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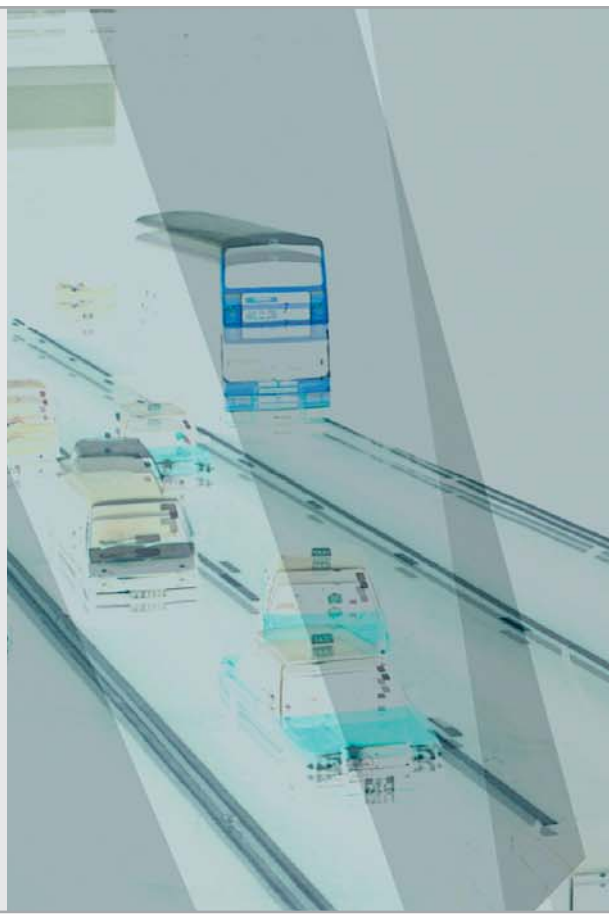
Modern Approaches to Digital Learning – DLL project's results

Byoma Tamrakar (ed.)

This publication is a collection of articles based on the research results of the Digital Learning Lab (DLL) project. The DLL research project is a joint project of HAMK University of Applied Sciences and University of Tampere. DLL commenced in 2004 and will be completed in 2007.

DLL is divided into nine research areas (work packages) and large varieties of eLearning topics are covered within these areas. The chapters of this publication which align with each of the DLL research area, touches upon the main issues on the modern eLearning research and practice, such as;

Strategies, management and organizational factors in educational organizations, Development and Safeguarding of Competencies of teachers, The Elements of Best Practices and Processes of Effective eLearning Environments, Virtual Computer lab-Instructor's perspectives, Learning Objects and the Web-based Learning Process, Mobile Tutoring and Learning Processes, Multicultural Competencies in eLearning, Impacts of Learning Technology and Future Views for eLearning, Important Factors in Methodological Choices in Educational Technology Research and Development, eLearning Research and Development and Organisational Collaboration.



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Contents

Introduction

This publication is a collection of articles on the key findings of the Digital Learning Lab (DLL) research project. DLL is an extensive and versatile e-learning venture (2004–2007), comprising of nine sub-projects: eLeadership and strategy work, eTeaching competences and their development, audio and video technology as well as collaborative web based tools, e-learning models and tutoring practices, learning objects and mobile learning, media literacy, impact of applications in education technology on learning processes, multi-disciplinary research methods of education technology, and productisation and project cooperation with organizations. The research project was undertaken jointly by HAMK University of Applied Sciences and University of Tampere. The working methods for the project included cooperation amongst networks.

The aim of the DLL project was to research e-learning both in technical and pedagogical context as well as in the context of media skills. The main goal of this research project was to produce theoretical information and especially to develop e-learning innovations which become landmarks of improved teaching and learning.

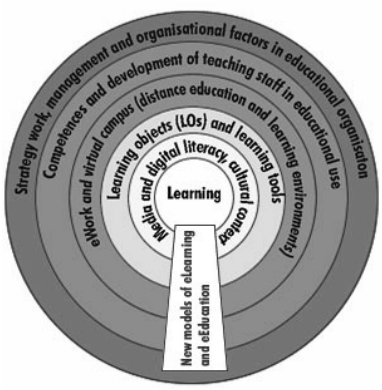

Figure 1. The research fields of DLL research projects are combined in e-learning.

As previously discussed, the DLL research project is divided into nine research areas and a wide variety of e-learning topics. The chapters of this publication which align with each of the DLL research areas. The core idea in all nine research areas was how to improve learning by using e-learning.

As one of the main outcomes of this research project, a model of e-learning within areas of research and development activities will be put into place in the future and this model will become a established procedure in HAMK of Applied Sciences and in the Faculty of Education in Tampere University (e.g. the research concept of educational technology for ad hoc needs and the concept for instructive research, the model of multicultural communication).

In addition, this research project has lead to publication of several scholarly theses as well as numerous postgraduate degrees in collaboration with the participating research institutions. Furthermore, it has also promoted cooperation with enterprises and communities, and contributed to the promotion of a new digital working and learning culture in the region.

The best outcome of the project is the cooperation and network that has been created amongst various teachers, researches, students, companies and vendors. Together we have learnt and improved learning with digital tools – media literacy is important competency for everyone.

Byoma Tamrakar

Leena Vainio

Virtual education is increasing and developing

Abstract

Mobile students need alternative learning methods, while fierce competition on the educational market leads to the need for development of new forms of operation. The young generation is accustomed to making use of opportunities provided by information and communication technologies and many have obtained experiences of various forms of virtual work ever since comprehensive school. Adult learners have also learnt to study online in their own workplaces. The teachers play a key role in practical implementation of reforms and the development of virtual education need motivated teachers and also support stuff who together develop new learning environment, learning methods and learning culture. The leaders have important role in the change process. This article examines which factors influence development of virtual education in Finnish Universities of Applied Sciences and how the change is being managed.

Introduction

Virtual education has been developed at all Finnish universities of applied sciences (professional higher education institutions also known as polytechnics) over the last ten years, while teaching and learning practices have also been changing. Expansion of virtual education has been driven by the desire to create a new type of learning culture, students' growing demands, internationalisation and hopes of reducing costs. Tony Bates (2000, 16) has listed the six most frequent reasons given for using technology in higher education as the following: 1) to improve the quality of learning; 2) to provide students with the everyday information technology skills they will need in their work and life; 3) to widen access to education and training; 4) to respond to the 'technological imperative'; 5) to reduce the costs of education; and 6) to improve the cost-effectiveness of education.

The Finnish Ministry of Education (Opetusministeriö 1995, 1999, 2004a) has published two national information strategies and complemented these with an information society programme with an objective to promoting the introduction of information and communications technologies (ICT) in the field of education, trai-

ning and research. The information society's strategies have emphasised the use of ICT in teaching and development of virtual education and content production. Extra pressures has also been imposed on universities of applied sciences within the Development Plan for Education and Research 2003–2008 (Opetusministeriö [Ministry of Education] 2004b), which set the aim that all degree programmes should enable students to obtain at least 20 credits as virtual studies. The basis for this has been to improve the quality of education and to provide different learners with flexible study opportunities.

The aim expressed by the Virtual Polytechnic Working Group for 2002 was for each polytechnic student to complete one course at the Finnish Virtual Polytechnic. The aim set for 2005 concerned entire degree programmes implemented completely in a virtual format (Lahtinen & Rautajoki 2002). A special focus has been on flexible provision of virtual education for students.

Virtual studies have increased and, in principle, students are able to collect up to 30 credits of studies from courses provided by their own or other universities of applied sciences. While the amount of virtual studies has multiplied over the last five years, the target of 30 credits per individual student cannot yet be achieved. The total amounts of virtual studies completed in 2000 and 2006 were about 30,000 and 200,000 credits respectively (Opetusministeriö [Ministry of Education] 2007).

Some universities of applied sciences are already offering adult learners entire degree programmes as virtual studies (see Kemi-Tornio University of Applied Sciences and HAMK University of Applied Sciences). Although there is supply, however, the current provision does not match the needs of most students: provision of online studies varies considerably between different degree programmes and the number of courses offered during the summer months is relatively small at this point in time. A majority of the courses being provided focus on optional studies, while very few professional courses are available. In a way, the shortage of professional learning content diminishes the value of virtual studies and students mostly enrol in them in order to take optional courses yet to be completed (survey for polytechnic students 2006, unpublished).

Nevertheless, the number of completed credits is not the main point of virtual education. When virtual studies are only examined in terms of the amount of completed credits and virtual provision, the whole concept remains narrow, when the issue really boils down to enabling and developing teaching or learning by integrating new and traditional forms of instruction and opportunities provided by information and communications technologies (Levonen et al. 2006). Functional, high-quality and flexible learning environments may ideally inspire learners to open up and visualise complex thought processes and engage in reflection and critical discussion, which may have a decisive impact on reform of teaching practices (Järvelä et al. 2006).

The Polytechnics Act (351/2003) outlines the mission of polytechnics (universities of applied sciences) as being to provide professional higher education and to carry out applied research and development work that not only serves education but also supports regional development and the world of work. *'Polytechnics have become an essential player in the regional innovation system.* [...] *A special responsibility for polytechnics in regional development is to support small and medium-sized enterprises and to develop welfare services.'* (Opetusministeriö [Ministry of Edu-

cation] 2004b, 45.) Virtual work and study is already commonplace in many workplaces. Universities of applied sciences should also prepare students for methods used in their future working life. A challenge for the future is for education to pay more attention to the distributed and mobile nature of knowledge-intensive work (Vartiainen et al. 2007). According to Vartiainen et al. (2004), 50% of work can be characterised as being knowledge-intensive. The job content of knowledge workers is demanding both cognitively and socially. Multi-locational employees collaborate with each other from afar. The distributed, multi-locational, mobile and asynchronous nature of work, combined with the diversity of the parties involved, seem to make it more demanding and difficult.

Universities of applied sciences themselves are organisations that should make active use of virtual working methods. After all, their units are based at several different locations and work is distributed. There are effective working groups and networks operating within and between universities of applied sciences, where collaboration and interaction is increasingly organised using information and communications technologies. Technology is not just about opportunities to learn at a distance, but also opportunities to learn in a way not available to previous generations (Bach et al. 2007). Kullaslahti et al. (2007) developed virtual education on different degree programmes at four universities of applied sciences, discovering during the course of the project that development of both virtual teaching and virtual work calls for commitment from all network members – and, in particular, for management.

Competence management as the platform for developing virtual education

The challenge for educators and technology developers is to apply new pedagogical trends and technologies so as to ensure that learning is at the same time highly situated, personal, collaborative and long term; in other words, truly learner-centred learning (Naismith et al. 2004). Mustonen (2003) argues that, in order for a school to develop, the interface between administration and teaching needs to expand and open up, which will make it possible to deal openly with issues relating to teaching and community management. Scardamalia and Bereiter (1999) suggest that such development is already discernible and that more radical changes will be needed in order for schools to become learning organisations. They see the role of students as being the most important factor for change; students must be seen as being members of the organisation rather than just clients, which means changing the function of the school from one of a service provider to one of a productive organisation. What Scardamalia and Bereiter mean by this is that, instead of passively absorbing the knowledge being taught, students assume an active role in knowledge production as part of the organisation. They suggest that it should be possible to compare student work to the work of a professional research team, which aims to produce knowledge. This does not necessarily need to mean production of completely new knowledge, because examination and reappraisal of various existing solutions are also a very important part of work conducted in scientific communities. Knowledge needs to be seen as being something that can be adapted and reused, rather than as an abstract truth residing in the teacher's mind. Scardamalia and Bereiter's thoughts effectively support the R&D activities carried out in connection with the educational mission of universities of applied sciences. Virtual working methods and virtual courses enable co-operation between workplaces, students and teachers and applied research conducted in collaboration with teachers.

According to Scardamalia and Bereiter (1999), student knowledge building forms an integral part of development. In the pedagogical sense, knowledge building refers to practices through which students take an active part in instruction, even by contributing to the production of it. Typical pedagogical practices related to construction of knowledge include problem-based learning (cf. topic-based learning) and dealing with various theories (cf. finding answers). The model highlights the significance of effective communication, collective learning and students' own thought processes. In the context of universities of applied sciences, this working model should form a part of the professional growth process.

Teachers play a key role in practical implementation of reforms. Development of personal practices and new educational innovations emerge through many changes (Cheung 1999). Based on a model developed by Rogers (1995), innovation adoption requires knowledge, persuasion, decision, implementation and confirmation. Implementation has turned out to be a complex stage, revealing the experimental, adjustment, mastery and personalisation phases through which innovation is adopted. However, innovation will not be accomplished if people are not prepared to support the process of adopting change through sufficient measures at the organisational level. When an organisation intentionally launches a change, it should be examined from the perspective of learning. A change is easy to plan in technical terms, but when the change targets people, devising diagrams or a strategic script is not enough (Viitala 2006). A change affecting an organisation is often a process involving implications that will reflect on the organisation's internal thought approaches, operational models and systems, functions and people's job descriptions and also the division of work between different organisations. The aspects that successful reforms have in common include a shared vision, clear goals, participants' commitment to reform, the working community's collegial culture and learning the skills required to adopt the reform.

In the early stages, the use of information and communications technologies rested on individual teachers for quite some time and teachers often brought up the fact that they did not receive enough support in their own development efforts. Bates (2000) points out that the key to success in higher education institutions, that have used ICT effectively and changed their operational culture, has been strong leadership. The National Strategy for Education, Training and Research in the Information Society also acknowledged the significance of leadership, which is why one of its aims was for all educational establishments to draft a strategy for using information and communications technologies in education by the end of 2002 (Opetusministeriö [Ministry of Education] 1999).

New forms of information and communications technologies enable reorganisation of operating environments. Carrying through a change calls for a strategic approach. Strategy makes it possible to allocate resources as efficiently as possible to identification and achievement of opportunities. Different universities of applied sciences have employed a variety of approaches to devising strategies. The management's commitment has varied and the task has often been assigned to a team responsible for developing online teaching.

Laakkonen (1999) divides strategy processes into three groups: power-coercive, normative-re-educative and empirical-rational strategies. Coercive strategies are centrally managed and averse to innovation and community participation. Knight

and Trowler (2001) describe management of change processes through five different approaches, which can easily be compared with the strategy processes depicted by Laakkonen. Their equivalent to centrally managed strategies is a bureaucratic process, where objectives are sent down from up high and the 'grass-roots' level simply has to put the change into action by following instructions. Brown and Duguid (1996) compare such a strategy to a 'route map' developed from the perspective of senior management without any awareness of local 'road conditions'. However, local 'road users' need to take road conditions into account and apply the strategy to everyday situations. They either solve such conflict situations by applying their own strategy to situations or, in the worst case scenario, by spending their time resisting change by all means possible. (Knight and Trowler 2001.)

Normative-re-educative strategies are based on centralised control. Knight and Trowler (2001) frame this in terms of the technical-rational approach. Leaders create a vision for the future; go through the objectives and procedures together with staff, thus committing staff to strategic decisions. Leaders are also personally involved in putting the vision into action. The material for empirical-rational strategies, in turn, is acquired through practice and strategies are devised on the basis of feedback collected. Knight and Trowler (2001) describe equivalent strategy models in terms of collegial or social practices. In the collegial approach, all parties' views are taken into account and change is constructed in the spirit of consensus, while colleagues support each other as the change moves forward. All parties feel that they own the change process themselves, which creates opportunities for success. In large multidisciplinary organisations, however, a collegial process may be too slow a way of bringing about change.

In terms of social practice, change is made in communities of practice. Change is based on shared expertise and the necessary decisions are made by those who lead the change. Problems are caused by conflicts in communities and specification of the direction of change. (Knight and Trowler 2001.)

The core points of strategies are clarifying a shared vision, putting it into action and committing participants to the objectives, implementation method and values of activities (Saari 2005). Strategy makes it possible to allocate limited resources as efficiently as possible to the identification and achievement of opportunities available in the environment. When change is being implemented, people must always understand why change is necessary. If the basic rationale for change, its moral purpose (Fullan 2005), has not been clarified, participants become frustrated by the whole exercise.

Study of management of virtual education

In this article, the focus of research is on virtual education development projects at six universities of applied sciences. The purpose of the study is to describe phenomena involved in the management of virtual education and to identify factors influencing adoption of virtual teaching methods within organisations. Management of virtual education was studied through interviews. Appointments for interviews were made through the Virtual Polytechnic contact people at the institutions involved, requesting the management teams responsible for virtual education to participate in interviews. Interviews were conducted using an open-ended questionnaire

and the 'significance of strategy components to successful change' model (Knoster 1997, Pohjonen 2001; Appendix 1). The interviews were conducted in the autumn of 2006 and spring of 2007.

Management was assessed using the following questions:

1. Using a mind map, please describe what virtual education means at your university of applied sciences.
2. How is virtual education managed at your university of applied sciences?
3. What are the grounds for developing online teaching (change pressures)?
4. What is the shared vision for virtual education?
5. What resources are used to make the change (capacity for change)?
6. Do you have any projects in place to promote development of virtual education?
7. What have been your successes in the field of virtual education? What are your success factors? How do you inform people involved in implementation of this and how do you reward their efforts?
8. What are the future challenges?

These questions were used as the basis to derive this article's research question: What factors promote virtual education at universities of applied sciences?

Interview participants included the Virtual Polytechnic contact person from one university of applied sciences; two representatives of degree programmes developing virtual education as part of their own programmes from another institution; the virtual education teams from three institutions; and the virtual education team leader, a head of a local education department, from one institution. Virtual teams are made up of online education support staff and degree programme representatives, who are usually teachers. One team also involved a library representative.

Factors promoting virtual education at universities of applied sciences

Leadership is key

External pressures and jointly specified objectives appear to support the development of virtual education. Institutional ICT strategies have provided guidelines for collective development efforts. The first strategies often remained 'route maps' that were not sensitive to 'local road conditions' (cf. Brown & Duguid 1996). Virtual education has not received unqualified support from everyone; there has also been some resistance to development. One issue raised in all interviews was that virtual education in technical fields had a slow start. It has only become possible to pay

more attention to local road conditions after integrating virtual education as part of curricular development work; degree programmes in technology are also now constructing virtual studies and virtual work practices. *'The pressures come from the world of work; after all, workplaces use online courses for in-service training on a daily basis and we also started to receive requests for continuing education as online courses, so we really had no choice but to start doing them. Luckily enough, we already had some good models and even in-house support for the job.'*

Administrative policies seem to play a significant role in terms of increasing virtual education. The most important policy to increase virtual education is organisation of support activities for virtual education. Development of virtual education usually rests with individual teachers at those universities of applied sciences where development is based on random projects and fixed-term support staff. Indeed, a new occupational group has emerged in these institutions: online learning support staff. At five universities of applied sciences involved in the interviews, there were ongoing discussions about the role and status of support staff in terms of whether development means development of education or development of information management, or perhaps development of more extensive support services, which would mean co-operation with library staff, for example. Among virtual education support staff working at the institutions involved, three employees had so far been appointed to official positions. The others were working on projects and did not as yet know whether and how their work would continue once the development projects came to an end.

In their virtual education development project, Kullaslahti et al. (2007) established that making education either partially or fully virtual requires seamless collaboration between several parties. Students and teachers are at the forefront, together with support staff providing support for virtual work. In addition, there is demand for online services provided by staff working at the library, the student affairs office, the international office and in other support services. It is becoming more and more common for students and teachers to meet workplace representatives, collaboration partners and educational management in online environments. All these parties need support services for online work. (Kullaslahti et al. 2007.)

Operational cultures at universities of applied sciences have not changed extensively as a result of virtuality. The group of developers, accompanied by a small group of other people, use virtual working methods in their own work. Representatives from two institutions reported that there were one or two leaders in their organisations who set a good example for virtual work in their own work. There is also no extensive awareness of provision of virtual education within all degree programmes. The report by Kullaslahti et al. (2007) also corroborates this observation: awareness of the opportunities and demands involved in online learning and degrees appears to be modest within management and administration as well as support services and, to some extent, among teaching staff as well. Institutional operations are still being planned from the perspective of local face-to-face instruction, even when it comes to organisation of online education.

Call for change agents

The best results are being achieved in those universities of applied sciences where change is being implemented in communities of practice and activities are based on

shared expertise. Change leaders seem to play an important role with their decisions on the direction of change (cf. Knight & Trowler 2001). Based on the interviews, it appears that the best results are being achieved at those universities of applied sciences where the individual responsible for development of virtual education is authorised to make decisions on the direction of change. Change management may be collegial leadership, but the most important thing is the opportunity to take steps in the chosen direction. Innovators are not necessarily the best people to develop virtual education holistically. It appears that innovators, who invent new forms of work and can get to grips with new software and hardware, cannot always cope with the necessary changes. Change agents need to be people who have the patience to inspire beginners over and over again.

The results obtained by Kullaslahti et al. (2007) also substantiate the significance of shared expertise. In their development project, teachers stressed the importance of joint planning and advance preparation, common procedures, definition of roles and responsibilities, and an open operational culture.

Isolated projects only seem to engage part of the group in development activities. If a degree programme or unit wants to achieve genuine change, only the involvement of all interested parties will ensure a change in procedures. Continuous progress in small steps leads to better results than extensive change projects which cannot be allocated sufficient time and human resources. The management's example seems to be important: *'The manager's involvement somehow gives the feeling that this is what is now important to us and we have to do our best.'*

Competence development and support

Developing the competencies of teaching staff appears to be the most important factor. In terms of developing different forms of teaching and work, integration of virtual education into daily work would seem to produce the best results. Learning new software applications and producing virtual contents in small steps increase teachers' confidence in their own abilities. A shared vision – towards the common goal – is the key to success. Different parties' divergent views and efforts that pull in different directions will grind everyone down.

There are plenty of different technical tools available in the ICT field and this wide variety affects achievement of common goals. Clear choices and priorities help to keep the focus on the essentials and to build collective competence. Sufficient resources, combined with technical and pedagogical support, help teachers to cope under pressure, in the same way as realistic feedback on both successes and areas for improvement does. Introduction of information and communications technologies also requires prioritisation. Organisation of an entire online degree programme requires persistent planning efforts among everyone involved in its implementation; it cannot be done along with all the old duties – a new procedure should change old practices. Representatives from two universities of applied sciences reported that they had transformed some of the joint planning work to be carried out using virtual tools and that the benefits were gradually starting to become clear. *'We have learnt to make use of ICT methods in our own work. Now we no longer waste time trying to find things discussed at the previous meeting – you can always find them*

on the learning platform. It somehow feels that you can remember things better after a TeamSpeak session – maybe it's because you focus on the essentials?'

Planning and doing things together takes time. It may be faster to plan your own courses if you do not have to listen to others or find a common understanding; however, working together enriches what you are doing. A teacher in one of the virtual teams said: *'You just don't get that much feedback working on your own – you have gradually grown used to the idea that you must speak about outputs and implementations with someone.'* As online education expands, it appears that teachers need a local support person to be available as required, at least in the early stages.

The interviews indicate that the best way to learn virtual teaching skills is by doing. Support should be available for those situations where problems emerge. It is only when teachers feel that they command the methods of virtual work that they are ready to expand their competence to cover new situations. Virtual work outside the educational institution with representatives from the world of work still feels relatively challenging. People want to obtain personal experiences with their own student groups and colleagues first. Consequently, leaders of virtual education play a key role in providing positive feedback and highlighting successes – this is how they can create confidence in order to expand activities.

Discussion and conclusions

Virtual education is here to stay at universities of applied sciences. Mobile students need alternative learning methods, while fierce competition on the educational market leads to the need for development of new forms of operation. The young generation is accustomed to making use of opportunities provided by information and communications technologies and many have obtained experiences of various forms of virtual work ever since comprehensive school. Adult learners have also learnt to study online in their own workplaces. However, are teachers being put in an unequal position when virtual education does not progress at the same pace at all universities of applied sciences and when there may even be quite pronounced differences between different fields? Or will virtual education become a watershed between universities of applied sciences?

Strategic objectives for development of virtual education had clearly been set at the senior level of the universities of applied sciences involved in the interview study. Nevertheless, it appeared that even the strongest mission statements were left unfulfilled at operational levels. Heads of degree programmes and teachers did not consider strategic objectives important and virtual education support staff became frustrated at being stuck in this limbo. Support staff was seeking individual enthusiastic developer-teachers, who would be ready to try virtual teaching and develop their own ICT skills. Heads of degree programmes seemed to play a key role in making decisions on the direction that virtual education should take. The virtual education strategy was thus closely linked to curricular development.

The universities of applied sciences involved in the interview study have allocated fairly substantial resources to development of virtual education. All these institutions had appointed a person to co-ordinate overall development of virtual education, while four institutions had included a few support people in the co-ordinator's

team to assist teachers in production of virtual courses and provision of advice on the use of learning environments. However, support staff work was not an established function in all the institutions involved – funding was based on projects, which were drawing to their close at the end of 2007.

It seemed that support for virtual education was directed at supporting provision of traditional teacher-driven education at most universities of applied sciences and strategic priorities also supported that specific development. There was very little discussion about new forms of work to develop expertise, which would involve active reflection on co-operation with the world of work. People had not as yet considered together the moral purpose (Fullan 2001) from the perspective of R&D activities and regional impact (Polytechnics Act 351/2001). Regardless of strategic objectives, virtual education is still very much being developed on the basis of individual teachers' enthusiasm and willingness. One university of applied sciences strongly highlighted co-operation with the world of work and genuine opportunities for students to develop their own competence in various projects. Its representatives felt that traditional teacher-driven virtual education does not fit in well with joint development projects carried out with the world of work. There is a need to further develop forms of provision further and to identify those areas in learning where education provided by the Finnish Virtual Polytechnic, for example, would be suitable.

Does the future belong to those universities of applied sciences that invest in sharing expertise within the community of practice and where students contributing to building new knowledge (Scardamalia & Bereiter 1999, Knight & Trowler 2001)? Project-based teaching and theses would enable a new type of learning culture, while different virtual working methods bring many opportunities for co-operation between educational institutions and the world of work.

On the one hand, virtual education is establishing its position; on the other, it is in constant transition as it is racing against developments in the world of work. From the perspective of management, the key is to build communities of practice that are able to assess the efficiency and effectiveness of chosen virtual teaching solutions by sharing expertise and experiences. The primary task for virtual teaching and virtual work is to increase competence. It seems that strategies that are too rigid do not promote development, even though a situation that is too indeterminate will also slow it down. A shared vision helps focus resources on the same objective.

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Appendix 1.

Significance of strategy components to successful change (Knoster 1997, Pohjonen 2001)

Successful change = Action plan = Changes	**Consensus/ moral purpose Consensus**	**Clear consistent vision/ Vision**	**Capacity for change/ Skills**	**Will/motivation Incentives**	**Resources**
Meaningless/unnecessary attempt = Sabotage		Clear consistent vision	Capacity for change	Will/motivation	Resources
Purposeless/ random attempt = Confusion	Consensus/ moral purpose		Capacity for change	Will/motivation	Resources
Anxiety, nervousness = Anxiety	Consensus/ moral purpose	Clear consistent vision		Will/motivation	Resources
Resistance = Resistance	Consensus/ moral purpose	Clear consistent vision	Capacity for change		Resources
Frustration = Frustration	Consensus/ moral purpose	Clear consistent vision	Capacity for change	Will/motivation	

Justus J. Randolph

Factors Influencing Methods Choice in Educational Technology Research and Development

The methods choice debate is one that resurfaces with regular frequency in the education research community. This regular resurfacing is not surprising though given the importance of methods choice. Decisions about methods choice affect and are affected by the political, economical, and social currents of the times (Greene, Lipsey, Schwandt, Smith, & Tharp 2007). The methods choice debate helps determine what the research community, the media, government agencies, program funders, and the public accept as convincing evidence. And, among many other reasons, methods choice is a reflection of a research community's underlying epistemological, ontological, and axiological positions.

In the 1980s, the methods choice debate in the social sciences flared when Cronbach and associates (1980) criticized Campbell's (1969) "reforms as experiments" view of evaluation in which laboratory research methods were favoured for informing policy. Julnes and Rog (2007, 1) wrote that Cronbach and associates' criticism was, "in effect nailing their ninety-five theses to the door of the edifice built on the experimental paradigm." Ten years later the debate resurfaced as what are referred to now as the *paradigm wars* — a conflict between those advocating quantitative methods and those advocating qualitative methods (see Datta 1994, Guba 1990, Scriven 1993). The paradigm wars waned as the mixed-methods paradigm gained increasing acceptance. In its latest form, the methodological debate has resurfaced in response to the U.S. Department of Education's (2003) decision to give funding priority to research that adopts formal random sampling and experimental designs.

