education with the other subjects of a school curriculum. Sometimes, especially in comprehensive schools, pupils have access inadequate ICT-technology. Regarding home economics education these worries are well justified. There may not be enough computers and printers, or they may be located elsewhere in the school buildings. The distance from the home economics classroom to the computer classroom may be too long. Or simply, the broadband speed is not high enough to facilitate meaningful use of the Internet. When listing the obstacles to efficient use of ICT, we could also claim that, so far, the lack of teacher education and teachers’ own skills have been constraints. Yet contemporary teacher education programs place strong emphasis on these issues. Regarding home economics teacher education at the University of Helsinki, media education and ICT-skills are integrated in students’ basic and subject-studies. Our purpose is to ensure the maximum use of these skills in studies and in teaching practice. At present, home economics teacher students may also choose either 15-credit/30 ECTS or 35-credit/70 ECTS course in media education as minor studies.

Developing teaching with ICT

In the previous section we argued the need for including ICT skills in the home economics teacher training programme. We will now briefly describe two projects, in which ICT played a key role in the development of instruction. As Jonassen (1995) argues, technologies can do more than extend the capabilities of humans: they can amplify them. However, in order to be meaningful and productive, the use of technology should engage learners in knowledge construction, conversation, articulation, collaboration and reflection. The findings of international research imply that net-based learning can substantially increase the outcomes of teaching and learning (Hakkakainen 2001, 18). In order to achieve positive outcomes, a new pedagogical and research-based conception of technology in the service of learning is needed. And that is what we have been seeking through the implementation of our projects (see Figure 1).

Figure 1. Two ICT -projects for developing home economics teacher training in the University of Helsinki. Typically net-based learning is mainly textual (net-discussions, digital texts). However, digital pictures play an important role in the domain of home economics education, where practical skills are essential to produce handmade artefacts. For example, to accomplish a certain task, a learner has to be guided by pictures. In some cases a traditional still-picture or sequence of pictures is not enough, but video is more illustrative. In our two projects, pictures were central supporters of the learning processes.

Digital video as a study material (DiViLearn)

The goal of this project was to find out how study material based on multimedia and digital video technology will serve the aims of teaching practical skills in home economics lessons. The study design was quasi-experimental. We explored the 7th graders’ (Comprehensive school) experiences when baking with the aid of
multimedia-based recipes (i.e. video clips) and compared their work process with those pupils who used the ordinary study materials (A4-sheet with written and drawn instructions). We had two empirical research questions:
1. What kind of qualitative differences can be observed in pupils’ work and learning processes?
2. How the pupils use the digital application, specially tailored for the baking task, and the links the application provided in a real classroom learning situation (jelly rolls and breakfast bread).

Baking was chosen because, from a pedagogical point of view, it covers a range of learning processes: e.g. scientific knowledge (rising, the way yeast works), practical hands-on skills, and affective elements (smell and taste of products) (see e.g. Kivilehto 1998). The baking process itself contains many critical points, which should be taken into account pedagogically. For example, how do you beat eggs and sugar to achieve the mixing, how do you roll the baked jelly-roll base and the bread dough into a flat, round shape? These points are critical, since failure at any step impairs the quality of the end product.

For the purpose of our project, two computers were set up in the home economics classroom. Both had large screens, to facilitate use of the computer while baking. The pupils were divided into two groups. One half (A-group) used the multimedia-based application and the others (B-group) used ordinary home economics study materials (A4-sheet, with written and drawn instructions). This enabled us to compare the pupils’ work qualitatively. We did not aim to measure their achievements or the output of the task. The teacher played a ‘background’ role, designed to support pupils’ responsibility for their own learning.

A-group differed from B-group in two respects. First, the pupils frequently confirmed the instructions. They checked the computer screen many times to see what to do next. While observing the students, we thought there might also be enthusiasm for the ‘new and modern’ way of receiving instructions in class. Novelty was surely appealing. On the other hand, it might be that the video application itself was leading them to proceed step-wise. Perhaps the pupil ‘forgot’ all s/he had learned before on baking, and just passively followed the instructions. If so, the video instructions may restrict the use of imagination and reliance on own skills. However, the application also provided many links, supporting the baking process with additional data, pictures, and information. This is a rich source of material, which supports individual learning styles. When questions arise, answers can be found on-screen, or if the answer is not found then the pupil can ask a teacher. As Järvelä (1998, 8) states, access to information on the Internet does not enhance learning by itself, it is the teacher’s role to support pupils to construct their own knowledge structures and fill in the information gaps.

Second, the A-group pupils were more goal-oriented than the B-group. They found it easier to get confirmation from the screen of the next step in a baking process. They also felt more secure: they could click the video-clips forward and backward as many times as needed to be absolutely sure what to do. This means, from a pedagogical viewpoint, an individualization in the use of the study material. Comparing video-clips with ordinary written or drawn instructions, the latter supply only printed information, nothing more and nothing less. If a pupil needs to understand critical points better, then there are only peers or the teacher for inquiries; the study material cannot give extra help.

The home economics teacher had consciously played the role of a supervisor, even before our project. But during the project the pupils noticed that the communication and cooperation culture between the pupils and the teacher was different from ‘normal’. Järvelä (1997, 98) has also noticed the changing roles of pupils and teachers in projects that apply ICT. After the lesson, we had a joint discussion with pupils and teacher. We also discussed the changing roles of teacher and pupil. The pupils came to the conclusion that despite the changing roles, it was as important and necessary as ever for the teacher to be available. Giving the pupils more responsibility does not free the teacher from the aims and pedagogical goals of the lesson. In all situations the teacher, and the teacher alone, bears pedagogical responsibility for the learning experience.
One of the strengths of this project was the comprehensive data available to us and the successful video editing of the material we used. This helped us to focus on the critical points of the baking process and, hopefully, to help the pupils learn new skills. Video instructions are more comprehensive and precise than instructions on a worksheet. The learner can see how to place their hands (e.g. when rolling the dough), what is the right consistency for dough (e.g. when mixing the ingredients), or what is the right colour of the cake in the oven. These points are hard to describe verbally and, if the teacher demonstrates the baking task, the demonstration cannot be ‘played back’ if the learner missed something essential. Using video-clips, you can playback as many times as necessary.

In discussion with pupils and teacher, many useful developmental ideas were generated. For example, video-data with sound is technically easy and could provide more levels for analyzing and demonstrating the critical points of the process. An extra pop-up window on a screen could display the whole work process (linear or graphic representation), and changing colour (e.g. green-finished and red – not yet started) could show how the pupil is proceeding. Simple graphics could also help the pupil see how much time s/he has used for different phases of the work process. A great challenge for future development of video-based study materials is to address individual differences in skills between learners. In our experiment, forwarding and rewinding the video-clips was the only way to individualize use of the material. However, this does not explain something should be done in a particular way. Nor does it explain particular phenomena, e.g. the behaviour of dough (it is whipping that coagulates the proteins in eggs). It would be possible to develop additional links on screen to answer these questions.

The video-based recipes we developed could be published on the Internet. In future, anybody using our departmental website could find, and save such study-material. For our teacher students, this project was a great learning experience. The new media should be adopted, adapted and used for the benefit of the learner.

Versatile net-based learning and teaching practice

In our second project (teaching practice project) our goal was, on the one hand, to enhance collaboration between university teachers and supervising teachers at teacher training schools, and on the other hand to develop home economics student teachers’ readiness to collaborate with other subject teachers. The project was an action research inspired pilot-study, which aimed to create pre-understanding of the net-based learning environment in subject-teacher education. The research questions were:
1. How could net-based learning be applied to support practice for the student teacher?
2. How could mobile tools alleviate the problems of incompatible time-schedules?

In 2002 net-forums Generation2 and Uniwap3 were used to offer supervising teachers and student teachers a discussion and information channel, which could be accessed anywhere and any time. This network-based learning environment was developed from the basis of distributed cognition (see e.g. Salomon 1993). Our project was a sub-project to Mobile learning project, which was coordinated by the Educational Centre for ICT at the University of Helsinki (see more in Seppälä 2002, Alamäki & Seppälä 2002, Kynäslahti & Seppälä 2002). One major interest was to test mobile tools in teaching.

The theoretical background of the project is the constructivist view of learning, especially socioconstructivist, where the main emphasis is on social, interactional and cooperative processes of learning. It also emphasizes the situational and contextual nature of learning. (Tynjälä 1999) In the research of learning, interaction, cooperation and social aspects of learning have been considered from various perspectives. Salomon and Perkins (1998, 3-5) have distinguished four different ways of defining the dynamics of learning as a social action:
1. Social mediation of individual learning (a person or a team helps an individual to learn, e.g. a teacher or a parent corrects ungrammatical utterances, or pupils work together to master algebra problems, each learning from the other),

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2. **Social mediation as participatory knowledge construction** (learning process and individuals involved are seen as an integrated system, in which the interaction serves as a socially shared vehicle of thought; the jointly constructed learning products are distributed over the entire social system rather than possessed by the individual),

3. **Social mediation by cultural artefacts** (intellectual partnership or help by cultural artefacts in the form of tools and information sources),

4. **Social entity as a learning system** (learning involving teams, organizations, cultures, or other collectives).

In our project, social mediation by cultural artefacts (3, above) was applied. Cultural artefacts, i.e. tools and products made by human beings, mediate and support learning processes (Säljö 2000, Tynjälä 1999). Socially shared symbol systems are embedded in our culture. The concept ‘distributed cognition’ is often connected to the social perspective on learning. Learning is considered as a phenomenon, which is distributed within a system of learner groups and the tools they are using (e.g. Hutchins 1991, Säljö 1996). In our project the focus was on the learning system, which consisted of ICT tools and information resources as well as the actors (teacher students, supervisors at teacher training schools and the university teachers).

In the project group (N=15) there were 9 home economics teacher students, 2 physics teacher students, 3 supervisors from the teacher training schools and one university teacher. A variety of tools and mobile technology were used for sharing ideas on lesson plans and teaching, information distribution, and delivering and receiving feedback on lesson plans as well as training lessons. Both tutors (supervisors) and peers took digital still photos during training lessons. The photos were then transferred via infrared to Nokia Communicator units and finally to the Uniwap database. Afterwards anybody in the group was invited to comment on the photos, even if s/he had not been following the lesson. Many of the photos illustrated interaction between teacher students and pupils. In the learning of practical skills it is crucial that a student teacher can receive clear, precise feedback on pupils’ improvement by means of pictures. The wireless connections offered students and teachers flexible access to email and Uniwap database anywhere (e.g. at home or on the road). Internet and Generation were accessible via fixed connections at the university, training schools or home. In this project net-based learning was blended, as connecting to the network was made possible with various tools, by different means and from various spaces. A key issue was to make interaction as flexible as possible, and in ways that would fit with the participants’ tight and incompatible time schedules.

After the teaching practice period the teacher students prepared their individual portfolios in which they selected and analysed the digital material that had been gathered. The portfolio was then published in the groupware Generation. During and after the teaching practice group interviews were conducted. After six months a net-questionnaire was sent to all participants. Even the portfolios were used during the evaluation process. The following table provides a condensed summary of the project’s objectives and how they were achieved (more detailed report in Pöntinen 2003).

**Table 1. The objectives and outcomes of the teaching practice project.**

<table>
<thead>
<tr>
<th>Project objectives</th>
<th>How were the objectives achieved?</th>
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<tbody>
<tr>
<td></td>
<td>- Feedback was precisely documented (vs oral-only feedback).</td>
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<tr>
<td></td>
<td>- Photos provided comprehensive information of oneself as a teacher.</td>
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<td></td>
<td>- Supervisors were easily reachable via e-tools -&gt; made studying more effective.</td>
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<td></td>
<td>- Net-discussions did not succeed as expected. -&gt; Lack of time for spontaneous exchange of experiences between student teachers.</td>
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<tr>
<td></td>
<td>- Reciprocity in sharing expertise between the university and the teacher training schools grew.</td>
</tr>
<tr>
<td></td>
<td>- A novel virtual teaching practice community was established. -&gt; The culture of openness was enhanced.</td>
</tr>
</tbody>
</table>
3. Enhance cooperation between home economics and science teachers and student teachers.
- Mobile appliances enabled cooperation between different subject student teachers.
- Net-forums opened a new discussion and communication channel for teachers.
- Participants gained new perspectives on another discipline through photos and comments in the Uniwap.

4. Facilitate cooperation between university teachers and teacher training school teachers.
- Encounters were increased through the net.
- A novel, shared net-tutoring was launched.

The teaching practice project achieved most of its objectives (Table 1). Very good cooperation between different participants was a significant factor in the success of the project. Both the students and the supervising teachers’ attitudes were positive to the project, and they were ready to adopt the ICT tools even if it was not always an easy task. The professional and financial support of the Educational Centre for ICT at the University of Helsinki and business partners were also key.

Discussion

In the title of this article, we asked where home economics education is going: to the byways or the highways of modern technology and its application in teaching and learning processes? Strolling on the byways is one option. There you might take small steps and maybe see more. New ideas can be critically discussed with others without getting out of breath. If you take the highways, the speed may be so exciting that the actual point - the goal - might get disturbed. On the highways, you move quickly, see many new areas and encounter many new stimuli – which may not be found on the byways. Curiosity may lead to unimagined areas. But on the byways, you take fewer risks. Where is home economics education going, and on what kind of ways?

Everyday life and the need for practical household skills will not disappear. You have to know how to do things by hand, or to evaluate the decision to buy services instead. When learning practical skills, a broad variety of methods should be adopted. In Dewey’s words, there is a need for ‘learning by doing’, but also learning with the aid of modern ICT applications, as we have demonstrated in our DiViLearn-project. Cognitive processes are also important: the learner has to understand the underlying phenomena. Otherwise, learning will only be able through trial and error, and the same mistakes will be repeated. In our DiViLearn project we observed how the pupils could get confirmation in their work process from the video clips. This helped them to avoid mistakes. However, the role of the teacher is crucial; s/he can guide the pupils not going too far to the sideways. Expanding the aims of learning to both theoretical understanding and practical skills will, in our opinion, produce the best quality learning. The quality of learning is difficult to measure quantitatively: many hours spent practicing a skill will be wasted without the cognitive understanding. Regarding ICT and the future of home economics, reasonable technological optimism is justified, without being blinded by the speed of development in ICT. According to Lipponen (2003) such blindness could endanger educators’ best efforts.

In our teaching practice project, online tutoring made the supervision more transparent than in traditional face-to-face supervision, which is an asset for the teacher student. Different perspectives on teaching (theoretical and practical) and other disparate opinions are more easily expressed online, and at their best lead to fruitful learning experiences. However, as Tuononen and Kurola (2002, 100) have stated, natural proximity and communication are essential elements in the supervision of teaching practice. The net-based learning environment offers tools for systematic follow-up of student teacher’s progress along the byways and highways of learning to be a teacher. Another aspect to be considered in the future is the role of net-discussions. Teaching practice is a very intensive period and teacher students are busy with planning their lessons and, therefore no much time for spontaneous net-discussions is available. In our project, exchange of information, delivering and receiving feedback on lesson plans, was the best asset of using ICT. More studies are needed on the online interaction and communication.

The mobile tools facilitated communication and gave the feeling of freedom. As one student teacher reflected on the contradictions:
As well as the tools gave the feeling of freedom, they also exploited the freedom. On the other hand, the difference between the normal mobile phone and the Nokia communicator is not so big. One also can switch off the communicator.

These kinds of comments emphasize the need for personal time management. High speed on highways can make students blind; unless one has good self-regulation skills (cf. Lindblom-Ylänne 2004). After the first innovative steps on the highways, attention should be directed to develop meta-cognitive skills.

In this article we have focused on the role of ICT for facilitating home economics teacher students' collaboration as the social aspects of learning were emphasized. Also using and developing ICT based study materials in home economics education has been our interest. Home economics teacher students are the future actors in schools and one part of their work will be teaching consumer’s practical skills (e.g. cooking, cleaning, and caring), which is one of the major contents of home economics lessons in Finnish and Scandinavian comprehensive schools. Practical skills and hand-made artefacts are becoming more and more important in today's information society where few people see any practical results from their work. Practical skills and hand-made products are not only evaluated by standards, such as economy, ergonomics or efficiency. Making by hand can also contribute to ‘learning to be’, in which the process itself is more important than the exactness of the end product. Also being able to collaborate with colleagues of other subjects (e.g. chemistry and physics) and sharing expertise is an important skill for a home economics teacher. ICT facilitates this collaboration, but it also demands a lot of efforts and new kind of communication skills and culture (c.f. Aarnio 1999 and Aarnio & Enqvist 2002).

In future these practical skills may become even more important, and their role will change. Instead of ensuring everyday survival, as their role has been in the past, practical skills will play a crucial role in creativity and mental well being. The more contemporary work is about dealing with abstractions, and never seeing any practical results from a hard day’s work, the more real, practical activities are needed to balance this. Jussi T. Koski (1999, 74) quotes a UNESCO report, listing four important dimensions of learning. The fourth is ‘learning to be’: peoples’ ability to develop themselves as personalities and as individuals, and their ability to find peaceful existence with one’s environment. Practical skills are an important element in this kind of existential knowing, and in future their role will be increasingly important. And when we have learned to be, then we are free to make our choice: do we want to proceed on the ICT highways or ICT byways. Either way, the path is surely worthwhile.