The field of educational technology research and development is not immune to these debates; in fact, the field has a long history of methodological debates of its own. The earliest artefact of this ongoing debate is Clark and Snow's (1975) initial methodological review and critique of educational technology research. Since Clark and Snow's article, at least 13 empirical methodological reviews of the educational technology literature have been conducted (see Randolph 2007a for a synthesis of these reviews). Other high and low points in the history of the educational technology methods choice debate have been Phipps and Merisotis's (1999) dismissal of almost the entire body of previous research on distance learning because of its methodological flaws, Clark's (1983) criticism of media comparison studies, the treatises of the Design-Based Research Collective (2003), Reeve's (1995) criticism of the

research questions of educational technology, and Williamson, Nodder, and Baker's (2001, 1) claim that "whilst much of the literature in [the field of educational technology] is comparatively light methodologically, this can be justified by a constructivist approach to teaching and learning."

According to Julnes and Rog (2007, 2), the current methods choice debate "is not … about the desirability of generating evidence or about the need to consider the relative value of different methodologies. Instead, the debate is primarily over when, or under what circumstances, various methodologies provide the most useful, or actionable, evidence." With much wisdom, Julnes and Rog state that the way forward in the methods choice debate is not to try to resolve the controversy, because the controversy involves deeply-rooted disagreements that are not likely to go away. Rather they suggest that way forward is "to clarify the issues to yield a more productive dialogue" (2).

It is with that piece of advice in mind that I put forth the goal of this chapter: to clarify the issues, I identify and describe some of the factors that are particularly important to consider when choosing methods for educational technology research and development. To make these factors more easily understood I break them into two categories, both of which are critical to understanding methods choice: *factors that influence the formulation of the research question* and *factors that influence how a research question is answered*. The factors that influence the formulation of the research question are:

- The research problem.
- The purposes of research and their corresponding traditions.
- The state of the previous research.
    - Five major categories of educational technology research questions.

And, the factors that influence how a research question is answered are:

- The methods used in the previous research.
- The research act implied in the research question.
- The feasibility of the research.
- Safeguards for propriety.
- The degree of utility needed.
- The degree of accuracy needed.
- The degree and kind of generalizability needed.
- The degree of stakeholder participation in the research process.
- The degree of researcher participation in the research setting.

With hope, identifying and describing these factors will help improve the productivity of the dialogue about methods choice in educational technology research within and between researchers, funders, policy makers, and practitioners. On a practical level, I hope that information offered here, especially the list of key questions in methods choice at the end of this chapter, can be used as an aid for planning educational technology research or as an instructional aid for those who teach and supervise educational technology students.

What I do not provide here is a concrete set of rules for determining what research approach to use, what data collection methods to use, what analysis methods, or what reporting methods to use over a large set of research situations. One reason is that what may constitute the best methods choices is somewhat subjective – hence, the deep-seated disagreements about methods choice that are not likely to go away. The other reason is that while I believe that there are probably some general guidelines that apply across cases, methodological choices are heavily context-dependent. The methods that bring about actionable evidence in one setting may not bring about actionable evidence in another. Methods choice involves a careful weighing of many factors to create the most actionable evidence possible.

Factors Influencing the Formulation of the Research Question

Of primary importance in methods choice is the formulation of the research question because "methodology is ever the servant of substance, never the master" (Greene et al. 2007, 112). While the research question may be of primary importance in determining the right research methods, there are a variety of factors that are of primary importance in determining the right research question – (a) the research problem, (b) the research purpose and its associated tradition, and (b) the state of the previous research. So, by substitution, the factors that are of primary importance in formulating the research question are the foundation on which methodological choices are made. (For the sake of simplicity, hereafter I use the term *research question* to refer to all of the following: scholarly research questions, evaluation questions, and development tasks.)

The Research Problem

My dissertation supervisor was fond of the maxim – "a lack of aspirin doesn't necessarily mean that there is a headache." Applying this notion to research, his point was that a lack of research does not necessarily mean that there is a need for research; research needs to be rationalized by both a need for and a lack of research on that topic. It is the research problem that demonstrates the need.

In this section, I make a distinction between three types of research problems in educational technology: the scholarly research problem, the evaluation problem, and the development problem. These types of research problems correspond with the different purposes of educational technology research and their associated traditions, which are discussed in the next section.

The scholarly research problem, "the intellectual quandary, dissonance, or perplexity" (Office of Research Services 2007, 2) differs whether it is an applied or basic research problem, as explained below.

In applied research, the problem [is based on a] need, which may be based on a public policy to be fulfilled or examined and/or on data indicating some shortcoming in educational or psychological services. The need is not, however, the problem. Any one need may be the basis for a number of different research problems, depending upon the research evidence that is available and judgments about how to best address the need. For example, the need to avoid the erroneous placement of

bilingual minority students in special education classes might lead to research on the sensitivity of school personnel to cultural influences on their decisions about students, on the evidence for the validity of the instruments used to classify bilingual students, or on the extent and nature of parental involvement in classification decisions. In basic research, the assumed need is for adequate knowledge, and reference to public policy or needs data is usually not necessary. (Office of Research Services 2007, 2.)

The most frequently seen types of educational technology research problems (or needs upon which they are based), which are implied by the major educational technology research questions that I discuss later, include:

- a disconnect between how educational theory informs technologies for education, and vice versa;
- a need for information about the best methods for educational technology research and development;
- a need for information about the best methods to implement and improve the utility of technological innovations;
- a need for information about the effectiveness of certain kinds of technological interventions; and
- a need for information about what factors moderate the effectiveness of certain kinds of technological interventions.

Compared to scholarly research problems, some other types of research problems, which I refer to here as *evaluation problems*, are local in scope. For example, an educational organization might have a need to respond to a local problem within their organization – perhaps there is a high degree of student attrition that needs to reduced, a need to determine if a certain distance education program should be continued or abandoned, or a need to determine if a program had been implemented as promised. Evaluation problems are typically articulated by program stakeholders.

Development problems, as the names suggests, concern the development of interventions or a lack of knowledge about how to best develop those interventions. For example, much of the field of educational technology deals with developing new or adapting existing technological interventions to solve current educational problems.

The purpose of educational technology research; whether it is scholarly, evaluative, or developmental; is to solve the types of problems mentioned above. In the next section, I discuss these different research purposes and the traditions with which they are usually associated.

The Purposes and Traditions of Educational Technology Research

Typically, research in educational technology is conducted for one or more of the following purposes:

1. to answer questions that are important for the development of an educational intervention;
2. to answer questions that are important to local stakeholders to improve, come to understand, or assign value to a program; or
3. to answer questions that are important to the scientific community.

While it is often difficult to draw a clear line between these purposes, determining the primary reason for conducting research is helpful in understanding methods choice. The research traditions that correspond primarily with the purposes of research listed above are (1) design-based research, (2) evaluation research, and (3) educational research, respectively.

It is important to note that research traditions can easily overlap one another. For example, findings generated from the questions of local stakeholders might provide important insights for a scientific theory; similarly, findings from basic research might serve as a starting point for the development of an educational intervention. In the sections below, I go into more detail about each of these research traditions.

The design-based research tradition. A research tradition that has gained much credibility over the past few years and that works well for developing educational activities or tools is design-based research, which "blends empirical educational research with the theory-driven design of learning environments" (Design-Based Research Collective 2003, 5). According to the Design-Based Research Collective (2003), the five characteristics of design-based research are:

First, the central goals of designing learning environments and developing theories or "prototheories" of learning are intertwined. Second, development and research take place through continuous cycles of design, enactment, analysis, and redesign… Third, research on designs must lead to sharable theories that help communicate relevant implications to practitioners and other educational designers. Fourth, research must account for how designs function in authentic settings. It must not only document success or failure but also focus on interactions that refine our understanding of the learning issues involved. Fifth, the development of such accounts relies on methods that can document and connect processes of enactment to outcomes of interest. (5)

As shown above, design-based research has many characteristics, the most unique being its "continuous cycles of design, enactment, analysis, and redesign" (Design-Based Research Collective 2003, 5). In the traditional research framework, summative, generalizable, and rigorous studies are valued; however, because those types of studies are long and resource intensive, they are not feasible for the initial

development of an intervention. Instead, in design-based research numerous rapid and flexible investigations are conducted to determine how to improve an intervention. After the intervention has been perfected through many cycles of design and testing, only then does it makes sense to conduct a summative, large-scale, and resource-intensive study. What is more, design-based research is an exploratory sort of activity and, as such, can lead to insights about theories that can be later tested using confirmatory measures. In the basic form of design-based research, no particular set of methods is prescribed; the appropriate method is the one that leads to the type of information that is needed to refine the intervention.

A popular manifestation of design-based research is Bannan-Ritland's (2003) Integrative Learning Design Framework (ILD). Figure 1 shows the phases in the ILD framework and how they compare with the phases of other design traditions, such as instructional design (Dick & Carey 1990), product design (Urlich & Eppinger 2000), usage-centered design (Constantine & Lockwood 1999), diffusion of innovations (Rogers 1995), and education research (Isaac & Micheal 1990). The ILD framework begins with an informed exploration phase that includes problem identification, a literature survey, problem definition, a needs analysis, and audience characterization. The next phase, enactment, includes researching the initial intervention design, creating a prototype, and then developing a fully detailed intervention. The next phase involves iterative cycles of pilot testing and refinement of the intervention. Bannan-Ritland describes the activities within this phase as formative testing, theory/system refinement, implementation, and evaluation. Note in Figure 1 how the later stages can loop back to earlier stages in the ILD framework. For example, the results of an evaluation might indicate that the intervention needs to be redesigned. After another cycle of implementation and evaluation, it could be determined whether the refinement of the intervention had its desired effect. The final phase of ILD, evaluation of the broader impact, has to do with the dissemination, adoption, adaptation, and summative evaluation of the intervention.

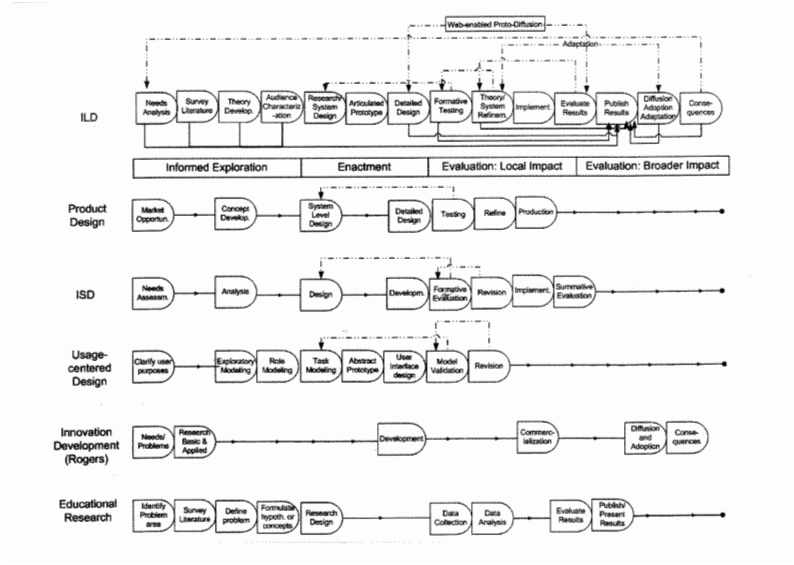

Figure 1. *Merging of design and research processes into the integrative learning design framework. From Bannan-Ritland, B. 2003. The role of design in research: The integrative learning design framework. Educational Researcher, 32(1), 21–24. Reprinted with permission of Sage Publications, Inc.*

Two helpful resources for design-based research are the Design-Based Research Collective's website (n.d.) and Kelly (2003). In the Design-Based Research Collective website (n.d.) one can find links to seminal writings on design-based research and links to various other design-based research resources. Kelly (2003) edited a special issue of *Educational Researcher* that contains a selection of articles that provide a thorough overview of the design-based research tradition.

The evaluation tradition. Three purposes are generally assigned to evaluation. Similar to design-based research, one purpose of evaluation research is to collect data that can be used to improve an intervention (formative evaluation). Another purpose is to collect data that can be used for decision-making or assigning value to a program (summative evaluation). Yet another purpose is to come to understand how a program works (Mark, Henry, & Julnes 2000). Regardless of the specific purpose of evaluation, evaluation research answers questions that are primarily of interest to local stakeholders.

There are a variety of evaluation traditions to choose from, but a standard method for conducting an evaluation consists of the following steps:

- Develop a conceptual model of the program and identify key evaluation points,
- Develop evaluation questions and define measurable outcomes,

- Develop an evaluation design,
- Collect data,
- Analyze data and
- Provide information to interested audiences (Frechtling, Frierson, Hood, & Hughes 2002, 15).

There are a many good resources for evaluation research. For example, the U.S. National Science Foundation has created a series of useful, free, and practitioner-oriented evaluation handbooks. The latest in the series is Frechtling, Frierson, Hood, and Hughes's (2002) *The User-Friendly Handbook for Program Evaluation*. It provides an overview of evaluation and types of evaluation, the steps involved in conducting an evaluation, an overview of quantitative and qualitative methods, and a section on strategies for culturally responsive evaluation. Other handbooks in this series include *The User-Friendly Handbook for Program Evaluation: Science, Mathematics, and Technology Education* (Frechtling, Stevens, Lawrenz, & Sharp 1993) and *The User-Friendly Handbook for Mixed Methods Evaluation* (Frechtling & Sharp 1997). Seminal books in evaluation research include Herman (1987); Mark, Henry, and Julnes (2000); Patton (1990); Preskill and Torres (1999); and Weiss (1998).

The educational research tradition. The final tradition I deal with here is the education research tradition. While design-based research and evaluation research may indeed be types of research on education, I have chosen to use the term *educational research* to refer to research that answers questions that are of interest to the education research community. Although design-based research and evaluation research can do much to answer the questions of the scientific community, that is not their primary function. There is no shortage of high quality books and resources on the practice of education research. They are too numerous to describe here, but I do recommend Gall, Borg, and Gall (1996) as an introductory text and guide to the multifaceted literature on education research.

The State of the Previous Research

For many reasons, becoming familiar with state of the previous knowledge on a research topic, by doing a literature review, is a critical factor in one's formulation of a research question. First, conducting a literature review or needs analysis makes it possible to determine how answering one's research question will contribute to pre-existing knowledge. The American Education Research Association (2006) suggests that research can contribute to knowledge in the following ways:

- It can contribute to an already established theory or line of empirical research,
- It can help establish a new theory,

- It can meet a practical need, or
- It can make up for a lack of needed information about a problem or issue. (34)

For example, the literature review should make it possible to determine whether there are established theories already and to what degree they have been substantiated. Or, from an empirical research point of view, a literature review can show if the key elements or variables have been identified, whether the associations between those elements are understood, and whether the causal mechanisms underlying the phenomenon have been identified. At any rate, these aspects about the state of the previous research will have considerable impacts on the focus of the current research. In some sense, the literature review is the mother of the research question.

Second, the literature review provides a basis for comparing and contrasting current findings with previous findings. Comparing and contrasting current findings with previous finding helps build an evidence base, puts the current study in context, and helps establish the degree to which a finding holds true over different participants, treatments, outcomes, and settings. Comparing and contrasting current and previous findings also give the current findings more meaning.

Finally, finding out about the previous research on a topic can help researchers locate themselves in what I call a *research family* and get a clear picture of how their research fits into a *research lineage*. By *research family,* I mean the individual researchers or groups of researchers that investigate the same topic. By understanding how one fits into a research family, it is easier to understand what Becher (1989) calls the *tribes and territories* of one's field. By *research lineage*, I mean the historical line of research on a particular topic. By understanding the history of research on a topic, researchers can appreciate how their research fits into that history, identify what is needed at the present, and predict what will be needed in the future. For this, Creswell (1994) suggests making a *research map* — a visual representation of how one's research fits in with the previous literature — to understand one's research lineage.

The Major Categories of Educational Technology Research Questions

In the sections above, I discussed, in general, the factors that go into choosing research questions. In the section below, I discuss what types of research questions those factors tend to yield in the field of educational technology. Here I used an empirical approach to identify the major categories of research questions in educational technology, between and within the design-based, evaluation, and education research traditions. With hope, identifying and describing the types of questions that are often seen in educational technology research will help add clarity to the debate about which methods are appropriate for answering these kinds of research questions.

Design-based research questions. The Design-Based Research Collective (2003) has given some suggestions for the types of research and development questions

that are of critical importance. The list below summarizes the major research and development questions mentioned there:

1. Research questions that deal with the development of theories or "prototheories" of learning.

2. Research questions that deal with the interactions of an intervention and the authentic setting.

3. Research questions that deal with how an intervention causes the desired outcomes.

4. Development questions that deal with how an intervention can be improved. (5)

In terms of Bannan-Ritland's Integrative Learning Design Framework (2003), these types of research questions mentioned above take on specific meanings through the steps in the informed exploration stage. Those steps are *problem identification, literature survey, problem definition, needs analysis*, and *audience characterization*.

Evaluation questions. Remember that one of the primary purposes of evaluation research is to answer questions that are important to program stakeholders. So, it is no surprise that questions in evaluation research come from people who are involved in a program or intervention. Typically, evaluation questions are generated in two phases – a divergent question phase and a convergent question phase. In the divergent question phase the evaluator collects an unedited list of research questions from the people involved in the program – for example, from the administrators, practitioners, and clients. In the convergent phase, the evaluator and sometimes the stakeholders decide which of the questions from the divergent list need to be answered first and which can be answered later.

Because there has been no review of the questions in educational technology *evaluation reports*, a lateral review of the questions in computer science education evaluations might provide some insight into the types of questions that educational technology evaluators strive to answer. I make the assumption here that the body of computer science education research is more or less generalizable to the body of educational technology research for two reasons: first, because so much emphasis is put on educational technology research and development in the field computer science education and, second, because the two fields exhibit many similarities in the quantity and quality of research methods used (see Randolph 2007a).

In Randolph (2007b), I conducted a review of 29 Kindergarten through 12th grade evaluations of computer science education programs that had been published before March 2005. I inferred the evaluation questions from those evaluation reports. For example, I assumed that if an evaluator had examined student achievement as an outcome, then it is safe to assume that at least one of the evaluation questions had to do with the ability of the program to bring about student achievement. The factors that were examined are equally telling. For example, if

gender had been examined as a factor then it is safe to assume that there was an evaluation question about whether the program had a differential effect for male or female participants. At any rate, Table 1 shows that the outcomes that the evaluation questions most often dealt with, in decreasing order of frequency, were attitudes, enrolment, and achievement in core courses and that the interaction factors that were examined most often were gender, aptitude, and race/ethnic origin.

Table 1. The Question Topics in K-12 Computing Education Program Evaluations

Question #	*Question topic*	*Frequency (%)*
	Outcome (out of 67 outcomes in 19 cases)	
1	Stakeholder attitudes	17 (25.4)
2	Enrollment	13 (19.4)
3	Achievement in core subjects	14 (20.9)
4	Computer science achievement	9 (13.4)
6	Teaching practices	5 (7.5)
7	Intentions for future CS jobs/courses	3 (4.5)
8	Program implementation	2 (3.0)
9	Costs and benefits	2 (3.0)
10	Socialization	1 (1.5)
11	Computer use	1 (1.5)
	*Factors (from 19 cases)**	
12	Gender	3 (15.8)
13	Aptitude	3 (15.8)
14	Race/ethnic origin	5 (26.3)

* More than one factor was possible per case. From Randolph (2007b).

Education research questions. In this section, I present the results of the types of research questions that have been of import to the educational technology community over the last ten or fifteen years. With hope, examining these questions of the past can help give more meaning to the research questions of the present.

In Tables 2 through Table 4, I summarize the results of three empirical reviews of the questions asked in educational technology research articles (Burghar & Turns 1999a, Burghar & Turns 1999b, and Burghar & Turns 2000). In those reviews, Burghar and Turns used an emergent coding technique to create an initial set of research questions types from all the articles published over a two to four year time period from three major educational technology forums – the proceedings of *Frontiers in Education* (FIE), *Educational Technology Research & Development* (ETR&D), and *Human-Computer Interaction* (HCI). Articles published between 1997 and 1999 were selected from FIE and ETR&D; articles published between 1995 and 1999 were selected from HCI.

Table 2. Major Categories of Research Questions from FIE (1997–1999)

Question #	*Question category*
1	What techniques can be used when designing technology-oriented distance learning applications?
2	What techniques can be used when designing educational technology applications?
3	How can educational technology be implemented?
4	How do students interact with educational technology?
5	How can educational technology support collaboration?
6	How can we assess student learning?
7	How can we assess the effectiveness of educational technology?
8	How have instructors at other locations used technology in the teaching of a particular subject?
9	What applications have other instructors designed to teach their subjects?

Note. From Burghar & Turns (2000).

Table 3. Major Categories of Research Questions from ETR&D (1997–1999)

Question #	*Question category*
1	How can we theoretically understand educational technology?
2	How can theory be applied to educational technology?
3	What are the effects of a given technology on practice?
4	What factors affect the implementation of a technology?
5	How can the development process be improved?

Note. From Burghar & Turns (1999a).

Table 4. Major Categories of Research Questions from HCI (1995–1999)

Question #	*Question category*
1	What methods can researchers use as they explore a design context?
2	How can user tasks be modeled and analyzed?
3	How can developers integrate users into their designs?
4	How do we characterize and design for group processes?
5	How do users interact with hypertext?
6	What can we learn about a task by studying users with varying levels of experience?
7	How can interface modalities be tailored to meet user needs?
8	How can the development process be improved?
9	How can user cognitive activity be represented in models and theory?

Note. From Burghar & Turns (1999b).

Comparing and Contrasting Questions across Forums and Traditions

Several differences across the research questions between forums and research traditions exist. First, evaluation questions tend to centre more on program effectiveness and its moderators than the research questions in design-based research or in forums like FIE, HCI, or ETR&D, whose questions deal more with methodological and theoretical issues within their fields. Second, the questions in HCI seem to be more specific than the questions in design-based research or in educational technology forums like FIE or ETR&D. For example, in ETR&D a major question is "What factors affect the implementation of a technology" whereas in HCI that question is usually broken down into its sub questions – for example, "how can interface modalities be tailored to meet user needs?" Third, it appears that the questions in ETR&D are more theoretical in nature than the questions in other forums. Two out of five question types in ETR&D deal with theory – "How can we theoretically understand educational technology?" and "How can theory be applied to educational technology?"

While there are some differences in research questions across the traditions and forums, nonetheless, there is enough similarity that overall categories of research questions across traditions and forums clearly emerge. By synthesizing the questions across the different reviews of research questions presented earlier (i.e., Design Based Research Collective 2003, Randolph 2007b, Burghar & Turns 1999a, Burghar & Turns 1999b, and Burghar & Turns 2000), it appears that the questions in educational technology can be grouped into five major categories. The evidence table (Table 5) below shows the major types of educational technology research questions and the sources of the sub questions on which they were based.

Table 5. The Five Major Types Questions in Educational Technology Research.

Type of Question	*Source*
Questions about theories and practice	Burghar & Turns (ETR&D), 1999a, questions 1 & 2 Burghar & Turns (HCI), 1999b, question 9
Questions about research & development methods	Burghar & Turns, (ETR&D), 1999a, question 5 Burghar & Turns (HCI), 1999b, questions 1, 2, 3, & 8 Burghar & Turns (FIE), 2000, questions 1, 2, 6, & 7
Questions about technology implementation	Burghar & Turns (FIE), 2000, question 3 Randolph, 2007b, question 7
Questions about the effectiveness of an intervention	Burghar & Turns, (ETR&D), 1999a, question 3 Burghar & Turns (HCI), 1999b, question 5 Burghar & Turns (FIE), 2000, questions 4 DBRC, 2003, questions 3 & 4 Randolph, 2007b, questions 1 through 10
Questions about the factors that moderate the effectiveness of an intervention	Burghar & Turns, (ETR&D), 1999a, question 4 Burghar & Turns (HCI), 1999b, questions 4, 6, & 7 Burghar & Turns (FIE), 2000, questions 5, 8, and 9 DBRC, 2003, question 1 Randolph, 2007b, questions 11, 12 and 13

Note. DBRC = Design-Based Research Collective. The question number refers to the question # columns in Table 2 through Table 4.

Questions about theory and practice. These types of questions deal primarily with how educational and psychological theories can inform educational technology practice and how educational technology practice can inform those theories. These types of questions also include theoretical questions about the disciplinary identity of educational technology. Two hypothetical questions in this category are given below:

- How has the theory of active student response been implemented in educational technology interventions?
- Do educational technology interventions that include active student response lead to increase academic performance, as the theory suggests?

Questions about research and development methods. These types of questions deal primarily with the conduct of educational technology research and development. They deal with the methods that can be used for conducting educational technology research and development and how those methods could be improved. Three hypothetical examples of research questions in this category are provided below:

- What research methods do educational technology researchers tend to use?
- In what circumstances do they use those methods?
- What are the strengths and weaknesses of using those methods under a variety of different research situations?

Questions about the implementation of technology. Two of the reviews presented here involved sub questions that deal with the implementation of technology. Some hypothetical examples in this question category are given below:

- What factors help increase the likelihood that a teacher will adopt an educational intervention?
- What factors help increase the likelihood that a student will adopt an educational intervention?

Questions about the effectiveness of a technological intervention. This group of questions includes formative questions about how to improve an existing technology and summative questions about how well an existing technology works in effecting a given outcome. Some hypothetical examples in this question category are given below:

- Does our educational technology intervention cause increased academic achievement?

- Does educational intervention X or Y lead to greater academic achievement?

Questions about factors that moderate the effectiveness of a technological intervention. While the previous group of questions deal with the main effects of a technological interaction, this group of questions deal with the factors that moderate the effectiveness of an intervention. Some of the factors that are examined in these questions deal with group versus individual learning, the academic subjects involved, the type of technological intervention used, the setting of the instruction, the level of previous experience, sex, age, among others. Some hypothetical examples in this question category are given below:

- Do students who have more previous experience with computers gain more from using the educational technology intervention?
- Do the previous results concerning an intervention generalize when the intervention is used in a different setting?

Some Caveats

These categories of research questions come from articles that were written between 1995 and 2005; therefore, they reflect the state of research between 2 and 12 years ago. Naturally, the field will have progressed and some of these categories of research questions will have changed. Some of the questions will have been answered and new questions will have replaced them. These categories of research questions are only meant as a guide for situating and evaluating a set of current research questions by examining the research questions and traditions of the past.

Factors That Influence How a Research Question is Answered

Earlier I identified some of the factors that were critical in formulating a research question. Those factors included (a) the research problem, (b) the purposes and associated traditions of the research, and (c) the state of the previous research. I also identified the general types of question topics being asked in educational technology research. In this section, I discuss that factors that are important to consider when choosing methods to answer a research question once it has been formulated. Those factors include (a) the methods used in the previous research, (b) the research act implied in the questions, (c) and some salient dimensions in methods choice, such as the level of accuracy, utility, propriety, and feasibility of an investigation.

It is important to note that the factors that influence the formulation of a research question interact reflexively with the factors that influence the methods used to answer that question. For example, one might have to modify a research question if it is not feasible or if it can only be answered through an investigation that causes excessive harm to participants. While it is true that the nature of the research question implies what type of research methods are appropriate, the factors that influence how research can be carried out can limit the type and scope of research questions that can be answered.

The Methods Used in the Previous Research

The research methods and procedures used in previous research can be an invaluable guide to designing research. The previous research will show which methods have worked well in the past and which have not worked so well, which variables are important to examine and which can be left out, and what contextual and environmental factors need to be taken into account. What is more, if it is important to accumulate evidence in a field, then a researcher might want to use the methods that were used in the past so that it is easier to make comparisons across studies. Finally, a researcher may decide to make a contribution to the field by investigating a topic using a method that has not been used before. Anyway, one has to be knowledgeable about a tradition in order to break with it. After all, "the accumulated past is life's best resource for innovation" (Brand 1999, 15).

Research Acts Implied in the Research Question

In order to be able to link research questions to research methods it might be helpful to review the categories of research acts (i.e., the types of actions one takes while doing research) that are implied by the research question. Some authors call these *the purposes of research*, but I call them *acts* here to not confuse them with the research purposes mentioned earlier (i.e. developing an intervention, answering local questions, or answering questions that are important to the scientific community).

Several authors have put forward suggestions on what are the research acts in social science research. These include Gall, Borg, and Gall (1996), Jarvinen (2000), Mark, Henry, and Julnes (2000), Shadish, Cook, and Campbell (2002), Stokes (1997), and Yin (2003). However, I have found it helpful to use the following categories of research acts to describe the kinds of activities that researchers do and the kinds of research questions they ask. Those categories are *identification*, *description, comparison*, *correlation, experimentation*, and *explanation*.

In some sense these research acts, from identification to explanation, are linear in their degree of ability to explain causal mechanisms. For example, one has to identify a causal factor to be able to explain how it works in a causal model. However, that linearity does not mean that one type of research act necessarily needs to precede another type of research act. For example, one does not necessarily need to do experimentation or correlation to make a causal explanation. And, it does not mean that one cannot switch back and forth repeatedly between research acts. For example, in grounded theory research one iterates between cycles of identification, description, and explanation to arrive at a theory based on the data gathered.

Identification. The first research act, which could just have easily have been labeled *exploration* or *orientation,* deals with becoming aware of a phenomenon, its contexts, and its constructs. For example, in order to create a quantitative survey to measure the degree of users' reactions to a new technological innovation, first one would have to identify the types of reactions that one wants to measure. Similarly, in qualitative research one might first have to establish that a phenomenon exists before describing the attributes or elements of that phenomenon. Identification is often the purpose of quantitative correlational research approaches and in many qualitative research approaches.

Description. One might use quantitative or qualitative description to describe the attributes of the phenomenon that came to light through the act of identification. In qualitative descriptive research, for example, if client satisfaction is identified as an important factor in some phenomenon, then the researcher might do a qualitative study to provide a detailed description of the attributes of client satisfaction. It might turn out that client satisfaction has several sub factors, and the researcher might have to revert to identification to become aware of those sub factors and, then, back to description to describe their attributes. In terms of quantitative descriptive research, the researcher might give out a survey to measure the degree of satisfaction clients report for each of the sub factors identified earlier.

Research questions that relate to quantitative description often begin with questions terms such as "How many…", "What percentage of…", "How often…" etc. Research questions that relate to qualitative description begin with terms such as "What kind of …", "What are the properties of …", "What is the meaning of …", "What are the types of …", etc.

Comparison. The next type of research act, comparison, consists of two or more instances of description and an analysis of how those instances of description differ. In the field of educational technology, a researcher might examine how the gaming choices of male students differ from the gaming choices of female students. Research questions that relate to comparison involve differences – for example: "Do expert and novice programmers differ in the how they use algorithm animation software?"

In comparison studies, researchers do not manipulate variables or assign participants to treatment or control groups. The point of contrast in a comparison study is usually on some nonmanipulable attribute, such as age, mother tongue, sex, or previous experience. In health research, comparison studies (also called causal-comparative studies or case-control studies) are frequently seen because often it is not ethical or possible to assign people to groups. For example, it would not be ethical to do an experiment in which a group of people are selected to be smokers and a group of people are selected not to be smokers. Comparative studies are useful in those cases when the effect is known, but the cause is not known or cannot be manipulated (Shadish, Cook, & Campbell 2002).

Correlation. Correlation consists of multiple instances of comparison to examine the (co)relationships between variables. For example, an educational technology researcher might be interested in knowing whether the use of a certain feature in a technological intervention is related with an increase in academic achievement. One practical outcome of examining correlations is that, under instances of high correlation, predictions about the behaviour of one variable can be made from the behaviour of correlated variables. Some examples of correlational research questions follow: "Is there a relationship between the number of hours a day spent watching educational programs and academic achievement?" or "Is there an association between the number of people in an online classroom and attrition?"

One important note is that correlation does not prove causation. Many occurrences are correlated but are not causally linked. *Confounding factors* can mask an actual association or make it appear that an association exists when one really does not. For example, there is a positive correlation between the sale of cooling fans

and drowning deaths, but obviously, one does not cause the other. The confounding factor is that the heat of the summer months is correlated with both an increase in the sale of cooling fans and with the number of people who go swimming (and subsequently drown).

While correlation does not prove correlation, it can be an initial clue that a causal relationship exists. The type of research act discussed next, experimentation can be used to help determine if a causal relationship does indeed exist.

Experimentation (causal description). Shadish, Cook, and Campbell (2002, 13) define an experiment as "a study in which an intervention is deliberately introduced to observe its effects." An educational technology researcher might conduct an experiment, for example, by introducing a newer version of a technological tool and comparing the academic results between the phases when the students used the newer version and the phases when the students used the older version. Experimentation might be thought of as a special case of comparison in which the researcher changes something about a situation and then makes a comparison. Or it might also be thought of a special case of description in which "the consequences attributable to deliberately varying a treatment" (Shadish, Cook, & Campbell 2002, 9) are described. Some examples of experimental research questions follow: "What are the effects of using a virtual data collection tool on the quantity of data that are collected?" or "Does technology intervention X or Y lead to better mathematics achievement?"

While experimental research is prized for its ability for the causal description of phenomenon, there are a few important caveats about experimental research and causal claims that need to be mentioned. First, while experimental research can generate information that can help support causal claims, it dos not guarantee causal certainty. Experimentation is a means, not an end, to arriving at sound causal claims. Shadish, Cook, and Campbell (2002) stated this point well. They wrote:

> *Experiments yield hypothetical and fallible knowledge that is often dependent on context and imbued with many unstated theoretical assumptions. Consequently, experimental results are partly relative to those assumptions and contexts and might well change with new assumptions or contexts....to the extent that experiments reveal nature to us, it is through a very clouded windowpane. (29)*

Second, experiments are good at causal description – that is, "in describing the consequences attributable to deliberately varying a treatment" (Shadish, Cook, & Campbell 2002, 9) – but are not so good at causal explanation – that is, in "clarifying the mechanisms through which and the conditions under which that causal relationship holds." For example, by flicking a light switch on and off and observing the light going on and off, one could easily use causal descriptive reasoning to conclude that flicking the light switch causes the light to go on or off. But knowing that flicking the light switch causes the light to go on is much different than being able to explain *why* or *how* flicking the light switch causes the light to go on.

Causal explanation. As mentioned above, experimentation produces data that is useful for causal description. Unlike causal description though, which is used for determining that a certain cause leads to a certain effect, causal explanation can

be used for explaining *why* or *how* a certain cause leads to a certain effect. Causal explanations often come about by examining a phenomenon in great detail.

Coming back to the light bulb example, if the goal were to provide an explanation for why turning on a light switch causes the light bulb go on, a researcher using causal explanation would look into the walls and examine the wires, bulbs, switches, fuses, circuit breakers, and such. From that, the researcher could come up with an explanation of how flicking a switch ultimately leads to light being emitted from a bulb. By doing pattern matching between what elements theoretically are needed to make a light bulb work and what elements are actually in place, the researcher could even determine that flicking the switch would turn on the light without ever having to actually flick the switch.

There have been many useful descriptions of how causal explanation works. Scriven (1976) describes causal explanation as a research act that uses a modus operandi approach – the same approach that a doctor uses to make a diagnosis or the same approach that a detective uses to catch a criminal. In short, in the modus operandi approach an observed pattern (e.g., a set of symptoms that a patient has) is matched with a known set of patterns (e.g., the set of symptoms associated with a particular illness). The often heard phrase in criminal investigation programs – this (pattern of evidence) is consistent with that (criminal phenomenon) – is evidence of the modus operandi/pattern matching approach in action. Mohr (1999) describes causal explanation as a research act that uses physical causal reasoning – the same reasoning that lets physicists predict the movement of objects. By knowing the theories that underlie physical causes, physicists can make causal explanations of physical phenomenon. However, the theories of human behaviour are much different than the theories of physical motion. Others such as Shadish, Cook, and Campbell (2002) describe causal explanation, not exclusively, as multiple cases of causal description. Whichever characterization of causal explanation one adopts, the essence is that it allows one to explain why or how causal systems work.

Dimensions in Research Acts

While research acts can be categorized as identification, description, comparison, correlation, experimentation, or explanation, it is also helpful to consider other dimensions – including whether the research adheres to qualitative or quantitative traditions and the degree to which the research is generalizable, accurate, feasible, appropriate, and useful.

General vs. local. One key dimension in research is to what degree results are local or general – that is, the degree to which results are generalizable across units, treatments, outcomes, or settings. In some cases it is sufficient to make local conclusions – that is, conclusions that apply to local participants, treatments, outcomes, and settings and that do not apply to other participants, treatments, outcomes, or settings. For example, in a program evaluation, it is probably sufficient to conduct research that only applies to the program being evaluated because the funders of the evaluation are primarily interested in the results of their program and not necessarily interested in the results of other programs. But, stakeholders in similar programs would probably be interested. In most cases in traditional educational research, conclusions have more worth if they are generalizable – that is, if the con-

clusions apply to other units, treatments, outcomes, or settings outside of the original setting. In fact, Stanley and Campbell (as cited in Shadish, Cook, and Campbell 2002, 97) argue that in research on teaching, "generalization to applied settings of known character is the desideratum."

Qualitative vs. quantitative. Traditionally, some of the research acts described above have been connected with either qualitative or quantitative traditions. For example, case study research has traditionally been regarded as qualitative research; experimental research has been traditionally associated with quantitative types of research. However, there is no reason that either quantitative or qualitative methods could not be used in any of the research acts. Theoretically, one could do an experiment in which only qualitative data were collected. Similarly, one could do a case study in which only quantitative data were collected, as Yin (2003) points out. There is growing support for combining qualitative and quantitative types of data to create a variety of evidence to support a claim (Creswell & Plano Clark 2006, Johnson & Onwuegbuzie 2004).

Exploration vs. confirmation. Another dimension of research is to what degree the goal is to explore a phenomenon or to confirm (or help disconfirm) a pre-existing hypothesis. In some types of research, like grounded theory, the researcher refrains from making a research hypothesis until the data begins to accumulate. In this type of research, the researcher might have an idea or a topic to explore but does not try to gather evidence for or against any particular proposition. One could say that the exploratory researcher wanders in a specific direction. This type of research is often considered to be useful when there is little or no understanding of a phenomenon or when a line of research gets stuck and new hypotheses need to be generated (Strauss & Corbin 1990).

In many other types of research the goal is to build evidence to help confirm (or disconfirm) a claim. For example, in hypothesis testing one creates a testable, a priori hypothesis that is usually based on previous research or theory. In this type of research, one arrives at knowledge by positing a variety of hypotheses, testing the validity of those hypotheses, and eventually deciding on which hypothesis of many is the most likely. For example, a researcher might posit from theory or previous research that the method of instruction is more important than the medium of instruction in terms of student academic achievement. The researcher would then conduct an experiment in which evidence could be gathered that would either support or discredit this hypothesis.

Another type of confirmatory research is replication research. In replication research, one replicates another researcher's investigation to see if the same results generalize across units, treatments, outcomes, or settings. While replication research is not generally given as much value by the scientific community as research that creates new information, replication is nevertheless a corner stone of science and provides an excellent opportunity for beginning researchers to hone their craft.

In reality, exploratory and confirmatory approaches intertwine. The act of trying to carry out confirmatory research usually brings about new hypotheses about a phenomenon. Exploratory research that keeps ending up at the same conclusion can help build strong evidence for, or against, a claim.

Level of participation. This dimension involves two aspects: (a) how closely researchers become involved in the phenomenon and setting they are studying and (b) how involved the participants in the study become involved in the research process. In some types of research, like ethnographic research, the researcher becomes a part of the community being investigated (see LeCompte & Schensul 1999). In other types of research there is a strict line between the researcher and participant. Also, in some types of research; like participatory action research or participatory evaluation; the participants collaborate with a researcher or the researcher acts as a facilitator for participants who carry out the brunt of the research (see Reason & Bradbury 2001). In other types of research, the researcher is the only person who participates in the design, data collection, analysis, and reporting of research. There are many ongoing debates and discussions about the pros and cons of the different degrees of researcher and stakeholder participation, but they are too numerous to go into here.

Accuracy. In some cases, it is necessary for research to have much accuracy; that is, it must produce sound information that is (a) comprehensive, (b) technically adequate, and (c) with judgments that are logically aligned with the data collected (Joint Committee on Standards for Educational Evaluation 1994). For example, it makes sense to have much accuracy when lives and well-being are at stake or when policies or programs are involved that affect many people or require large amounts of resources. Also, in some cases accuracy is expected as a matter of fact, such as in dissertations or in articles in prominent journals. In other cases, however, less accuracy is acceptable. For example, it would certainly be impractical to conduct a randomized group experiment in every cycle of a design-based research study. Likewise, it would be impractical to spend a large part of an organization's resources on answering a large set of evaluation questions with much accuracy. Instead, it might be better to focus on answering the most important evaluation questions with more accuracy and answering the less important evaluation questions with less accuracy. Accuracy and feasibility are often tradeoffs.

One aspect of accuracy is reliability – the degree to which measurements are consistent over time, situations, or raters. Having high reliability is important in some types of research and less important in others. For example, high reliability of measurements might be important when creating an instrument to predict success in a graduate program in educational technology, but it would be less important in the early stages of a design-based research study when several informal investigations are being conducted to gain insights into how an intervention can be improved.

Utility. Ideally, research should be "informative, timely, and influential" (Joint Committee on Standards for Evaluation 1994, 4). But, the import given to utility can vary across research traditions. For example, in formative evaluation the goal is to create information that can and will be used to improve educational programs or policies. The stakeholders need to be able to easily understand and use the evaluation information. In other types of research, like basic research, the utility of the research is expected in the future. Although the utility of basic research is latent, basic research has been shown to be an essential factor in a large proportion of major breakthroughs (Comroe & Drips, 1976). Also, what kind of evidence is considered to be actionable or useful varies across settings and audiences. Remember that the crux of the methods choice debate is deciding "when, or under what circumstances,

various methodologies provide the most useful, or actionable, evidence" (Julnes & Rog 2007, 2).

Propriety. Propriety, the degree to which the rights of individuals involved in research are protected (Joint Committee on Standards for Educational Evaluation 1994), is a critical dimension in all types of research. However, different types of research have different types of propriety issues. For example, meta-analytic research – research about research outcomes – generally does not involve propriety issues dealing with the treatment of human participants; however, it does involve other propriety issues involving complete and fair assessment, disclosure of findings, conflicts of interest, and possible fiscal responsibility. In other types of research, the ethical treatment of human participants is a critical factor in the choice of a methodology. For example, deciding on whether to use a randomized experiment or some other research design can hinge on the ethical issues involved. For example, Boruch (2007) puts forth a set of questions, which follow, to determine if a randomized experiment is ethically justifiable.

- *Is the social problem serious?* Is the answer is yes, then consider a randomized trial to evaluate the purported solutions. Otherwise a trial is not worthwhile or ethical.
- *Are purported solutions to the problem debatable?* If the answer is yes, then consider doing a randomized trial. If the answer is no, then adopt the purported solution.
- *Will randomized trials yield more defensible (less equivocal and unbiased) results than alternative approaches to estimating effects?* If the answer is yes, consider mounting a randomized trial. If the answer is no, then rely on the alternative approach.
- *Will the results be used?* If the answer is yes, then consider mounting a randomized trial. If not, forget about the trial, or redesign the randomized trial so that rights are protected. (56 – 57)

Feasibility. Feasibility, the degree to which research does not consume more time, money, or resources than necessary, is also an important consideration in research design. Some research traditions, like design-based research, are based on repeated, rapid cycles of investigation. And, therefore, it would be impractical, if not impossible, to do a randomized trial each iteration. In short, one has to weigh the costs of each type of research design with the benefits that could potentially come about. Also, what may be feasible in one setting might not be feasible in another.

Conclusion

In summary, there is no simple answer for which method is most appropriate for a given situation. As discussed above, there are many factors that influence methods choice. There are factors that influence the formation of the research question: (a) the research problem, (b) the purposes of the research and their corresponding

traditions, and (c) the state of the previous research. There are also factors that influence how a research question is answered: (d) the research act implied in the questions, (e) the feasibility of the research, (f) safeguards for propriety, (g) the degree of utility needed, (h) the degree of generalizability needed, (i) the degree of stakeholder participation in the research, and (j) the degree of researcher participation in the research setting, among others factors. For each research situation, the researcher must carefully weigh these factors together to finally decide on which research methods to use.

To aid in this process of considering and weighing the methodological factors mentioned here, at the end of this chapter I have included a list of key questions in methods choice. With hope, this list of key questions will be useful for helping student researchers think through the considerations involved in methods choice and as an instructional aid for those who teach or supervise students of educational technology.

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Key Questions in Educational Technology Methods Choice

1. What is the research problem that you plan to resolve?

2. Is there a social problem related to your research problem? Is so, what is it?

3. What is the primary purpose of your research?
    a. To develop an intervention.
    b. To answer questions important to local stakeholders.
    c. To answer questions important to the scientific community.

4. What type of research contribution do you intend to make?
    a. Contribute to an already established theory or line of empirical research.
    b. Help establish a new theory.
    c. Meet a practical need.
    d. Make up for a lack of needed information about a topic.
    e. Other.

5. If you are investigating a phenomenon, what is the state of theoretical knowledge about the phenomenon?
    a. There are no established theories.
    b. There are theories, but they are not yet substantiated.
    c. There are substantiated theories, but new theories need to be developed.
    d. There are substantiated theories, and they are sufficient.

6. If you are investigating a phenomenon, what is the state of empirical knowledge about the phenomenon?
    a. The important variables or the elements of a phenomenon have been identified.
    b. The associations between those elements or variables have been substantiated.
    c. The causal mechanisms regarding the phenomenon are clear.

7. Which of the previous studies are related to your research and how are they related? (A good way to answer this question is to create a research map.)

8. Who are the major researchers in your field?

9. What research methods were used in the previous research? (For example, you might answer this question by making a table in which you describe the following characteristics of the previous studies, as applicable: the research approaches, the methods of data collection, the methods of analysis, the variables examined, the settings involved, the participants involved, or other salient characteristics.)

10. What is your general research question and how does it relate to the research questions asked in the previous research?

11. What category of educational technology research question does your general research question fall into?
    a. Questions about theories and the practice of educational technology.
    b. Questions about research and development methods.
    c. Questions about technology implementation.
    d. Questions about the effectiveness of an intervention.
    e. Questions about the factors that moderate the effectiveness of an intervention.
    f. Other.

12. Which of the following research acts are implied in your research question?
    a. Identification.
    b. Description.
    c. Comparison.
    d. Correlation.
    e. Experimentation (causal description).
    f. Causal explanation.

13. To what degree do you intend for your research to generalize across participants, interventions (or phenomenon), outcomes, and settings?

14. To what degree do you intend to do exploratory or confirmatory research?

15. To what degree will you involve stakeholders in the research process?

16. To what degree will you (the researcher) be involved in the research setting or involved in the phenomenon being investigated?

17. How accurate do your findings have to be? (e.g., how many participants will you need, how many pages of transcripts do you intend to get?)

18. Who are the possible audiences for your findings and how will you disseminate your findings to them in a way to ensure that your results are timely, informative, and influential?

19. What safeguards are in place to ensure that your research is ethical?

20. What are the time and resources necessary to carry out your proposed research? (Create a budget and timeline, including estimated work hours.)

Jaana Kullaslahti

Competence required in online teaching

Introduction

Development of information and communications technologies (ICT) has constantly offered new opportunities for teaching and learning. The shift described by Tella (1997) from computer-based education (CBE) in the 1960's and 1970's to the era of network-based education (NBE) that started in earnest in the mid-1990's reveals the change in concepts used in the field. Even now, concepts relating to online teaching and their uses still vary. Tella (2001, 17) uses 'network-based education' to refer to teaching, studying and learning that is supported by or partially based on materials accessible through or available on information networks and on the Internet in particular. Subsequently, Tella and Ruokamo (2005, 6) have expanded the concept of network-based education to include network-based mobile education (NBME), i.e. the use of mobile techniques, technologies and applications for educational purposes. Other commonly used terms include 'online learning', 'e-learning', 'Internet learning', 'distributed learning', 'virtual learning' and 'web-based learning'. The terms 'distance education' or 'distance teaching' (e.g. Thach & Murphy 1995; Williams 2003; Egan & Akdere 2005; Darabi et al. 2006) and 'online teaching' (e.g. Goodyear et al. 2001; Spector & de la Teja 2001; Aydin 2005; Hampel & Stickler 2005) are most commonly used in literature focusing on teachers' competence in online education. 'Distance education' is a more traditional and extensive term, emphasising the distance between students and the teacher, whereas 'online teaching' highlights the use of information networks in education. These terms are used to describe the geographical separation of teaching and learning and the use of information networks in order to promote interaction between teachers and students, availability of materials and support for learning and teaching.

In the future, online education will form a constantly expanding part of education, which calls for teachers to acquire new types of competence. The WP2 subproject of the DLL research project has examined competencies required in online teaching and the development of teachers at universities of applied sciences as online teachers through surveys and biographies. In this article, I shall provide an overview of competencies required in online teaching. The empirical section will be published later as part of a doctoral thesis.

Teaching staff's competence as a national priority

The Finnish Ministry of Education (Opetusministeriö 1995; 1999a; 2004b) has published two national information strategies and complemented these with an information society programme with a view to promoting the introduction of information and communications technologies in the field of education, training and research. The first National Strategy for Education, Training and Research in the Information Society for 1995–1999 still focused primarily on equipping educational institutions with technical devices and networks and initiating continuing teacher training. The key priorities in terms of educational institutions in the subsequent National Strategy for Education, Training and Research in the Information Society for 2000–2004 included development of teaching staff's competence, as well as creation of institutional strategies for the educational use of ICT and assessment of the curricula that were effective at the time. The strategy also included national network projects, the Virtual School and the Virtual University and, later on, the Virtual Polytechnic. While the National Strategy still described teachers' competence in the educational use of ICT at a general level, this was specified in a related project plan by creating a three-step OPE.FI level model (Opetusministeriö [Ministry of Education] 1999b). The description of the levels was further clarified in the subsequent project plan (Opetusministeriö [Ministry of Education] 2002). The first step, OPE.FI I, covers basic ICT skills. This is the target level set for all teachers for 2004. The second step, OPE.FI II, is a target level at which teachers can use the skills that they have acquired to develop instruction, make use of learning materials available in their field and follow developments in and the social impact of information and communications technologies. This is the level of educational use of ICT that half of all teachers are required to master. The third step, OPE.FI III, is the level of specialised knowledge, which 10% of teachers should master. Teachers at this level have more in-depth command of the various opportunities for using ICT in education, while also being capable of advising and training their colleagues and producing diversified learning materials and processes. One of the objectives set out in the Information Society Programme for Education, Training and Research 2004–2006 is to make appropriate use of ICT in learning and in teaching part of everyday school life. The aim detailed in the 'Knowledge in the information society' programme section was for at least 75% of teachers to have obtained skills to use ICT in teaching by the year 2007.

Along with institutional information strategies and teachers' skills level requirements (OPE.FI), teachers' ICT competence has been charted through various surveys carried out at universities (Koski-Kotiranta & Kynäslahti 2003; Nevgi & Juntunen 2005, Lavonen et al. 2006), in municipal education services covering different levels of education (Ilomäki et al. 2001; Koivisto et al. 2000) and at universities of applied sciences (Koivisto et al. 2002; Kervinen et al. 2002). The OPE.FI levels (Opetusministeriö [Ministry of Education] 1999b) were initially described in quite a lot of detail, from the perspective of technical know-how in particular, whereas pedagogical competence was still outlined in general terms. This description method has also influenced the contents of various competence surveys, which have often focused on measuring individual technical competencies.

Professional expertise in terms of competence

Professional expertise has been examined in terms of both 'qualification' and 'competence'. However, these concepts are not used in the same sense (see Ruohotie 2005, 31; Ellström 1998, 40). Streumer and Bjorkquist (1998, 252) have pointed out that the different meanings of the two concepts are based on different approaches, such as psychology or economics, as well as geographical and historical backgrounds. As they point out, there have been changes in the usage of the concepts and 'competence' is now often used in lieu of 'qualification'. The more widespread adoption of the concept of competence into Finnish higher education and vocational education and training is related to development of the European Qualifications Framework (EQF) and the Bologna process in higher education, which was launched before the EQF (Commission of the European Communities 2006).

Dictionaries define the terms 'competence' and 'competency' as being interchangeable. They both mean the condition of being capable or qualified, i.e. ability, capacity or proficiency. Based on information searches, both terms are also used to describe online teachers' knowledge and skills. However, there is a subtle distinction between the terms and use of the terms is related both to the hierarchy of terms and to different points of departure underlying their definition (see Moore et al. 2002, for example). When using the term 'competence' (pl. competences), the starting point seems to be a holistic conception of an individual's ability to meet the demands of his or her job or function and of any changes to it. The term is thus used to describe an area of competence within a specific job or function. 'Competency' (pl. competencies), in turn, refers to a more narrow understanding and also to different elements of overall competence. This term is used to describe an individual's behaviour in terms of competent performance of a job or function. In this sense, competency can be expressed as various lists of individual skills and attributes that can be measured in detail, aiming to ensure adequate performance of work assignments. In other words, 'competence' is a broader and more complex concept than 'skill' or 'performance'. When defining professional competence, Kanfer and Ackerman (2005, 337) refer to an individual's optimal rather than typical performance: in other words, what the individual can do under the best possible circumstances. They define abilities, knowledge and skills, motivation, personality, and self-concept, including self-esteem and self-efficacy beliefs, as elements of competence.

In my study on competencies required in online teaching and development of teachers at universities of applied sciences as online teachers, the approach is based on teachers' own perception and vocational teachers' expertise is dealt with in terms of competence, which describes individual or collective abilities or qualifications to perform an online teacher's tasks and teaching work in changing ICT-based operating environments.

Roles and tasks as premises for competencies

Teaching in an online environment requires teachers to apply different skills and operating methods than computer-assisted education provided in the same place and at the same time. Spector and de la Teja (2001) have summarised the differences as follows. Online teaching activities are distributed, which means that participants are at different physical locations. Classroom instruction typically means that

everyone is at the same location at the same time. In terms of timing, online activities may be synchronous (simultaneous) or asynchronous (non-simultaneous), or both. Activities are mainly learner-centred and based on individual or collaborative work, compared with predominantly teacher-led classroom teaching activities that appear to be similar for all learners. In classroom teaching, information technology is mostly used for presentations and consultation. Online teaching activities make wider use of information technology; in addition to those mentioned above, IT is used for organisation and management, production and many-to-many interaction. Challenges presented for teachers in online education thus include many-to-many and technology-mediated interactions, several options in terms of temporality and types of activity and online tools, as well as distributed presence and activities.

Previous studies have mostly approached the competencies of online teachers through the roles and tasks necessary for online education and the competence required to perform these. In most cases, the point of departure has been definition of the requisite competencies for the needs of continuing teacher training or online teacher training programmes and their curricula. Perceptions of roles and competencies required for distance education at higher education institutions have been studied twice among US and Canadian distance education experts (Thach & Murphy 1995; Williams 2003) and once among US student-practitioners of distance education (Egan & Akdere 2005), using the Delphi technique and almost identical designs. These studies have been carried out approximately five years apart from one another. The first of these resulted in a competency model with ten core competencies at its centre. Half of these represented communication and interaction skills, including interpersonal communication skills, collaboration/teamwork skills, writing skills, feedback skills, and English proficiency. The remaining half were classified as technical skills, including planning skills, organisational skills, knowledge of the distance education field, basic technology knowledge, and technology access knowledge. These competencies were linked to what where identified as being four primary roles: instructor, instructional designer, technology expert and administrator. The outer circle of the model included the following seven supporting roles: remote site facilitator, support staff (responsible for timetables, registration, etc.), editor, librarian, evaluation specialist and graphic designer. This first study coincided with the introduction of the World Wide Web. Consequently, distance education at the time when this competency research was being conducted was still mostly based on traditional textbooks, handouts and correspondence materials, which were complemented with audio and video conferences, video and audio tapes and e-mail. Ally and Coldeway (1999) criticise the results of the study for remaining generic in terms of competencies, albeit that the important key roles had been clearly identified. They call for more specific competency definitions for the purposes of developing training programmes for distance education professionals.