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home economics education, home economics teacher training, information and communication technology, net-based learning

Footnotes

1 Personal Digital Assistant
2 A groupware developed by a Finnish company R5 Vision (http://www.r5vision.com/index.asp?tab=2&lang=eng). The learning environment is accessible only for invited members.
3 A WAP (Wireless Application Protocol) - based learning environment elaborated in cooperation by ICL Invia and the Educational Centre for ICT at the University of Helsinki (http://ok.helsinki.fi/index.php?language=3).
Pedagogical foundations of IVA Learning Management System

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Abstract

Most of the Learning Management Systems are advertised as pedagogically neutral, referring to avoidance of any preferred teaching/learning paradigm or method. In this paper we are going to argue that trend towards taken-for-granted pedagogical neutrality of LMS is mainly good for marketing purposes. From the viewpoint of pedagogical innovation, the built-in pedagogical neutrality of LMS increases the alienation of theoretical discourse of educational science and technology from the practice of teaching and learning. One solution would be designing a ‘pedagogically biased’ LMS, as it was done in the Centre for Educational Technology, Tallinn University. This paper describes the design framework and process of IVA LMS, as well as its implementation in Tallinn University.

A pedagogical neutrality trend in learning technology

The domain of learning technology has recently undergone the impressive developments. Emerging standards for learning object metadata, content packaging, learner information and quizzes are bringing interoperability of learning management systems to a new level and signal the global educational market that the field of e-learning is becoming mature (Collier & Robson, 2001). E-learning platforms are getting more expensive and complex from the user’s point of view. Competition between commercial learning management systems (LMS) is increasing, many universities and companies are considering to leave their current LMS in favor of some alternative (Paulsen, 2002). One of the main selection criteria is related with ‘pedagogical neutrality’ of the LMS, defined as disconnection from any specific pedagogical approach. This makes sense if we look at LMS from the marketing perspective – keeping the system detached from any certain methodology seems to make it more attractive to largest possible audience.

The concept of pedagogical neutrality is not a new one, it has been known long before e-learning era, with slightly different meaning. The notion has been used while regarding to the unwanted impact of teacher’s religious (Noddings 1993) or political (Kopelson, 2003) beliefs to his/her teaching practices. Different teaching methods are rooted in hardly compatible (even incommensurable) belief systems, ideological and theoretical paradigms. Pedagogical neutrality implies the avoidance of preferred paradigm, ideology or religion. Although the pedagogical neutrality is by most LMS developers taken for granted as a desired property of a system, it has been recently criticized by some authors like Friesen, who states that ‘applications that are truly pedagogically neutral cannot also be pedagogically relevant’.

In the context of learning management systems, pedagogical neutrality becomes visible in user interface design – in the vocabulary, functionalities and structure. Let us take a closer look to all these three characteristics and see what impact pedagogical neutrality has on each of them.
1) Vocabulary. The use of pedagogically neutral vocabulary in designing the user interface of an LMS seems to be an easy task at the first glance: one should avoid the specific terms introduced by certain educational theorists (e.g. cognitive schemas by Piaget, instructional events by Gagne, taxonomy of learning goals and test questions by Bloom). The question is: if we succeed in avoiding all terms connected with any learning theories, what kind of vocabulary shall we end up with in a user interface of a LMS? The obvious answer is: the technological vocabulary. Software developers (most of whom never studied educational science) borrow the concepts for LMS user interface from their own domain that is definitely “pedagogically neutral”: forum, chat, object, file, upload, download, database etc. Large part of vocabulary comes inherently from Content Management Systems (e.g. login, account, access rights, upload), as LMS is a subset of CMS. Clearly, introducing a revolutionary change of LMS UI vocabulary towards pedagogically biased one would reduce significantly the usability of LMS, as majority of learners are not familiar with pedagogical terms. Instead, we suggest to use metaphors which illustrate intuitively the pedagogical “point” of a certain feature of the system. The use of metaphors in the LMS user interface design will be discussed in the next chapter.

2) Functionalities. IMS project (see Learning Design specification at www.imsglobal.org) has illustrated convincingly that any pedagogical method can be translated into activity diagram using Unified Modelling Language (UML) – an universal technological language for describing roles, relations and functionalities within a software system. In the end, all pedagogical interactions in the learning process (even in the classroom settings) can be described as sequences of nodes, activities, flows, conditions, decisions etc. But translation on the other way, from UML activity diagram into a pedagogically meaningful action is not a trivial task. If we want to facilitate effective learning with a LMS, the functionalities of the system should be based on the practices that are either familiar from the face-to-face learning situations or developed (and validated) by educational research.

3) Structure. Majority of existing LMSs are structured in a similar manner, following the mainstream design trends for CMSs. Two of the most popular approaches for structuring the LMS are based on the use of spacial metaphors (e.g. hallways and classrooms in Fronter) or toolbox metaphors (e.g. sets of communication, content and assessment tools in WebCT). None of the LMSs listed in www.edutools.info is using any alternative structuring approaches (e.g. based on the certain teaching/learning methods or didactical principles).

We argue that pedagogically neutral vocabulary, functionalities and structure of an LMS decrease the pedagogical affordance of this system, flattening and narrowing the teaching and learning strategies of both teachers and learners. We use the term ‘affordance’ here in the sense it is defined in the domain of Human-Computer Interaction (Preece, 1993): as a property of user interface, allowing (or even: calling to) the certain actions rather than others. Initially this term was introduced by perceptual psychologists as “a property of an object, or a feature of the immediate environment, that indicates how that object or feature can be interfaced with” (Norman). A round doorknob in the middle of the door has poor affordance, as it does not indicate to an inexperienced user from a distance if it should be turned, pulled, pushed or lifted in order to open the door. Affordance of the software systems can have an impact on the mental models of users. We call it „PowerPoint syndrome”: a lecturer who has been using MS PowerPoint for years starts gradually to think and write “in bullets”. We believe that built-in pedagogical affordances of an LMS could have a similar effect on e-learning practices and thus, can promote desired teaching and learning strategies (active and meaningful learning, collaborative knowledge building, problem-based inquiry learning). It is important to stress that this is not promoting “one teaching/learning style fits all” approach. Teachers and learners are different, their preferred learning and teaching styles vary, different subjects require different approaches etc. This is why a LMS should have several alternative “built-in” pedagogical features.

De-theorizing the practice of e-learning

A contemporary American pragmatist philosopher Richard Rorty has explained the history of science with it’s “paradigm wars” as a process of evolution of competing vocabularies. According to Rorty,
the ultimate ambition of every scientist (or school of thought) is to provide a new, hopefully ‘the final’ (meta)vocabulary which allows to redescribe all previous theories in the field. The new vocabularies are born first as the sets of metaphors, ‘borrowing’ the semantics from other domains. When the vocabulary develops, metaphors are evolving into strictly defined terms. People are switching from one vocabulary to another if it seems to be more practical, useful (i.e. suits better for describing and explaining the important phenomena). Thus, we can interpret the modern pedagogical theories as advanced vocabularies, that help us better describe and explain the aspects of learning and instruction. It is inevitable that advanced terminology, methods and models are not trivial an need certain level of expertise in the domain. Unfortunately, the education seems to be a domain in which anyone feels him/herself as an expert. As it was shown before, the call for pedagogical neutrality of learning management systems implies the avoidance of any pedagogical vocabularies in designing the user interface of LMS. One could hardly imagine a project management, publishing or imaging software, which carefully avoids central concepts of the domain. Why should we do this with learning technology?

**Design framework for IVA – a “pedagogically biased” learning environment**

The starting point of the IVA project was the assumption that carefully planned, pedagogically biased UI design, structure and functionality of the system (alongside with the relevant pedagogical training) can lead to the catalytical influence on the learning paradigms held by the teachers and students, therefore gradually changing these paradigms as well as resulting strategies of learning and teaching. We did not start developing IVA from scratch, but built it on top of a radical constructivist learning environment Fle3 from Helsinki University of Art and Design (see Leinonen et al, 2002). In order to avoid enforcement of only one narrow pedagogical theory, the structure and functionalities of IVA have developed to be quite flexible (as opposed to the somewhat stricter approach of Fle3) which allows the use of various teaching and learning strategies. Yet the vocabulary and structure of IVA are biased towards constructivist approach to learning and teaching. The conceptual model of IVA is based on the suggestions by D.H. Jonassen (1994), who defined the three cornerstones for constructivist learning environments (referred below as 3C-model):

- authentic and meaningful Context for learning, provided by teacher,
- support, time and space for personal knowledge Construction,
- opportunities for Collaboration between students.

To achieve ease of use and intuitiveness, many familiar metaphors (both verbal and visual) have been used in designing the user interface of IVA. Materials prepared by teachers are put onto the Bookshelf, communication and collaboration between students takes place in the Workshops area. Directly drawn from the 3C model by Jonassen, the user interface of IVA is structured into three sections:

- Webtop (personal knowledge construction area) – learner’s personal, web-based „workbench“
- Bookshelf (area for establishing a meaningful context for learning) – the place where learning resources and guidelines are provided by teachers
- Workshops (collaboration area) – section for groupwork and discussions.

The idea behind this kind of enforced pre-structuring of the learning environment is based on expectation that teacher should keep these three sections in balance and thus, support and promote the constructivist approach to learning. In addition to these three sections, there is the Management section accessible for teachers only (for managing participants, tests, inner groups etc) and administrator. Aside the read-only rights for students in the Bookshelf section, the work environment for teachers and students is identical.

Portfolio, Bookshelf and Subgroup Workshop are based on Fle3 Webtop structure, which has been expanded by IVA developers. Knowledge Building and Jamming tools are also inherited from the similar Fle3 modules. In addition to the substantial changes in struc-
ture and design of user interface, IVA has number of additional functionalities, which are more closely described below.

Lobby: the starting point

After logging into IVA, a user enters the Lobby where he/she can select a course to proceed with, enroll to new courses, change his/her personal preferences, check the course events in the calendar and view his/her personal IVA usage statistics. An internal mail system of IVA can be used for private conversations among groupmates. In is also possible to forward a copy of IVA internal mail messages (but also grades and news) to user’s e-mail address. Recently visited or updated courses are listed on the front page of the Lobby. A click on the course title takes the user into the course environment.

Bookshelf section

After entering the course environment, Welcome Page of this course is displayed – it is a blog that contains a welcome message, notices and updates related with the course. The Bookshelf is an area for teachers to store study materials and other course-related information in, it has just read-only access for students. Teacher can create folders and sub-folders on the Bookshelf, upload files, add text memos, Web links and Wikis. Wiki is a rapid hypertext publishing tool that allows easy online creation of hypertext documents which are automatically linked with each other. This is not an original tool of created by IVA developers (see wiki.org for more information about Wiki), we integrated a modified version of an open-source Zope product called Zwiki into IVA. Several files can be uploaded to the Bookshelf at once, as a zipfile. The author of the course can distribute materials into different folders by type (syllabus, book, slides, gallery, links etc), but it is equally possible to use a different ways of structuring the content of the Bookshelf – e.g. creating a folder for ever major subject, or building a pure constructivist context as a collection of different case studies. The only default element in the Bookshelf are Welcome Page and Course Information Page which contains description (name, goals, content, grading rules, literature, dates) and participants list of the course. The information is fully editable for teachers while students can only see the information and send messages to fellow students.

Webtop section

Each user has a separate instance of Webtop for every course she/he is enrolled to. The purpose of the Webtop is to collect and publish different personal materials during a course. The Webtop is divided into two sections:

1. Portfolio is a public part for course-related documents like assignments, lecture notes and reflections. Other participants in the course have read-only access to all Portfolios in the course. For each assignment created by the teacher, a special drop-box folder is automatically created inside the Portfolio. If the assignment has a fixed deadline, student will lose the write access to this folder after the deadline.

2. Logpage displays the IVA usage statistics within this course for the user (number of page views, read and sent messages, last access time, grades). All the assignments with deadlines, grades and feedback from the teacher are also listed on the Logpage.

Student can create additional folders and sub-folders into their personal Portfolio, and add files, memos, links and Wikis – just like teachers use the Bookshelf. All these Portfolio objects can be managed, edited and reordered by author, who can also limit the access to each object (for teacher only, selected fellow students, selected sub-group, all coursemates or anyone). Author can check who has viewed the object and when: it means that every student has an opportunity to see whether the teacher has read his/her essay or not.

Workshops section

The most important and feature-rich section of IVA is Workshops area with three workshops:

- a structured discussion forum called Knowledge Building
- Jamming that allows student collaboration in working with different media files
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- GroupPortfolios, used as a common working area for smaller Subgroups.

As implemented already in FLE3, the Knowledge Building (KB) is an asynchronous discussion forum with structure and functionalities strongly rooted in social constructivist learning theory. KB discussions are oriented towards finding solutions to research problems which are set up on a basis of an authentic context (e.g., real-life case) provided by teacher. Every submission to KB forum belongs to certain knowledge type. IVA has multiple knowledge type sets, drawn from different learning theories. For example, the typeset based on Hakkarainen’s Progressive Inquiry learning theory (1999) contains the following knowledge types:

- Problem
- My Explanation
- Scientific Explanation
- Evaluation of the Process
- Summary

In addition to existing knowledge typesets (Progressive Inquiry, Six Hat Thinking, Design Thinking Types, Forum), teachers are allowed to create new ones with IVA’s knowledge type management tool. As the structure is stricter than usually in web forums, teachers can more easily influence and guide the discussion, preventing straying off the main focus.

The Jamming is a tool for collaborative media projects. Media files in different formats can be uploaded, modified into new versions and commented. As a repository of different graphics, sound, video and text files as well as a versioning tool, the Jamming can be used as an unique group work tool in various courses.

In the next version of IVA, a new module will be available under the Workshops section: a collaborative concept mapping tool. This allows users to create and edit visual concept maps, derive new versions (like with Jamming media projects) and merge the maps produced by different sub-groups.

Management section

Management section (accessible by teachers only) contains tools for managing course participants, subgroups, assignments, quizzes and events in the course calendar. Assignments management tool provides an easy way for teacher to access and grade the students’ homeworks. A submission folder is created automatically for every assignment inside of each student Portfolio (in case of group assignment – in GroupPortfolio). Teacher has access to a grading table with links to all students assignments (both individual and groupwork).

The academic traditions in Estonian universities enforced us to include multiple-choice quiz tool in learning management system, although the computer-assessed quizzes do not fit well with constructivism learning paradigm. Available question types include all of the IMS Question and Tests Interoperability specification compatible question types such as matching, multiple choice, numerical, mark all correct, yes/no, paragraph and short answer. Besides that we have added automatic word problem generation engine, which can be used in chemistry for providing percentage calculation problems (e.g., solution strength) with different parameters for each student.

Students can access quizzes under Workshops section. After the quiz has been marked by system and/or teacher, a student is able to view his/her quiz results only on his/her private Logpage.

Technical implementation

IVA is built on Zope, the leading open-source application server. Authentication, user and rights management is done with the built-in tools of Zope. Data processing is mostly done with Python scripts and methods, while web pages are mostly built with Zope Page Templates (ZPT). Data is stored in the Zope Object Database (ZODB). IVA is available in five languages (Estonian, English, German, Finnish, Russian) under GPL licence. The source code, documentation and detailed information about IVA is available on IVA project home page at http://www.htk.tpu.ee/iva and in CVS at https://www.htk.tpu.ee/repos/iva/. The content of IVA can be exported in the format of IMS-compliant XML-files, e.g., course content can be imported to IVA from WebCT.
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Conclusions

The first experiences of using IVA in Tallinn University during 2003-2005 (about 5000 user accounts, over 120 courses online) have shown that metaphor-based vocabulary eases significantly the learning and implementation of complex LMS. Pre-structuring of the user interface has not been perceived as a problem by the users of IVA, 3C balancing model is accepted well both by instructors and students. In fall term 2005, the comparative studies will be carried out in order to estimate the impact of ‘pedagogically biased’ LMS on teaching and learning practices of IVA users.

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Knowledge visualization

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Abstract

Graphical external aids serve two related but quite distinct purposes: for communicating an idea that already needs to exist or to discover the idea itself. We can define this field of activities as knowledge visualization. Knowledge visualization aims to improve the creation and transfer of knowledge by using computer and other, traditional visualization methods complementary. Beyond the mere transfer of facts, knowledge visualization aims to further transfer insights, experiences, expectations, and opinions by using various complementary visualizations. We used classification for visualization tools and mechanisms, developed by Card, where application of visualization is defined on different four levels. The characteristics of visualization on all four levels are described in the chapter, illustrated by noticeable implementations from last two decades presented in the literature.