The research conducted by Williams (2003) took place in 1999, when the Internet was also available to participants in distance education. The group of top ten competencies necessary across all distance education roles, i.e. the general competencies, changed to some extent. The study classified the general skills into the following categories: communication and interaction, management and administration, technology, and learning and instruction. The focus was still on communication and interaction skills, including collaboration/teamwork skills, interpersonal communication skills, English proficiency, writing skills and questioning skills. Of the technology skills, basic technology skills became more important, ranking second

just behind collaboration/teamwork skills, whereas advanced technology skills, such as engineering, became less important. The importance of competencies related to pedagogy – including knowledge of the distance learning field and skills in development of student-focused learning environments as a new competency – increased among the top ten competencies, while adult learning theory also moved up the list. A new management and administration competency that made the top ten list was knowledge of support services. New roles that emerged in the study included 'leader/change agent' and 'trainer', which are necessary for both organisational and individual change. The role-specific competencies considered to be very important were those related to the roles of instructional designers, instructors/facilitators, trainers and leaders/change agents. The study defined thirteen roles required in distance education. In practical terms, one individual can assume several roles and all of them should be fulfilled by staff members.

The most recent of the series of three Delphi studies (Egan & Akdere 2005) differed from the previous ones in terms of its expert group, i.e. student-practitioners, or distance education students already practising in the field. In terms of roles, the results were consistent with one of the previous studies (Williams 2003) in all other respects except for a newly emerging role of systems expert/consultant. In all, the authors identified 14 roles: administrative manager, instructor/facilitator, instructional designer, technology expert, site facilitator/proctor, support staff, librarian, technician, evaluation specialist, graphic designer, trainer, media publisher/editor, leader/change agent, and systems expert/consultant. The general competencies identified in the study matched 21 and 28 of those found in the first and second of the previous studies, respectively. There were a total of 21 general competencies common to all three studies. While the previous studies had stressed the importance of communication and interaction skills, the latest one emphasised technology competencies; 75% of student-practitioners assumed that the difference was due to the focus on technology competencies in their current training. This raised the question of the appropriate focus of distance education programmes in terms of competencies. Analysis of content-related trends in management and administration competencies reveals that knowledge of support services and knowledge of intellectual property, fair use and copyright regulations, consulting skills and change agent skills have emerged alongside planning and organisational skills. The areas that have assumed a more prominent role in the learning and instruction category include a student-focused approach and the relevant planning and functional skills.

Analysis and validation of the competencies of distance instructors in the United States Navy indicated that successful performance of pedagogical and logistical roles requires technological experience and genuine awareness of the significance of interaction in distance education. Consequently, the competency requirements specifically raised in the study included technological, interaction and logistical competencies and mastery of teaching content (Darabi et al. 2006). Applying the classification used in connection with the three above-mentioned Delphi studies (Thach & Murphy 1995; Williams 2003; Egan & Akdere 2005), the 20 competencies presented above can be outlined as follows. Technology competencies: use relevant technology effectively and accommodate problems with technology. Competencies related to communication and interaction: exhibit effective written, verbal and/or visual communication skills, create a friendly and open environment, facilitate productive discussions, employ appropriate types of interaction, ensure appropriate

communication behaviour within the given environment and foster a learning community. Competencies in management and administration: manage logistical aspects of the course, provide learners with course-level guidelines, identify when and how to use various methods of distance education, monitor learner progress and assist learners in becoming acclimatised to the given environment. Competencies related to learning and instruction: evaluate the effectiveness of the course, assess learner's learning based on stated learning goals and objectives, stimulate learner's critical thinking, provide timely and informative feedback, employ appropriate presentation strategies to ensure learning, encourage learners to become self-directed and disciplined in their educational pursuits and improve professional knowledge, skills, and abilities as necessary. (Darabi et al. 119–122.)

A workshop of US and European researchers and practitioners in online teaching identified the roles and tasks of online teachers and related competencies, arriving at the following roles: process facilitator, adviser/counsellor, assessor, researcher, content facilitator, technologist, designer, and manager/administrator (Goodyear et al. 2001). All these roles were considered to be involved in online teaching, but to varying degrees of importance in different situations. Workshop participants raised questions about whether all the roles and competencies were unique to online teaching and how they were coloured by certain philosophical values. They also saw similarities between skills required for traditional and online teaching. Consequently, the group feels that there is demand for more specific competency analyses to investigate the prerequisites for the success of online programmes implemented using different methods and tools.

In addition to those listed above, online teacher competencies have been examined in different roles, such as an online tutor (Reid & Newhouse 2004), a mentor (Aydin 2005) or a moderator (Salmon 2000), from the perspectives of the personal experiences and organisations of researchers and practitioners. There are also codes of conduct and lists of skills necessary for online teachers or tutors based on literature, previous studies or personal experiences (such as Smith 2005).

Discussion

Competencies necessary for online education may be examined either at individual or organisational level, in terms of an individual teacher's behaviour in a specific role or all those participating in online teaching as a team. As the competency studies presented above pointed out, one individual may assume several different roles, but most roles should be fulfilled by staff members. Individual teachers pioneering online instruction typically play several different roles. As provision of online education expands within an organisation and extends to cover programmes fully completed as distance education, this also requires differentiation of roles and possible specialisation among certain individuals. The importance and competencies assigned to different roles thus vary depending on the operating environment and the distance education models and technologies being employed.

Outlining the historical development of the relationship between technology and teaching forms the foundation for understanding online teaching competencies and their development. Technological developments do not necessarily replace the characteristics and user habits of prior stages of development; instead, these

can still be seen in today's practices. The content-related trends in competencies simultaneously reveal the emergence of more user-friendly, but also more extensive technologies. In terms of management and administration, aspects that have become more important include managing the 'big picture', organisation and guidance as part of alternating synchronous and asynchronous work and issues relating to intellectual property rights and data security. Likewise, interaction has diversified and management of it requires different skills in different environments. In terms of learning and instruction, a student-focused approach is critical, along with the teacher's proficiency in his or her own teaching field and its pedagogy. As Hampel and Stickler (2005) have pointed out, teaching foreign languages online, for example, requires teachers to have skills that are different from those required for face-to-face instruction and for online instruction in other subjects. When teachers are trained for online teaching, basic technology training is important but not at all sufficient, since other competencies also deserve more attention. Online education should also aim for teachers to find their own creative teaching styles, making use of the different opportunities provided by the web.

Previous studies have mostly approached the competencies involved in online teaching as groups of online teachers' roles and tasks and the skills, knowledge and attributes required to perform these. They do not necessarily indicate whether or how online teachers actually use these attributes. While the contextual nature of competencies has been raised as part of many studies, more specific descriptions of competencies required in different contexts are very rare. Approaches have, indeed, been mostly rationalistic. According to Sandberg (2000), an interpretative approach examines competencies in terms of perceptions constructed by individuals of their work based on their own experiences. These perceptions should also constitute the point of departure for identification, description and development of professional competence. My own research examines online teachers' competencies and their development both through questionnaire surveys and biographies. The main focus of my work is on an interpretative and holistic approach.

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Byoma Tamrakar

Intercultural Competencies in eLearning

Abstract

Intercultural competence today is at the core of researchers in the fields of communication, psychology and education, and for practitioners of business, diplomacy, development cooperation, and social and healthcare among others. A major sector where intercultural competence for practitioners in the field of education becomes a prerequisite is eLearning and online communities. Despite the numerous benefits eLearning systems can offer on a global scale today, difficulties can often occur when the eLearning systems are not designed with consideration to differences in characteristics of various learning cultures. Differences in learner characteristics often occur in terms of race, culture, ethnicity, nationality, gender and cognitive learning style in multicultural learning environments. Therefore, it is extremely important to prepare eLearning systems and online communities, which incorporate the elements of intercultural competence in order to make these systems more effective in multicultural environments. This article reviews what recent literature suggests on the features of intercultural competencies in general and attempts to outline the key characteristics of intercultural competence in preparing eLearning systems and online communities.

Keywords: *intercultural competencies, intercultural effectiveness, intercultural eLearning competencies.*

Introduction

As a consequence of globalization, multiculturalism is on the rise. With the steep rise of multiculturalism, there is an increasing need for people to be able to deal effectively and competently with the diversity of race, culture and ethnicity. In general terms, one's ability to deal effectively and appropriately with diversity is referred to as intercultural competence (ICC). Intercultural competence today is at the core of research in the fields of communication, psychology and education. It is also of extreme importance to the practitioners from the fields of business, diplomacy, development cooperation, and social and healthcare among others. One of the major sectors where intercultural competence for practitioners in the educational field be-

comes a prerequisite is online learning, popularly known as eLearning, and online communities. This is because Internet is described as a melting pot in which people of different races, religions, nationality, and abilities share experiences and skills with each other and learn from each other (McVay Lynch, 2004).

Concept of Intercultural Competence

Intercultural competence is a relatively new concept and there has been no consensus about it so far. The concept of intercultural competence is also referred to with different terms; some refer to it as multicultural competence while others call it cross-cultural competence. While these concepts can be viewed as having ostensibly similar and overlapping meanings, they can also be separated into different categories. The concept of cross-cultural competence tends to compare two cultures using similarities and differences whereas the concept of multicultural competence focuses on several (usually more than two) cultures existing side by side and deals with their basic psychological processes. The concept of intercultural competence among these three concepts emerges as the most dynamic concept as it mainly focuses on interactions between cultures at interpersonal levels (Landis & Wasilewski, 1999).

Other researchers have further identified various other terms and issues that relate to intercultural competence such as: cross-cultural adaptation (Kim, 2002), cross-cultural effectiveness (Kealey, 1989), intercultural effectiveness (Cui & Van Den Berg, 1991), cultural shock and intercultural competence (Wiseman, 2002), cultural adjustment (Benson, 1978), cultural communication effectiveness (Ruben, 1987), intercultural communication competence (Gudykunst, 2004; Gudykunst & Kim, 1997; Kim, 1991) and intercultural transformative process (Taylor, 1994).

There is a lack of specificity in defining intercultural competence presumably due to the difficulty in identifying the specific components of this concept but in simple terms and according to Chen and Starosta (1996), it can be defined as the abilities amongst people to interact and understand effectively and appropriately with others who have multilevel cultural identities and are ethnically, racially and culturally different from one another. Taylor (1994) defines intercultural competence as a transformative process whereby the 'stranger' develops adaptive capacity, altering his or her perspective to understand and accommodate the demands of the host culture effectively. As such, intercultural competence is not a result of something, but rather an ongoing, individual internal process. An interculturally competent person manifests increased affective, behavioural, and cognitive abilities such as empathy, adaptive motivations, ability to tackle alternative perspectives, behavioural flexibility, and person-centred communication. Thus, intercultural competence can be defined as transformation of learning and a growth process where an individual's existing, often implicit, knowledge is diversified to intercultural knowledge, attitude and behaviour. The learning and growth process allows individuals to incorporate intercultural knowledge into their high level cognitive schema. While some scholars incorporate certain set of features such as empathy, adaptive motivations, ability to tackle alternative perspectives, behavioural flexibility, and person-centred communication as the elements of intercultural competence, others also add elements such as technical skills, foreign language proficiency, and situational factors as additional elements to intercultural competence. However, some scholars also state

that intercultural competence does not comprise individual traits but is rather the characteristic of the association between individuals and that no prescriptive set of characteristics guarantees competence in all intercultural situations. Therefore, intercultural competence is contextual; it provides behaviours that are both appropriate and effective, and it requires sufficient knowledge, suitable motivations, and skilled actions (Lustig and Koester, 1999, 66).

Components of Intercultural Competence

Traditionally speaking intercultural competence or competence in general is often divided into three main components:

1. **Knowledge**: also known as cognitive factors
2. **Motivation**: also known as attitude
3. **Skills**: also known as competence in social relations and communication behaviour

Intercultural competence scholars consider Knowledge, Attitude and Skills to be the key components of ICC and each of these components alone is not sufficient to achieve intercultural competence.

Knowledge

Knowledge in the ICC context refers to cognitive information about the people, context, and norms of appropriateness that operate in a specific culture. The kinds of knowledge that are considered important in order to achieve ICC are culture-general and culture-specific. Lustig and Koester (1999) state that culture-general knowledge provides insights into the intercultural communication process abstractly and serves as a powerful tool to make sense of cultural practices regardless of the culture involved. Culture-specific knowledge includes information about the forces that maintain the culture's uniqueness and facts about the cultural patterns that predominate. Culture-specific knowledge also involves information about the specific customs that govern intercultural communication in the culture.

Many scholars also regard knowledge or awareness about one's own self and culture, popularly known with the term 'self awareness' as crucial to attaining ICC. In this context, awareness involves exploring, experimenting, and experiencing. Awareness about one's own culture facilitates understanding of other cultures. It is also considered reflective and meditative and it can in turn, be manifested in self as well as in others. Chen and Starosta (1996) state that higher the degree of both self awareness and cultural awareness, greater the intercultural cognitive competence of that person. Similarly, Fathi (1988) cites that the best way to train people who must deal with cultural differences might be to teach them about the characteristics of their own culture rather than those of others. The idea behind these admonitions, in practical terms, means those people who are aware of one's own cultural systems

and have the understanding of why and how they interpret events and experiences, are more likely to be able to select alternative interpretations and behaviours that are more appropriate and effective. Thus, knowledge component entails both culture-general and culture-specific knowledge, and self awareness schemata for achieving ICC.

Motivation

Motivation in this context is people's willingness to try to understand and adapt to the expected norms of the specific culture. Motivation refers to the overall set of emotional association of people like *feelings* and *intentions*. *Feelings* (Lustig and Koester, 1999) are people's emotional and physiological reactions to thoughts and experiences. Feelings of happiness, sadness, eagerness, anger, tension, surprise, confusion, relaxation and joy among many other emotions may occur in intercultural encounters. Feelings can also be accompanied with anxiety, perceived social distance, attraction, ethnocentrism, and prejudice. Feelings involve people's general sensitivity to other cultures and their attitudes toward the specific culture and individual of any given intercultural settings. *Intentions (Ibid.)* are people's goals, plans, objectives, and desires that focus and direct their behaviour. Intentions are often affected by stereotypes people have about other cultures and stereotypes reduces the number of choices and interpretations people are willing to consider. Feelings and intentions influence an individual's decision to interact with others on different levels. If people's feelings like fears, dislikes, anxieties etc. predominate their affect toward the other, they have negative motivation, and are likely to avoid interactions, even if they have the requisite knowledge and skills to perform. However, if people's interest and good intentions predominate their affect toward the other, they have positive motivation, and will seek out and engage in interaction with the other. Thus, while attaining ICC people should have curiosity and interest along with a positive attitude. In addition, people seeking to attain ICC should have the intentions and desire to break down cultural barriers and be ready to accept that all cultures have their own internal coherence, which they call the truth; that truth is plural; and that different cultures have different values.

Therefore, motivation component of ICC entails appropriate feelings such as eagerness and willingness to experience some uncertainty, and positive intentions, hence learning to reduce the negative influences and increase positive influences on the motivation to interact with people of different cultures.

Skills

Skills refer to behaviours of people while interacting in a specific culture in intercultural settings. Skills are the actual performance of those behaviours of people that are regarded as appropriate and effective. People in the intercultural setting can have necessary information (culture-general, culture-specific) and be self aware, and be motivated by appropriate feeling and intentions, but still lack the necessary behavioural skills to achieve ICC.

Over the years, various scholars have introduced numerous models to develop intercultural competence at personal levels. In many of these models, behavioural

assessment skills are emphasized as the key elements of the learning process of intercultural competence. In almost all behavioural assessment models, similar performances of the behaviours are accentuated. One of the most appealing among them is Jolene Koester and Margaret Olebe's (1988) Behavioural Assessment Scale for Intercultural Competence (BASIC), a guide to the very basics of intercultural competence, where various types of communication behaviour are meticulously described.

The BASICs of Intercultural Competence

The comprehensive model of intercultural competence called "BASIC" was developed by Koester and Olebe (1988), which is based on the work of Ruben and his colleagues (as cited in Lustig & Koester, 1999). The BASIC model of intercultural competence (cited in Lustig & Koester, 1999, 72) is elaborated on the culture-general level and eight components of intercultural competence skills are highlighted in this model namely; display of respect, orientation to knowledge, empathy, interaction management, task role behaviour, relational role behaviour, tolerance for ambiguity, and interaction posture. This model moves beyond the standard delineation of skills, knowledge, and motivation and notes the elements that are not mentioned by others, such as respect, task role behaviour and interaction posture. The model also contains elements noted by many other scholars of intercultural competence including empathy and tolerance for ambiguity. The details of the BASIC model are given below.

Display of Respect

Displaying of respect refers to acting respectfully despite the fact that specific words and body language of displaying respect differ from culture to culture. The action of displaying respect is considered an element that increases the likelihood of a judgment of competence. Display of respect for others is a culture-general concept and each culture has its unique way of displaying respect to others. What is considered respect in one culture might not necessarily be regarded as the same in other cultures. Respect can be shown in verbal and non verbal manners. While displaying respect, it is recommended to use the language that can be interpreted as expressing concern, interest and understanding of others, formality in language, including use of titles, absence of jargons, and an increased attention to politeness. These actions generally convey respect in most cultures. Nonverbal display of respect is showing attentiveness through the position of the body, facial expressions, and the use of eye contacts in a prescribed way. Furthermore, a tone of voice that conveys interest in the other person is also recommended as a means to show respect to others. Therefore, with the concept of display of respect, it is recommended to have the general ability to show respect and positive regards for another person.

Orientation of Knowledge

Orientation of knowledge refers to the understanding that our knowledge of others is framed by our cultural experiences; our personal attitudes and opinions are not universal facts. While learning a new culture, people develop feelings of

'rightness' of a particular way of seeing events, behaviours, and people. People then tend to think and behave as if their personal knowledge and experiences are universal. Therefore, with the concept of orientation of knowledge, it is recommended for people to have an ability to move beyond the perspective of one's own cultural framework and demonstrate actions that all experiences and interpretations are not universally shared by others but rather individual and personal. Statements such as "This entire Muslim world is…" or "All Finns are…" are examples of cultural biases and are a sign of poor intercultural competence.

Empathy

Empathy refers to communicating our awareness of the feelings and thoughts of others, and the skills to behave as if one understands the world as others do. Empathetic behaviours include verbal statements that identify the experiences of others and non verbal codes that are complementary to the moods and thoughts of others.

Interaction Management

Interaction management skills refer to regulating as well as taking turns in conversations. These skills instigate the behaviours that involve the initiations of ideas related to group problem solving activities. Interaction management skills entail the know-how of turn taking both verbally and non-verbally.

Task Role Behaviour

Task role behaviour refers to welcoming ideas in group problem-solving activities such as initiating new ideas, requesting further information of facts, seeking clarifications of group tasks, evaluation the suggestions of others and keeping the group on the task at hand. Task behaviours are strongly intertwined with cultural expectations, and task expectations defer from culture to culture. Therefore, recognising the link to a culture's underlying patterns and being willing to acknowledge that tasks are accomplished by cultures in multiple ways is recommended.

Rational Role Behaviour

Rational role behaviour refers to building relationships with group members by encouraging participation and mediating conflicts. Rational behaviours comprise of verbal and non verbal messages that demonstrate support for others and help solidify feelings of participation. The recommended behaviours under rational role behaviour are harmonizing and mediating conflicts between the interacting members, encouraging participation from others, general display of interest, and willingness to compromise one's position for the sake of others.

Tolerance of Ambiguity

Tolerance of ambiguity refers to responding to new situations with comfort, without being defensive or judgmental. With tolerance of ambiguity, having the ability to cope with nervousness and frustrations when interacting in new and unclear situations and having the ability to adapt quickly to changing demands is recommended.

Interaction Posture

Interactive posture refers to responding in non-evaluative and non-judgemental ways to others' attitudes, beliefs and values. Non-evaluative and non-judgemental are characterised by verbal and non-verbal messages, which should be based on the descriptions rather than interactions and evaluations. Therefore, it is crucial while interacting in an intercultural setting to select messages that do not convey evaluative judgements.

Intercultural Competence in eLearning

One field in which intercultural competence plays a vital role both as a requirement for the effectiveness of the system as well as a result of the system is the field of eLearning. eLearning is a growing trend with increasingly more people using the Internet as their medium of education and to connect with people from multiple races, religions, nationalities and abilities. It has enabled people to bridge the gap between race, culture, religion and gender while allowing them to share their ideas and experiences, and to learn from each other.

Ample literature is available on the causality of intercultural competence through eLearning. However, literature focusing on the prerequisites of an effective eLearning system so as to make it appropriate and effective to learners from all racial, religious, ethnic and cultural backgrounds seems to be lacking. McVay Lynch (2004) touches upon the subject. In her book titled, "Learning Online", she encourages people to regulate discourse on ethics of treating others with respect, sincerity and fairness in the context of intercultural competence and eLearning. This only forms the foundation for requirements that demand attention while creating effective eLearning systems. Much research still needs to be done in this field.

McVay Lynch describes eLearning intercultural competence in terms of personal ethics and encourages online educators/learners and communities to treat others with respect, sincerity and fairness. While emphasizing the basic components of ICC she further touches on the issues like Language, Netiquette, and Silences and Humour as key elements of behaviour assessment skills for obtaining eLearning intercultural competencies. Furthermore, McVay Lynch emphasizes the ethical issue of respect for each individual as paramount for the effective operation of online learning and online communities. To ensure that ethical respect, people are encouraged to focus on the codes such as: a) the unacceptability of lying; b) the amount of self disclosing required; c) judging the borderline between controversial and offensive; and d) how to handle conflict. According to McVay Lynch, to become

an interculturally competent person in the context of eLearning one should have the following attributes.

Language; Native and non native speaker

Language is the means of communicating ideas, beliefs, values and feelings. Although the Internet offers the opportunity to learn any given courses in many different languages and cultures from around the world, English continues to be the most common language within the available online learning settings. Even with the common language of English, there are large variations in its use in various parts of the world, which cause problems in online learning. The problem is usually magnified if the online learners of communities consist of native and non native speakers. Therefore, the following assessments are recommended while interacting with the non-native speakers.

- Use uncomplicated language and clear explanations.
- Write clearly and avoid slang and idioms.
- Summarise what each person has written to assure that you have understood.
- Clarify and confirm that your explanation has helped the participant understand.
- Check for understanding avoiding "Yes/No" questions.
- Pause longer when waiting for responses; allow time for each person to reply. Pause time varies in cultures. If pause time is neglected then it is the same as interrupting the other person.
- Allow non-native speakers to finish their sentences by themselves.

Language fluency does not equal cultural fluency and neither is it a reflection of intelligence.

Netiquette

Netiquette in this context refers to the ground rules to guide how to interact with online teaching/learning and communities. Netiquettes are usually established within each online course. While establishing an online course or community, it is recommended that netiquettes should address how participants identify themselves, the community mode of operation and style of communication (formal/informal), and frequency of participation which will help reduce the chances of offending others by overstepping on unknown boundaries. In addition, taking into consideration the depth of cultural beliefs and ethics around some specific rules are recommended. In some cultures, written texts are seen as fixed form of expression

and are of importance and worth reading. In such cultures, higher the status of the author, lower the expectation of it being challenged. In such situations, producing a paper based on personal opinion can be uncommon and students are likely to rely on the collective opinions and choose not to participate in discussions believing that their opinions will not be valued. Therefore, if such situations arise, people are recommended to point out the required cultural norms within the required communication of online group. This can be done by adopting the following actions as example and/or explanation.

- Contradict someone politely.
- Join the conversation.
- Draw attention to common points of view.
- Come to a conclusion.
- Depersonalise opinions and arguments.

Silences

It is stated that in online intercultural interactions, silences can occur in the form of text where certain topics are avoided or in the form of irregular contribution of messages to the discussion board. These silences can mean disapproval, approval, neutrality, an admission of guilt, or a sign of incompetence. In some cultures (Asian), silence can be considered as a sign of respect for the expertise of others or of displeasure, while in other cultures, silence can mean a respectful distance from strangers. With online interactions, silence can represent the following features as well.

- Too busy.
- Not present for the moment; holiday, illness, pressure or work.
- Following along just fine.
- Having difficulties.
- Waiting to be called upon.
- Uncomfortable in responding to something with which the person disagrees.
- In a position where a person feels there is nothing appropriate to say.
- Waiting for a difficult situation to cool down before responding.
- Taking time to carefully word what to say.
- Unable to access the course.

If silences occur in online interactions, people are recommended to ask their online student or online mate to reply, or to give reasons for their silences on a regular basis. Tactfully explaining why the subject is being raised is recommended.

Humour

Humour is mostly culture, language and individual specific and within any specific culture, people's level of comfort with humour defers. Some humour can be appropriate in one culture and completely inappropriate in another culture hence cau-

sing difficulties in intercultural interactions. Therefore, considering the following points before interposing humour into online communities is recommended.

- Does the humour rely on jargon?
- If ridicule is part of humour, is it self-depreciating? Free of implications for the others in the group?
- Use at appropriate times and not in the middle of serious dialogue.
- Pay attention to the reception of humour.
- "He he" or "lol" are indicators of good reception.
- If no such response is received, better ask than assume if the other person is offended.
- Use humour with intent.
- To develop comfort zones in groups, warn ahead of time about one's style of humour to avoid awkwardness.
- Hurtful or misinterpreted humour is not funny; admit your mistakes and apologise.
- Use emoticons or parenthetical statements to make sure the readers are clear you are making a joke or using humour.

As is evident from the above paragraphs, ICC has a wide scope and can be interpreted in a variety of ways. Furthermore, its applicability and implications in relation to eLearning is widespread. Thus, learning to be interculturally competent to at least a certain extent is imperative in today's world.

Learning to be Interculturally Competent

It is commonly acknowledged that contact and experience with people from other cultures in positive settings enhance and foster ICC, reflecting on the idea of contact hypothesis: the more one is in contact with other cultures, the more one knows and the better one gets in intercultural encounters. However, an individual's reaction to the process of intercultural learning might vary from person to person. Some may find this process extremely stressful and overwhelming and thus may start to develop various kinds of maladaptive adjustments, while others might find it interesting and start to have a profound respect for many varied points of views and in turn be able to better understand others, communicate appropriately and effectively. Therefore, intercultural learning is a developmental process which is individually centred; stages of development of this process are determined by each individuals' attitude towards differences between their own culture and the new culture they are associating with. In this context, Bennett (1993) has introduced

a model called 'The Developmental Model of Intercultural Sensitivity (DMIS)' as a framework to explain the reactions of people to cultural differences. According to Bennett, people confronted with cultural differences react in some predictable ways as they learn to become interculturally competent. He refers to this subjective experience of difference as 'Intercultural Sensitivity', a developmental phenomenon that can be described in terms of six alternative stages. Bennett's model was based on observations and interactions with individuals who were in the process of learning ICC. The model defines culture as any group with a set of similar constructs. Therefore, the intent of the model is not limited to racial, cultural, and ethnic diversity; all forms of diversity and differences among individuals may be included in this definition.

The basic assumption of the DMIS model is that one's experience of cultural difference becomes more complex and sophisticated as one's competence in intercultural relations increases. Each stage of this model indicates a particular cognitive structure that is expressed in certain kinds of attitudes and behaviours related to cultural differences. By recognizing the underlying cognitive orientation toward cultural difference, predictions about behaviours and attitudes can be made and education can be tailored to facilitate development into next stage. DMIS is divided into two major stages; *ethnocentric* and *ethnorelative*, and both stages incorporate three states each.

Ethnocentric stages

In the DMIS model, the first three states belong to the *ethnocentric* stage, where one's own culture is considered as central to reality and it is the frame through which one perceives and interprets other cultures. In these states, cultures are understood and evaluated on the basis of monocultural perspective.

Denial of cultural difference is the state in which one's own culture is experienced as the only real one and other cultures are avoided by maintaining psychological and/or physical isolation from differences. People at this state are not interested in cultural differences and might act aggressively to eliminate a difference if it impinges on them.

Defence against cultural difference is the state in which one's own culture is seen as the only good one. This state is marked by the 'us and them' mentality where 'we' are superior and 'they' are inferior. People in this state are threatened by the cultural difference and therefore they are highly critical of other cultures regardless of whether the other culture is being the host, guest or new.

Minimisation of cultural difference is the state in which elements of one's own cultural worldview are experienced as universal. People at this state expect similarities in worldviews from others and they may become insistent about correcting others' behaviour to match their expectations.

Ethnorelative stage

The second stage of DMIS comprise of *ethnorelative* states, which mark an important paradigm shift to the view that cultures can be best understood in their own context and are thus relative to one another. They cannot be either interpreted or judged in any meaningful way from a solely monocultural perspective.

Acceptance of cultural difference is the state in which one's own culture is perceived as just one of the various complex worldviews. Here acceptance does not mean agreement, where cultural difference may be judged negatively but not ethnocentrically. People in this state are curious and respectful towards cultural differences.

Adaptation to cultural difference is the state in which the experience of another culture yields perception and behaviour appropriate to that culture and ones' worldview is expanded to include constructs from other worldviews. People at the adaptation state are able to look at the world through different eyes or perspectives and intentionally change their behaviour to communicate more effectively in another culture.

Integration of cultural difference is the state in which ones' experience of self is expanded to include the perspectives of different cultural worldview. People at the integration state often deal with the issues related to their own cultural marginality. This state is common among non-dominant minority groups and global nomads.

With the DMIS model, Bennett conceptualises 'Intercultural Sensitivity' as a continuum ranging from an ethnocentric perspective to a more ethnorelative world view. The model implies a developmental progression in an individual's awareness and understanding of cultural difference but Bennett states that "it does not assume that progression through the stages is one-way or permanent" and that "each stage is meant to characterize a treatment of cultural difference that is fairly consistent for a particular individual at a particular point of development" (Bennett, 1993, p. 27).

Similarly, Kim and Ruben (1988) refer to ICC learning process as a process of 'Intercultural transformation' where people transform from cultural to intercultural and move beyond the thoughts, feelings and behaviours of their initial cultural framework to incorporate other cultural realities. They describe this process as "a process of growth beyond one's original cultural conditioning." One of the consequences of extensive communication experiences and the internal transformation that results from is the development of a cultural identity that is dynamic and thus open to further transformation and growth. In other words, an intercultural person's cultural identity is not "frozen". Kim and Ruben explain that this does not imply a culture-free or cultureless identity but rather a dynamic one that is not bound by a membership to any particular culture.

Another consequence of intercultural transformation comes in the form of a cognitive structure that enables broadened and deepened understanding of human conditions as well as that of cultural differences; the resulting view of things is larger than the one provided by any single cultural perspective. Kim and Ruben argue that "the increased cognitive depth and breath is, in turn, likely to facilitate corresponding emotional and behavioural capacities as well".

Overall, the process of intercultural learning is an intense one for numerous reasons and its content can be difficult to grasp. Firstly, it requires learners to reflect upon matters with which they have had little firsthand experience. Secondly, unlike more conventional approaches to education, which tend to emphasise depersonalized forms of cognitive learning and knowledge acquisition, it includes highly personalised behavioural and affective learning, self-reflection, and direct experience with cultural differences. Thirdly, "learning-how-to-learn", a process-oriented pedagogy, replaces learning facts, a product-oriented pedagogy, as a major goal. Fourthly, intercultural education involves epistemological explorations regarding alternative ways of knowing and validating what we know, i.e. the meaning of truth and reality (Paige, 1993, 3).

Additionally, becoming interculturally competent demands a wide range of culture-general knowledge from peoples' behavioural repertoires and people are also required to apply that knowledge to the culture that they interact with. People also have to be emotionally and skilfully responsive with various ranges of choices in order to act competently depending on the limitations of any given situation. They also have to have extensive intercultural interaction experiences and have the know-how of adjusting to different patterns of thinking and behaving.

Conclusion

Literature and models developed by various scholars on attaining ICC is plentiful. Although not much literature is available on the required competencies focusing particularly on eLearning systems, the various approaches and models that are available and discussed in this article together serve as the basic guidelines in preparing eLearning frameworks. Nevertheless, it is important to remember on the outset of attaining intercultural competence, that developing intercultural competence at a practical, day-to-day level is a major challenge for learners and educators alike and to become a thoroughly interculturally competent person might be an impossible mission. However, the most important thing is to realize that learning intercultural competence is a multifaceted, on-going and life-long learning process. During this learning process, people might experience moments of regression and stagnation but they have to bear in mind that it is always an on-going process. It will enable them to keep on developing and expanding their competence; there might still remain challenges but the process will also be enriching as well as rewarding.

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Jorma Saarinen

Interactive Educational Technology

Abstract

Demand for pedagogically sensible use of interactive educational technology seems to be increasing all the time, in place-independent adult education in particular. Online learning calls for new types of interaction and guidance in education, while also requiring students to exercise strict self-regulation. A traditional learning platform constitutes the core of the learning process, around which users build processes containing diverse synchronous and asynchronous media elements. The Digital Learning Lab (DLL) research project paid particular attention to the use of interactive synchronous educational technologies. Good learning outcomes were achieved through solutions such as Internet telephony included as part of a learning platform, including teamwork features. Use of a web-conferencing system turned out to be a superior technical solution in many respects, not only due to synchronous interaction, but also because of the possibility to record and subsequently review teaching sessions. Based on research findings, it seems that actual video conferencing is falling behind as a form of educational technology, because high-quality transmission of supplementary material would require another system anyway. Research also indicates that a lecturer's still image or a small web camera image is sufficient to humanise interaction in most cases. Current web-conferencing systems are already quite good technologies for synchronous interaction, but further development work is still required, in order to increase flexibility of moderation and team working methods and to improve good guidance practices in particular.

Time- and place-dependence of educational technology

The role of educational technology in learning has increased considerably in recent years. Its progress seems to be continuing and even picking up pace. (Kujala et al. 2006.) In this article, educational technology refers to those learning tools and methods that provide extensive and diverse study opportunities and a wide variety of interaction and guidance tools and methods without strict dependence on time or place.

Based on time- and place-dependence, a learning event may be divided into the following four groups:

1. Place and time dependent learning
2. Place-dependent but time-independent learning
3. Place-independent but time-dependent learning
4. Both time- and place-independent learning.

Place-dependent but time-independent learning refers to situations where the subject being studied requires heavy-duty hardware, such as simulators, in order for learning to take place. The learning event is primarily based on a cognitive learning approach, where students resolve cognitive conflicts through independent exercises. However, time-independence is limited in the sense that students need to schedule a specific time slot for their studies.

Place-independent but time-dependent learning means learning opportunities organised such that students can follow expert lectures, for example, and be in direct interaction with the lecturer without having to travel to the lecture venue. Such teaching arrangements have been employed as one-way events ever since the radio became prevalent in the early 20th century. In the early years in particular, interaction was organised via postal correspondence. Later on, it may have been accompanied by systems enabling faster interaction, such as use of the telephone as a return channel.

With the introduction of online lectures on the Internet, this teaching arrangement has made a comeback. The reason why this method attracts interest may be that it is most reminiscent of safe and familiar classroom instruction.

Both time- and place-independent learning is most strongly based on a constructivist learning approach, where a teacher steers students into the learning situation in such a way that they will independently seek solutions to problems and build their own knowledge of the topic. This makes it possible for learning to take place both in a classroom and outside the constraints of available room space and official timetables. However, even this will often involve time-dependence at the beginning of studies and at the end with tests arranged to assess learning.

At present, good teaching arrangements often involve several of the above-mentioned forms of learning that are different in terms of time- and place-dependence and simultaneously based on different learning approaches. There is thus no need to examine the dimensions of time- and place-dependence in terms of orthodox learning events, but because they illustrate different dimensions of research into educational technology.

The elements of online instruction can therefore be used both to enrich classroom instruction and as part of processes that are fully implemented as distance learning.

According to Nevgi and Tirri (2003), online instruction differs from direct contact instruction in that it enables time- and place-independent interaction between the student and the teacher. They state that 'open learning environment' is mostly used as a term referring to instruction that is based on a constructivist learning approach and makes use of information and communications technologies (ICT) and, in particular, information networks. This means a working and learning environment where students can study at their own pace. Adapting Moore's (1989) division, however, Immonen (2001) distinguishes between three types of interaction: learner-content interaction, learner-instructor/teacher interaction and learner-learner interaction in online learning. Each type of interaction has its own distinct characteristics. Yli-Luoma (2005) in turn emphasises the significance of reflection on what has been learnt, where feedback received by the learner may play a major role. Ruokamo and Pohjolainen (1999) point out that meaningful learning is intentional. What they mean by this is that learning is bound to each learner's own goals and objectives. This process can be supported through contextual and situational learning, so that learners can get involved in the most realistic and practical situations and problem solutions possible. This also enables a high degree of transferability of the content learned to practical workplace contexts.

Based on their study of experiences among online students at Open University, Mannisenmäki and Manninen (2004) have established that online study requires students to exercise strict self-regulation, be active and possess metacognitive skills, because they are the ones responsible for their own progress. Nevertheless, students found the quality of learning in online instruction even better than in traditional face-to-face instruction. According to them, online students are often physically alone in a space. The most common reason for dropping out of online courses is, indeed, the loneliness of online learning and the lack of guidance. This is why it is useful to organise a face-to-face meeting before the course, where students can see each other and check any issues that may be bothering them. Such a face-to-face meeting is also an effective way to support students' team formation process.

The traditional learning platform

The so-called traditional learning platform is usually the most familiar tool to everyone involved in planning online studies. The platform is used to store the materials and link libraries that are required for studies. Interaction with students usually takes place through asynchronous messages or, less frequently, synchronous keyboard chat. Since there are few contact classes, the teacher includes learning assignments intended for independent study as part of the learning materials. Conversely, those teachers who post interactive learning assignments on the learning platform are as yet few and far between (Kujala et al. 2006).

According to Järvelä (2004), in order for studies to become meaningful, interesting and appealing, interaction should take place at all of the three above-mentioned levels. The latest tools developed for the traditional learning platform make it possible to increase interaction between students through working in small groups or teams. The Wiki tool, for example, allows a small group to work on a joint assignment by adding to and editing the same Wiki document almost simultaneously. Keyboard chat is also used for collaboration to some extent. Matikainen (2003) cites discussions on online forums and video conferencing between participants as examples

of asynchronous and synchronous communication, respectively. He suggests that online interaction is characterised by the absence of social cues, which means that what gets through to the recipient is only the factual content of the message without any non-verbal gestures or other cues. Soila (2003) emphasises the significance of interaction to learning in all learning approaches, since learning is created in interaction with the environment. Indeed, almost all types of online instruction have made use of either asynchronous or synchronous interaction. However, unplanned and unorganised online discussions do not serve learning objectives, since only a planned and organised online discussion brings any added value to instruction.

Performing interactive learning assignments, where interaction takes place between the learner and the material, requires specialised IT competence that teaching staff only seldom possess to a sufficient extent. When assessing the technical and pedagogical usability of digital learning materials in the traditional sense, people often speak about operating on the learner's terms, the capability of the material to activate learners or collaborative learning (see Nokelainen 2004). The feature common to all these criteria is interaction.

When considering what other ways there are to introduce more synchronous interaction between students to the traditional learning platform, the opportunity to use voice comes to the fore. Since a regular telephone is a clumsy device for this purpose, the DLL research project started to study voice transmitted over the Internet Protocol (VoIP) by means of packet switching. Internet telephony can only seldom be integrated into the traditional learning platform, which is why the connection is usually established using separate voice applications. This study and its results will be discussed below in more detail.

Media elements in asynchronous learning material

Factually speaking, media elements are modes and methods of communication. As a general rule, media elements should be used richly, while already considering and weighing up in advance during the scripting phase why each particular media element is used in a specific context. The purpose of the chosen medium is to communicate the matter to the recipient as effectively as possible. A media element chosen recklessly as an end in itself may become the main focus of the message, while communication of the actual core content is pushed to the background.

Making diverse use of media elements requires good IT skills. According to Karjalainen (2003), teachers feel that organisation of online courses is problematic if they perceive their IT skills as being weak. Tella et al. (2001) also indicate that the teacher's extensive media skills assume a key role in online instruction. Skills-related problems are generally perceived as being more substantial than technical and pedagogical ones. People should be able to use their skills continuously, so as not to let them slip their minds. The most frequently cited pedagogical challenge is the heterogeneity of students.

Media elements are commonly divided into eight types: text; hypertext and links; images, graphics and drawings; visualisation; audio; video; animation; and databases.

The first two are probably still the ones most commonly used in learning materials. They are easy to use when teachers simply want to upload materials to the network. However, this is not enough for a high-quality interactive online course. Student feedback has been found to include criticism about text pages that are too long, which make for a mind-numbing read on a computer screen. A text page and its links should therefore be divided into smaller sections and large masses of text should be replaced with other media elements.

The next three media elements – images, graphics and drawings, and visualisation – are more diversified compared with text-based media elements, making online learning materials illustrative and lively. Nevertheless, people are often guilty of using images and drawings on websites that are just too large. In practical terms, this unnecessarily slows down and impedes loading the pages, needlessly consuming the data communications capacity available to students. Several research findings indicate that use of large images is due to the misconception that a large image opened in an editor when creating a web page will become smaller by scaling. This is actually what seems to happen on-screen, but the original large image file still remains in the background. The only proper way forward with this is to change the number of pixels in the image to an appropriate size using image processing software. Even now, although computer displays have generally improved, no image should exceed 640 × 480 pixels without a special reason. The image compression format also affects the file size. The format commonly used in photographs is the JPEG image compression format that displays 16.8 million colours. The more precise you want the image to be even when compressed, the larger the file size is going to be. For drawings, 256 or less is an ample number of colours, which means that the sharp-toned Graphics Interchange Format (GIF) is the most appropriate image compression format for this purpose.

The next three media elements – audio, video, and animation – are more diverse than those mentioned above and work to illustrate online learning materials. Indeed, people often say that one picture is worth a thousand words and one good animation is worth a thousand pictures. Observations show that audio is the most sensitive of these elements, posing the highest number of production, quality and reproduction problems. A typical audio element in offline learning material is the sound of the original activities, the soundscape or the presenter's commentary. The safest way to compress an audio file is to use MP3 format because of its relatively small file size and good compatibility with different sound-reproduction systems. If the subject is recorded on video, the media element will either consist of moving pictures only or both the video and original audio in sync. In practical terms, there are three compressed video formats that work on websites: Windows Media, Real Media and QuickTime, which all have viewers (media players) that can be downloaded free of charge. Therefore, the website designer needs to indicate in advance the media format used in learning materials in order to avoid giving students in the middle of their study sessions nasty surprises. The best form of service is for the website to provide each video element in all three formats. Animation, in turn, is literally a simplified moving diagram of the subject being studied. In practical terms, there are two animation formats working with online materials, namely, RealNetworks and Macromedia Flash. In order to function, both require a free plug-in to be separately installed into the computer browser. Macromedia Flash animations have recently become the de-facto standard in learning materials. Students have also given positive feedback on their ease of use.

The most versatile and extensive media element is a real-time database. The most descriptive example of an online database is probably a stock management system that constantly keeps track of products in stock at any given time. The use of a database for learning materials is often inconspicuous. The properties of a database application can be cleverly used for tasks such as interactive exercises and selection of new assignments according to each student's progress and learning needs. A common database application used on websites is PHP. It requires website designers to have programming skills, but students or other users do not necessarily even notice that they are using a database with their browser.

Synchronous interaction and guidance

Online instruction differs from traditional face-to-face instruction in many ways, raising educational guidance and student counselling front and centre. According to Mannisenmäki (2003), literature presents synonymous titles for an online teacher, such as 'instructor', 'trainer', 'mentor', 'facilitator' and 'coach'.

As mentioned above, almost all learning platforms contain at least one synchronous interaction tool, the chat feature, which can be used to facilitate learning. However, its role has remained relatively modest, because keyboard chatting has turned out to be slow and awkward. In practical situations, the conversation has already moved to another topic before all participants have finished adding their comments. The messages also disappear when users exit the chat. This is why the benefit of synchronism remains relatively minimal, or even nonexistent, compared with asynchronous discussions.

Mänty and Nissinen (2005) suggest that technical instruction should also be included as a key part of educational guidance, in the early stages of study in particular. People should be able to deal with any emerging problems quickly. In the worst case scenario, lack of technical support may cause a course to fail, even if it is well planned and implemented in all other respects.

The project studied the use of chat in interactive teaching situations among a group of university students (n=14) in the autumn of 2005. A three-hour chat session based on advance reading material turned out to be an effective but also strenuous interactive event. The conversation tended to unwittingly move on to a new topic too fast, so that messages were in a very illogical order when analysed retrospectively. When stored, the chat teaching session generated more than 60 pages of dense text. The stored text, annotated with the instructor's comments, was made available for students on the learning platform. The general message of the feedback discussion was that this was a good experience but that participants would not apply it to their own instruction to this extent, at least not right away.

A new synchronous interaction tool introduced to certain learning platforms (such as Moodle) is Wiki, which allows students to compile a joint document, such as a report on a learning assignment, as teamwork in small groups on an almost online basis. The usability of Wiki as a Moodle tool was studied in the autumn of 2006 with two student groups studying for the Bachelor of Business Administration degree on the Degree Programme in Business Information Technology. The young students' group (n=22) carried out collective course assignments in teams made up

of 4–5 participants. In the feedback discussion, they scored Wiki's ease of use quite low. Document layouts did not work as desired, extra characters appeared in the text and several lines of previously written text could suddenly vanish when another team participant saved his or her own changes. The participants pointed out that the tool's basic idea was good, but that its technical implementation was still badly incomplete. Nevertheless, these students mostly considered online learning in small groups to be as good as (31%) or better than (50%) classroom learning. Almost two thirds (62%) felt that working in small groups online enhanced the results of work or clearly exceeded expectations.

The adult learners' group (n=17) was also interested in working on other team assignments using Wiki at the beginning of the course, but their interest waned after the initial introduction. The adult group's feedback discussion also revealed reservations towards Wiki, even though one of the small groups did use it more fluently than the rest. These examples indicate that Wiki is not an actual interaction tool, nor will it become one. Its properties are at their best when an entire student group works on a joint output and participants take turns to write their own contributions to the joint document.

Polling tools built for synchronous interaction in face-to-face teaching sessions and public events include a system known as Response. It has been used over the course of a few years in events such as the ICT in Education conference in Hämeenlinna and as part of some TV programmes to collect viewers' comments. The system functions such that questions are first written on a computer and then displayed onscreen for the audience, using a data projector. Respondents then point their polling handset towards an infrared receiver located in the room and push the number of the option that matches their own opinion. Once the response time is over, the response distribution will be immediately displayed on the computer screen and projected on the projection screen as a graphical representation. This makes interaction with the audience or students fast and synchronous. The applicability of the system to educational purposes was studied at the Staff Days seminar at HAMK University of Applied Sciences in 2006. After the seminar days, teachers were given a survey asking how they would find using the system for their own teaching work. The responses (N=225) indicated that there would not be much use for the system in education once the novelty had worn off. Respondents felt that, compared with other feedback collection methods, the system was only better for collection of feedback from mass auditorium events, but that traditional systems were more suitable for course feedback surveys.

Since there is a distinct need and demand for synchronous interaction in online learning, we will next examine audio- and video-based synchronous online interaction systems studied as part of the DLL research project and experiences gained from these.

Audio systems

Voice chat over the Internet Protocol (VoIP) is attractive because the applications are available free of charge. The required computer accessories are inexpensive and there are no extra communications costs, provided that the user already has a sufficient broadband connection. As part of DLL research, project participants drew

up user instructions for audio systems based on good practices and tested auxiliary devices best suited to different situations. In order to enhance VoIP use, 300 'Internet headsets' – i.e. headsets with one earpiece and a microphone arm – were handed over to HAMK staff during the summer of 2005. Based on user experiences, leaving the other ear free was a good method, because it did not isolate the user too much from the outside world. Headset users were asked about their experiences in December 2005. Those respondents who had put the headsets into active use found them to be good. Most user experiences involved either the Skype or the TeamSpeak system.

Probably the best-known telephony system is Skype. Its key feature is that users can phone other users over the Internet free of charge. The system also comes automatically with a chat feature between different parties and it is now also possible to attach a web camera to the system. Without an extension, however, use of Skype is limited to a relatively small number of synchronous users. The best voice quality can be achieved in two-party conversation and guidance situations. The presence of more than two parties at the same time requires the moderator to take a determined approach. At most, the system allows five simultaneous users. The DLL research project studied Skype's functionality in supervision of Bachelor's theses and in group guidance. Feedback from both mentors and those receiving advice has mostly been positive.

Since there seemed to be demand for more extensive use of audio systems, the DLL project also explored the possibility of using the TeamSpeak system. Initially, the solution used for this purpose was an application installed on the Virtual Polytechnic's server, where the project reserved one meeting room (channel) for research purposes. When the system proved to be viable, a version of the TeamSpeak application allowing up to 100 simultaneous users was installed on HAMK's own server, while also starting systematic user training and investigation into good practices. Specific meeting rooms have been dedicated for use by degree programmes to hold meetings and training events. Some of the dedicated rooms were protected by passwords, while ten public meeting rooms were also set up. The number of simultaneous sessions (meetings or training events) was not restricted. This made it possible for a relatively large group of students to easily divide into several small groups during their studies and again return to the common room at the appointed time. Use of microphones was organised such that the instructor's microphone was voice-activated, while other participants' microphones were programmed to start with the Push-to-Talk button. The system also makes it possible to send instant messages to other groups or units. In addition, all discussions can be recorded as audio files for later listening and revision.

The specialisation studies for eLearning Specialists that started in January 2006 made use of the DLL project's R&D work in many ways right from the start. The TeamSpeak system was used alongside the learning platform (Moodle) in such a way that an online lecture was first given jointly to the whole student group, whereafter students (n=28) divided into small groups to do exercises through discussions. Their completed outputs were saved as a Wiki document. Student feedback was positive and enthusiastic. The system appeared to work. A distance learning opportunity was also implemented with the same student group by means of a web-conferencing system. The results of this part of the study will be discussed in the following sections.

Web-conferencing and online meeting systems

The need for synchronous online lectures and their asynchronous recordings started to grow with increasing provision of distance education. As part of its research, the DLL project studied the functionality of a web-conferencing system called Horizon Wimba and its applicability to HAMK's distance education needs over a six-month period in 2005. During the testing period, the application turned out to be difficult to use and insufficient in terms of its functionality, so it was abandoned. At the same time, participants spent two weeks testing an application called Macromedia Breeze, which had many appealing properties, but also some shortcomings. The application should have been purchased on the basis of licence fees for the estimated number of users and installed on HAMK's own server. The application was not tested any further. HAMK's Forssa Unit had tested Marratech's web-conferencing system, which turned out to be a versatile but heavy and relatively expensive system. Its functionality differed from other systems in that all users needed to install a specific client application on their computer in order to gain access to sessions. This application was not tested any further either. The project also tested the LearnLinc web-conferencing system, which had been adopted by Kemi-Tornio University of Applied Sciences, using five test usernames. The system appeared to function well, but it was clearly the most expensive of all those tested.

In December 2005, HAMK University of Applied Sciences signed an agreement with Helsinki University of Technology (HUT) to the effect that HAMK would take over 20 host licences of the WebEx conferencing system purchased by HUT for a period of one year. In this context, a host refers to a user authorised to set up and start sessions (meetings, conferences or teaching sessions). There is no limit to the number of session participants. The application is located on the global WebEx organisation's servers and 24-hour support is available for users. The above-mentioned eLearning specialisation programme started to use the WebEx conferencing system right from the start, in January 2006. At the beginning of the programme, teachers' own user experiences were still limited. However, they succeeded in transmitting the teaching situation to distance learning sites at the same time and in the same form as it took in the classroom. Speech was transmitted from wireless microphones to the WebEx system and students in the distance learning sites saw the same things as those shown on the teacher's computer screen and on the classroom projection screen. Voices from the distance learning sites were transmitted through headset microphones to classroom loudspeakers. The system has a specific tool for making requests to speak. Another feature that turned out to be a useful arena for questions and comments was sending instant messages in a message window (chat) during study sessions.

The recording was made from a computer logged in with a student username, such that it did not disturb the teacher's work. The recording was later edited by deleting empty start and end segments and stored on the media server. The link to the recording was located on the learning platform used for specialisation studies.

Initially, the most severe problem with the WebEx system was poor audio quality and audio delays, which made it difficult to ask questions in particular. As a result, the WebEx system was complemented with the TeamSpeak audio system, which produced high-quality and real-time audio. After many suggestions for improve-

ment, a new WebEx version was introduced in May 2006, with high-quality and real-time audio.

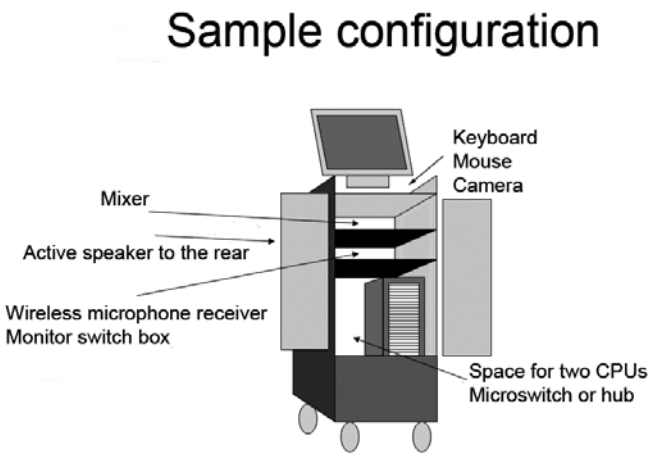
The experiences gained from the specialisation studies showed in concrete terms that distance education requires constant readiness to use a back-up system. As long as there is willingness and as long as no-one gets bogged down in technical details, it is possible to improve things and create good practices. One such independently created practice is making advance recordings in WebEx format, which means that recordings can then be linked to online learning materials and to the learning platform, as determined by the teacher responsible for instruction. This makes it possible for students to view and listen to a lecture asynchronically prior to the actual online lecture, so that they can discuss the topic with the teacher in more detail and ask for clarification of any points that had remained unclear during the synchronous online lecture.

At the beginning of the eLearning specialisation studies in 2006, students were asked about their capabilities for online work. 26 students responded to the survey. Two thirds of them (65.4%) had participated in an online course as students, but more than half (53.8%) had never produced any online material. Those who had produced learning materials (n=12), had only worked with media elements containing hypertext (91.7%) or images (75%). Video- and web-conferencing systems were unfamiliar to almost everyone. Most respondents had access to a computer both at home and at work (84.6% and 80.8% respectively). Almost everyone (88.5%) had a broadband or LAN connection at home, while 65.4% had access to a laptop computer. As part of their education, respondents wished to learn advanced skills in producing online learning materials and media elements, using videos and making Flash animations. What was noteworthy here was that the need for technical skills was the aspect emphasised the most in the initial survey for the programme. During their studies, students produce an extensive project based on their own needs. Project supervision has shown signs of a growing significance of understanding the learning process. At the end of their studies, all students had good skills and tools enabling them to work online.

Encouraged by the good results, the new eLearning specialisation programme that started in January 2007 was offered completely online. There were plenty of applicants for the programme. While students were also given the opportunity to physically attend some direct contact courses, they did not use this opportunity very much. This leads to the conclusion that courses implemented online are in great demand, especially on programmes intended for working adults.

The use of distance learning systems in education proved to be such a positive thing that the project continued studying it by building an eJames prototype, which was tested in practical distance education. eJames is a trolley on wheels connected to an electric conductor and a data network cable in the classroom. The teacher has a wireless microphone communicating his or her voice both to classroom loudspeakers and to online students through an audio system. Comments made by online students are conveyed to classroom loudspeakers. There is another wireless microphone available for comments, passed around in the classroom as required. The trolley also has another computer for storage. The eJames prototype has attracted attention at conferences and on regional TV news, for example, and it has

been tested in several practical training situations. Experiences have been encouragingly positive.



However, the prototype still requires further development. Current objectives include reducing the weight of the mobile trolley and identifying good practices. Based on experiences, it also seems necessary to place two monitors on the trolley.

In view of the online degree programmes due to start in 2007, a fixed WebEx and audio system was built in two computer labs, based on the eJames prototype. This made it possible to implement simultaneous distance and face-to-face courses in these classrooms. Online teaching studios were built for those teaching situations where all students were online. In such cases, it is important that teachers have a peaceful space for teaching, where they can fully concentrate on their work and on interaction with distance students.

Video-conferencing systems

Video-conferencing systems started to break through in distance education in around the mid-1990's. The transmission technology used at the time was based on ISDN connections. Connection costs were relatively high and connection quality was often poor. (See Saarinen 2001, for example.) After the start-up phase, use of video conferencing in education fell away until around 2004, with the introduction of new reliable and high-quality systems working on the Internet. At the same time, the transmission capacity of information networks increased rapidly. According to Wiio (2004), a highly usable device is understandable, easy-to-use, comprehensive and aesthetic from the user's point of view. Fortunately, video-conferencing equipment has recently been developing in the right direction. Manninen (2003), in turn, emphasises that provision of information about the technology being used and about other issues is always a key part of the technical aspect of online instruction.