Introduction

A constructivist approach to learning assumes that all knowledge is constructed from, and based on, previous knowledge. Such an approach can be successful in the knowledge formation of learners when previous knowledge of the individual is used as the basis or starting point for new instruction. In order to achieve deep learning and mastery of subject knowledge, each learner must be actively engaged in constructing his own knowledge base. This can be achieved by letting each learner take full control of incrementally constructing his own knowledge base and by specifying the knowledge modules he is acquiring.

Learning theory and research have shown that understanding a subject domain depends on mastering a set of relations among important concepts in that domain. Successful learners develop an elaborate and highly integrated frameworks of related concepts, similar to those of experts. Moreover, such highly organized cognitive structures of the subject matter facilitate problem-solving and other cognitive activities (Novak, 1998).

Norman (1993) emphasised that «the power of unaided mind without external aids is very constrained. But fortunately human intelligence is highly flexible and adaptive, superb at inventing procedures and objects that overcome its own limits. The real powers come from devising external aids that enhance cognitive abilities.» People use aids from «external» world, especially cognitive artifacts, to extend or amplify cognition.

Current educational environments still rely primarily on a text-based syllabus approach to describing course content as well as
whole curricula. This traditional approach is too limiting. It fails to delineate the relationship of concepts and skills covered in a given course to those covered by other courses. It also fails to show the knowledge base that a learner will have acquired at the end of his/her course of study, as such base relates to lifelong learning. New demands placed on teaching and learning environments call for a more engaging experience for learners.

**Visual Cognition and Perception**

A majority of our brain’s activity deals with processing and analyzing visual images. Visual representations are superior to verbal-sequential representations in different tasks. Human’s input channel capacity is greater when visual abilities are used and our brain has a strong ability to identify patterns. Research on visual imagery (Kosslyn, 1980; Shepard and Cooper, 1982) suggests that visual recall seems to be better than verbal recall. It is not clear how images are stored and recalled, but it is clear that humans have a natural ability to use images. Instructional psychology and media didactics investigate the learning outcomes of text-alone versus text-picture. Mandl and Levin (1989) present different results in knowledge acquisition from text and pictures. Weidenmann (1989) explores aspects of illustrations in the learning process. The use of visual representations are helpful to functions of visual communicate different knowledge types.

Consequently, graphical inventions of all sorts are an important class of the external aids that make humans beings smart are (Card et al., 1999). Graphical external aids serve two related but quite distinct purposes. One purpose is for communicating an idea. In this case, the idea to communicate already needs to exist. Another purpose is to use graphical means to create or discover the idea itself. We can define this field of activities as **knowledge visualization**.

Knowledge visualization thus designates all graphic means that can be used to construct and convey complex insights. Beyond the mere transport of facts, knowledge visualization aims to transfer insights, experiences, attitudes, values, expectations, perspectives, opinions and predictions, and this in a way that enables someone else to reconstruct, remember and apply these insights correctly. The field of knowledge visualization merges approaches from information visualization, didactic techniques, visual cognition and visual communication research, as well as more practical approaches, such as visual programming languages.

Knowledge visualization aims to improve the creation and transfer of knowledge by using computer and other, traditional visualization methods complementary. Examples of such visualizations are sketches, diagrams, images, interactive visualizations, information visualization applications, imaginary visualizations, stories. While information visualization concentrates on the use of computer-supported tools to derive new insights, knowledge visualization focuses to transfer insights and to create new knowledge in groups. Beyond the mere transfer of facts, knowledge visualization aims to further transfer insights, experiences, attitudes, values, expectations, perspectives, opinions, and predictions by using various complementary visualizations.

Visualization through visual imagery has been an effective way to communicate both abstract and concrete ideas since the dawn of man. Examples from history include cave painting, hieroglyphs, Greek geometry, and Leonardo da Vinci’s revolutionary methods of technical drawing for engineering and scientific purposes.

Visualization today has ever-expanding applications in science, engineering, all forms of education, interactive multimedia, medicine etc. Typical of most applications of visualization these days is the extensive use of computer graphics (Williams et al., 1995). The invention of computer graphics may be the most important development for the visualization field since the invention of central perspective in the Renaissance. The development of animation also helped advance the field of visualization.

**Visualization Levels of Use**

Card (1996) defined application of visualization on four levels of use:

- visualization of infosphere,
- visualization of workspace,
- visual knowledge tools, and
- visual objects.
In the rest of the chapter we are going to describe characteristics of visualization on all four levels of use and to present some important concepts and noticeable implementations presented in the literature.

Visualization of infosphere

Visualization can be combined with information access techniques to help the user to find information. Infosphere is defined as information outside the users working environment, such as World Wide Web, digital library or set of learning materials. The visualization could take a form of virtual place that contains documents, or it could be more abstract.

Visualizing the contents to be learned about an instructional material is an effective way to facilitate learning. The effectiveness is not obtained only by looking at the visualized representation. The knowledge visualization accordingly requires learners to devote more attention it.

Various visualizations have been developed to show the structure of a region of the Web. These are intended to provide users with maps to guide browsing. Additional information, such as visibility, size, or other relevant characteristics of particular documents can also be visualized.

Common assumptions behind these visualizations are that users may more easily learn the structure of the information space (e.g. Web) as a result of using a map.

Natto

Perhaps the most obvious representation of Web structure is as a graph of nodes connected by links. Natto (Shiozawa & Matsushita, 1997) was one of the first systems for visualization of Web pages by drawing a graph that is initially distributed on a flat horizontal plane. The placement of the nodes depends upon attributes of the Web page (e.g. size, title, number of images) which are mapped to the plane. The user may select nodes and raise them vertically to stir up the structure. Adjacent nodes maintain a close proximity to the raised nodes so that the structure is gradually disentangled from the plane. Natto demonstrates a method of transformation by manual control. However, there are limits to the number of nodes that may be deposited on the flat plane before selection becomes difficult. The range of pages is fixed when the visualization is generated.

Narcissus

Narcissus (Hendley et al., 1995) also produces a graph-like representation. Given the obvious difficulties in visualizing large hypermedia structures, an effective approach has been to use various techniques to simplify the information space before the visualizations.

Occlusion is automatically reduced through the metaphor of attractive and repulsive forces. Documents exert repulsive forces on each other, whereas the links between them lead to attractive forces. Simulating these forces results in tightly inter-linked sets of pages that are grouped into spatial clusters within the visualization. Although occlusion can still occur, the problem of two objects occupying the same space at the same time is eliminated. An additional scaling mechanism is offered by agglomerating clusters into a single, identifiable object. Narcissus does this by surrounding clusters with a translucent surface to effectively remove most of the detail.

Open Text Index Visualization

Users are often interested in significance, credibility and reliability of the documents found in the Web. To some extent, they can assess these characteristics from the number of links to selected document or site or according to number of accesses to the document or the site. Open Text Index database contains this type of data and there is appropriate software (plug-in) available that supports visualization of this information automatically, dynamically, and compactly, in three dimensions (Bray, 1996). Individual sites are represented as zigzarrats crowned with globes: the diameter expresses the number of pages, the height the visibility, the size of a globe floating overhead the luminosity, and the color the site’s domain. Sites are distributed in space based on the strength of the linkages between them.
Some of the principles that were adopted by the author (Bray, 1996) are:

- The “site” is the appropriate unit of display.
- The appearance of a site should reflect its visibility, as measured by the number of other sites that have pointers to it.
- The appearance of a site should reflect its size, as measured by the number of pages it contains.
- The appearance of a site should reflect its luminosity, as measured by the number of pointers with which it casts navigational light off-site.
- The appearance of a site should reflect the information encoded in its Internet domain address.
- The appearance of a site should reflect any information about its subject category coverage that may be deduced heuristically from its textual content and from connectivity to other well-categorized sites.
- Sites should be distributed in space in a fashion that reflects the strength of their connectivity.

All the above mentioned systems aim at supporting understanding, manipulation, and navigation through complex information spaces. The described metaphors are used to utilize three-dimensional space. Opposed to 2D, the visualization space is enlarged, but the handling effort increased. A natural 3D metaphor should help the viewer to navigate his way through the more complex visualization space.

The results are promising and enormous amount of data items can be visualized in an efficient way. Due to direct volume rendering, including transparency and highlighting techniques, the focus area can be analyzed without losing context information. It is shown that the visualization metaphor of a 3D scatterplot is intuitive and easy to use and insight in relations and patterns of an unknown data set can be gained within short time.

**Visualization of exploration history**

Hypertexts generally provide learners with hyperspace where they can explore domain concepts/knowledge in a self-directed way. Exploration involves cognitive efforts to construct knowledge from the explored contents. Learning can be substantially improved when we can help learners reflect on what and why they have explored in hyperspace. The representative aids are hyperspace maps. These maps can visualize learners’ exploration history and allows them to know where they are located in hyperspace, what they have already explored, and to what extent.

Learners need an effective reflection support that visualizes knowledge structure, constructed by learners during exploration. It needs to consider exploration process deeply since it has a great influence on how to shape knowledge.

<table>
<thead>
<tr>
<th>Exploration Purposes</th>
<th>Visual Representation</th>
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<tbody>
<tr>
<td>Supplement</td>
<td>Inclusion</td>
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<tr>
<td>Elaborate</td>
<td>Set or Part of tree</td>
</tr>
<tr>
<td>Compare</td>
<td>Bidirectional arrow</td>
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<tr>
<td>Justify</td>
<td>Vertical arrow</td>
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<tr>
<td>Rethink</td>
<td>Node superposition</td>
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<tr>
<td>Apply</td>
<td>Arrow</td>
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Learners generally start with a learning purpose and explore hypertext. When they explore selected document, they have a local purpose called exploration purpose to search the next node that fulfills it. We call the process of achieving an exploration purpose as primary exploration process. This is represented as a link from starting node where the exploration purpose occurs to terminal node where it is fulfilled. There are sometimes several terminal nodes linked with one starting node.

Exploration purpose specifies how to improve knowledge obtained in the starting node. An exploration purpose produced in visiting a node is not always fulfilled in the next node. Learners may then need...
to keep it until they find the terminal nodes. Another exploration purpose may also turn up. They would accordingly keep and achieve several exploration purposes concurrently.

In the exploration process, learners would relate knowledge in the starting nodes with knowledge in the terminal nodes to construct knowledge structure. The knowledge structure is shaped according to the exploration purposes specifying how to relate. Each exploration purpose would provide its own way of knowledge construction.

Knowledge structure is represented as the relationships between starting and terminal nodes of exploration. This representation can be looked upon as a map of knowledge they have constructed. In order to represent knowledge structure understandably, symbols presented in the table above were used. An example of visualized browsing history from (Kashihara et al., 1999) is presented in the figure.

**WebPath**

Exploration history is visualized in some other way in WebPath (FrÉcon 1998). WebPath generates a three-dimensional representation of a Web browsing history within virtual reality environment. WebPath runs alongside a conventional browser and is updated whenever a page is visited. Each page is represented as a cube upon which one of three page properties is displayed (the page background image, the first image in-lined in the HTML or the page background colour). The image, representing property, is used as a reminder of local context of the visited document.

The vertical position of the cube is incremented at each visit so as that the most recently visited cube is at the highest point. Semi-transparent layers divide the space so that the older pages gradually become more obscure due to a fogging effect. This effect can be seen over a number of successive layers.

The horizontal position of the cube can be determined dynamically during run-time, either by mapping the horizontal axes to two of a possible eight metrics (e.g. loading time, number of images, server name) or geographically over a world map. Successive pages are linked by directed arcs. All visited pages result in a new cube, irrespective of whether they have been previously visited. WebPath also extends a web history by allowing dynamic querying using three variables. However, the tool acts as a reminder to already viewed documents rather than as a guide to undiscovered regions of the Web.

**Visualization of an information workspace**

Visualization of an information workspace is the use of visualization to organize multiple individual visualizations or other information sources and tools to perform certain task. The desktop metaphor for graphical user interfaces, an integral part of most operating systems used nowadays, today performs a similar function. Because user has information needed at hand the time cost and effort of doing some task is reduced.

Many more sophisticated applications for visualization of an information workspace have been implemented in the last decade. We are going to present most relevant and noticeable from among them which are supposed to have an influence on the future developments in this field.

**WebBook and WebForager**

WebBook and WebForager are an attempt to implement in an interactive visualisation of the Web. The limiting factor when surfing Internet in search of information is time. We know from empirical studies that the tendency for users to interact repeatedly with small
sets of "local information". That is why users tend to structure their information workspace in a way that somehow optimises the cost structure of access to information (Card et. al, 1996). Local information can be found at a low cost. Larger set of information is used at an intermediate cost of retrieval and large spaces of distant information where the cost of finding it is much higher. We can illustrate the above described categories with the papers in the desktop, papers stored in the drawers of the desk and documents in the library.

As the Web does not exhibit an information structure that supports such classification, two new concepts were introduced by Card, Robertson, and York. The web page as interaction unit was replaced with an entity with a higher level of integration. The tool that supports this concept is called WebBook. Extended workspace with multiple entities is implemented by means of WebForager.

WebBook, as its name indicates, uses the book metaphor in order to aggregate web pages into a structure that is visualised in 3D with the appearance of a book. Each page is a web page that is shown the traditional way, but you can flip it to see the other pages. Links to other pages of the WebBook are coded in a different colour than those that point to external pages. If they are located in another WebBook, the current one is closed and the one containing the referenced page is open. If the page lies outside the workspace it is presented as a standalone page floating in the WebForager environment.

The pages of the WebBook can hold user placed bookmarks and user can flick through the pages to get a quick idea of the information they contain. A WebBook can be stored on a shelf or bookcase of WebForager. When you ask for it again it opens at the last page visited.

WebBooks are built dynamically so that the algorithm can read the bookmarks of your favourite browser and build the corresponding book. It is also possible to follow all the links of a particular page building a book with them. You can also create topic books about a specific subject or a WebBook with the pages that come out of a search engine enquiry.

WebForager is a 3D space where you can place WebBooks, shelves and bookcases and/or just individual web pages, as if it were a real desktop. Individual pages can be grabbed and incorporated into WebBooks at the user's will.

The space is organised hierarchically into three levels that respond to different interaction intensities. Most intensive interaction is on the first level is Attention Focus. The page or open book allow immediate interaction. The second level is Immediate storage space is implemented as a desktop where you can leave the pages or entire books. To access them you have to close the focus and select the desired element. Books and pages can be left at different heights and distances. The third level is Tertiary storage space. Shelves and bookcases contain large amounts of books or pages that are seen as book covers.

HotSauce

HotSauce is a 3D "fly-through" interface for navigating information spaces (Guha, 1997). HotSauce was a specific 3D spatialization of the Meta Content Framework (MCF) also developed by Guha. MCF was a way of describing and organizing the structure of an information space. This is called metadata and is separate from the actual content. For example, a library catalogue is vital metadata that enables books to be found on the shelves.

MCF is an open format for representing information about content. The content targeted includes web pages, ftp files, desktop files, email, and structured databases.

HotSauce worked as a plugin to an existing browser so that when a hyperlink to a website was selected the user was dropped into a first-person perspective view of the Web. It was a videogame view with Web pages floating as brightly colored blocks in an infinite black space. It is easy to fly into and around the space, using the mouse to guide the direction of flight and holding down buttons to go forwards and backwards. A page can be accessed by simply double-clicking on the relevant block.

Individual web pages are represented by rectangular blocks, labeled with the page title, while broader 'topics' are indicated by the rounded-cornered rectangles which provide an organizing structure for the information space. Different hierarchical levels of the information space are denoted by different colors of the floating blocks as well as
their spatial depth in the 3D display. Labels can be repositioned or selected to invoke the content.

**Camtree**

Many display design options exist for mapping information space into a visual representation. We can display a large tree structure with mapping it into the traditional 2D geometric representation. More innovative mappings can be the Camtree (Dix et al., 2003, Robertson et al. 1991) which exploits a 3D geometry to display hierarchical structures in a more compact way than 2D. It is only possible to lay out certain sorts of network (called planar graphs) in two dimensions without lines crossing. The third dimension can be used to help with both network and hierarchy layout. In the case of a network, nodes can be laid out in three dimensions, both reducing clutter and meaning that lines no longer cross, but simply pass by one another. This has the disadvantage that nodes and lines may obscure one another, but so long as the user can rotate the network or fly around it, these hidden nodes can be seen. Similar techniques can be used for hierarchies.

In Camtree, part of the Xerox PARC Information Visualizer, the sons of every node are placed on a 3D cone that connects them to the father, so that the growth of the tree is less than the corresponding 2D geometry. Thus, although some nodes are hidden at any particular moment, it is possible to view the entire tree. The projection of 3D shadows highlights the presence of possibly hidden parts.

A second hierarchy visualization, the Conetree, is similar to the Camtree but displays the hierarchy from top to bottom as in the organization chart (Dix et al., 2003). Although these two representations are very similar, it is far easier to display names for each node in the Camtree. This is because most hierarchies are relatively broader than they are deep. Hierarchies with up to 10,000 nodes have been visualized with the Camtree and Conetree.