The DLL research project also participated in training and other events organised by Funet-TV and IT-Peda, which involved writing guidelines for the use of video technology in education (see http://tv.funet.fi, http://www.video.funet.fi/videoneuvotteluopas and http://www.uta.fi/itpeda/osahankkeet/videoteknologia.html [in Finnish]).

Video conferencing typically refers to a video and audio connection established between two points. Connections between more than two sites require a bridging service. The video-conferencing equipment purchased for HAMK University of Applied Sciences works as a bridging service between up to four points, where necessary. In the event that there is need for more synchronous connections, the institution will order a bridging service from the University of Helsinki, for example.

The DLL research project examined some alternative uses of video conferencing. A video-conferencing studio is a high-quality but relatively expensive solution to organising video conferences. Equipment and microphone systems specifically purchased for video conferencing guarantee high video and audio quality. A video-conferencing studio feels like a good solution specifically for meeting and conferencing purposes. However, the currently available uses of video conferencing have not received very high scores in distance education.

Experiments with small devices attached to the computer USB bus (ViGO) showed that it was possible to establish a functional video-conferencing connection to other systems. The equipment was reasonably priced, but it only came with a relatively low-quality web camera. (See Saarinen 2002.) In order to function, the system required a separate application to be installed on the computer, which turned out to be quite problematic due to different language versions. Subsequently, when Windows XP operating system updates (SP2) were launched, the application stopped working altogether. As a result, use of this separate device remained minimal.

An application-based software codec was tested on a few computers. With the latest computers, the application was able to establish an ordinary video-conferencing connection with other video-conferencing equipment. The camera and microphone were attached directly to the computer. However, the application consumed computer processor capacity to such an extent that it was only possible to maintain the connection on computers equipped with high-capacity processors and it did not allow running any other capacity-demanding applications at the same time. This video-conferencing system did not reach a level required for practical applications.

The VRVS (Virtual Room Videoconferencing System) offered by the Funet network is a browser-based system developed by CERN for research and educational purposes, which is freely available to registered Funet members. Each member can reserve a virtual room from the system and invite parties to a video conference. In 2006, the VRVS Team also developed an application known as EVO (Enabling Virtual Organizations), which offers additional application services and a secure data connection to virtual rooms. This system turned out to be quite useful for video-conferencing purposes to personally registered Funet members. Although it is easy for staff at higher education institutions to register as members, this system has not become very popular in practical situations either.

The main strength of using video conferencing in distance education is the good interaction opportunity between distance learning sites, whereas the fact that it 'only' communicates video image and audio can be considered a weakness. When the presentation text is also first compressed and then decompressed again as a video, it inevitably becomes smudgy during the process and the smallest text sizes become illegible. In addition, the so-called 'talking head' does not have much intrinsic value after the initial introductions. This is why people have started to seek other solutions to complement video conferencing, in order to improve presentation quality.

The simplest solution is to send a graphical representation by e-mail to the distance learning site, where a local tutor can show it in a high-quality format. This also makes it possible to print and distribute lecture notes locally.

Another opportunity is to use a desktop-sharing application alongside the video-conferencing system. Transmitting a static image does not burden the connection very much, which means that a high-quality image can easily be transmitted to a distance learning site. There are plenty of applications available for transmitting images in this way (see Netviewer, Pcvisit, BeamYourScreen, for example). Application sharing makes it possible to show presentation graphics while transmitting high-quality audio and video using a video-conferencing system. The above-mentioned WebEx system can also be used for this purpose. When the WebEx application is launched without audio and video features, it can be used to share applications or edit a joint document, for example, while transmitting video and audio through the video-conferencing system.

Online streaming is a one-way form of video transmission. Usually, the recorded material is also stored in a file so as to allow its asynchronous viewing at a later date. When synchronous streaming is complemented with a synchronous feedback tool, such as Internet telephony with TeamSpeak or chat, the result is an interactive situation that is almost reminiscent of a video conference. However, use of streaming for this purpose is rare, especially since web-conferencing systems, such as WebEx, and application-sharing systems have become popular. It is much more common to record a video of a teaching situation either in a classroom or in a specific studio and store the clip on a streaming server to be viewed asynchronically. In such cases, the streaming video can also be complemented with presentation graphics, comments, etc., and unnecessary segments can be deleted. Video clips can be edited using regular video editors, such as MovieMaker that comes with Windows operating systems.

User experiences and research results

An online survey was set up to assess user experiences from people who had used the interactive educational technology systems described in this article. The total number of responses was 29. The respondents had participated in various interactive online events, such as working on the online guidelines, a meeting of communications teachers, a video conference, a steering group meeting, work meetings, a training event or a group seminar. The most common tools used for these purposes were Skype or TeamSpeak, but video-conferencing and web-conferencing (WebEx)

tools had also been employed. The majority of respondents were women (79.3%), full-time teachers (51.7%) and those aged between 35 and 50 (44.8%).

Interaction was considered sufficient by 71.4% of respondents, while 67.8% reported that they had felt as if the other party had been present and speaking directly to them. 71.4% considered that the technology used in the event they attended was appropriate for distance work, while only 46.4% felt that it was suitable for distance learning. 67.9% felt that the technology made distance work more efficient, compared with only 33.3% stating the same for distance learning. The responses lead to the conclusion that use of an audio system is enough for work purposes, but that learning requires more possibilities. Due to the limited number of responses, it was not possible to separately analyse the answers given by web-conferencing system users.

The respondents' propensity to adopt new technologies was also not particularly exceptional – those who counted themselves among early adopters and those who did not accounted for 39.2% and 46.5%, respectively, while the rest (14.3%) were neutral. The average of all responses was 2.82 on a scale from 1 to 5. In the next question, the majority of respondents (60.7%) indicated that they were not wary of using new technologies.

Propensity to give advice was high among the respondents, since 57.2% reported that they would be happy to advise other people on how to use new technologies, with the average of all responses being 3.64. 64.3% of respondents stated that they would gladly share their new implementation ideas with others, with the average of all responses being 3.82. Consequently, it is fair to say that the respondents are enthusiastic users of technology and community-spirited when it comes to helping colleagues.

Other experiences cited in the responses as positive aspects of using new technologies included the marked reduction in need to travel and the fact that meetings were carefully prepared and briefer and more intensive than those held face-to-face. Respondents also felt that technologies brought added value to distance courses. They perceived that the relatively low reliability of equipment and the fact that it was more difficult to get to know new people formed a common problem and challenge. There was a strong need for technical support in the introduction phase, whereas easily accessible helpdesk-type support was considered sufficient later on. Generally expressed wishes included small-scale supervised training events and instructions as part of the introductory folder. Local, quick and sufficient user support should be available.

The Response system was tested in August 2006 at a major public event in Ikaalinen, with about 650 members of HAMK staff in attendance. The audience was asked questions about presentations dealing with educational technology, to which they could respond as teams formed with others sitting close to them. After the event, participants were given an online survey and 223 participants responded. The majority of respondents (67.3%) were from Hämeenlinna, 61.5% were women, and there was almost a fifty-fifty split between those working in teaching and other positions (46.4% and 53.6% respectively). 62.2% of respondents had become acquainted with a corresponding system before, either as users or by seeing it in use. The others (37.8%) were encountering the system for the first time. More than half

the respondents stated that the system activated the audience (73%), was efficient and easy to use (60.4%) and increased interaction and interest in the subject (54%). Quick feedback from listeners or students and activating students or listeners to reflect on the subject were cited as benefits by 80.2% and 62.6% respectively. Other benefits of the system reported by respondents included honest feedback and receiving information that would not otherwise be available. In other words, synchronous interaction with the system was a success at the public event, but its use was assessed in more reserved terms when transferred to a teaching situation. About one third of respondents would use the system to activate classroom instruction or to collect student feedback. One in nine respondents did not perceive any need for its use whatsoever. Responses to open-ended questions expressed doubts that the novelty of the system would soon wear off and, if purchased, it would ultimately remain unused. This was why the system should be initially rented when required.

The Virtual Computer Lab

While synchronous interactive online learning solutions do achieve quite a realistic interaction environment, doing exercises in order to learn new skills also requires hardware and software. One such opportunity to use hardware and software is provided by the Virtual Computer Lab, where users can schedule computer and software resources and use them over the Internet. In addition to regular scheduling, students have the opportunity for interactive collaboration and to invite the instructor or some other expert to join the session. The Virtual Computer Lab is discussed in another article included in this publication.

Conclusions

Based on DLL research and practical experiences, it appears that the basic technical problems involved in online learning have mostly been solved by now. As good practices have become more prevalent and network capacity has grown, teaching and learning online will increase substantially over the next few years. Creating the learning process on the web and an integrated interaction and guidance process form the foundation for good learning outcomes.

A learning platform similar to the current one will probably be the best place for creating a learning process in the future as well, complemented with synchronous and asynchronous interaction tools as required in each specific situation. Interactive learning materials, including assignments, will be located on a separate media server as learning objects and linked to the study units on offer at each specific time. Media elements will be used in learning objects in a rich and purposeful manner. Objects will make use of audio and video alongside text and images. Different learners and their study preferences will be taken into account.

As an interactive tool, video conferencing will probably remain a solution mostly used in situations where interaction and seeing the other party's face play a key role. Such situations include conferences, expert lectures and presentations. Among those participants who are acquainted or have been previously introduced, an audio-based system is often sufficient. In addition, participants will need a system that allows them to send the necessary documents to other parties. E-mail messages

or website links are often sufficient for this purpose. If it is necessary to work on a joint document as part of a meeting, participants will need a system that allows application sharing, such as WebEx.

The system that appears to be most suitable for synchronous online lectures is one where video either plays a minor role or no role at all. What is more important is a user-friendly system that allows users to show and share presentation documents and also work in teams. Audio transmission as part of the system should be of high quality and easy to use. The system also needs to provide an easy opportunity to store online lectures and learning objects produced from them.

The WebEx system that is currently being tested meets many of these challenges, but audio system management is still needlessly complex in terms of making requests to speak and starting teamwork assignments. The system's weaknesses also include its relatively high price. The direction would appear to be right, but the system still requires further R&D work.

The Virtual Computer Lab seems to be a promising innovation for study of applications that require exercises to be carried out in genuine and supervised online environments.

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Ilkka Yläkoski

The Virtual Computer Lab from the Perspective of Online Instructors

Abstract

As a subject, computer science is very technical both in terms of contents and environments. For technical as well as traditional reasons, physical computer labs still play a key role in computer science education. However, relevant learning and teaching functions can be achieved over the Internet using a Virtual Computer Lab. Since the Virtual Computer Lab has only been developed as a technical solution for distance learning purposes, the shift to online learning leads to significant changes in students' own learning environments and cultures. The overall objective of this article is to answer the question of how computer science education should be provided when it is completely virtual and makes use of a Virtual Computer Lab. Proposals concerning pedagogical practices are based on the Community of Inquiry model and aim to take the special characteristics of computer science into account. In addition, the article includes a brief overview of those practical tasks relating to the Virtual Computer Lab that online instructors need to carry out in addition to their other duties.

Introduction

In recent years, online courses and various online learning environments have become more and more commonly employed for different educational purposes. Such online courses aim to provide students with learning opportunities similar to those offered by traditional classroom teaching. The essential learning tools available online are related to areas such as learning materials and assignments and their distribution, communication with other students and teachers either synchronously or asynchronously, and tools for either independent or collaborative production of information. In an ideal scenario, these can be found in a single environment – namely, a learning platform.

This environment is sufficient in itself if students have access to the tools required to perform assignments, or if the tools are available on the learning platform. In practical terms, the competencies required in many occupations involve command of certain occupation-specific programs or applications. These are typically taught

in computer labs using software that often requires user licences or plenty of disk space, such as a programming environment. In these cases, distance learning will often need to be complemented by direct contact instruction in a physical computer lab. Even if students have the opportunity to install software on their home computers because of a student licence, for example, only a few students are able to install all the necessary environments on their personal computers, which means that genuine online study of IT applications is often likely to be unsatisfactory.

Typical online courses that cannot be implemented on a general-purpose learning platform can be found in the field of information technology and computer science, where the outcome of a learning assignment is not necessarily a text document but a program, device configuration or some other special-format file. A typical characteristic of creating such files is that they are made up of artefacts, which are used to create new knowledge or further artefacts. By nature, they may either be purely conceptual, such as theories, models or algorithms, or concrete, such as experimental setups and software components. These epistemic artefacts are especially important in education, where the main uses of knowledge are for creation of further knowledge (Scardamalia & Bereiter 2006).

Usually, special solutions are available for implementation of online computer science courses, such as JERPA, the Environment for Remote Programming Assignments in Java (Emory & Tamassia 2001), or the Finnish VIOPE (Vihtonen 2001). In addition to actual work, these environments also enable transfer and storage of material related to learning assignments over the network as well as real-time monitoring of instruction (JERPA). Such environments may also perform other tasks that facilitate teaching, such as automatic checking of learning assignments. Sometimes, however, there may be such a vast amount of necessary support material that the learning environment needs to be complemented by a separate CD-ROM sent out in the post, for example (Jackson 2001).

These special arrangements are typically course-specific and, as such, they are not very generic. A general-purpose solution is, for instance, a teaching arrangement implemented around Citrix Presentation (or MetaFrame) Server, as some Finnish higher education institutions have done. Citrix Server itself is a type of software that makes it possible to run applications on the server while only installing the user interface on the client computer. This means that it is quite possible for students to use computers that may be several years old, whereas the maximum number of simultaneous users is determined by the server's own resources. Such centralisation provides several benefits, which may be related to application sharing, supervision of work or load balancing. Based on Red River College's experiences, Citrix is effective for program- and software-specific solutions but too costly for universal access (Macintosh 2002).

Online instruction can also make use of Internet-based meeting and conferencing software, such as WebEx, which support studying with various tools, such as real-time discussions in small groups, shared drawing and writing tools, surveys, file transfer, recording and application sharing. Application sharing means that all participants in a meeting can see how the presenter uses a specific application and can also access it remotely. Such applications do not actually work as terminal servers, which mean that using graphic design software with the WebEx solution, for example, is inefficient in other respects except for the perspective of illustration. In

this sense, Citrix Server offers a more efficient solution for remote access to applications, while also allowing equivalent application sharing between all session participants. Unfortunately from the pedagogical point of view, both WebEx and Citrix are teacher-centred, because these solutions require a specific teacher role (or a session host) to allocate rights and possibilities for work to participants.

The Virtual Computer Lab

In this context, the Virtual Computer Lab refers to an online resource that can be scheduled for remote work or study. Online resources are computers, operating systems, programs and learning objects (online courses). The Virtual Computer Lab also includes a scheduling service, which ensures that the resources required for study are available at a specific time. In other words, this is an educational technology solution used to promote distance learning. In general terms, a Virtual Computer Lab provides the same opportunities for study as a real computer lab, but students do not need to physically go to the lab. There are three different working models: independent work, collaboration in small groups over the same subject, and collaboration under an instructor's real-time supervision. (Yläkoski 2005.)

Although existing e-learning technologies enable real-time discussion online, they do not allow simultaneous work on a joint software project, for example, whereas the Virtual Computer Lab makes this possible. Collaboration in the Virtual Computer Lab is carried out such that the same session can be accessed from several terminals at the same time. This means that communication takes place either via audio or video. Those participating in the session via audio feed agree who uses the mouse or keyboard at any specific time. The Virtual Computer Lab is suitable for independent or small group work, but not for such classroom instruction that is essentially teacher-driven. The features of classroom instruction can be increased by also using web-conferencing applications such as WebEx.

The Virtual Computer Lab is most suitable for distance study of such environments and applications that are only intended for use by a single person. These include various workstation-based utility and design software applications. In addition, other possibilities include installation and maintenance tasks of servers and application environments. Conversely, it is not sensible to use the Virtual Computer Lab for education focusing on applications that have initially been designed for use with a browser, such as the SAP enterprise resource planning system, where the most natural way to manage users is to use the integrated tools of the application or service.

The Virtual Computer Lab itself does not set any limitations on the target computer's operating system, the remote access application or the distance learner's access rights. The only technical requirement for the target computer is that there is a remote access protocol or application available for the operating system. The Virtual Computer Lab enables distance learning with administrator rights in different Windows operating systems, Linux distribution versions or Mac operating systems, for example. In other words, the Virtual Computer Lab is not only a solution to sharing applications over the Internet, but also a general-purpose solution for remote access to all target computers and applications such that reserved resources can be

used as and when needed. In technical terms, the solution is based on open source code implementation technologies.

Most remote access computers are also virtual, i.e. virtual machines shown on the network as separate devices, while actually being simulated programmatically on their own host systems, known as virtual servers. The current system includes three virtual servers hosting a total of about two hundred virtual machines, which are switched on when a remote connection is established.

The system's specific problem is data security. A firewall and secure connections play a key role in technical implementation of data security. In addition, the system can only be accessed by students enrolled on the relevant course according to the student information management system.

The most significant benefits of the Virtual Computer Lab are perhaps economic ones, because the Virtual Computer Lab enables more efficient use of facilities, computers and software licences. By means of remote access, an educational establishment's different units can use each other's software licences, even when situated at different locations. Other economic benefits include more diverse course provision, because programs and their environments can be pre-installed on hard disks and implemented as required. Examples of other benefits include faster kick-off for learning, which is a significant advantage in provision of short-term courses in particular. One key problem in adult learning is the scarcity of guidance, because adult students cannot make it to the computer lab as frequently as daytime students. The Virtual Computer Lab makes it possible to bring real-time instruction to distance learning to cover the problems faced by students.

Remote access to the Virtual Computer Lab

Use of the Virtual Computer Lab requires distance learners to have access to Windows XP and a broadband Internet connection preferably. As the connection is established over the public and unsecured Internet, they will also need VPN (Virtual Private Network) software to secure their connection. In technical terms, this software connects distance learners from their home computers to the higher education institution's student intranet when the VPN connection is established. Correspondingly, students who are already connected to the student intranet do not have to go through any of the above-mentioned steps or installations, which allows very free use of teaching labs.

Learners use a browser to log on to the scheduling server in the student intranet, where they can schedule time to work on their chosen computer in a virtual lab. The computers available on the scheduling server have been grouped into virtual labs according to their properties.

If distance learners notice, when logging on to the scheduling server, that they have already reserved a computer for that particular time, they can simply open a connection to the computer once they are logged on. When scheduling a computer, distance learners will also indicate whether they are planning to work on their own or as part of a small group. In the latter case, they will also schedule work time for

other group members, who in turn will not need to take any further action. Scheduling can be performed from a different computer than the one used to access the reserved computer remotely.

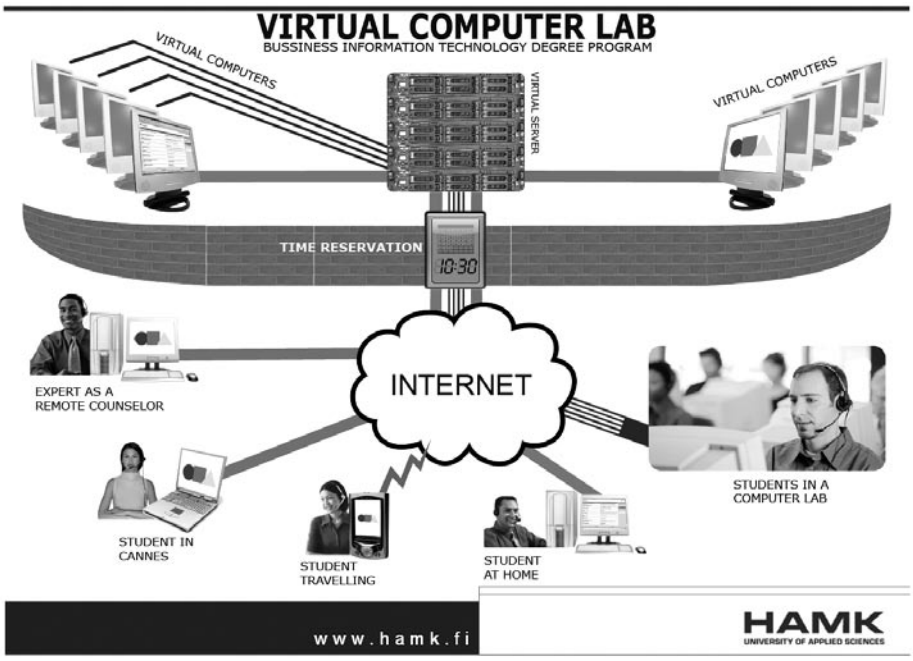


Figure 1. How the Virtual Computer Lab works.

In addition, users may also have several computers at their disposal at the same time; only the daily amount of scheduled time is restricted. Learners can also transfer any files created on the remote access computer to their home computers whenever necessary.

Outlining the pedagogical model

Choice of improvement areas

From the pedagogical viewpoint, the Virtual Computer Lab has not been developed in accordance with any specific approach to learning. On the contrary, it is mainly an educational technology solution to a situation where the subject of distance learning is a specific IT skill. In technical terms, it should be seen as being a means to promote learning, encouraging students to work independently and in small groups. However, it involves the challenge of determining which types of pe-

dagogical practices are best suited to the Virtual Computer Lab or to online study of computer science.

Areas for improvement were charted through student surveys. The target group covered both young and adult learners. The questionnaire surveys fell into two different categories. One of them only consisted of open-ended questions and was given to adult learners participating in specialisation studies for eLearning Specialists once they had become acquainted with independent and collaborative remote use of applications in the Virtual Computer Lab. These students were not experts in computer science, but they all operated in the teaching field. The other survey targeted degree students and mostly consisted of questions with response options given on a numerical Likert scale. The survey was essentially based on the Motivated Strategies for Learning Questionnaire developed by Pintrich (Pintrich & Ruohotie 2000) and on the Online Learning Interaction Inventory model by Northrup (2002).

What should be expected of distance learners

In computer science education, traditional teacher-driven classroom instruction has often applied the same pedagogical solutions to all students. Conversely, successful online distance learning requires a shift towards more individual pedagogical solutions. As a result, both the need for and development of individual solutions call for awareness of the types of personality traits that have an effect on successful completion of distance learning courses. This means that it becomes desirable to identify those traits of distance computer science students that have a bearing on learning achievements and satisfaction. The qualities needed by distance students are often associated with high motivation and capability for self-regulated learning.

Motivation can be measured using the Motivated Strategies for Learning Questionnaire (MSLQ) presented by Pintrich and his colleagues in 1995. This instrument is divided into value and expectancy components. Value components may be extrinsic, such as test grades, or intrinsic, such as personal satisfaction. Expectancy components are related to beliefs about control of learning, self-efficacy for learning and performance, and test anxiety. The MSLQ instrument was originally developed for classroom teaching situations. Self-regulation comprises a set of learning processes, such as setting goals, using effective learning strategies, assessing one's own performance, effective time management and evaluation of learning. (Pintrich & Ruohotie 2000.)

The learner-driven factors that have been studied quite extensively include students' age and gender. Lim, Morris and Yoon (2006) have suggested that age is an important factor influencing learning outcomes. Learners aged between 20 and 29, with more immediate needs to use the learning content, were both more satisfied and performed better in their test compared with other groups. Learners' prior experience of distance learning, their learning styles and high motivation also had a distinct bearing both on learning outcomes and satisfaction. Conversely, gender had no significant effect. A corresponding result was achieved when examining the significance of gender to technological self-efficacy, i.e. the belief about control of distance learning tools (Holcomb, King, & Brown 2004).

Bell & Akroyd (2006) have studied which factors related to self-efficacy and self-regulation will best predict learning achievement. Based on their study, the best predictors of learning achievement were prior academic achievement and expectancy for learning. The only factor relating to self-efficacy was thus expectancy for learning and the course, where positive expectation anticipated positive outcomes.

When students who are used to face-to-face learning choose an online course, they may face problems due to a different learning environment. Deka and McMurry (2006) have explored learner-driven factors that would provide learners with a basis for choosing the learning format that is best for them. The study was carried out by comparing face-to-face and online learners. Distance learners' success in their studies was significantly dependent on their learning techniques and on their confidence in the ability to master the learning content, which in turn had a bearing on their self-regulation in their distance studies. Learner-initiated communication with the instructor had a slight effect on success in distance learning. As such, students opting for an online course instead of a face-to-face course differ from the average student in many ways (Cavanaugh 2005).

Interaction

Interaction can be defined from several points of view. In the simplest terms, 'interaction is engagement in learning' (Hillman, Willis & Gunawardena 1994). While the degree to which interaction affects learning outcomes is somewhat unclear, what seems clear is that it does contribute to student satisfaction and interest in studying in distance learning environments (Sharp & Huett 2006).

A commonly used method of classifying interaction in distance learning is the tripartition defined by Moore (1989): learner-content, learner-instructor and learner-learner interaction. The first of these is essentially related to educational objectives. The learner-instructor relationship emphasises the instructor's task to motivate, counsel and encourage each learner, in addition to organisation of learning. Interaction between learners is necessary in areas such as evaluation and application of information. As technological tools are becoming increasingly important for communication, learner-interface interaction has been proposed as being a specific type of interaction, as well as learner-feedback interaction or interaction taking place when a student observes interaction between other students. (Sharp & Huett 2006.)

Northrup (2002) has suggested the Online Learning Interaction Inventory instrument to assess interaction in online environments. The instrument uses various attributes to measure interaction with educational content, collaboration, conversation, learners' metacognitive skills and effectiveness of support. A similar framework for interaction has been proposed by Hirumi (2002), who divides interaction into three levels, starting from learners' cognitive and metacognitive processes and ending at a level of interactions that aim for learners to achieve clearly defined objectives.

Sharp and Huett (2006) have studied whether one type of interaction is more relevant than another. The research was carried out in the form of a literature review. They consider that the key problems with current forms of distance learning are the

absence of a sense of community and learner isolation. It is the authors' contention that research shows that learner-learner interaction, in particular, should improve the learning experience in a distance learning environment. They arrive at this conclusion regardless of the fact that there is no research-based consensus; however, the benefits of collaborative learning have been reported so frequently that the conclusion can be applied to planning distance education.

Collaborative learning

Collaborative learning comprises several different viewpoints that are related to themes such as intragroup trust, feeling of togetherness, building new knowledge, learning itself and the underlying factors supporting it. From the perspective of institutional research, for example, collaboration allows people to accomplish more than they can when working on their own. Depending on the field of research, the subject may be how information is acquired and created individually or in groups, what activities, concepts and communication methods are involved, or how these become visible in the workplace, for example.

Based on her literature review, Haythornthwaite (2006) writes that collaborative learning comprises active knowledge building, improved problem setting, study and distribution of knowledge and information between peer learners in accordance with the constructivist learning approach. New knowledge can be created by combining ideas and information through testing them against other people's ideas. Collaboration also models the way work unfolds outside classrooms. It allows students to emulate and train for future workplace practices, such as sharing ideas, voicing opinions, working as part of a team and managing projects. In addition, collaboration enables students to learn how to do all this online, while also gaining the skills that they need for online communication and group management. Collaboration also addresses needs for social interaction, which further facilitates work relationships (Haythornthwaite, Kazmer, Robins & Shoemaker 2000).

It is also necessary to be aware of the limits of collaboration, such as the time, effort and trust among peer learners required for peer collaboration. Knowledge sharing may not occur if there is competition for limited resources or if there is not enough time for peers to commit to collaboration. While collaborative learning does not require long-term interaction in order to be useful and effective, building trust and an online community does. Some consider that there is too much knowledge sharing or that collaboration is too much of a load. In addition, working online can take more time, so the combined effect may be even more pronounced for online groups than for offline groups. (Haythornthwaite 2006.)

According to Haythornthwaite, collaboration may mean different things depending on the situation. On the one hand, it may mean that students co-ordinate their own activities; on the other, it may mean applying or creating knowledge. In other words, do learners already have the knowledge required to accomplish a task, or do they need either shared or joint understanding to do so? In the former case, successful completion of the task requires good communication and distribution of information between participants. In the latter, good communication is even more important because collaborators need to create a common language. In addition to communication, a process of negotiation will be needed to delimit the task, agree

on goals and come to shared meanings. Interaction relating to work may also be either strong-tie or weak-tie collaboration. Both kinds of collaboration have their place and merits, which mean that emphasis should not be placed solely on forms of strong-tie small group collaboration.