**City metaphor**

A major problem in modern information systems is to locate information and to re-find information one has seen before. The use of appropriate navigation metaphors can help to make the structure of modern information systems easier to understand and therefore easier to use. Dieberger proposed using a city metaphor as a virtual reality interface for information spaces (Dieberger & Frank, 1998). Cities are complex spatial environments and people know how to get information, how to reach certain locations in a city, and how to make use of the available infrastructure. This metaphor is based on knowledge transferred from the fields of architecture and city planning and designed to support navigation in the resulting virtual city environment. Dieberger and Frank defined a detailed ontology of city elements, describing how each element pertains to a navigational structure. Navigation tools provide the infrastructure to move in the Information City.

Cities are grown organic wholes. Their structures develop out of the needs of their users and from the interaction of many people. People acquire a mental image of the city environment based on these grown structures. A well-designed real city provides a well-balanced mix of the five city elements defined by Lynch (Lynch, 1982): node, path, edge, district and landmark. This allows users to easily learn paths, to describe and remember routes and locations. It also may give locations in the city a feeling of place which provides context for objects nearby and a framework for social interaction.

A city that consists only of similar blocks with little or no differentiation is difficult to use even when plenty of structural elements are available. Finding a particular building in a district would still involve looking at each of them in sequence -- just like scanning a list of file names.
If buildings look differently, possibly giving an indication of their contents, age, and use then finding a certain building in this environment will be much easier. As the user’s needs change also the visualization of additional information may change according to the task at hand. This change provides several different views of the same environment, each of which can be optimized for certain navigational tasks.

A user enters the city searching for information on the use of “spatial metaphors in information visualization”. He might first fly over the city for a moment, studying its layout and decides to research in the computer science district. Entering the computer science district he notices fast what a busy and fast-moving area this is. There are plenty of kiosks around offering access to latest news in various areas of computer science, each of the news messages with a link to the corresponding sub-district or district, and showing how often is has been accessed.

The Information City is designed to be a multi-user environment. It is not a sterile information graveyard but a social space. The information rich environment of the Information City supports users in giving directions, in recognizing landmarks and so forth.

**Visual knowledge tools**

Most visualizations fall at the level of visual knowledge tools. They either arrange information to reveal patterns, or they allow the manipulation of information for finding patterns, or they allow visual manipulations. While the first two categories of the visualization levels of use, namely visualization of infosphere and visualization of workspace, mainly deals with organization of the existing data/information, stored locally or globally, visual knowledge tools are used for knowledge construction by student.

Visual knowledge tools support powerful methods of teaching and learning that utilize graphical ways of working with ideas and presenting information. Visual learning helps students:

- brainstorm ideas,
- develop, organize, and communicate ideas,
- see connections, patterns, and relationships,
- assess and share prior knowledge,
- develop vocabulary,
- outline for writing process activities,
- highlight important ideas,
- classify or categorize concepts, ideas, and information,
- comprehend the events in a story or book,
- improve social interaction between students, and facilitate group work and collaboration among peers,
- guide review and study,
- improve reading comprehension skills and strategies, and
- facilitate recall and retention.

**Concept maps**

Concept mapping is a technique to visualize the relations between concepts (Novak, 1998). A concept is an abstract, universal psychical entity that serves to designate a category or class of entities, events or relations. Concepts are bearers of meaning as opposed to agents of meaning. A single concept can be expressed by any number of languages.
Concept maps are diagrammatic representations which show meaningful relationships between concepts in the form of propositions. Propositions are two or more concept labels linked by words which provide information on relationships or describing connections between concepts. Concept maps encourage understanding by helping students organize and enhance their knowledge on any topic and help them to learn new information by integrating each new idea into their existing body of knowledge. Concept maps can be used in different phases of knowledge construction process and for different purposes.

Teaching a topic
In constructing concept maps, difficult concepts can be clarified and can be arranged in a systematic order. Using concept maps in teaching helps teachers to be more aware of the key concepts and relationship among them. This helps teachers to convey a clear general picture of the topics and their relationships to their students. In this way, it is less likely to miss and misinterpret any important concepts.

Reinforce understanding
Using concept maps can reinforce students’ understanding and learning. This enables visualization of key concepts and summarizes their relationship.

Check learning and identify misconception
The use of concept maps can also assist teachers in evaluating the process of teaching. Misdirected links or wrong connections alert educators to what students do not understand, providing an accurate, objective way to evaluate areas in which students do not yet grasp concepts fully.

Evaluation
Concept maps are ideal for measuring the growth of student learning. As students create concept maps, they reiterate ideas using their own words.

The use of concept maps as a teaching strategy was first developed by J. D. Novak of Cornell University. It was derived from learning theory which places central emphasis on the influence of students’ prior knowledge on subsequent meaningful learning. The most important single factor influencing learning is what the learner already knows. Thus meaningful learning results when a person consciously and explicitly ties new knowledge to relevant concepts they already possess. When meaningful learning occurs, it produces a series of changes within our entire cognitive structure, modifying existing concepts and forming new linkages between concepts. This is why meaningful learning is lasting and powerful whereas rote learning is easily forgotten and not easily applied in new learning or problem solving situations.

The idea of concept maps is also known as semantic networks, cognitive structures, knowledge structures, or conceptual knowledge.

An important advance in our understanding of learning is that the human memory is not a single „vessel” to be filled, but rather a complex set of interrelated memory systems.

While all memory systems are interdependent (and have information going in both directions), the most critical memory system for
incorporating knowledge into long-term memory is the short-term or „working memory“ (Novak, 1998). All incoming information is organized and processed in the working memory by interaction with knowledge in long-term memory. The limiting feature here is that working memory can process only a relatively small number (five to nine) of psychological units at any one moment. This means that relationships among two or three concepts are about the limit of working memory processing capacity. Therefore, to structure large bodies of knowledge requires an orderly sequence of iterations between working memory and long-term memory as new knowledge is being received.

One of the reasons concept mapping is so powerful for the facilitation of meaningful learning is that it serves as a kind of template to help to organize knowledge and to structure it, even though the structure must be built up piece by piece with small units of interacting concept and propositional frameworks. (Novak & Wandersee, 1991).

There are several software applications available that support creation, modification and examination of concept maps.

The CmapTools (Cañas et al., 2004) program empowers users to construct, navigate, share and criticize knowledge models represented as concept maps. It allows users to, among many other features, construct their Cmaps in their personal computer, share them on servers (CmapServers) anywhere on the Internet, link their Cmaps to other Cmaps on servers, automatically create web pages of their concept maps on servers, edit their maps synchronously with other users on the Internet, and search the web for information relevant to a concept map. The CmapTools client is free for use by anybody, whether its use is commercial or non-commercial. In particular, schools and universities are encouraged to download it and install it in as many computers as desired, and students and teachers may make copies of it and install it at home.

In Inspiration, students are supposed to think and learn visually (IARE, 2003). Inspiration allows them to create a picture of their ideas or concepts in the form of a concept map. It also provides an integrated outlining environment to develop ideas into organized written documents. Inspiration’s combination of visual and linear thinking helps deepen understanding of concepts, increase memory retention, develop organizational skills, and tap creativity.

The resulting concept maps can be stored in a form of images, document outlines or web pages.

**Animation in visual knowledge tools**

Visual knowledge tools can increase the value of graphical representations when we add new functionalities such as animation. The recent advances in computer technology, especially increased processing power and storage capacities, enable developers to
integrate animations as well as high degree of interactivity into visual knowledge tools.

Given the breadth of concepts for which animation seems appropriate and the increasing accessibility of computer tools for animating, the enthusiasm for animation is understandable. (Tversky et al., 2002). Lowe reports that current educational use of animation suggests two main underlying assumptions about their role in learning (Lowe, 2004). Firstly, many animations are apparently used to fulfill an affective function, that is, to attract attention, engage the learner, and sustain motivation. In tertiary education, animations are more likely to be used for a second and very different purpose; to fulfill a cognitive function. In this role, animations are intended to support students’ cognitive processes that ultimately result in them understanding the subject matter. We are mainly interested in animation’s potential to play cognitive role.

Research into how people learn from animations is beginning to indicate what types of visuospatial and temporal manipulations may help to improve their educational effectiveness. A key issue is how a learner’s information processing load can be kept within the limits of available processing capacity while ensuring that what is provided remains highly relevant to the learning task. Recent findings show that user control of animations needs to be guided to some extent so that learners’ interrogation strategies are more productive (Lowe, 2004). Designers of educational animations have the responsibility to consider which portions of the dynamic sequence may be more effective if presented as static frames rather than in animated form. Learners could be directed towards these portions and given guidance as to the aspects warranting particular attention.

Animations do not require the learner to perform mental manipulations of the display material because the depicted situation’s dynamics are available to be ‘read off’ directly. A learner can thus concentrate on the central task of understanding the content rather than generating and running an internal dynamic mental model from a static external representation. For learners who otherwise lack the capacity to carry out the necessary cognitive processes, animation can have an enabling effect. Animation can also benefit learners who already possess the necessary capacity but who could process the information more readily if its dynamic aspects were presented explicitly. In this case, animation is described as having a facilitative effect.

**Visually Enhanced Objects**

Visualization can also operate at the level of visually enhanced objects. These refer to objects that have been enhanced with visualization techniques. Large amounts of abstract, often numeric, data are processed and displayed in a new form to derive new insights or simply make the stored data more accessible. This process is often called scientific visualization.

When there is no physical space associated with the data there exists no internal concrete spatial model for use. Therefore, a useful metaphor needs to be developed and abstract space with an intuitive mapping to spatial dimensions need to be defined. Visualization typically helps to improve information retrieval, access and presentation of large data sets – particularly in the interaction of humans and computers.

Scientific visualization deals with different data types, and specific user goals (exploration, analysis, or presentation). The visualization space ranges from 1D to 3D Cartesian coordinates and often multiple views are used. The limitation of the viewing space (i.e., screen space) is common, and the importance of interaction, and interactive feedback is common consent. The goal is gaining insight about the underlying data through a visual metaphor relying on the human ability of visual perception.

Data sources for information visualization range from text analysis to customer surveys, measured experimental data, and log files. So data in this domain can have different characteristics which require different visualization methods. Whether the data is hierarchically organized or not, or the data has categorical values, or sampled data, the visualization method must be aware of such characteristics.

A distinction that could be done for the data is whether the values are nominal (they are only equal to or different from other values), ordered (they obey to a ‘smaller than’-relation), or quantitative (when arithmetic operations can be done on them) (Card & Mackinlay, 1997). If the structure of hierarchically organized data is
an important part of the information, special visualization methods are needed which take that fact into account. Although much work has been done using 3D graphics to visualize physical objects in the scientific visualization field, still only a limited number of methods use three-dimensional space to visualize abstract data. But 3D is getting more and more common and several techniques have been generalized and extended to work in a tree-dimensional viewing space.

The data which is used in information visualization usually provides just abstract information. Questions concerning the student behavior, may occur while working with data, measured in an experiment, unexpected relations may be interesting for the viewer. The field of possible questions is widely spread. And even if no concrete questions or goals can be formulated, data exploration can provide quick overview of the data and insight into details.

Scientific visualization techniques try to comply with the need to transport this information to the user in an efficient way. Information can be related to several items (attributes), which are then understood as dimensions. A huge number of data points and a lot of dimensions are common in data sources for information visualization, being a big challenge for the visualization method in use. A reduction must respect the characteristics of the information, so special techniques are necessary.

To handle a large number of dimensions can be a goal of the visualization metaphor itself, or done by reduction techniques which map the high-dimensional information into a lower-dimensional visualization space. Some techniques, like interest highlighting, use peculiarities of the human perception system as privileged visual cues, like color for instance which is a very strong visual cue.

There is a lot of software packages and software libraries available for scientific visualization for different research fields. An exhaustive survey of packages can be found at The Cornell Theory Center Web site (Dolgert, 2005) and at SAL (Scientific Applications on Linux) websites (SAL, 2005), where shareware, GNU and freeware packages and libraries can be found.

In behavioral sciences, and especially in education research, SPSS, SYSTAT and SAS as statistical analysis tools are widely use to visualize experimental data. Nowadays, spreadsheets as integral part of office automation tools (Excel in MS-Office and Starcalc in StarOffice), are getting powerfull tools for scientific data visualization and are easy to use.

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Artificial Intelligence Methods for Interpretation of Web-based Testing Results

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Abstract

We have developed a web-based system for learning and teaching of math in primary school. It can easily be adapted for other courses in different educational institutions. The system is implemented by means of PHP script language and MySQL database on Apache web-server. In the testing phase the system supports the didactic evaluation of thematic units through the evaluation of the tests.

We used artificial intelligence methods and machine learning to build the models, i.e. decision trees, which were used to classify students into classes and to present knowledge hierarchy respectively to the achievement of individual goals examined by certain exercises. Decision trees give teachers an overview of the importance of the goals, which influence the classification of students into classes. The teacher is indirectly given the feedback about the structure and knowledge level compensation by means of model analysis.

Introduction

Our society, on the threshold of the third millennium, becomes informational and pursuant the submission of information emphasizes the educational system. The goal of these changes is not only to improve the quality of the educational process with the help of different achievements of communication technology, but also to achieve a variety of organisational forms and better flexibility as regards time, place, content and pace of education. In spite of all the advantages, the systems cannot totally displace or replace specialists. Despite extraordinary speed with which they can work on the enormous amount of data with high mathematical accuracy, they still can’t exceed the human minds and their broad knowledge. Because of the high degree of parallelism in human brains, people can also quickly solve some problems, for which the computer would need essentially more time to solve them or it wouldn’t be able to solve them at all [9].

The idea of the teaching process is slowly changing with the information and communication technology (ICT) and the teacher here is not only the knowledge transferor and mediator of certain facts, but the teaching process is also organised within the meaning of searching, producing and creating new knowledge. Contemporary information communication technology and progress in telecommunication...
development enables students to acquire knowledge from different sources. Classroom isn’t restricted with four walls anymore. We consider all stated above through the implementation of our system.

The main advantage of a web-based teaching environment is that learning can be realized independently from time and space, and teaching can support individualism and self-initiative. In this way students can choose the most suitable time and place for learning individually.

Based on available knowledge and technology we tried to create a system, which would be helpful to teachers, parents and above all to students in the following manner:

To the teachers as a didactic shift for processing materials, which variegates lessons, relieves teachers from composing and validating tests and adapts lessons to individual students.

To the parents as an accessory, that helps their children with learning, revision and fulfillment of certain lessons.

To the students as main users in the presentation of materials in new, interesting and interactive way, so students would learn better and easier.

Web-system presentation

Our web-based system for learning and teaching is based on a general model and includes the following phases:

1. TESTING THE STUDENT: The test contains several exercises. In the case of primary school math, we chose 12 exercises. Some of them are more complex and contain sub-exercises. There are two types of exercises:

   1. «choose the correct answer», where three answers are offered to the student and he has to choose among them;
   2. «enter answer», where the student has to solve the task and then write the formatted answer into an input field.

2. VALIDATION OF THE TEST or QUALIFICATION OF THE STUDENT: After the student finishes the testing, the system informs him about the correctly and incorrectly solved exercises and the marks received for the individual exercise. It offers him two possibilities to:

   1. repeat the testing, for which the student can decide if s/he estimates that the system hasn’t qualified him correctly or s/he thinks that s/he hasn’t been solving exercises properly due to various reasons;
   2. save the results’ achievements in the database, from where s/he can see them or erase them at any time later.

If s/he decides to store the results in the database, the system offers help of two types:

   1. Help, regarding to the correctly and incorrectly solved exercise. The system displays a table and offers help for exercises that were solved incorrectly. Help for each particular exercise is such that it displays a concretely solved similar task to the student.
   2. Help, regarding to achieve a number of points on the test. Help is prepared for five categories. To the students, who are solving the test very badly, it offers review of all materials with short and evident examples. The better the student solves the test the less help s/he gets. If s/he solves the test for mark 3, the system offers connections with a similar content. At mark 4 the system offers only a brief review of materials and connections to the similar materials, other mathematical materials and some connections to the foreign materials. At mark 5 the system offers only the table of connections to the pages with other mathematical materials and to the foreign materials.

As a reward for saving the results to the database, the student can get the certificate about his/her achievements on the test. The certificate is formatted in Microsoft Word format and it could be printed or saved. Our intention is to variegate the web-page and, at the same time, to motivate the students.

3. SAVING THE STUDENTS RESULTS OF TESTING: The system offers the possibility to save the students’ results into a database from where they can see them any time they visit the system again.
The intention is to enable the self-evaluation of the students. They can see if they achieved progress in their knowledge or still are on the same level or decrease their knowledge. This should serve also for the internal motivation of students because they would accept the regression of their knowledge as an additional motive to learn and improve their knowledge. The internal motivation is most important if we want to improve students learning and their habits. The saving of results of testing is anonymously, which increases the trust of the students into the system. Otherwise the students could be afraid, that their results would for instance be seen by their teachers, which could influence their validation.

4. OTHER POSSIBILITIES OF THE SYSTEM:

- **Reviewing the results:** The user can check his/her previous results any time s/he wants and can also delete them from the database. Beside of each result there is an hour and date of solving the test. So s/he can quickly see if his/her knowledge is in progress, if it decreases or if it stays on the same level.
- **Adding and deleting bookmarks:** The user fills in the form for entering the bookmark, which is the URL address of the document, containing the bookmark. The purpose of bookmarks is to save interesting URL addresses, found on the web, which are related to the materials on this page. So s/he will not have to search them again. The bookmarks can also be deleted.
- **Recommending bookmarks:** The system can also recommend URL addresses, saved by other users. The address is recommended only if the same URL address has been saved by at least two other users and the current user already has one of the URL’s from other users. That way we prevent recommendation of personal URL addresses to other users.
- **Adding and deleting comments:** The user can save comments that proved to be useful for solving the test. Comments can also be deleted.
- **Changing password:** The user can change the password any time s/he wants. This requires to enter the old password and to repeat the new password twice. Changing the password will be necessary if someone thinks others have discovered it or for personal reasons.

From the teachers' point of view the next activities are important: handling the students data and building decision trees, gaining important information from already built decision trees.

The teacher’s purpose of these activities is to get information about the success of handling the materials in the certain class in a simple and, for students, interesting way.

In this way, each particular topic can be exercised by students after it has been described in the teacher’s lesson. For students, this is an interesting lesson of fortifying the materials, which also offers them immediate feedback information on their knowledge. For the teacher it means instant feedback information about the success of his/her teaching. The teacher can find out, which parts of materials were acquired well and which topics need to be explained again. From the constructed models the teacher can get an overview about the knowledge level of individual groups. S/he can see which tasks are solved most successfully by the students. At the same time, the teacher can see which exercises are solved less successfully by students from the lowest group.

**Methods of Artificial Intelligence**

For processing tests we have used methods of artificial intelligence, more concretely the knowledge discovery from data. **Knowledge discovery from data** (KDD) is the nontrivial process of discovering implicitly, so far unknown and potentially useful knowledge from data, which consists of three phases:

1. data preparation,
2. data mining (DM),
3. interpretation, evaluation and presentation [6].
Phases of Knowledge Discovery from Data

The goal is the production of new knowledge for better decision-making, classification or prediction [11]. The most important phase of knowledge discovery from data is data mining. There are many methods of data mining, and many of them are originating from machine learning. Decision trees, which we used to build our models, belong to this field.

Machine Learning

Machine learning can be defined as described as modeling data. The input of a machine learning system is a dataset or domain and a priori knowledge about the domain. Its outputs are models that describe and explain data.

Machine Learning Algorithm

**Decision Trees**

Decision trees are models for representing a series of rules that lead to class or value. Methods of constructing the decision trees belong to the field of machine learning. The basic task is to build the decision tree from a tabular data, which illustrates the dependence between chosen input attributes and chosen output attribute, called class.

Decision trees belong to the broader class of procedures of inductive learning, which belongs to automatic learning from solved instances. Inductive learning is a type of learning with the help of a set of instances, which are described with inputs and outputs. The goal is to find the hypothesis, which is based on learning instances and which is capable to predict the class of the instances with given attributes. The approach is simple and efficient, but above all useful. It also offers a good explanation of the way how we can come to offered decision.

When we want to predict a class with the decision trees, first of all we have to prepare a dataset of solved instances. Then we divide the set into a training set, with which we construct the decision tree, and testing set. The purpose of the testing set is to verify reliability of the built decision tree. First we define a set of attributes, which describe an individual instance (input data) and we choose one decision attribute (class), which represents the solution of a given exercise. Then we define classes of possible values to all attributes. At attributes with discrete values the attribute takes certain number of possible values, at attributes with numerical values the classes are defined by intervals. Discrete attributes could be of ordered and unordered type. Through the construction of the tree every attribute can represent one internal node, also called attribute node. Such attribute nodes can have exactly so many branches as attributes have classes of possible values. The leaves of the tree represent the decisions and represent classes of possible values of decision attributes.
Sample Decision Tree

Decision trees describe training data and enable a classification of new instances. To classify an unknown instance, the tree is routed down according to the values of the attributes tested in successive nodes, and when a leaf is reached the instance is classified according to the class assigned to the leaf.

**Construction of the Decision Tree**

We construct a decision tree by using the training set, which consists of training instances. The characteristics of training instances are described with a set of attributes and with class (class label, category, outcome) to which it belongs. Classes mutually exclude one another, which means that training instances can belong only to one class. Attributes can be discrete or continuous.

A decision tree consists of nodes and links. There are two kinds of nodes. Every internal node (non-terminal node) contains a split, which is to test the values of attributes and with that separates the training set to smaller sub-sets. Leaves (terminal nodes) are external nodes and are marked with classes [3][9][11][12].

Regarding to the class, we distinguish between classification and regression decision trees.

Nodes are connected with links and links are marked with different outcomes of particular events or attributes. In that way the number of links, which come out of the node, depends on the number of possible solutions of particular exercise.

The procedure of generating a decision tree from the training set is called induction of the tree. At the induction we start with a blank tree and the whole set of training objects. Then on every step with the help of the heuristic evaluation function we choose an attribute, which has not been used yet. If there are not enough training objects or if the data contains missing values, then it usually leads to over-fitting. The result of that are large decision trees with a lot of unimportant branches. That’s why it is important to stop the growing of the tree. For this purpose the procedures for pruning unimportant branches exists [3][9][12].

**Decision Trees as classifiers and guidelines for further work**

For teachers decision trees are important for gaining information about the importance of particular topics and verifying goals through students’ classification. At the same time they can check the presumptions about the difficulty of a particular topic in the test and with that they get an overview of the test structure. The decision tree also represents absorption of knowledge in one or more classes. This way it is good feedback information to the teacher about the success of teaching. At the same time with the absorption of knowledge the nature of the knowledge is also captured. Certain parts of material
are more difficult in advance for understanding in comparison with the other. The social structure of students also influences the knowledge absorption. Some of them have more opportunities for individual help than others. This means that the teacher doesn’t get just a clear picture about his success, but the decision tree also reflects the importance of concrete exercises in concrete environments for classifying students in classes.

The decision trees could also be used statistically for test solving. Such a decision tree should be constructed on much larger dataset to present an average statistical pattern of students’ behaviour at absorption of the knowledge. In that case we would use the decision tree as an »Oracle« and one of the goals of such a tree would be the direction of the student. Students that didn’t do well on the test would be directed to the topics on the top of the decision tree, because they are the most important ones. Students with good results on the test would just get the most important topics, because elementary exercises are probably uninteresting and boring for them. That way we would point out the use of the decision trees from the students’ point of view. At the same time tests based on the decision tree are much shorter than ordinary tests. Students are going to be directed to different subsets of exercises, so testing becomes individualized regarding to results.

With regressive decision trees we can describe how well classified students get good results and which exercises are less successfully solved by students from lower classes. Regressive trees could be of big help to the teachers when they are estimating the tests and when preparing the materials for individual work of students or level groups.

In the future work will involve implementation of some other methods of artificial intelligence and statistics. We could use clustering methods for interpretation of the test results, which would divide students in subsets with similar knowledge absorption properties. After classifying the student in the class, we could compare the results of other students in the same class.

We could also realize the selective testing (exercise after exercise), which would mean, that the test would be constructed regarding to momentarily achieved result. This means that the test would be totally adjusted to the individual student. After all we could also discover with association rules the legalities of the whole set of data. Those represent typical patterns of knowledge absorption.

Summary

The main purpose of our web-based system was the implementation of some artificial intelligence methods or the construction of decision trees for classifying the students into classes. With the acquired data we have built different decision trees, which represent the structure of students’ knowledge. Regarding the small amount of not very qualitative data, the qualification accuracy was pretty good and even surprisingly high.

We could notice from classification trees, which topic influences the classification most. On the other hand we could see from regressive trees the behaviour through the testing of students who belong to the highest and lowest class. The teacher gets a perfect picture about the structure of the test and the knowledge level in the class. S/he can also see which exercises were, solved very well by the students from the highest group and offer them new challenges. For example for the lowest group s/he could explain again some specific topics.

For further work we could expand the database and add advisers, which could be implemented as a button on the web page. The button would be like a hidden decision tree, which would classify students into classes. On the other hand that would also be an interesting way of using decision trees in a way, that the system would classify new students regarding to the statistics of previous test results and also with missing values.

Constructed models are suitable mainly for experimental use for advisers and not for laic use for students and parents. Despite this the
adviser should still lean mostly on his/her own knowledge, judgement and experience, and critically judge the opinion of the model.

Advantages of constructed models:

1. They enable consistent, objective and systematic predictions;
2. They offer to the advisor second opinions, which reduce the possibility of making mistakes;
3. The possibility of secondary evaluation enlarges the reliability of prediction.

The weaknesses of the models are mainly that they are not 100% reliable. The classification accuracy is on the average about 80%. From the model’s point of view it is sufficient accuracy, but from the students’ point of view, especially those ones that are classified in wrong classes, the accuracy is bad. Wrong classification can be especially problematical in cases for students with low self-confidence. Besides this, we cannot predict how the classification will influence the motivation of the students and regarding to this also on the final result. We also have to take into consideration that our web-based system is in its starting phase and a lot of complexions and improvements should be made.

We see an interesting option for further use and construction of similar systems for educational purposes. Classical lessons in classrooms are for new generations of students less and less interesting and that is where the systems could make a big difference on all spheres of education. It offers new forms of work, which would contribute to improve the quality of education.

References

Key words

Web System, Prediction, Classification, Decision-making, Decision models, Knowledge Discovery from Data, Data Mining, Decision Trees.
Abstract

In most cases learning objects are used for individual learning (reading, looking, playing, quizzes) or by teachers in their teaching (presentations). The production of the learning objects is also considered to be the task of the publishing industry. Firstly in this paper we argue that learning objects should be specifically designed – in a different way than at the moment – to promote truly social constructivist learning. Secondly we present that teachers should have an active role in the design and development of the learning objects. Therefore we introduce the concept of participatory design of learning object templates (PILOT’s) and develop a framework for participatory design of learning objects. The PILOT is one type of learning objects that can be designed within the framework. These learning objects support the progressive inquiry knowledge building process in the Knowledge Building discussion tool, as found in the Fle3 and IVA virtual learning environments. Design research methods such as participatory design and scenario-based design are used in the research. In the paper we also show how the IMS Learning Design Specification could be used to design learning objects for social constructivist learning.

Learning Objects

The term Learning Object (LO) has been around for a decade already. It was first introduced in 1994 by Wayne Hodgins who named the CedMA working group as “Learning Architectures, APIs and Learning Objects” (Polsani 2003). Hodgins came to the idea of interoperable pieces of information when he was watching his child playing with LEGO blocks (Jacobsen 2001). During the last 10 years there have been several attempts to standardize the field. As a result the IEEE Learning Technology Standards Committee has agreed on the Learning Object Metadata standard in 2002. However, the term Learning Object itself has still several definitions. At most basic level it is a piece of content that’s smaller than a course or lesson (Mortimer 2002). Mortimer further defines the learning object as “any entity, digital or non-digital, that may be used for learning, education or training” (IEEE 2002). This definition has been used as the basis for the Learning Object Metadata standard.
criticized by several authors because of its too broad range (Wiley 2000; Polsani 2003).
A more restricted definition comes from James L’Allier, who defines learning object as “the smallest independent structural experience that contains an objective, a learning activity and an assessment” (L’Allier 1997).
Some authors emphasize the similarity with object-oriented programming. “The learning object (LO) model is characterized by the belief that we can create independent chunks of educational content that provide an educational experience for some pedagogical purpose. Drawing on the object-oriented programming (OOP) model, this approach asserts that these chunks are self-contained, though they may contain references to other objects; and they may be combined or sequenced to form longer educational interactions” (Quinn 2000). This connection with LO’s and OOP has also been criticized (Sosteric et al. 2002).
The search of the pedagogical foundation of the LO-thinking leads us to John Locke’s (1632−1704) epistemology, the theory of knowledge and the educational philosophy. In the “Essay Concerning Humane Understanding, Volume II” Locke presents his theory on how human gains knowledge by first understanding simple ideas and then by combining these simple ideas together to get more complex ideas. Locke writes “The impressions then that are made on our sense by outward objects that are extrinsical to the mind; and its own operations about these impressions, reflected on by itself, as proper objects to be contemplated by it, are, I conceive, the original of all knowledge.” (Locke 1690)
The Lockean conception of knowledge has lead in the Western tradition to the teaching practice which regards students as empty boxes that must be filled up with knowledge. Moreover the knowledge first consists of simple ideas which then can build up more complex ideas. Thus teaching must be a practice of offering a student small pieces of information that are related and connected together.
In our approach, based on the cultural psychology, to use the concept of LO may appear strange. We see that the meaningful and significant learning is not only a simple consumption of knowledge, but an active participation to production of knowledge in communities. However, if we leave the idea of using LO’s for gaining knowledge to memorize in the background we may consider and discuss about other characteristics of the LO’s.
An important aspect of learning objects is reusability. A reusable learning object (RLO) can be used by multiple users on multiple occasions in different educational contexts and settings. According to L’Allier’s definition of the learning object the component parts of RLO are objective (an element that describes the intended criterion-based result of a learning activity), learning activity (an element that teaches towards an objective), assessment (an element that determines if an objective has been met) and the metadata, which is needed for indexing and searching the learning objects (Leeder et al. 2004).
Several guidelines have been published on the design of learning objects. Ilomäki et al. have assembled the pedagogical guidelines for designing learning objects in the CELEBRATE project, which is a large learning object repository for secondary education. Special suggestions are provided for problem based learning, discovery learning and progressive inquiry. Authors find that many kind of LO’s can be used for progressive inquiry learning, depending on the process. It is important that the learning object should give specific support and scaffolding for the progressive inquiry process (Ilomäki et al. 2003).

Social constructivist learning with ICT
In most cases learning objects are used for individual learning (reading, looking, playing, quizzes) or by teachers in their teaching (presentations). Our views are based on the social constructivist theory that sees learning as a participation in social processes of knowledge construction.
Progressive inquiry is a pedagogical model developed in the department of psychology, University of Helsinki. The theoretical roots of the model are in the cultural psychology and social constructivism as seen by Vygotsky (1978). According to Vygotsky human cognitive structures are socially constructed. The construction happens in a human-human interaction and cannot be separated from the social, cultural and situational context where it is taking place.
Progressive inquiry is meant to be a practical model of learning based on the principles of social constructivist learning. In the progressive
inquiry students are encouraged to engage in the process of question-and explanation driven inquiry (Muukkonen 1999). As a method of teaching and learning this means that the pupils are encouraged to make their conceptions of the topics studied explicit and then the study group is working together to improve the presented ideas and explanation.

Often teachers and pupils are using some computer supported collaborative learning (CSCL) environments operating on some information and communication technologies (ICT), such as personal computers or mobile devices. The CSCL environment is used to save their study problems, own theories and scientific information in a shared database. The student's knowledge artefacts are often in a form of discourse and linked to each other. The database keeps track of the pupils' process and makes it possible to go back in it, reflect and review the process and to reorganize the knowledge brought and discovered by the pupils.

We have developed Fle3 learning environment (see http://fle3.uiah.fi), which is designed in general for social constructivist learning and particularly for progressive inquiry. The environment contains three learning tools: WebTop, Knowledge Building and Jamming. WebTop can be used for storing different items (files, links, notes) related to the studies and making them available for other course participants. With the WebTops students can build up their own data structures by organizing materials in and outside the Fle3 in their own way. With the Knowledge Building tool groups can carry out a knowledge building discourse to give sense to the context. The Jamming tool is used for collaborative design and construction of digital artefacts (images, sound, etc) (Leinonen et al. 2003). The tools originally created in Fle3 are present also in the IVA learning management system (Laanpere, Põldoja, Kikkas 2004), which was developed based on the Fle3 source code in Tallinn University.

The main tool of the Fle3 is the Knowledge Building. The discourse and production of the student's own knowledge objects is guided and structured by using different knowledge type sets. These are sets of labels with associated instructions to enhance the discussion process towards a process that the knowledge type set tries to support. Users must choose an appropriate knowledge type when posting a note to the Knowledge Building. The most commonly used knowledge type set in Fle3 is the Progressive Inquiry specifically designed to scaffold students in their co-inquiry.

The conceptual framework of progressive inquiry is often presented (Muukkonen 1999; Hakkarainen, Lonka, Lipponen 1999) as six steps that are loosely following each other. The steps are:

1. Creating context.
2. Engaging in question-driven inquiry.
3. Generating one's own working theories.
4. Critical evaluation of knowledge advancement.
5. Searching new scientific information and

All six aspects of inquiry are shared with fellow inquirers – the learning community – where pupils are helping each other to refine their thinking and advance their common knowledge related to the topics under study. The aim of the process is accumulation and deepening of knowledge of all the pupils. As the students are encouraged to start the process with some open-ended research questions that are driving the inquiry, pupils - with the help of their teacher - may present questions that are suitable, challenging and motivating for them.