In her study, Haythornthwaite (2006) writes that research suggests that, in terms of online learners, visibility, speaker-audience relation and co-presence with others are the key factors affecting students' willingness to share information and contribute to online collaboration. In other words, factors influencing online collaboration are not just technical, but also include the same as those found in face-to-face communication. The barriers that have emerged for students to overcome, however, reflect the way that technological choices combine with expectations assigned to these.

The Community of Inquiry model

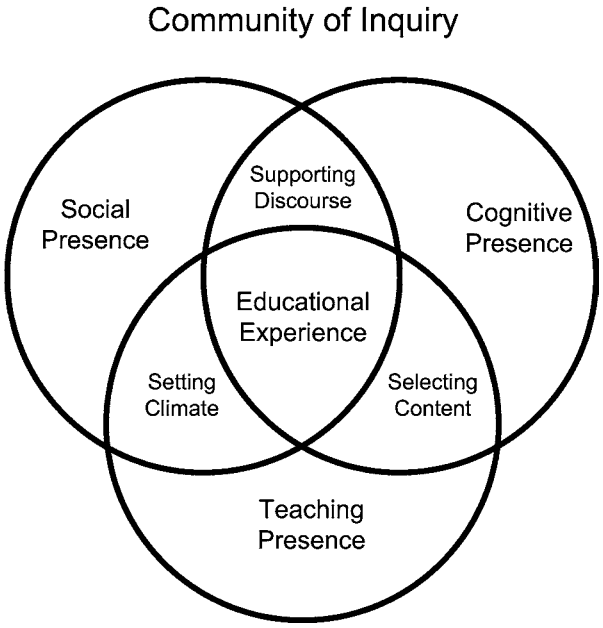
This model, developed by D. R. Garrison, T. Anderson and W. Archer (2000), constitutes three core elements essential to an online community for educational purposes: cognitive, social and teaching presence. The developers of the model suggest that it represents the basic dimensions that different roles take in an online community. The overlapping areas of the core elements form the three key responsibilities of an authentic educational experience. The research method used in the Community of Inquiry model was content analysis of text-based data (Garrison et al. 2000; Rourke et al. 2001a; Rourke et al. 2001b; Poscente 2002).

As shown in Figure 1, cognitive presence is related to the construction of meaning and confirmation of understanding through communication supporting this purpose. One starting point for cognitive presence has been the authors' view of critical thinking as being the goal of all higher education. Categories associated with cognitive presence include a triggering event, such as the teacher's task assignment, its exploration, integration by creating meaning to ideas gained through exploration of the event and a resolution through practical testing, thought experiments or consensus building. (Garrison, Anderson & Archer 2001.)

Social presence encompasses the ability of participants to coalesce for a common purpose, which may demand significant role adjustment from students in virtual communities of inquiry. Through social presence, online students perceive other participants as 'real people'. Phenomena associated with social presence include emotional expression, perception of others' presence and a sense of community. (Garrison et al. 2000.)

Teaching presence calls for management and monitoring of the cognitive and social dynamic to create a purposeful community of inquiry. This in turn requires the teacher to capitalise on the media to achieve intended educational experiences, and attend to the inevitable role identity adjustment of students. Teaching presence consists of three main components, the first of which is related to design and organisation of course contents, while the second focuses on functioning as a facilitator so as to retain students' interest, motivation and participation in active learning. The third main component is concerned with direct instruction of students, offe-

ring them intellectual and professional leadership and sharing knowledge. (Rourke et al. 2001a.)



The Community of Inquiry model has been used to study student role adjustment in new online communities of inquiry by comparing previous face-to-face learning experiences with equivalent experiences in an online environment. Results indicate that face-to-face learning experiences focus on social and teaching presence, while online learning experiences are more cognitive or internally oriented. If this explanation has validity, it would have implications for the quality of learning outcomes. (Garrison, Cleveland-Innes & Fung 2004.) On the other hand, strong social presence created in small groups may also weaken a group's relationship with the whole class (Stein & Wanstreet 2005). Some have also suggested that emotions might form their own element of presence in the Community of Inquiry model, where they have actually been included as part of social presence (Campbell & Cleveland-Innes 2005).

Based on his data covering more than 2,300 online students, Shea (2006) showed that students were more likely to report a stronger sense of learning community when their online instructors had exhibited stronger 'teaching presence' behaviours. Individual underlying factors included creating an accepting climate for learning, keeping students on track, diagnosing student misperceptions and helping to resolve disagreements related to these.

Although the Community of Inquiry model has essentially been developed for online learning environments where text-based communication plays a key role, it has

also been applied to pedagogical planning of an online seminar ('webinar'). The main reason was the absence of other appropriate theoretical models for situations where communication is also based on the use of audio, graphics, video and application sharing. (Neumann & Carrington 2007.)

Guidelines for online instructors

Stodel, Thompson and MacDonald (2006) have explored learners' perspectives on what is missing from online learning compared with face-to-face learning in the classroom. Their inquiry focused on interviewing those learners who had perceived deficiencies in this respect. Learners had perceived deficiencies in the robustness of online dialogue in the sense that the dialogue was not the same as in the classroom from the perspective of emotions communicated as part of interactions, for example. In addition, they did not feel that it was as spontaneous as in traditional classroom instruction, where it is possible to digress from the subject as required. Some had also perceived other participants as being faceless and had experienced problems in socialising with each other and their professors. As a result, the authors decided to provide recommendations relating to areas such as allowing flexibility and coaching learners how to learn online, so as to shift their focus from an individual perspective to one of community. The authors also considered it essential for instructors to understand all online students, regardless of how interested they are in online learning.

T. Smith (2005) has identified 51 competencies for online instructors. 18 of the competencies are related to pre-course phases, such as course organisation, managing different expectations and command of the necessary technologies. One of the required competencies is concerned with the instructor's ability to act as a facilitator, focusing not only on course content but also on development of community. This involves paying attention to different forms of interaction and collaborative learning, without overwhelming students who may be unfamiliar with online learning. Due to the large amount of guidelines prepared to support online instructors, the BE VOCAL approach (Be Visible, Organised, Compassionate, Analytical and Leader-by-example) has been suggested as a useful mnemonic for the principles of effective online instruction, in particular for relatively new online instructors (Savery 2005).

Brent Muirhead (2004) has presented various strategies for encouraging interaction, including engaging teaching situations and humanising the online environment by introducing teachers' and students' biographical posts. It is also advisable to integrate stories into discussions, because the online environment can be lonely at times and students want to get to know their teachers and fellow students. Instructors should give positive feedback on students' abilities and knowledge both through public newsgroups and private e-mail messages and should provide students with sufficient flexibility to make learning experiences more individualised.

Dool (2007) presents the main principles that he uses to prevent internal conflicts in online teams and resolve them when they occur. Even before the actual work starts, he impresses on students the importance of committing to teamwork and reminds them of the significant weight of teamwork in course assessment. He also posts a reminder or two about the importance of positive teaming both before and

during the team process and expects the team to keep a specific log documenting the team's activities and describing who did what. Dool expects teams to work out in the open in 'team rooms' of some sort, to which he has access in order to monitor the team in action. He does not allow teams to communicate solely through e-mail. These practices make it possible for him to detect and intervene in potential conflict situations. Dool states that even though not all team conflicts have been eliminated, the above-mentioned practices have contributed to reducing the number of conflicts considerably.

Pedagogical Solutions for the Virtual Computer Lab

Defining the scope of research

There is quite an abundance of literature relating to pedagogical solutions in the sense that several suggestions are available for online instruction. For instance, a manual for online instruction (Brandon 2005), available free of charge, is a collection of 834 tips provided by more than three hundred experts in the field. The average instructor would not be able to memorise such a large number of tips or put them all to use. In addition to this problem, even scientific publications do not often offer a unanimous insight into what to do in specific situations. This may be partially due to the limited scope or contextual nature of empirical experiments, which means that it is uncertain whether practices can be generalised. Consequently, it would be more relevant for an instructor to gain an understanding of the overall situation and develop practices for deficiencies that would improve learning outcomes and student satisfaction. Such a practice-oriented development of instruction has been applied in distance education in programming at the University of Joensuu (Torvinen 2004), for example.

In this article, a pedagogical overview is outlined by using a pedagogical model (Community of Inquiry) developed by Garrison and his colleagues (Garrison et al. 2000). Garrison's model was chosen because it offers a holistic vision of online communities for educational purposes. Although no other appropriate theoretical models have been developed to date, this model has also been applied to pedagogical planning of a 'webinar' (Neumann & Carrington 2007).

Practices have been devised by taking the perspectives of Garrison's model into account in designing a specific computer science course. Although the Community of Inquiry model has essentially been developed for online learning environments where text-based communication plays a key role, themes relating to teaching material, learning objectives and cognitive presence were excluded from this study on the basis of preliminary analyses of surveys. Cognitive presence was excluded because the related idea of critical thinking was developed on the basis of text-based communication, while the epistemic artefacts produced in computer science also require consideration of other types of perspectives. On the other hand, online computer science education may also lead to a focus on themes of cognitive presence at the expense of other elements, which could be attributed to the nature of computer science, combined with the observation presented in literature (Garrison et al. 2004) that online courses emphasise cognitive themes. For this reason, this article focuses on themes of social and teaching presence.

The proposed practices are also partially based on research findings specifically obtained through pedagogical research into computer science. The practices are being developed for the first course in the Java programming language, which can be offered to students in a completely virtual format. Teaching and learning take place in the Virtual Computer Lab and classroom instruction is provided in the form of online sessions using WebEx. The learning platform used in the course is Moodle.

Climate and interaction

In an extensive ethnographic study, Garvin-Doxas and Barker (2004) have studied the effects of defensive climates on communication in introductory computer science courses. For instance, a defensive communication climate prevents students from asking questions when they fail to understand something, or complicates collaborative peer learning. It also divides students into those who have confidence in their abilities and those who don't. Instructors and teachers play a key role in creating a defensive climate and they are also the ones holding the key to changing the climate. A defensive climate is reinforced by behaviours such as when the instructor approves or relies on experienced students' evaluative or judgmental communication, where they may, for example, describe their own superior (!) programming solution. A defensive climate is also created when instructors tend to encourage students to find 'mistakes' (!) in their own sample codes, for example, or when they explain that the introductory class is for everyone, including experienced students (!), or use neutral and distant language.

The authors suggest various methods to change a defensive climate, such as using students' names and small groups where students can share what they have learnt with each other. Instructors should explain to students that experience or prior knowledge is basically good, but does not equate to intelligence. Both instructors and students should employ descriptive rather than evaluative communication of problems and solutions. In these respects, instructors should thus actively influence the type of language used. Instructors should also acknowledge the difficulty of understanding the content and support all students equitably, using various instruction methods depending on the situation. (Garvin-Doxas & Barker 2004.)

Based on literature, learner-learner interaction has a significant bearing on learners' satisfaction with distance learning. This is also indicated by preliminary analyses of student surveys, which indicate that some students perceive the computer lab as being a social meeting place. In addition, many students expressed their doubts about the difficulty of communication without face-to-face contact. Consequently, this requires instructors to take action to support the climate, on the one hand, and in terms of both technical opportunities and students' abilities, on the other.

A teacher-driven computer lab

Traditionally, computer science instruction is carried out as frontal instruction, where students follow the steps shown by the teacher using a video projector, doing the same on their own computers. Based on students' responses, this practice – i.e. teacher-driven instruction – should be applied more rigorously, in particular in the early stages. This view was justified by the fact that it is not possible to progress in

distance education at the same pace as in traditional classroom instruction. The teacher should also take into account technical difficulties and students' different levels of technical know-how, which may vary quite considerably between individual students. Teachers are also expected to prepare very well in terms of both material and script, in order for their time management to be in appropriate proportion to the subjects being covered. It would also be important to pay careful attention to timing and pace in order for students not to 'lose track' once they encounter a technical problem. In addition, feedback should be collected often enough during online sessions, so as to be aware of potential problems and of whether the pace is appropriate.

This means that the group should be small, i.e. less than 10 people, which leads to simultaneous demand for more than one online instructor. Respondents suggested that teaching assistants could act as online instructors, but also expected them to have a very high standard of expertise. Personal instruction was perceived as being a desirable target. Peer instruction between students, which works well in classroom contexts, was seen as being difficult in distance learning situations. Respondents justified this by stating, for example, that every teaching group includes students who are 'afraid' of technology, and whose instruction should therefore not be delegated to other students.

This need demonstrated by students for teacher-driven, strictly scripted instruction provided in small groups is not only in contradiction to the prevailing conception of learning, but also very difficult to fulfil both in organisational and technical terms. The former means that there are not enough computer science professionals available for online sessions to cover every small group. The latter means that students in frontal distance education would need two monitors: one to follow the teacher's work and the other to work on themselves. This requirement is not feasible.

Distance students' needs to return to the teacher-driven approach may also be interpreted to indicate that their insecurity about the success of distance learning is so great that they turn to the teacher-driven approach to find a solution. Since students' requirements cannot be fulfilled, it is crucial to find practices that ensure successful learning. The first of these calls for giving up frontal instruction, which can be replaced by a carefully scripted online session where the teaching content has been converted into screen recordings.

Screen recordings are target-defined and functionally perfect learning objects (from the student's perspective). There can also not be any discontinuities between the recordings. The recordings are equipped with a brief description of their objectives. In practical terms, learning objects are the same as dividing a recording of a traditional class into short meaningful segments. They make it possible to convert traditional teacher-driven frontal instruction into an instructional session where students can progress at their own pace. This pedagogical solution is mostly suitable in cases where the subject of learning is completely new. When moving on to applied programming skills, the approach should shift more towards collaborative working methods.

Collaborative teaching methods

Applied programming exercises can be performed collaboratively in the Virtual Computer Lab, making use of WebEx small groups. Programming exercises carried out in small groups should be characterised by openness (Bower 2007). Open assignments include modification of existing programs or debugging and revision of a program that is erroneous (in syntactic, semantic or conceptual terms). Exercises are complemented by enabling peer assessment. The purpose of peer assessment is to illustrate to students the possibility of alternative strategies. Transfers from one computer to another can be accomplished by means of VNC (Virtual Network Computing) software or the WebEx application sharing function.

One collaborative working method in the field of computer science is pair programming. This means that one of the two partners controls the keyboard and mouse and is responsible for entering program code, while the other looks out for potential defects and comments on them. These roles are switched as the programming session continues. The traditional approach to teaching programming has been based on the perspective that each student should write their own programs individually. Pair programming is not the same as a two-person team project, where both participants typically have their own personal areas of responsibility. In such cases, the coding is completely or partially done by individual students and the parts are only integrated into a single program before handing in the project. With pair programming, all code is developed at a single computer with both learners working together. The benefits cited for using pair programming for learning purposes include more students passing the course, higher quality programs, less coding time and increased student satisfaction. However, there is no unanimity on better learning outcomes. Pair programming can be done both with and without the instructor's supervision. (McDowell, Hanks & Werner 2003.)

Introducing pair programming in distance education is not necessarily straightforward, since it is essentially used in situations where people are sitting physically side by side. Nevertheless, pair programming is easy to arrange in the Virtual Computer Lab. In the first stage, the partners enter their own virtual room in TeamSpeak. In addition to hearing each other's voice, they can thus also listen to their instructor via WebEx. Since each Linux server functioning as a programming platform includes both the VNC server and VNC client software, one of the partners can switch to the same session as the other with one command line command and take over the keyboard. The instructor is then responsible for attending to the learning process such that both partners take an active role in the work. When course assessment is based on both joint and individual performances, this contributes to directing the work towards a more collaborative approach.

Implementation of a collaborative software project online causes even more resistance than doing one as part of classroom education. Doubts about the success of such a project are due to reasons such as the difficulty of organising regular meetings online, because it is difficult enough in any case from the perspective of students. Calongne (2002) suggests effective communication, responsiveness and a good team composition as solutions with which fears of online software projects can be overcome. By effective communication, Calongne means productivity that promotes project objectives. In addition to guidance, mentoring and answering

questions, the instructor is responsible for monitoring students' correspondence both on discussion forums and via e-mail. In terms of team formation, Calongne draws attention to the fact that teams were more productive when participants were allowed to form their own teams instead of being assigned by the instructor, even though the instructor had attempted to take learners' individual qualities into account when determining the composition of teams.

Communication has been chosen as being the critical point for the practical project included in the planned Java course. The first part of this is a plan drawn up by each team of students, determining how the team will spend its time, when and how they will meet online, how to achieve mutual understanding and how to resolve different conflicts. The plan will then be reviewed by the instructor and implementation will be considered as part of assessment. In order to enable good internal communication and intervention in potential conflicts, the instructor needs several different practices which will provide students with a sense of the teacher's continuous presence and monitoring of the project specifically outside online sessions. In addition to traditional instruction methods, such practices include monitoring e-mail discussions and dropping in on online or IRC discussions. In this respect, it becomes critical for the instructor to prepare a personal time management plan.

Challenges for online computer science instructors

Literature holds a wide range of competencies that a good online instructor should fulfil. When these are combined with special requirements relating both to the subject and to its online implementation due to the use of technologies such as the Virtual Computer Lab, WebEx or Citrix, online computer science instructors may easily feel that they are faced with a considerable challenge. On the one hand, some of the proposals for instruction provided in literature are just as suitable for face-to-face classroom instruction as for an online environment. Many personal practices preferred by the teacher may thus be quite easily transferred to an online environment, whereby the challenge of online instruction may become more realistic. On the other hand, when developing online instruction, it makes sense for the instructor to pay attention to themes that are exclusive to online environments. These include humanisation of the online environment through measures that enable a similar feeling of visibility and presence as the one created without any special effort in classroom instruction. Such measures include organisation of specific online meeting places for students and small groups, use of participant biographies and active involvement that creates a sense of presence for online students.

A specific area of instruction that may easily be overlooked is attending to students' online learning skills both in general terms and in situations where students are not familiar with or even interested in online learning. This is associated with coaching students towards collaboration and making use of various networks on individual courses as well, however, without creating the impression that learning is exclusively collaborative, but pointing out instead that each individual course also includes clearly independent assignments.

In a typical computer science instruction situation, the work itself is intertwined with problem-solving. This corresponds to 'over-the-shoulder' instruction in a traditional workshop, which takes place online instead. Over-the-shoulder instructi-

on can be implemented in a Virtual Computer Lab by means such as VNC. It is also possible to make wider use of these instruction situations by recording them and making the recordings generally available through an easy-to-update FAQ (Frequently Asked Questions) site, as proposed by Twidale and Ruhleder (2004). This example goes to show that it makes sense to pay attention to subject-oriented instruction methods, in which case instructors should make use of various technologies in order to diversify instruction.

Use of the Virtual Computer Lab from the instructor's perspective

From the instructor's perspective, use of the Virtual Computer Lab involves work stages that take place before, during or after a course. Some work assignments are technical in nature, which means that some of these can be delegated to technical support staff. The teacher can also assume the administrator's role to some extent.

Before the course

Before starting a course, the instructor needs to define the computer resources required for this purpose. These include the quality and quantity of the required licences. Since the Virtual Computer Lab makes it possible to schedule and access computer resources at a specific time, the number of computers and licences need not be the same as that of the students enrolled on the course. It should be borne in mind here that traditional frontal instruction is not possible in these contexts and that teaching material should allow learning without teacher-driven instruction. In terms of computer environments, it is necessary to determine which system programs will be used and what types of access rights, usernames and passwords are used to operate computers. The general rule of thumb that should be observed here is that passwords should always be made available to instructors, so that they can access all computers where necessary. Settings related to remote control of computers should be tested carefully to ensure that all course exercises can actually be carried out. When testing the equipment, both individual and collaborative remote use of computers should be taken into account. In addition, it is necessary to decide whether the computers used are virtual or not. The choice will typically fall on virtual when the number of users is high. Correspondingly, where the course requires considerable computing capacity, applications should run on separate servers, allowing no more than a few synchronous sessions.

When course-specific computer resources have been determined, this information is submitted to the schedule planner. In terms of the Virtual Computer Lab, schedules should be planned with due consideration for phasing the instruction, in order to avoid potential overload. Overload occurs in a situation where too many courses have been scheduled for the Virtual Computer Lab at the same time. This does not result in actual overload, but the system will only allow a certain number of virtual computers to run on each server, which means that not all users can access their computers.

In terms of the student information management system, teachers need to make sure that they enter course start and end times correctly. In addition, they should enrol students on the course at least a few days before it starts. The student infor-

mation management system is connected to the GroupWise e-mail system, where distribution lists will be created for each specific course. Since the scheduling service uses this distribution list to verify whether a specific student has access to the Virtual Computer Lab, instructors can easily check their e-mail application to ensure that all enrolled students have access to the Virtual Computer Lab. This check is crucial in order to guarantee a smooth start to the course. At the same time, instructors should send information about the course implementation code (course code + implementation code) to the system administrator, who will enter this data into the system. The learning platform provides students with more specific information about which computer is used by which student.

When the scheduling system has been configured, instructors will send an e-mail message to students, asking them to do a test login and schedule a time for their first teaching session. This concerns those students with previous experience of using the Virtual Computer Lab. For other students, the course will be preceded by an online session on use of the Virtual Computer Lab.

Problem situations during online sessions and courses

When using the Virtual Computer Lab, instructors should be prepared to deal with both potential technical and administrative problem situations.

Typical technical problems for which instructors need to prepare include failure to log on, schedule a computer or use the scheduled computer remotely, or failure to establish a remote connection from the home computer. Sorting out these problems will inevitably create a feeling that use of the Virtual Computer Lab is difficult. This is why a specific assistant should be available to guarantee smooth online sessions and solve technical problems that arise during teaching situations. The system itself offers alternative methods for the above-mentioned basic functions for students. These include using a generic username, staff login instead of logging in as a student and establishing a remote connection to a parallel VPN. Online instructors would do well to monitor use of the system from the perspective of overall load. They should be careful when performing updates and software installations that form an integral part of computer science instruction, because these may lead to system overload and to a significant increase in response times in situations where a procedure such as a system update is launched simultaneously on a large number of virtual machines. It is also advisable to monitor system use per student as required, in order to be constantly aware of whether the work is progressing smoothly. The principles of monitoring student work should be discussed at the beginning of each new course.

An administrative problem situation may emerge when a student needs to use the personal virtual machine outside the normal course schedule, for example. Such a situation is exceptional in the sense that machines are only available for specific courses and they are not assigned for personal use at all. It is also not possible to develop a function that would show which machines are being actively used by individual students. This being the case, independent work is carried out in a specific training lab, where students also have the opportunity to work outside actual classes. In the event of possible abuse, a student account can also be temporarily closed.

It is also possible to arrange computer exams in virtual labs. This makes it necessary to hide the computers used for exams, which can be done directly in the scheduling service after the exam. An actual practical problem arises if some students log on as staff for some reason, because staff have access to all labs. In such cases, the most sensible thing to do is to temporarily disable access to the exam lab from the scheduling server, which means that the machines can only be accessed through separate VMWare client software. When the course ends and student outputs have been assessed, the instructor must also ensure that these computers can be freed up for further access. At the same time, they should also deal appropriately with special cases, such as Open Polytechnic students.

Administration of the Virtual Computer Lab

As demonstrated by the above-mentioned examples, instruction in the Virtual Computer Lab requires technical competencies, which are related to supporting student work either from a technical or an administrative perspective. To some extent, these tasks are part of the administration of the scheduling server in the sense that their performance requires administrator rights. Actual technical administration is divided into two main components: administration of (virtual) computers and the scheduling server. Administration of virtual machines is carried out using VMWare client software, which makes it possible to establish a console connection to all virtual machines. This means that there is no need to use actual remote access software (such as Remote Desktop). Typical administration tasks are related to switching virtual machines on and off, installing virtual machines or troubleshooting 'jammed' machines. The console connection also makes it possible to monitor student work remotely.

Basic administration of the scheduling server includes setting up labs and computers. Although this can be done on the scheduling server, it is more convenient to set up, say, 400 computers and 10 virtual labs using MS Excel and then read the Excel files into the scheduling server. Since user management is based on course implementations, individual users are basically set up in special circumstances only. These also include setting up those students who are not enrolled in the higher education institution. Management routines allow browsing and deleting scheduled events in a situation where students cannot do so themselves.

Communication between administration and students flows both ways. Students can provide the administrator with feedback on the scheduling server, while the administrator can add public bulletins to the front page or send computer-specific messages to students. The overall system status can also be monitored through log files. The system administrator can naturally change settings for the Virtual Computer Lab, such as the maximum allowed amount of daily connection time or the number of virtual machines running on the server.

Summary

This article aimed to outline the types of pedagogical practices that are most suitable for the Virtual Computer Lab and online study of computer science. The first observation is that the teacher-driven working culture typical of traditional computer

labs cannot be created in the same way as in face-to-face education. The necessary practices have been selected making use of Garrison's Community of Inquiry model. The proposed practices bring to the fore various forms of collaborative learning, which have been adapted to the framework of computer science as a subject. In addition, the general competencies of online instructors working in Virtual Computer Lab environments have been complemented in ways that take into account certain phenomena prevalent in the subject, such as a potentially defensive climate.

Successful transition of computer science education to online environments is a challenging task for organisers, but its inevitability becomes clearer and clearer with increasing requirements on education in terms of effectiveness, quality and performance targets. In pedagogical terms, this calls for shifting the focus away from traditional technical and cognitive themes and towards productive communication, telepresence and various forms of peer work. Regardless of its challenges, this change will be rewarding for those who make it.

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Pasi Silander

Learning objects and the web-based learning process

Abstract

Learning materials like Learning Objects (LOs) play a significant role in web-based and computer assisted instruction. The digital learning materials used should be integrated into the overall learning process – learning materials seldom work in a pedagogically meaningful way on their own, without planning the learning process or without tutoring from the teacher. This article gives an overview of the use of web-based learning materials in education and of planning of the related learning situation and process from the perspective of learning objects.

Learning Objects

Learning objects (LOs) are unitary and compact 'pieces 'of digital learning material that can be used in various learning processes and in the various phases of the learning process (Pitkänen & Silander 2004). They are relatively atomic and independent entities and this allows them to be used for several purposes; LOs are re-usable. Learning objects can be used in web-based learning processes based on different pedagogical models – in this respect, they are pedagogically open. However, a learning object typically guides students' learning (perception and information processing) in terms of cognitive processes. Compared with traditional digital materials, learning objects offer a wider range of possibilities for use in terms of content. In most cases, the same learning object may be used in different subjects or educational fields. Combining learning objects in different ways also makes it possible to take different learners into account in the learning process more effectively and to create individual web-based learning pathways – i.e. learning processes.

Learning objects may have various pedagogical functions and purposes in the learning process. They may guide learners' information processing or function as raw material for learning, such as providing a context or a starting point for collaborative discussions on a learning platform. In particular, learning objects bring added value to the stages of the learning process (e.g. difficult things or phenomena) that would otherwise be difficult to teach or illustrate. For instance, a learning object may be a visualisation, an interactive simulation that makes an abstract theory

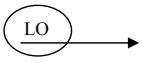
more concrete through an analogy. A LO may also be a framework or a template, a 'scaffold' that learners will build on.

Taxonomy of Learning Objects

In this context, we use the 'learning object' concept primarily to describe learning materials that guide a learner's learning sub-processes, are pedagogically structured and stimulate learning processes in the learner's mind. If a learning object is considered as being the target of learning or information content (such as a vocabulary list), it does not bring any significant added value to web-based teaching and learning in pedagogical terms. A learning object may also be a content-independent tool for learning and thinking (such as a mind tool), which guides learners' information processing. On the other hand, a tool that is very generic (such as a spreadsheet application) cannot be considered to fit the definition of a learning object, because such a tool does not exactly guide any sub-processes of learning by itself. As a broad concept, a learning object can be examined by means of the following figure (Figure 1) and classification (Cavas et al. 2003, Silander & Pitkänen 2004).

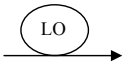
Types of learning objects

1) **Learning seeds** (learning objects that stimulate a learning (sub-)process in a learner's mind and guide the learner's information processing)



2) **Target of learning** (the content being learnt, the subject matter being taught)

3) **Learning tools** (~ cognitive tools that guide the learner's learning process and actions)



   3a) **Context-dependent** (context-bound) **learning tools** (learning tools that are essentially linked to a specific content or subject)

   3b) **Context-independent** (context-free) **learning tools** (learning tools that can be used with different contents and subjects)

4) **Tools/Utilities** (such as a graphics or spreadsheet application and other such tools that do not guide the learning process)

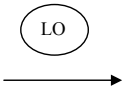


Figure 1. Types of learning objects. Different types of learning objects described in relation to the learning process.