The design research problems

The use of Fle3 and IVA has shown that the knowledge building process would be easier for teachers to exploit if there are ready-made content packages that frame the context and give a starting point for the progressive inquiry process. The idea of the ready-made content is not to provide material that students should study in a traditional manner, but to open problems and questions that the students want to solve during the inquiry study process. The content should generate the desire to present own hypothesis on the topics and find scientific information on them. This way the ready-made content may help teachers to create context and students to set up study problems and start generating one's own working theories.

The design problems of the research are:

- How to support social constructivist learning with ready-made rich media content packages (LO’s)?
• What are the general features of the package?
• Would the package help teachers and pupils, who do not yet know very well how to use the progressive inquiry model in their teaching and learning practice?
• What is the framework for easy modification and further development of learning objects for social constructivist learning?

The design research is looking for answers to the questions by building up concepts and developing a prototype of a package. In the following section we will present the concept and the design process of the prototypes and the framework to develop them.

**Participatory design of PILOT’s and the design framework**

We have developed a concept of PILOT’s – Progressive Inquiry Learning Object Templates. PILOT’s are rich media content packages (learning objects) that support the progressive inquiry process in a virtual learning environment. The word *template* emphasizes the reusability (using, editing, modifying and sharing) of these learning objects. Teachers are expected to actively participate in the design process by editing the PILOT’s according to their study context and sharing them with the community. Nowadays a lot of innovation in design is coming from the users.

In the Scandinavian design tradition the involvement of actual users in the design process has been important for several decades. The roots of participatory design approach go back to 1970’s, when members of worker’s and trade unions started to participate in the design and deployment of computer systems at their workplace. Since the workers had no experience in systems design, participatory design needed methods that were understandable for the end users. Such methods include the active use of scenarios, game like situations, mock-ups and prototypes (Ehn 1992).

In the case of teachers, participatory design methods can support the development of learning objects for social constructivist learning. The main goal is to develop a framework, which supports the design process of learning objects. The prototypes of learning objects are developed beforehand in order to be used in participatory design to develop the framework. The design of learning object is much broader than graphical design: it includes specifying the learning objectives, choosing pedagogical methods, designing the content, etc. There are several collaborative environments like SourceForge (see http://sourceforge.net/) and Savannah (http://savannah.nongnu.org/) for software developers. Year 2004 brought into focus the term **social software**. This relates on environments like LinkedIn (see https://www.linkedin.com/), del.icio.us (see http://del.icio.us) and Flickr (see http://www.flickr.com) and various concepts easy web publishing (blog, wiki). We argue that features of social software can be used in a framework for collaborative design, development and reuse of learning objects.

One special type of learning objects that can be developed and within the framework are called progressive inquiry learning object templates (PILOT’s). PILOT’s are the ready-made content packages made to facilitate progressive inquiry learning inside virtual learning environment. In the PILOT project we develop several content packages on the topic of wetlands for use in biology or geography lessons and environmental education study projects that are integrating several school subjects. The project is a collaboration between the UIAH Media Lab Learning Environments research group, Uusimaa Regional Environment Centre and schools using Fle3 learning environment.

The design process was carried out by the principles of participatory design by thinking and discussing among the design team about the scenarios of the possible use of the PILOT’s in a primary school education (Carroll 2000). The scenario has been shared among the design team members to reflect and clarify the concept.

According to the national educational curriculum, the six-grade teacher is starting a course in her classroom on wetlands. The course should have a perspective of environmental conservation and lead student to understand what the wetlands are and why they are important. The teacher is an expert of the progressive inquiry learning method and has been using Fle3 with her students for several years. She starts the planning of the course by searching from Internet ideas on how to organize the course with her students. With the help of a search engine she finds a PILOT with a title “wetlands” from the learning material database of the Finland’s Environmental Administration. She looks for the description and realizes that it
could be suitable for her needs. As the PILOT is offered by the Environmental Administration she may trust that it is well designed and contains valid information. She downloads the PILOT to her own computer and brings it to her Fle3. She takes a closer look of the content of the PILOT inside Fle3 and makes some minor editing to some ready-made research questions of the PILOT. Now she is ready to use the PILOT. She starts the course with her students.

Box 1: Scenario of the use of PILOT in a six-grade environmental education.

Based on the scenarios we started to design the first prototype of PILOT. The main content of the PILOT, the knowledge building context, was written in cooperation between environmental experts and pedagogy expert. The texts were refined in several iterations. When contexts were ready short scenarios were written to describe the multimedia part of PILOT’s. The scenarios were discussed with the project group and then implemented in Macromedia Flash. According to the scenario the context text is used as a voiceover and the most important keywords from the text are displayed in the movie (see Figure 1). In Fle3 the context will have a hyperlink to the flash movie, which is published in a web server or learning object repository.

![Figure 1: Initial research questions are displayed in the Flash movie](image)

The prototype was used as a mock-up for discussions. It has been published on the web (see [http://fle3.uiah.fi/pilot/](http://fle3.uiah.fi/pilot/)) and presented to researchers working in the same field, teachers using Fle3 and other people interested in the innovative use of ICT in schools. We found this kind of informal discussions to be a very fruitful input for improving the concept. It can be seen as one method of participatory design.

**PILOT’s and learning technology standards**

When designing learning objects we must be aware of learning technology standards. Information technology cannot function without agreed standards, which help to achieve interoperability. Interoperability is defined as the ability of two or more systems or components to exchange information and to use the information that has been exchanged (IEEE 1990). For example the Internet is based
on several standards: HTTP for connection, URL’s for locations, HTML for documents etc.

The following learning technology standards are important for PILOT’s: IMS Learning Design Specification, IEEE Learning Object Metadata standard (IEEE 2002), IMS Simple Sequencing Specification and IMS Content Packaging Specification. In this paper we will focus on the IMS Learning Design, because this might be the most interesting for readers with pedagogical background. The IMS Learning Design specification works on the level of the course or unit within the course, not on the level of individual learning objects. The progressive inquiry learning event is an activity on the course level. The aim of the IMS Learning Design Specification (IMS LD) is to prescribe various activities for learner and staff roles in a certain order. It can be seen as the lesson planning for e-learning. The Learning Design specification is a framework that supports pedagogical diversity and innovation, while promoting the exchange and interoperability of e-learning materials. It also supports mixed mode delivery (“blended learning”). This enables traditional approaches such as face-to-face teaching, lab work and field trips. IMS LD is based on Educational Modelling Language (EML) and existing IMS specifications.

IMS LD specification has been divided into three parts, known as Level A, Level B, and Level C. Level A contains all the core vocabulary needed to support pedagogical diversity. Level B adds Properties and Conditions to level A, which enable personalization and more elaborate sequencing and interactions based on learner portfolios. It can be used to direct the learning activities as well as the record outcomes. Level C adds Notification to level B (IMS 2003a).

IMS specifications usually include the Best Practice Guide, the Information Binding and the Information Model. Since the specifications are often quite complicated the Best Practice Guide is a good starting point (IMS 2003b). To give an example about the practical usage of the specification the progressive inquiry learning process on the wetlands topic is described on the Level A. The description in Level A may contain the following parts:

1. Introduction
2. UML Activity Diagram
3. Key Points of Note

4. XML Document Instance

As an example we present the Introduction part of IMS LD level A in Box 2. In the PILOT project we have experienced that IMS LD level A scripts can be used as a well-structured scenarios in participatory design. The general framework for designing and developing learning objects could feature a wiki-based scenario writing tool, which has a template with IMS LD level A structure. This kind of tool would help teachers to design learning objects and share their ideas with others.

The Wetlands Introduction

The Wetlands is designed to be a six-week progressive inquiry learning event (2 lessons in a week) for students at the age of 13–15.

The learning event has three main phases:

1. Finding out what is a wetland? (“Kosteikko - maan ja veden välissä”)
2. Studying different kind of wetlands and their differences (“Suo siellä, kosteikko täällä”)
3. Why are wetlands important? (“Kosteikossa kuhisee”)

These three main phases are also the contexts in the Fle3 Knowledge Building.

The resources and facilities needed include:

- Content:
  - Aims and Objectives of the learning activity itself.
  - Short and full descriptions of the course contexts.
  - Ignition questions, which aim is to help to get the KB on the run
  - Multimedia PILOT’s of the course contexts
- Tools:
  - Learning environment with Knowledge Building tool.
  - Image processing software
Designing Learning Objects for Social Constructivist Learning

- Pen and notebook
- Study books and CD-Roms
- Microscope
- Binoculars
- Ph test kit
- Rubber boots
- Audio and video recording equipments

- Communications:
  - Small groups and classroom discussions
  - Knowledge Building discourse
  - Presentations

PILOT is the new type of the learning object developed to introduce the topic and to encourage the Knowledge Building discussions.

The basic sequence of the learning event is:

1. Introduction to the wetland’s topic
   a. Multimedia “teaser” about the wetlands in general
   b. Classroom discussion about the wetlands
   c. Introduction to progressive inquiry learning
   d. First progressive inquiry session in KB

2. Different types of wetlands
   a. Multimedia “teaser” about different types of wetlands
   b. Classroom discussion about the topic
   c. Progressive inquiry session in KB

3. The biodiversity of wetlands
   a. Multimedia “teaser” about the biodiversity of wetlands
   b. Classroom discussion about the topic
   c. Progressive inquiry session in KB

Box 2. The IMS Learning Design description for wetlands learning event (Level A)

Evaluation process of PILOT prototypes and the framework

Testing and evaluation of PILOT’s is planned to be carried out in Finland and Estonia. The purpose is to find out how the Learning Objects fit to different school cultures and to find out how the localisation, contextualisation and situation of the PILOT’s should be carried out. Four secondary schools will be the test beds. Testing will take place in natural science lessons and take 6 weeks with 2 lessons per week.

The testing will focus on the evaluation of PILOT’s efficacy in a progressive inquiry learning process. The testing will look at how well (or not) students and teachers will be engaged with the PILOT’s inside the virtual learning environment. Empirical data will be collected to study how the students’ progressive inquiry learning will be with the PILOT’s and how PILOT’s will be modified and reused by the teachers.

Firstly testing and analysis should simply answer if PILOT’s help students and teachers to start progressive inquiry learning. The possibilities are that students will find it easier to adapt progressive inquiry with PILOT’s or that the use of PILOT’s will actually lead to a process that is not more progressive inquiry but anything else.

Secondly the research will focus on a general framework of editing and reusing learning objects by teachers. It will be studied how teachers use, edit and improve PILOT’s and how they share their improvements of the PILOT’s among other teachers.

Structured and unstructured questionnaires and the audio recorded group interviews will be used with the purpose to collect students’ and teachers’ opinions and point of views about the PILOT’s and their use. Also observation of lessons and video recordings of classroom activities will be used as additional data collection methods. Collected data will be analysed with statistical methods using data coding and systematizing.

Conclusions

PILOT is currently a work-in-progress. The first prototypes of rich media content PILOT’s have been developed to be used for presenting and discussing the concept with users and other stakeholders. The PILOT’s have been tested internally in the design team and discussed in several seminars, workshops and in informal setting with teachers and other educational and pedagogical experts. The design research that is one form of action research that takes place in iterations. At the moment we have completed the first iteration.
The development process has shown that participatory design and scenario-based design methods, which include experts from different fields is suitable for developing this kind of learning objects. The design research still requires evaluation and iteration of the first prototypes.

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Learning objects, social constructivism, participatory design, learning design, design research
Abstract
Nowadays students have to study materials, which are too theoretical and are not connected with real life problems; thus students study out of context. Besides, the curriculum in Estonia consists of cross-curricula topics. On the one hand complicated or even missing learning materials and on the other hand lack of time due to the missing lessons do not enable to provide enough knowledge and skills to the students to cope with life outside the school.

One of the possibilities is to use modern technology as learning tools being also an important part of every day life and at the same time with new technology, cases and problems taken from today’s society to find out learning objects’ usability and practicality as learning materials. The results of the evaluation showed positive feedback towards learning objects as being suitable, acceptable and easy to use from technological and pedagogical point of view.

This article consists of 6 chapters. The first chapter introduces the problem statement, aims of the research and research questions. The second one, a short background of the theoretical part introduces learning objects and problem-based learning. The third chapter describes methodology of the study and designed learning objects’ prototypes and the fourth research findings. The article ends with strengths and weaknesses of the study and conclusions.

Terje Väljataga, Tampere University of Technology
Introduction

Due to the changes in society and ever more developing technology, innovations are needed also in the field of education in Estonia to provide students new knowledge and skills, which are the prerequisites to be successful and to cope with every day life. Information and communication technology (ICT) is one of the rapidly developing branches, which embraces all the subject fields in society. Therefore ICT should be used also in many ways in education to apply new teaching approaches and to achieve required knowledge to handle the real life problems.

There are two main aspects this study tried to analyse and solve. First, the national curriculum of Estonia consists of cross-curricula topics for instance “Environment and sustainable development” and “Information technology”. Due to this, special books, compact materials, textbooks, etc. are missing and therefore learning materials related to these topics need more attention.

Second, nowadays students have to study materials, which do not have a connection with real life problems and therefore the learning process is meaningless, but in environmental education it is significant to transfer acquired knowledge in day-to-day environmental problem solving.

On the one hand cross-curricula topics with missing learning materials and learning design problems in today’s classroom and on the other hand learning objects as ICT innovation in terms of computer-based learning materials in education will get some attention in the following chapters and research findings will be provided.

The main question of this research was to find out the suitability of problem-based learning objects for environmental education considering creation possibilities provided by ICT. Based on the main question the following sub questions were formulated:

1. Are problem-based learning objects practical and usable for environmental education?
2. Does the new type of learning objects as problem-based satisfy the needs of teachers from the pedagogical and technical point of view?
3. Do the learning objects fill in the gap in terms of the learning materials in environmental education?

Theoretical aspects

What are the learning objects?

Nowadays, in the field of E-learning, learning objects are commonly used terms and there seems to be as many definitions as there are people to ask (Mortimer, 2002). Based on the Learning Technology standards the learning objects are regarded as any entity, digital or non-digital, which can be used, re-used and referenced during technology-supported learning (IEEE, 2001). In generally, various learning objects’ definitions introduce the same criteria and requirements for learning objects. Taking into account the main features from the pedagogical and technical point of view one of the requirements is the possibility to use learning objects many times individually for multiple purposes without losing their educational context (“Reusable learning”, 2002). Reusability presumes interoperability which means the content from multiple sources must work with different learning objects (Lowerison et al., 2003). As learning objects are meant to be reusable they should be discoverable by tagged with appropriate descriptive metadata based on IEEE LOM standards (IEEE, 2004) and IMS Learning Design specifications (IMS Global, 2003) in order to be identified according to pedagogical and technical description (“Reusable learning”, 2002). In addition to technical aspects the objects must have some intrinsic instructional value to facilitate the learning process (Mills, 2001).

Learning how to solve problems

Real life offers every day new complex and integrated problems, such as environmental problems, which embrace aspects from different parts of society.
In a problem-based learning environment, students are encouraged to dive into the problem, construct an individual understanding, and finally find an answer to the problem (Dillon and Zhu, 1997). Problem solving tools may ask the student to think critically, make empirical observations, collect data, or make interpretations.

The problems are not meant to result in one, static solution, but rather solutions evolve as new information is gathered in an iterative process. Like the solutions that are found, there is more than one approach to solving the problem (Stepien, Gallagher, 1993).

**Problem types**

Problems vary in their nature, the way they have been presented, problems components and interactions among them (Jonassen, 1997). Well-structured problems predominate in schools, which possess correct and convergent answers with prescribed solution process. Problems related to the environment are good examples of ill-structured problems from every day practice. Ill-structured problems have opposing or contradictory evidence and opinions, for which there is not a single, correct solution that can be determined by employing a specific decision-making process (Kitchner, 1983).

Designed problem-based learning objects prototypes for evaluation consisted of the following ill-structured problems:

1. **decision-making** problems, which require selecting a single option from a set of alternatives based on a set of criteria (Jonassen, 2004);
2. **strategic performance** involves real-time, complex and integrated activity structures, where the performance uses a number of tactics to meet a more complex and ill-structured strategy (Jonassen, 2000);
3. **case analysis** goals are vaguely defined and little is known about how to solve the problem, because information available to the solver is prodigious but incomplete, inaccurate or ambiguous (Voss et al., 1991),
4. **dilemmas** as the most ill structured problems with no solution that is satisfying or acceptable to most people (Jonassen, 2000).

**Problem presentation**

As problems and problem solvers can be varied, technology and multimedia enable the students to present the problems in many different ways from simple text-based problems to very complex multimedia combinations. Presentation types may be divided into four parts according to multimedia possibilities:

1. Text-based problem presentation, where the problem is introduced to the students using text.
2. Graphics and pictures can complement text-based problems to increase the visual part of the problem, which allows students better acquisition of the problem’s idea.
3. Simulations and animations can present real situations from everyday life. Simulations about complex cases bring the real situation closer to the problem solver, help to understand the content of problem and increase the fidelity of problem presentation.
4. Problem-based stories as videos with existing cases from everyday life provoke the students’ interests and arouse their attention, which leads to find the solution to the problem.

Previous classification is not the ultimate, as different presentation types which can be mixed depends on the nature of problem. Choosing and combining multimedia presentation types, overload in terms of human senses may occur. For instance if all the information is presented text-based students will be visually overloaded as they are using just eyes to acquire information and auditory channel is unused (Mayer, 2001). In addition to visual sense better learning outcomes will be received by using both auditory and visual channels as they balance each other and enable to build mental connections between presentation types (Mayer, 2001).
Knowledge type sets

The nature and the complexity of problems require using different methodologies. Knowledge type sets provide the way to organise one's thinking to solve problems. The notion of the knowledge type set is coined by the designers of FLE3 (future learning environment), where the “Knowledge Building” tool is created enabling groups to carry out knowledge building discussions to debate on the given context and build their own theories according to the knowledge type set (Leinonene, Kligyte, 2002).

Edward de Bono’s Six Thinking Hats technique’s purpose is to direct thinking and help individuals deliberately adopt a variety of perspectives on a subject that may be very different from the one that they might most naturally assume (de Bono, 1985). There are six hats with six colours and each ‘hat’ presents a way of thinking. Thinkers can put metaphorical hats on or take off to play roles of different thinking.

One of the knowledge type sets is a pedagogical model of progressive inquiry learning developed in the department of psychology at the University of Helsinki in Finland. This learning model is based on the research findings of Bereiter and Scardamalia (Scardamalia, Bereiter 1991). An important aspect of progressive inquiry is to guide students in setting up their own research questions and working theories, where they can integrate new knowledge with the present ones. Students are making their conceptions public and working together for improving shared ideas and explanations. This is gradually moving the circle towards more complicated problems to find better explanations and solutions by going through the same steps (Hakkarainen et al., 1999).

People face every day complicated problems of many aspects and they have to find solutions to them. To understand the whole problem, including all the participants that are part of the problem or somehow related to this, the problem solver should put him/her to the different roles and see things from their point of view. Role-play deals with solving problems through action, where the participator plays a part in a situation. Role-play methods for problem solving has high requirements for players and needs many different skills, such as the ability to adapt to the situation and the role described in the problem, to make difference between important and less needed information for finding the best solution, etc.

Methodology of the study

To find answers to the problems and research questions, the methodology was divided into three main phases:

1. The analysis phase consisted of the literature review about learning objects and problem-based learning aspects, the analysis of the curriculum to find out cross curricula subjects and their drawbacks, and the analysis of learning materials for teaching cross curricula topics;

2. The design and creation phase, where five prototypes of learning objects were designed as web-based with the goal to cover the drawbacks found in the analysis. Every prototype describes one of the environmental problems taken from the real life in Estonia. Different senses of human beings were taken into account for choosing presentation types of the problems. As the environmental problems are varied in terms of their nature, complexity and solution options, three different knowledge type sets were provided to find the best solution to the problems.

A web page template was made considering the aspects to minimize cognitive overload and to keep the structure of objects dynamic (figure 1).
Design and Evaluation of Problem-based Learning Objects for Environmental Education

Figure 1: Learning object’s interface

In figure 1 different interface areas are marked with the black numbers: the title field (1) is positioned on the top of the screen by providing the name of the problem, the main area as the body (2) of the page by introducing the short description of the problem by illustrating it with pictures on the right side of the body page, the menu (3) as the navigation area on the left side of the page by providing links to the problem description, additional information and solutions hints. The style of interface remains the same throughout one learning object and all the learning objects are to enable on the one hand teachers to create a whole course using these learning objects and on the other hand to provide

Home page ——— Additional information ——— links to articles, videos, audio etc. ——— Solutions hints

Figure 2: Hierarchical structure of learning objects

3. The formative evaluation phase was carried out as a micro evaluation (evaluation outside classroom setting) using a walk through and expert appraisal instruments (table 1). During the walk through respondents checked the design of learning objects with some checklists on important characteristics of components of learning objects and their consistency. Expert appraisal was done by three educational experts, who reviewed the objects and answered the questionnaires to gather comments on the usability of prototypes and practicality of certain key components of the prototype.

Table 1: Instruments and aspects for evaluating learning objects’ prototypes

<table>
<thead>
<tr>
<th>Evaluation aspects</th>
<th>Micro evaluation</th>
<th>Expert appraisal</th>
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</thead>
<tbody>
<tr>
<td>Learning objects’ characteristics</td>
<td>Likert-scale questionnaire</td>
<td>Open-ended questionnaire</td>
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<tr>
<td>Problem description in learning objects</td>
<td></td>
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<tr>
<td>Practicality and usability aspects</td>
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<td>Advantage and disadvantage</td>
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<td>Improvement suggestions</td>
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Research findings

Analysis phase

During the literature review about learning objects some aspects struck the eye. The articles are mainly discussing the learning objects’ definitions and the authors are debating the features of the learning objects as well as the possibilities to store them to the repositories and metadata elements. Few materials are available about case studies, how teachers have used them in classrooms, how to create and design learning objects, how to integrate them to the curriculum and learning processes and how to use them in real learning situations.
Despite of the theoretical material about problem-based learning and its aspects, case studies with respect to how to apply problem-based learning to the real classroom situations are missing. As problems are varied and different approaches to solve them are needed, hints and suggestions how to explore problems from different sides are poorly presented.

From the point of research it can be concluded that special attention to the reusable learning material is needed, as most of them do not provide suitability in terms of interaction, learning approaches and learning content, which leads to find new tools and new ways to present the learning content to students.

Design phase

Formative evaluation of the learning objects’ prototypes enabled experts to ask for opinions with respect to the design and the creation process. Naturally, people are different and the way they understand the design aspects can vary in a wide range, especially opinions related to the interface colours. Most of the evaluators emphasised the well-structured screen with the simple and attractive design, which makes the object easy to use. It can be concluded that designing process of computer-based learning material and evaluation of this design are subjective and depends on the person’s preferences of overall design.

Evaluation phase

Formative evaluation was divided into two parts: A walk-through for evaluating the characteristics of the learning objects and problem descriptions, and the experts’ appraisal about the aspects of practicality/availability, advantages and disadvantages with improvement suggestions in terms of pedagogy and technology.

The content of the learning objects was highly evaluated as it embraces every day’s real environmental problems, which enable to create authentic learning environments providing constructive ways of learning. Also a student-centred approach with real problems and logics, a well-structured interface design motivates learners and makes the learning effective. Some of the experts found additional materials missing in order to understand the problem completely presented in learning objects (table 2, 3). Considering pedagogical aspects it was the purpose to provide either all the necessary information in some learning objects for solving the problem or just some information as hints to give the direction to the students to move on and find their way towards the right solutions.

With respect to practicality evaluators pointed out those problem-based learning objects can be applied to the environmental education to fill in the gap as missing learning materials. In addition, at the same time learning objects can be used to develop students’ knowledge and skills in terms of computer literacy and enable them to achieve the desired goals in curriculum with respect to information technology. In conclusion, the experts’ evaluation showed that learning objects are easy to learn and easy to use from both the pedagogical and the technical point of view as they do not require specified information technology skills from students and teachers.

Table 2: Summarised results of the walk through: learning objects’ characteristics in five learning objects

<table>
<thead>
<tr>
<th>Learning objects’ characteristics</th>
<th>Learning objects…</th>
<th>Learning objects…</th>
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</thead>
<tbody>
<tr>
<td>... is granular (freestanding, enable to take into parts)</td>
<td>9 1 2</td>
<td>1 is not granular (freestanding, does not enable to take into parts)</td>
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<tr>
<td>... is interoperable (among applications and environments)</td>
<td>8 1 5</td>
<td>... is not interoperable (among applications and environments)</td>
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<tr>
<td>... is usable in different contexts and purposes</td>
<td>6 2 2</td>
<td>... is not usable in different contexts and purposes</td>
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<td>... is reusable</td>
<td>14 1</td>
<td>... is not reusable</td>
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<tr>
<td>... provides interactivity</td>
<td>9 1 4 1</td>
<td>... does not provide interactivity</td>
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<tr>
<td>... is with clear goals</td>
<td>14 1</td>
<td>... is not with clear goals</td>
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<tr>
<td>... is understandable content</td>
<td>14 1</td>
<td>... is not understandable content</td>
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<tr>
<td>... has instructional value</td>
<td>14 1</td>
<td>... has not instructional value</td>
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<tr>
<td>... is easy to use</td>
<td>14 1</td>
<td>... is not easy to use</td>
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</table>
Table 3: Summarised results of the walk through: general aspects and problems in five learning objects

<table>
<thead>
<tr>
<th>General aspects and problems in learning objects</th>
<th>Structure of the learning object is logical</th>
<th>Structure of the learning object is not logical</th>
<th>Learning object is not constant</th>
<th>Learning object is not overloaded with information</th>
<th>Problem is relevant in learning object</th>
<th>Problem is not relevant in learning object</th>
<th>Problem presentation type is suitable to the problem</th>
<th>Problem presentation type is not suitable to the problem</th>
<th>Knowledge type set is in accordance with the nature of problem</th>
<th>Knowledge type set is not in accordance with the nature of problem</th>
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<tr>
<td>Based on the results of the prototypes’ evaluation some general recommendations were provided:</td>
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<tr>
<td>1. Add additional material as examples from the other countries</td>
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<td>2. Add more video interviews with content experts</td>
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<td>3. Provide many knowledge type sets with the opportunity to choose</td>
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<td>4. Provide video with different formats</td>
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<td>5. Provide more interactive activities for students</td>
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Strengths and weaknesses of the study

Every study has weaknesses and strengths, which come to the fore during the research process. Looking back to the study and the way it has been done some weak and strong points can be brought out.

During the study some weak sides occurred mainly in terms of reliability. Problems related to the curriculum and learning materials were based on the author’s experiences and some of the colleagues’ opinions. To get a more reliable overview about this problem’s statement some questionnaires for the teachers should have been done to get their opinions about learning materials for environmental education and their attitude towards ICT use in classroom. According to the learning objects’ suitability with respect to the teachers’ knowledge and the skills about ICT is questionable.

Secondly, learning objects suitability for the real learning situation is questionable and problematical, because educational experts used in this research cannot be accounted as real content experts. Also evaluation of learning objects in real learning situations with students as users should have been done besides of the micro evaluation.

The third weakness of this study is also related to the formative evaluation as it expects repeated evaluations and improvements to get better results and to eliminate all the drawbacks related to the learning objects’ design aspects.

Aforementioned the weak sides of the study and the reasons why all these steps were not carried through are mainly due to the lack of time.

Some of the strong points of the study are stressed below. This study paid attention to several, basically different, problems at the same time. According to the curriculum drawbacks occurred in terms of cross-curricula topics, because of the lack of time and the missing learning materials, which can be solved by shareable learning objects with authentic problems from real life. Secondly students study out of context, because of the out of date pedagogical approaches, such as teacher-centred learning, therefore problem-based learning objects can be a solution to provide students-centred and more constructive learning approaches. In addition, to provide learning materials for environmental education using learning objects as computer-based materials, the goals of the cross-curricula topic such as information technology will be partly accomplished.

Besides of that this study introduced new learning objects’ types as being problem based and due to that it stressed the weaknesses of already created learning objects’ metadata, which needs improvements not only to add missing data, but to revise and complement existing metadata elements and sub elements.
Finally this study provided the opportunity to improve the author’s ICT skills and the use of multimedia for creating learning materials.

Conclusions
The main idea of this study was to explore problem-based learning objects as a new tool for environmental education in Estonia. Based on the results of the study learning objects can satisfy current and future learning needs. Problem-based learning objects can provide an efficient way of facilitating the instruction and interactive learning for students. Some of the suggestions for the future research, which came out from the study will be the following:
1. More attention should be paid to the learning solving problems. Problem-based learning with authentic problems from real life can provide constructive way of learning;
2. It became evident that learning objects’ metadata does not offer elements for all kind of learning approaches and therefore a need for reorganising and complementing metadata is needed;
3. The study showed that the national curriculum in Estonia has some drawbacks, for instance the cross-curricula topics are too teacher-centred, which presume the curriculum adjustment to the requirements that come from information society;
4. Evaluation results reflected learning objects’ suitability for environmental education, thus innovations should be done in ICT infrastructure within the Estonian educational system to prepare acceptable and suitable environments for creating and using new learning tools.

Future studies in this field would help to analyse the educational situation in Estonia with respect to ICT in education, ICT possibilities in schools for facilitating and improving education. Accessing and applying learning objects into the curriculum could impact teachers to integrate other technologies into their classroom practice and achieve better learning outcomes from students.

References


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**Key words:**

learning objects, progressive inquiry, six hats, role-play, knowledge type sets, problem-based learning
Creating eContents in Teacher Education

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Abstract

The paper deals with the transformation process of traditional lecture notes into web-based learning modules with multimedia elements (eContents) for use within Teacher Education. The influence of the transformation process is considered by three main questions: Which traditional learning material is selected for the transformation process and why? Does the knowledge of teachers change when they do some transformation work from traditional lecture notes into eContents? In which way does the development of eContents influence the didactic patterns of the teachers? Some experiences are described of a work done in co-operation of two teachers at the State College of Teacher Education in Linz, Austria, together with their students. The outcome of the co-operation is the web-based learning module "Active Learning".

Zusammenfassung


Background to the development of creating eContents

As new technologies such as radio and television have emerged, teachers have used them to extend the range of what they could teach and illustrate ideas in different ways, bring new material to students, and motivate learning. The process of adopting new technologies has not been quick or effortless, however. Today, teachers are being asked not simply utilize new equipment, but to fundamentally transform their institutional practices. At the State College of Teacher Education in Linz two teachers encouraged their students to transform existing traditional learning material to digital web-based learning material with multimedia and interactive elements. The traditional learning material is chosen from the course “Active Learning”, a course at the State College of Teacher Education with 2 ECTS points. Within this class the students are expected to learn actively about constructivism and cognition. The lecturer provides the learning material as papers. Within a seminar group the lecturer tries to offer the contents as lifelike as possible. The aim of the lecture is to make own experiences with learning principles and to enable students to observe, analyze and reflect learning situations at school practice. “Applied Information Technology” aims to acquire multimedia competencies with respect to old as well as new media. The students are expected to handle the basic functions of standard software for HTML-authoring, image processing, audio and video cutting. These two classes co-operated in order to transform the lecture notes “Active Learning” into eContents. The present outcome can be seen on the Web [1].
Design of the study

When existing traditional learning material of the course “Active Learning” is transformed to digital web-based learning material with multimedia and interactive elements, the knowledge transformation process should be explored. The aim of this study is a better understanding of the transformation process. How does knowledge change in the context of multimedia and what are the didactic patterns in the background?

The project needed 4 months work for two lecturers and 51 students (3 ECTS each) to learn and transform existing traditional learning material into web-based learning material with multimedia and interactive elements. The students between 18 and 25 years, worked in 12 groups of 3 to 4 individuals. The lecturer of the course “Active Learning” provided the traditional learning material as well as a good understanding for the course contents. The lecturer of the course “Applied Information Technology” conducted the project and provided the just-in-time instructions in order to obtain technological knowledge, when requested by the students. She performed all research activities. Both lecturers together with the students discussed various ways to enrich the traditional learning material with multimedia elements and interactivities in an elementary way. Students were expected to go to their practice schools, to apply learning principles described in the learning material and to document the observed learning principles with the help of multimedia technology. The project ended with four 90-minute sessions where students presented the newly created web-based learning material enriched with multimedia and interactive elements. In these sessions the students were asked to reflect on the development and implementation of the web-based learning material. 7 students dropped out, 44 students filled out an evaluation questionnaire at the end of the project. The questionnaire consisted of 11 items with open answers for a qualitative evaluation.

In order to aim a deeper understanding of the knowledge transformation process the lecturer of the course “Active Learning” was interviewed at the beginning and at the end of the transformation process. The knowledge transformation process of the lecturer is explored on the level of a qualitative single case study.

Selecting and representing learning material

How to identify and represent knowledge?

In order to understand the influence of information- and communication technologies (ICT) on knowledge creation it is necessary to consider the topic from the perspective of technology as well as to consider the human factor. Knowledge management is a new science created from practitioners of companies seeing knowledge as a big issue in organisations. At the beginning the concepts emphasized technologies a lot (Probst et al. 1997). This led to discontentment and the 2nd generation of knowledge management arose emphasizing the human factor more and more (Verna 2002). Knowledge management of the 2nd generation is seen as a social and cultural process, not reduced to economical or technical problems. Theories of generating knowledge for organisations were developed considering the disciplines of information sciences, economics, and social sciences (see Fig. 1).

Social sciences embed information tasks related to acting. Economics deal with information exchange between working places, departments and institutions, and information sciences deal with data processes regarding data representation.

The following describes the main disciplines and steps necessary when creating web-based material enriched with multimedia elements.

Figure 1: The constituent disciplines of Knowledge Management (Wehner 2002)
Nonana and Takeuchi (Nonana/Takeuchi 1997) distinguish explicit knowledge from implicit knowledge. Implicit knowledge also called tacit knowledge is hard to communicate whereas explicit knowledge can be communicated systematically with languages.

Knowledge creation takes place within the transformation process between implicit and explicit knowledge. The spiral of knowledge creation comes from four knowledge transformations between implicit and explicit knowledge (see Fig.2). Implicit knowledge is transferred tacitly within the socialization through common experiences. Within externalisation implicit knowledge becomes explicit knowledge. Comparing facts, rules or processes can lead to new perspectives and creates new knowledge. Externalisation arises from constructive dialogues or from collective reflections represented by metaphors or analogies. Explicit knowledge is the known kind of knowledge formulated and processed systematically. Through combination explicit knowledge generates new knowledge, through internalisation explicit knowledge is transformed to implicit knowledge. This last transformation is a big issue on learning processes and results in experiences.

Regarding the concepts of Knowledge-Management (Clases/Wehner 2002) the question of knowledge-identification is closely connected to the question of how to represent knowledge. What kind of knowledge can be identified and how is it represented? Important factors to answer the questions are assessment, usability, also copyright of knowledge.

Figure 2: Four kinds of knowledge transformation
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Figure 3: Knowledge transformation when working on traditional learning material to create eContents
In this article the concepts of knowledge management are not treated in the context of organizations but in the context of individual teachers within their classes at the State College of Teacher Education (see Fig.3). Four basic knowledge manipulation activities that appear to be common are acquiring, selecting, using, and internalizing knowledge (Holsapple et al 1998). Acquiring knowledge refers to the activity of identifying knowledge and transforming it into representation that can be internalized and used. Selecting knowledge refers to the activity of identifying needed knowledge and providing it in an appropriate representation to an activity that needs it. The main distinction to acquisition is that it manipulates resources already existing in the organization rather than those in the environment. The two activities require different skills, different levels of effort, and costs. Internalizing is an activity that alters an individual knowledge resource based on acquired, selected, or generated knowledge. Using knowledge is the activity of applying existing knowledge and producing an externalisation of knowledge (Holsapple 1999).

There is a need to take care about the teacher's competencies regarding the technological skills needed for the transformation process. Capturing knowledge involves the functionalities of gathering knowledge from the organization’s knowledge resources. Capturing knowledge from a colleague is implemented differently than capturing it from a computer system. Moreover, implementations differ from one colleague to another.

Identifying knowledge says a lot about knowledge assessment, and the intended use of the elearning module. Personal preferences regarding novelty, importance, usability, accessibility, personal interests are criteria for the selection process.
With respect to the function of knowledge four kinds of knowledge are distinguished (Kiel/Rost 2002):
- “know that”
- “know why”
- “know how”
- “know where”

Regarding the knowledge transformation process there are questions like
- What are the criteria for selecting learning material to transform it into eContents?
- What kinds of knowledge can be discovered in the learning material?
- What kinds of representations are used?

**Example “Active Learning”**

The learning material for the transformation into eContents was selected by the lecturer of the class “Active Learning” at the State College of Teacher Education in Linz, Austria. She answered in the interview at the end of the project: “I have chosen the contents of my class Active Learning because in this class there are many activities to do for the students. I think presenting activities is appropriate for multimedia editing. The experiences students make are exciting to present them in a multimedia way. All traditional lecture notes could be taken to transform them into multimedia learning material. I for myself prefer to choose contents where activities can be put into audio or video files, etc. Students should be able to make their own experiences and present them with the help of multimedia technologies. The chosen content is very important for me. I think it is very relevant for learning at school. Students have to make their own learning experiences to realize the importance of several principles and follow them when teaching pupils at school. Active Learning is at the interface between cerebral biology, cognitive psychology and cognitive learning theories. The work in my class represents the following process: Making one’s own experiences with several learning principles leads to own and theoretical explanations, which furthermore leads to scientific theories. Following the theories one has to think about suitable learning situations for pupils at schools.

The theoretically studied learning principles should be applied in real school practice. I try to start with students’ activities so that they can make their own experiences. I hope to produce a field of tension so that they want to study some theory to decrease the conflict area. It is characteristic for all my classes to start with students’ activities and to link them with their own and with scientific theories. The students are in the first study year. That means that their knowledge varies a lot. I give different assignments the students can do according to their interest with different prerequisites. From a pool of assignments they can choose a relevant one for them. I ask them to do some observations at school practice with respect to a learning theory they have studied. The students have to analyze the observations made in school practice under the aspects of the studied theory. They have to evaluate the studied theories regarding its usability in school practice. It would be useful if the students could document their observations in a multimedia way, show pictures, audio and videos of relevant learning situations, discuss them in a discussion forum, and extend the eContents with their findings. The analysis and documentation of learning situations in school practice on the Web would have an added value for other teachers.”

The selection process of learning material by the lecturer was influenced by the extent to which students are expected to be active. Activities are seen to be appropriate to represent them in a multimedia way. Additionally, the learning material is seen as very important by the lecturer. The function of the knowledge is predominantly a combination of “know why” and “know how”.

The possible kinds of representations of the selected traditional learning material were discussed by the two lecturers together with their students. The media used in the web-based learning material have a big impact on how the contents will be understood by the readers. The representation of the knowledge depends on the aimed learning goals. Several empirical research studies show, how people integrate visual and verbal presentations (Mayer R., 2001). Representing learning material in a multimedia way has to take into consideration seven principles of multimedia design:

1. **Multimedia Principle:** students learn better from words and pictures than from words alone.
2. Spatial Contiguity Principle: students learn better when corresponding words and pictures are presented near rather than far from each other on the screen.
3. Temporal Contiguity Principle: students learn better when corresponding words and pictures are presented simultaneously rather than successively.
4. Coherence Principle: students learn better when extraneous words, pictures and sounds are excluded rather than included.
5. Modality Principle: students learn better from animation and narration than from animation and on-screen text.
6. Redundancy Principle: students learn better from animation and narration than from animation, narration, and on-screen text.
7. Individual Differences Principle: design effects are stronger for low-knowledge learners than for high knowledge learners and for high-spatial learners rather than for low-spatial learners.

In the web-based learning module “Active Learning” the seven principles are taken into account [1]. Contents are visualised simultaneously by pictures next to the corresponding text. Videos are not presented besides texts. There is a certain tray which contains the videos (see Fig. 10). The video try can be opened to view the video. It can be closed to continue reading the texts. Animations are firstly shown next to the text as a static graphic. The animation can be started by mouse click (see Fig. 11).

The additional discussions the students had with their lecturers to represent the learning material in a multimedia way extended the explicit knowledge about the treated learning principles.

Drawing up the didactic design

Does multimedia generate a new didactic?

The transformation process from lecture notes into eContents requires a theory that can be combined with school practice. “Instructional design is the linking science – a body of knowledge that describes instructional actions to optimise desired instructional outcomes, such as achievement and affect” (Reigeluth C. M. 1983, p.5). The instruction should provide
- clear information of the goals, knowledge needed, and the performance expected,
- thoughtful practise: the opportunity for learners to engage actively and reflectively,
- informative feedback: helping learners to proceed more effectively,
- strong intrinsic or extrinsic motivation.

The 2nd generation of instruction-design models take care about the necessities of the society of knowledge. “It provides powerful tools for identifying and understanding the interrelationships that are likely to impact the practitioners’ ability to successfully implement new paradigm of instructional theory as well as theorists’ ability to successfully build comprehensive instructional theory.” (Reigeluth 1999).

Instructional-design theory requires at least two components: methods for facilitating human learning and development, which are also called methods of instruction, and indications as to when and when not to use those methods which is called situations (see Fig. 4).

The two major aspects of any instructional situation are the conditions under which the instruction will take place and the desired outcomes of the instruction.
- Instructional conditions include the nature of what is to be learned (see Bloom’s Taxonomy (Krathwohl 2002) e.g. rules are learned differently from the way skills are learned,), the nature of the learner (e.g. prior knowledge, learning strategies, motivations), the nature of the learning environment (e.g. independent, in team), and the nature of the instructional development constraints (e.g. time, money).
- The desired outcomes include the levels of effectiveness (extent to which the learning goals are achieved), efficiency (effectiveness divided by time and cost of the instruction), and appeal (extent to which the learners enjoy the instruction).
Increasing the probability that the desired results will occur. Aspects like type of learning, control of learning, focus on learning, grouping for learning, interactions for learning, and support for learning are considered (see Fig. 5).

Example “Active Learning”

We have to distinguish the didactic design of the classes and the didactic design of the created web-based learning material. The didactic design within the classes corresponded with the instructional-design model “Collaborative Problem Solving” (Nelson 1999). On the one hand the goals were content knowledge regarding learning principles as well as process knowledge to put the learning principles into school practice. On the other hand the goals were content knowledge as well as process knowledge regarding multimedia production e.g. image processing, creating audio and videos, creating web-pages. These two areas, learning theories and multimedia, were combined in that way, that content knowledge regarding learning principles was represented in a multimedia way. Some representation elements were gained from school practice applying content knowledge with respect to learning theories. For this, content knowledge regarding multimedia was gained and applied. Within this framework, students worked in learning groups with 3 to 4 students, used learning resources together and conducted hands-on experiments at practice school, where they worked with pupils of the age of 11 to 14 years to solve the challenge. Through these problem solving activities, students developed understandings, skills, and to some extent information in the domains of learning theories, multimedia and project management.

Although the lecturers chose the educational objectives and selected the contents, the students should have taken more responsibility for their learning outcomes, because they chose the road needed to achieve those outcomes for themselves. The students learned collaboratively and determined in their teams, how they used the acquired knowledge and resources. The extent to which the students felt responsible for their learning outcome corresponded with the extent to which they felt successful. Students, who did not feel successful, claimed about lack of support and co-ordination from the lecturers at the end of the project. Unfortunately, they did not speak about the occurring difficulties during the project. They did
not interact to get help from the lecturers during the project but they claimed at the end of the project. About two thirds of the teams said, that they succeeded in the project work and that they felt responsible for their learning outcomes.

Figure 6. Starting page with title graphic and 3 various navigation possibilities.

Figure 7. Tray with hints to solve the problem

Figure 8. Tray with personal notes

Figure 9. Tray with literature

Figure 10. Tray with video

Figure 11 Animation graph
The didactic design within the web-based course expects from the learners to learn by doing as active participants in their own learning process. Without being involved in a seminar group “Active Learning”, it is possible to gain some understanding for the content, but it is nearly impossible to gain the corresponding skills-based knowledge and to foster the development of critical thinking and problem-solving skills, even the learners learn very self-regulated. For this, the learners must be able to organize the hands-on activities and discussions autonomously for themselves. The social context for the expected learning activities is essential. Some aspects of the design of the web-based learning material are shown in Fig.6-12 [1]. The contents can be selected totally learner-centered from the content tree as well as from the title graphic. On the starting page (see Fig.6) all presented learning principles are linked with respect to different learning strategies of the learner. Each chapter represents a learning principle and can be navigated with the help of the navigation tree at the left hand side of each page. Additionally, the chapters can be navigated from the title graphic which is presented with one click from every position in the web-based learning material by clicking the overview button. From the title graphic, the learner can start with tasks to make own experiences, or with reading articles, or with hands-on considerations in the context of school practice. The content can also be read page after page by forward and backward buttons on the top of the right hand side. In this case, according the topic “Active learning” every chapter starts with activities for the learner (see Fig.7-10, Fig. 12). Learning is organized around goal based scenarios having content and process goals. While this strategy is flexible, it is in the cognitive domain of learning with hands-on activities. The eContents contain tasks to do individually (see Fig.8) but learning in teams is essential for analyzing and reflecting learning situations. A discussion forum is provided in order to support relationships among learners. Learning is supported in various ways, e.g. cognitive support from resources as downloads from the literature tray; hints for problem solving from the hints’ tray (see Fig.7); cognitive and emotional support by human interactions in a virtual discussion forum (see Fig.13) or in face-to-face seminar groups (see Fig.10).

**Implementing the module “Active Learning”**

**Selecting the Tools**

For creating or editing multimedia elements like photos, graphics, animations, audio, video, commercial software was used. The students claimed about the lack of software licenses at home. They would have enjoyed to do some work at home, but this was not possible. In future, free software will be taken for cutting audio and video sequences, editing photos, graphics, and animations. This is also an advantage for the schools at primary or secondary lower level, where the skilled students go after they have finished their study at the State College of Teacher Education. Many primary and secondary level schools cannot afford the money for expensive commercial software licenses. They need skilled teachers being able to search, select and work with free software.

Because the Austrian Federal Ministry of Education and Science signed a general license agreement with a company offering the HTML editor Content Creator [2], it was reasonable to collect experiences with this software package. Providing a template contents can be produced in reasonable time with a consistent interface structure. Certain interactions like quizzes or info maps are supported. The contents can be exported from the Content Creator program and then imported as learning modules into a learning management system. eSITOS is the accompanying learning management system and was produced for schools from the same
company as the authoring tool Content Creator. Students are allowed to install Content Creator at home and produce templates for learning modules. In order to finalize the learning module it must be exported. For this, a license key and an online connection to the company's server are necessary. Both, the content tool as well as the learning management system are provided for schools by the Austrian Federal Ministry of Education and Science.

Nevertheless, because students did not find the authoring tool Content Creator comfortable enough, there is a need to continue looking for appropriate authoring tools and multimedia software that can be used for reasonable low money and time. Because media production is very affording and time consuming, it is reasonable to organize the created media in a reusable way e.g., in a media pool with a database system.

**Working Together**

Creating eContents requires students to work together collaboratively. Group tasks were assigned with respect to different parts of the content. Since students should gain comprehensive multimedia competencies, each group was expected to do some HTML editing, create and edit photos, audio, and video. The students were provided with the navigation structure of the web-pages and all texts. The students' duty was to consider and produce appropriate media to visualize the contents in a correct and motivating way. They had to take care about the copyright. Each student team determined a project leader with the duty to organize the collaboration within the group. The responsibilities in the group were distributed.

**Assessment**

Each member of a group was given two grades: one for the team's work and one for individual work. Each student was expected to write an individual learning diary. Each team's work was presented at the end of the project and evaluated by the whole seminar group.

**Evaluation**

Because of the product-oriented working process within the two classes “Active Learning” and “Applied Information Technologies” students had to work very intensively on the topic “Active learning.”

The interdisciplinary working process between the two classes was very challenging for the students. They had to manage subject-oriented tasks in the domains of learning theories and information technologies as well as organizational tasks and hands-on co-operate successfully.

Although most of the students claimed that the task was too time consuming they agreed that the task was very challenging, interesting, and meaningful to them. The content knowledge that was learned was closely related to how students will use it in their professional life. The transformation process had a significant effect on the students' learning with respect to their teaching practice as well as regarding their ICT skills. The discussions about the various kinds of representations of the traditional learning material caused a deeper understanding of the learning principles with regard to the school practice, because most of the students' teams tried to record one learning principle with a video camera in their school practice. The students gained a deeper understanding of the learning principle they transformed into eContents than of the other learning principles. Because the students had to create a multimedia product based on theory as well as on school practice they had to plan in detail how to put the learning principle into school practice and how to document it in a multimedia way.

**Conclusion**

Transforming lecture notes into web-based learning material, which is enriched with multimedia elements, is a big challenge. When eContents are created, several factors must be taken into consideration. Firstly, the selection of the material is essential. The selection process has to take into consideration the target group and the learning objectives which should be aimed with the web-based learning material. Not every learning objective can be reached from web-based learning material. Only the lower categories in the cognitive domain like knowledge and comprehension and perhaps some applications can be learned autonomously from web-based learning material. The higher categories like analysis, synthesis, and evaluation cannot be acquired from web-based learning material autonomously. The higher categories of learning objectives need a lot of activities within
learning teams. However, the intended usage of the web-based material must have an influence on the selection process. The didactic patterns did not change essentially with the transformation process. The didactic patterns were taken from the traditional classes, but the product-oriented demands encouraged an open exchange of ideas. The product-oriented demands to create web-based learning material lead to deeper discussions about hands-on activities. The documentation of hands-on activities at school practice were seen as appropriate possibility to produce motivating, illustrative learning objects. A deeper interaction between learning theories and school practice can be seen as a good result of the transformation process.

The transformation process can only be done interdisciplinary. In this project, the topic “Active Learning” was treated from different perspectives e.g. from the theoretical point of view, hands-on at school practice, skills-based for multimedia representation. This caused a deeper understanding of the contents and lead to some skills in the corresponding areas. Creating eContents for Teacher Education bring a deeper insight and understanding in the structure of disciplines and the connections between different disciplines for teachers. Although several organisational or technological problems will occur and frustrate sometimes the teachers as well as the students, it means a chance to obtain personal, organisational and professional, interdisciplinary work among teachers and classes. Nevertheless, at school there is a need to purposefully use appropriate social skills and co-operate with parents and also with organisations outside the school in order to provide as much as real life learning situations for the pupils.

A reflective autonomous teacher education institution has to take care about contemporary organisational developments and has to understand the structure and dynamics of its own knowledge. Transforming traditional learning material into web-based learning material is a chance to obtain a deeper understanding of the structure and dynamics of the own knowledge. Additionally, the created web-based learning material can be the fundament of a teacher education organized as e-learning – organized at a distance - in the future.

References

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Links

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