1. Learning seeds

Learning seeds are learning objects that contribute intentionally to stimulating learning processes in a learner's mind and often guide the learner's information processing – i.e. learning. Such objects may guide the learner's perception and information processing processes by means such as activating questions, support or scaffolds for thinking, interaction and feedback. Learning seeds may also be raw materials for online discussions and collaborative knowledge building and they may function as frameworks or templates for working on the subject matter.

2. Target of learning

This category comprises content oriented and *presentation*-type learning objects, which represent the content being learnt. In addition, *illustrative* learning objects, which aim to illustrate the thing/phenomenon being learnt (such as through animation or passive simulation), are also considered to fall within this category. Such objects are *sources of information* for the learning process. In such cases, the role of the learner may be quite passive. The added value provided by these learning objects may remain somewhat questionable when compared with traditional media, such as books or videos.

3. Learning tools

These objects may be *(a.) context-dependent* learning objects (bound to specific subject matter), which guide a learner's information processing and often provide feedback for the learner. This category includes *interactive simulations*, which function as tools and illustrative elements of the subject matter, while also guiding the learner's perception and information processing. These learning objects may bring significant added value to learning when compared with traditional media. On the other hand, learning tools may also be *(b.) context-independent* learning objects that may be used to learn different things/phenomena. These promote learning primarily at the level of the learner's cognitive (perception, thinking) and knowledge-building processes. Context-independent learning objects may be used for creating conceptual artefacts or for guiding the learner's process by means of the pedagogical model being applied.

4. Tools/Utilities

Utility-type learning objects include drawing or calculation applications, for example, which cannot be counted as being part of the learning tools category, because they do not guide the sub-processes of learning or the learner's own thought or problem-solving processes. Moreover, these tools are not usually very context-dependent; on their own, they do not offer any subject matter to learn, which means that the learner needs to create his/her own contents.

Dimensions for analysing learning objects

The figure below presents dimensions that make it possible to examine individual learning objects and their properties at functional and pedagogical levels. These dimensions can be used to create a profile for a learning object that determines e.g. the type of web-based learning guidance required in the specific learning situation.

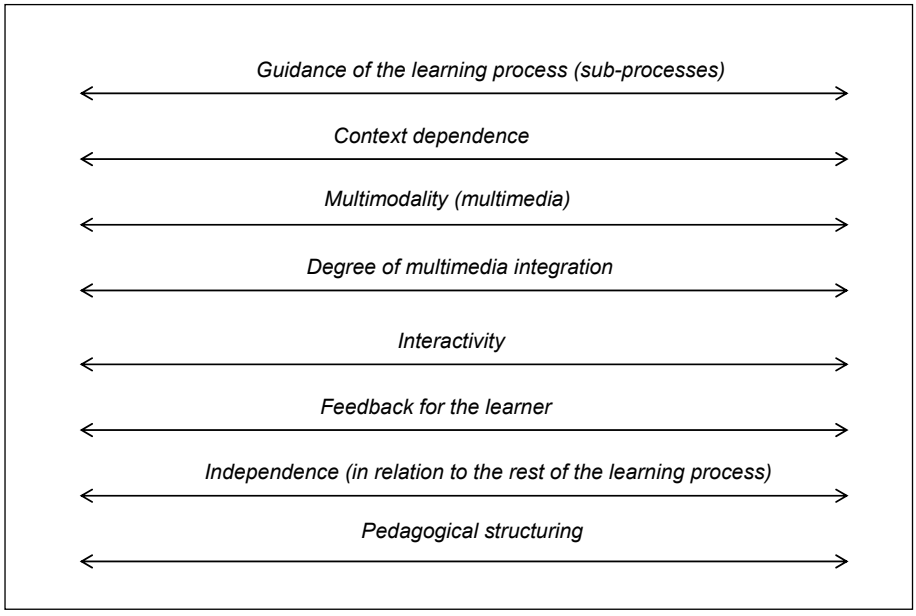


Figure 2. Dimensions for analysing learning objects in terms of guidance required for the learning process.

A learning object may guide a learner's *learning process*, or it may be an animation or a video clip illustrating a thing/phenomenon. It is often the case that a reusable learning object only guides the learning process at the level of learning sub-processes (the learner's cognitive process, such as perception or comparison, combination and elaboration of things), which means that it is the responsibility of instructors (and learners) to construct the overall learning process. It is conceivable that the learner builds his or her own individual learning process as part of the learning situation, but the instructor needs to create a framework for this process and guide it by means such as assigning learning tasks and setting general objectives. However, the essential aspect of web-based learning is to create a *pedagogical structure* for the learning object according to the situation and an approach to the learning

object, i.e. a context or the 'glasses' through which the learning object should be examined. As part of the learning process, the learning object is also linked to the pedagogical model being applied.

Context dependence describes the extent to which a learning object is bound to a specific content or subject. When using relatively context-free learning objects, such as learning tools (mind tools/cognitive tools), the instructor needs to link the learning object to the subject matter being learnt. If the learning object is a utility-type object, it should also be linked to the learning situation and the learning process in addition to content. When the learning object itself is *interactive*, it is better equipped to guide the learner's learning sub-processes, which means that there is less need to use externally guided learning techniques or problem-solving strategies. A learning object may also provide learners with pedagogical *feedback*, which reduces the need to receive feedback from instructors or peers. Due to their atomic nature, however, learning objects are naturally incapable of providing feedback on all of the learner's actions, in which case other forms of feedback and reflection become essential. When a learning object is very atomic and *independent* in relation to the rest of the learning process, it becomes more reusable and can therefore be used in quite different learning processes and with various pedagogical models.

Pedagogical structuring of and approaches to learning objects

The pedagogical functions of learning objects create the interface that determines how the learning object and the related learning sub-process are linked to the overall learning process (Silander & Koli 2003). The same learning object, such as a simulation, may be used at different stages of the learning process, in which case it may have several pedagogical functions. For example, a simulation can be used as a basis for setting problems at the beginning of the learning process and for reflection at the end of the process. This places emphasis both on the *approach* to the learning object, which will partially determine the pedagogical function of the learning object, and on the interfaces between the learning process and the learning object (on both sides of the learning object).

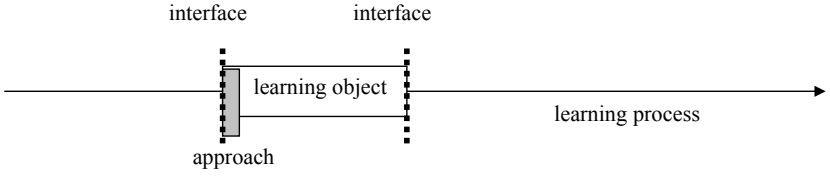


Figure 3. Uses and interfaces of a learning object as part of the learning process.

A learning object may in itself contain several approaches (pedagogical applications and functions) orienting the student or the teacher/instructor may need to create these for a specific learning situation. The teacher (or instructor) may create an approach to the learning object by means such as learning assignments or cognitive activation of the student. The approach works like a pair of glasses (the context and focus) for the student to examine the learning object and process the subject matter being learnt. It should be noted that it is the approach that the teacher will often use to create the pedagogical function for the learning object.

Interfaces for the learning object – i.e. how the object is linked to or is part of the overall learning process in a pedagogically meaningful manner – must be created actively. Otherwise, it is highly likely that learning objects will be seen as being fragmented pieces of information without overall meaning.

When using a simulation as a basis for setting a problem, for example, the approach to the learning object may be a question posed by the teacher, such as, 'Why does the simulation work in this way?' or 'Why did the simulation produce that particular end result and what questions does the simulation inspire in learners?' This may be followed by instructing students to go to a discussion forum on a learning platform to write questions that have occurred to them and to set their own problems. At the reflection stage, in turn, students may reflect on their own skills and knowledge on the basis of the simulation – are their own explanations and conclusions formed as part of the learning process enough to explain what happens during the simulation, do they thoroughly understand the phenomenon/thing presented by the simulation and how has the simulation illustrated what they have learnt? In other words, learning objects often require pedagogical structuring and modelling of the thing/phenomenon and guidance of the learner's cognitive processes, such as perception.

Pedagogical functions and applications of learning objects in the learning process

When designing web-based instruction, special attention must be paid to planning the learning process and integrating learning objects into the learning process. As learning objects are small and compact learning materials, there is a danger of fragmentation of the learning process and information. The use of learning objects must be planned with careful consideration for the specific application of each learning object in the learning process and the way it is linked to other elements of the learning process. In web-based instruction based on the learning process, it is always important to take account of the pedagogical function of the learning object, i.e. the objective of its use. How is the learning object supposed to promote learning? The application for a learning object that first springs to mind is not necessarily always the most effective one in pedagogical terms.

The pedagogical functions of the learning object (Silander 2003) determines the application and context of the object as part of the learning process. It should be noted that a single learning object, such as a simulation, may have several pedagogical functions and applications. In addition to the learning object, the pedagogical function may be determined by the learning assignment or the teacher's instructions about the perspective from which the learning object should be approached and how it should be processed.

Table 1. Classification of learning objects based on their pedagogical functions (Silander 2003). It should be noted that a single learning object may have several pedagogical functions.

Pedagogical function of learning object	Description
1. Activation (cognitive)	A learning object used to activate learners' existing knowledge structures and cognitive processes that promote learning something new.
2. Context creation, problem setting	A learning object used to create a context may be a video-based case study, for example, which can create an authentic starting point for learners to set authentic problems. A learning object used to set problems may be structured pedagogically such that it guides learners to set problems that are essential in terms of the subject matter.
3. Testing a hypothesis/ working theory	A learning object that learners can use to test their own explanations (working theories and hypotheses) and, subsequently, as a basis for drawing their own conclusions. Such a learning object may be an interactive simulation, for example.
4. Information source	Most learning objects may be used as sources when acquiring information as part of a collaborative problem solving and knowledge-building process, for example. (In this context, source-type LOs are primarily those used as raw material for building knowledge, not to create a context or test a hypothesis.) Such a learning object typically enables illustrating the thing or phenomenon being taught – in particular, describing procedural information, such as a process required to perform a specific working phase.
5. Knowledge building	The knowledge building process is guided by learning objects that are typically learning tools (~ mind tools). These may be tools for learners to present their own conceptual artefacts, tools for distributed cognition with functional support, scaffolds or problem-solving tools, etc.
6. Reflection	Reflection on the learning process, the learner's thinking, mental scripts for various situations, competence, etc. by means of a learning object. The learning object may guide the learner's reflection process.
7. Testing/Assessment	A learning object used to test the learner's skills and knowledge and assess learning and competence. Ideally, such a learning object is designed so as to allow instruments for testing learning and assessing the learner's competence in web-based learning that are more authentic than traditional means of measurement (such as tests and oral or written exams).

Pedagogical evaluation of learning objects

Evaluation of the pedagogical quality of learning objects is a challenging task. Learning objects are small pieces of learning material and often do not contain any learning objectives as such. The objectives for use of a specific learning object are determined by the context – the learning process where the object is being used. It is therefore difficult to measure the pedagogical effectiveness of learning objects just by examining the objects in isolation. In many cases, however, the objective of pedagogical evaluation of learning objects is to evaluate universal quality without contextual factors. Silander et al. (2006) have developed indicators for evaluating the pedagogical quality of learning objects (see Table 2 below), which can easily be applied to heuristic evaluation. The problem with many previous evaluation criteria has often been the focus of questions on properties other than promotion of learning.

Table 2. Pedagogical quality indicators of learning objects and questions used as scaffolds for evaluation.

Indicator	Questions
1. Intentionality	1.1. Does the learner work in an intentional and goal-oriented manner when using the learning object? 1.2. Are the learner's actions transparent when using the learning object? 1.3. Do the learner's thought and problem solving processes become visible when using the learning object? 1.4. How does the learner's own thinking become visible and how is it supported by the learning object?
2. Authenticity of the learner's processes	2.1. Are the learner's cognitive processes in line with the authentic situation when using the learning object? 2.2. Is the problem setting of the learning object authentic? 2.3. Are practices, methods, tools and contents authentic, in line with the real world? 2.4. How is the learning object linked to the culture of expertise in the field in question?
3. Support for knowledge building activity	3.1. Does the learning object enable the learner's own knowledge-building process? 3.2. How does the learning object support the learner's knowledge-building efforts? 3.3. What kinds of knowledge building processes does the learning object enable?

These pedagogical indicators of learning objects have been used in heuristic evaluation of learning objects and learning object designs created by the production rings of the Finnish Virtual Polytechnic (see e.g. Silander et al. 2006). The pedagogical quality indicators also provide an essential basis for further development of learning objects without piloting them in different contexts.

Discussion

The use of learning objects as part of pedagogically meaningful instruction requires teachers to have new skills and views on instructional design. Learning objects are very strong tools for learning, which will probably bring solutions to many open questions in web-based pedagogy. Evaluation of pedagogical quality may provide valuable information both in support of development of learning objects and for development of the pedagogy of learning objects. These experiences can be used especially when developing mobile learning objects for authentic learning situations.

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Kati Koivu & Tomi Terentjeff

Perceptions of mobile tutoring of work placements among health and social services students

Abstract

The Mobile tutoring project has examined how to support students' learning process in authentic learning environments by means of mobile tutoring. The Mobilogi tool enables tutoring dialogue between a teacher and students in the Moodle Learning Management System (LMS) over a mobile phone by means of text messages (SMS).

This article presents a pilot study investigating how students perceive tutoring of work placements by means of Mobilogi and whether pre-fed tutorial messages can be used to promote students' learning on the job. The pilot study involved two teachers responsible for tutoring work placements and ten students on work placements. The group involved in the study consisted of students in the field of health and social services at HAMK University of Applied Sciences, who were completing their curricular work placement periods. Tutoring of work placements followed the tutoring model used at the educational institution. Instead of replacing any of the traditional tutoring methods with mobile tutoring, it was introduced in addition to other forms of tutoring. The Mobile tutoring project was based on the AEFIRIP model for mobile learning and tutoring.

Key words: m-learning, on-the-job learning, work placement, tutoring

Introduction

The underlying idea of mobile learning is that the learner is mobile. We pick up and interpret things around us, which we then apply in new contexts in new ways. We learn things that are significant to ourselves, even if they were not part of any specific formal learning objectives. (Vavoula & Sharples 2002.) However, we can also aim to support formal learning processes that take place in authentic environments. In this article, the learning process refers to pre-planned and goal-oriented learning that progresses gradually over time (Koli & Silander 2003).

This article presents the Mobile tutoring project included in Work Package 5 of the DLL project, which examined how students perceive mobile tutoring in support of on-the-job learning processes. In this context, on-the-job learning is understood, according to the definition of work-based learning by Hulkari (2006), as being a goal-oriented period of learning as part of vocational education that takes place in an authentic working environment. On-the-job learning means goal-oriented learning of vocational skills, accomplished through supervised activities and reflection on experiences gained from work. (Hulkari 2006, 12.)

Work placement and on-the-job learning play an important role as part of education in health and social services at universities of applied sciences (professional higher education institutions also known as polytechnics). Work placement is seen as being part of each student's personal study plan, where work placement, project-based studies and writing the Bachelor's thesis form an overall process of identifying one's own professional strengths. Work placement periods are important in terms of continuous development of contacts between the Degree Programme and the world of work. (HAMK WWW 2007.)

'The general objective of studies leading to a polytechnic Bachelor's degree shall be to provide students with extensive practical basic skills and knowledge and theoretical foundations of these with a view to functioning in expert positions in the relevant field... The objective of the work placement shall be to familiarise students in a supervised manner with practical work assignments that are essential in terms of professional studies in particular and with application of knowledge and skills in working life.' (Government Decree 352/2003 on Polytechnics, section 7.)

A teacher's role in tutoring of work placements may often remain very minimal due to lack of time resources. Working on a work placement period may focus on performing work assignments without any significant reflection and learning. Nevertheless, mobile tutoring makes it possible to ensure that learning in a workplace environment is pedagogically structured. By means of mobile tools and methods, the teacher gets to influence the learning process of students on work placements in authentic learning situations, thus creating an authentic learning environment.

The Mobile tutoring project tested the Mobilogi tool, which allows teachers to send questions to support the learning process as text messages to students' mobile phones (http://www.mlearn.org.za/CD/papers/Silander.pdf), while also enabling students to text back their answers and notes that are stored in the Logi tutoring tool. The Mobilogi tool has been developed within the Tieto Virtaa ('Information Flows') project co-funded by the ESF (http://www.elearningcentre.hamk.fi/hankkeet/index.php [*in Finnish*]). The Mobilogi tool enables tutoring dialogue between a teacher and students in the Moodle Learning Management System (LMS) over a mobile phone using text messages (SMS). This article presents a pilot study where the Mobilogi tool was used to support tutoring of work placements in the field of health and social services. Mobile tutoring was designed in compliance with the pedagogical AEFIRIP model for mobile learning and tutoring (Silander & Rytkönen 2005). The group involved in the study consisted of students in the field of health and social services at HAMK University of Applied Sciences, who were completing their work placement periods in the spring or autumn of 2007.

Work placement and learning

The worlds of education and work have come closer together and workplaces are increasingly viewed as being pedagogical communities. Along with theoretical instruction offered at educational institutions, work-based learning is considered to provide vocational skills that can be directly applied to working life. (Hulkari 2006, 13.) In her doctoral dissertation entitled 'The concept of quality of work-based learning, self-assessment and development in upper secondary vocational education and training in the field of health care and social services', Kirsti Hulkari has explored work-based learning as a learning method. Hulkari suggests that we have shifted from practical training, based on the behaviouristic theory of learning, to work-based learning. In traditional practical training, it was enough for students to engage in work assignments, observe and imitate other people's work. With the introduction of a cognitive and constructivist approach to learning, the student's role in the learning process has changed. The student's active role as a learner has become pronounced, while attention has focused on understanding integrated wholes and reflection by the student on his or her own work and actions. (Hulkari 2006, 28–29.) The learner is not only the implementer of his or her own learning process, but also its assessor. However, reflection and assessment skills do not develop on their own; the learner needs plenty of support in this respect. (Järvinen, Koivisto & Poikela 2000, 90–91.)

A student's learning process can be supported by means such as open-ended tutorial questions. Aarnio and Enqvist (2001, 60) speak about 'open-ended and pure questions that open up the train of thought' – i.e. questions that do not necessarily have ready answers. Open-ended questions can be used to request students to explain phenomena, operating principles and causal relationships and to make analogies, analyses and syntheses. By answering open-ended questions, learners make their thought processes explicit, thus increasing in-depth processing of things. Learner-driven and authentic knowledge creation means that students make the world visible and real for themselves through their own actions. When they reflect on things from their own internal points of departure, students create new knowledge where they make things true and understandable for themselves. (Aarnio 2006, 20.)

Learning is bound to the content of work and the operating environment, which means that reflection is a prerequisite for creating the desired knowledge structure. The learning objectives set for work-based learning are mostly based on the theory of experiential learning and the humanistic conception of humanity. (Hulkari 2006, 30–31.) The core of experiential learning lies in the experience produced by the learning process, rather than in the experience taken as the starting point. The aim is to understand and conceptualise what has happened. Järvinen, Koivisto and Poikela (2000, 89–90) also emphasise appropriate timing of reflection. Learning needs to be supported through experimentation and application, which gives learners experience on which they have already reflected during the process and on which they can also reflect after the activity. Nevertheless, experience or increased knowledge do not guarantee learning as such; the key is observation of and reflection on things and their conscious understanding. (Ruohotie 2002, 137.) Those learners who know themselves and their learning process better and know how to apply this knowledge in practice, will often perform better than others in problem-solving situations. Metacognition steers learners' ability to reflect on, understand and control their own learning. The basic prerequisite of acquiring metaknowledge

is the ability to observe one's own cognitive processes and results. (Ruohotie 2005, 44.)

The teacher's job is to guide students towards developing metacognitive skills and to encourage them to acquire information and build up their skills independently. In this context, tutoring refers to all those purposeful and pre-planned means that a tutor uses to promote a learner's learning. High-quality work-based learning requires both the student and the tutor to play an active and reciprocal role in the work-based learning process. (Hulkari 2006, 103.) Koli and Silander (2003) have determined the starting points for tutoring in terms of the aims of each specific tutorial event, expectations set on learners or the purpose for which learners are being motivated. They have listed the purposes of tutoring as follows:

The purposes of tutoring may be:

1. Advancement of the learning process
    - by means such as motivating learners to learn and achieve their own objectives

2. Reflection
    - content
    - learning process

3. Critical analysis of the theme/subject

4. Focusing
    - by means such as guiding learners towards key questions

5. Guiding towards in-depth processing of information
    - acquisition of further information
    - setting one's own hypotheses – assumptions
    - externalisation of knowledge, such as mind maps
    - synthesis
    - comparison
    - specification of expression
    - application to practice
    - collaborative knowledge building
    - critical assessment of information
    - setting one's own problems

6. Problem solving and cognitive strategies

(Koli & Silander 2003)

Learning to learn on the job is an ability that develops as studies progress, which means that the role of tutoring becomes pronounced at the early stages of studies in particular. The ideal situation is when individual demand for and supply of tutoring are in harmony. However, the quality of tutoring may remain poor due to busy schedules. The busy pace of work of tutors and workplaces may make it difficult to receive and provide tutoring at the right time. (Hulkari 2006, 102–103.)

Mobile learning

Mobile learning is not just about learning by means of portable devices, but learning that takes place across contexts. Mobile learning is often blended with other types of learning and a mobile device can act as a tool for thinking. (Walker 2006, 5–6.) Walker gives an example where learners know that their discussion is being recorded, which makes them process what they say even more profoundly. Mobile learning is often associated with informal learning, which leads to a juxtaposition between mobile learning and formal education. This, in turn, poses problems when trying to develop theories of mobile learning. (Winters 2006, 7.) In a workshop organised by the Kaleidoscope Network of Excellence in the spring of 2006, mobile learning was defined as follows: *'Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies.'* (Winters 2006, 8, citing O'Malley et al. 2003.) The workshop also listed the following key characteristics of mobile learning:

- Enables knowledge building by learners in different contexts.
- Enables learners to construct understandings.
- Mobile technology often changes the pattern of learning/work activity.
- The context of mobile learning is about more than time and space.

(Winters 2006, 8.)

Mobile learning applications are best viewed as mediating tools in the learning process, not as ends in themselves. In addition, mobile applications should complement existing learning tools and methods in a natural manner. (Winters 2006, 9.)

Different theories and applications of mobile learning are based on traditional learning theories. Naismith, Lonsdale, Vavoula and Sharples have examined the functions of mobile learning on the basis of existing theories.

1. Behaviourist *– activities that promote learning as a change in learners' observable actions*

Examples include series of assignments where students receive feedback from the application after giving the correct response.

2. Constructivist *– activities in which learners actively construct new ideas or concepts based on both their previous and current knowledge*

Learners are encouraged to be active constructors of knowledge, with mobile devices now embedding them in a realistic context at the same time as offering access to supporting tools.

3. Situated *– activities that promote learning within an authentic context and culture*

Examples include applications and operating models where mobile devices support learning in authentic contexts, such as museums.

4. Collaborative *– activities that promote learning through social interaction*

Mobile devices can support mobile computer-supported collaborative learning (MCSCL) by providing another means of co-ordination without attempting to replace any human-human interactions, as compared with, for example, online discussion boards which can be used to substitute face-to-face discussions.

5. Informal and lifelong *– activities that support learning outside a dedicated learning environment and formal curriculum*

6. Learning and teaching support *– activities that assist in the co-ordination of learners and resources for learning activities*

In higher education, for example, mobile devices can provide course material for students, including details of due dates for assignments and information about timetable and room changes.

(Naismith, Lonsdale, Vavoula & Sharples 2004, 2 – 4.)

The approach used as a basis for the Mobile tutoring project is the **AEFIRIP model for mobile learning and tutoring**, developed as part of the DLL project, where learning is seen as a constantly progressing cyclical process (see Silander & Rytkönen 2005). The AEFIRIP model is based on contemporary learning theories and pedagogical models of e-learning, such as Progressive Inquiry, Activating Instruction and Problem Based Learning, but it focuses on the characteristics of mobile learning in particular. The model has been developed for authentic learning situations where different kinds of mobile devices are used in support of learning. The specific focus is on examining the critical phases of the learning process taking place in an authentic environment and on tutoring of these phases. In this model, mobile technology is seen not just as a mediator of collaboration or participation, but also as a trigger and platform that includes guidance and support for learning methods and the learning process. (Silander & Rytkönen 2005.)

AEFIRIP is an acronym that stands for **A**ctivation, **E**xternalisation, **F**ocusing, **I**nterpretations, **R**eflection and **I**nformation **P**rocessing. The words describe the phases through which it is possible to support the learner's learning process. (Silander & Rytkönen 2005.)

Moodle and mobile phones as tools for mobile tutoring

The Mobilogi application enables tutoring dialogue between a teacher and students in the Moodle Learning Management System (LMS) over a mobile phone. The *Logi* is a tutoring tool that makes it possible to document tutoring discussions between individual students and tutors. The Logi can be used as a stand-alone tool for tutoring, or it can be linked to a learning platform for use as a tutoring tool.

The applicability of the Moodle Learning Management System for use on mobile devices has been studied at Canada's Open University, for example. This research indicated that, using the default settings, Moodle is already a very mobile-friendly LMS. Most Moodle functions will also work on mobile devices. However, there are particular problems with those applications that rely on JavaScript. In addition, mobile devices are still lacking support for multimedia and interactive learning objects. (Cheung, Steward & McGreal 2006, 16.)

Mobile phones are being used as tools for on-the-job learning in the eTaitava ('eSkilled') application developed within the joint WISE project between Jyväskylä Vocational Institute and a company called Jussi Rautalampi Oy. The application is used for provision of feedback for and assessment of on-the-job learning periods. The idea is to ask on-the-job learners about their daily news using simple questions. The questions are pre-designed and they are easy to answer using either a mobile phone or a computer. The answers given by students are stored in the eTaitava web service database, where the teacher can monitor the progress of on-the-job learning with the aid of diverse reports. (www.etaitava.fi [*in Finnish; information in English available at* http://www.mobiletools.fi/en/?page=etaitava].) The eTaitava system consists of a mobile application and a web reporting tool. The mobile application can be installed on almost all colour-display mobile phones. The application uses GPRS data transmission. (Pirttiaho, Paalanen & Holm 2007.)

The eTaitava and Mobilogi applications have a lot in common, as both are used for tutoring on-the-job learning by means of tutorial questions sent to mobile phones. In both applications, students' answers are stored on a website for later viewing. However, there are also differences between the applications. While eTaitava users need a specific mobile application on their mobile phones, Mobilogi users can make use of the SMS features available even on the most basic models of phones. eTaitava is a commercial product, currently marketed and developed by Mobiletools International Oy. Mobilogi is an open source application developed for the Moodle Learning Management System, which does not require any separate licences. In the eTaitava application, students reply to questions sent to them using a pre-defined graphical scale. To answer a question, such as 'I'm applying things that I learnt at school in my work assignments', students can choose an option on a sliding scale ranging from 'well' to 'poorly'. (Pirttiaho, Paalanen & Holm 2007.) Mobilogi tutorial questions, in turn, are always answered verbally by text messages. In the Mobile tutoring project pilot study, students did not need to reply to the tutorial questions using the mobile phone at all if they did not feel like it, since the questions were actually intended to function as thought-provoking aids for reflection.

The Mobilogi application

The Mobilogi tool enables tutoring dialogue between a teacher and students in the Moodle Learning Management System over a mobile phone by means of text messages (SMS). The application is still being developed and it was tested as part of the Mobile tutoring project presented in this article.

Mobilogi functionality – tutor/teacher

The basic functionality of Mobilogi is as follows: The teacher adds the topic of a question or the title of an assignment to the 'Subject' field. Next, the teacher writes the message that they wish to send to the user(s) in the 'Message' field. The teacher then either chooses a learner's name from the drop-down menu at the top of the screen, or ticks the 'To all' box, and the message is then sent to all learners. All sent messages are stored in students' personal logs, which each student and the teacher can browse on Moodle.

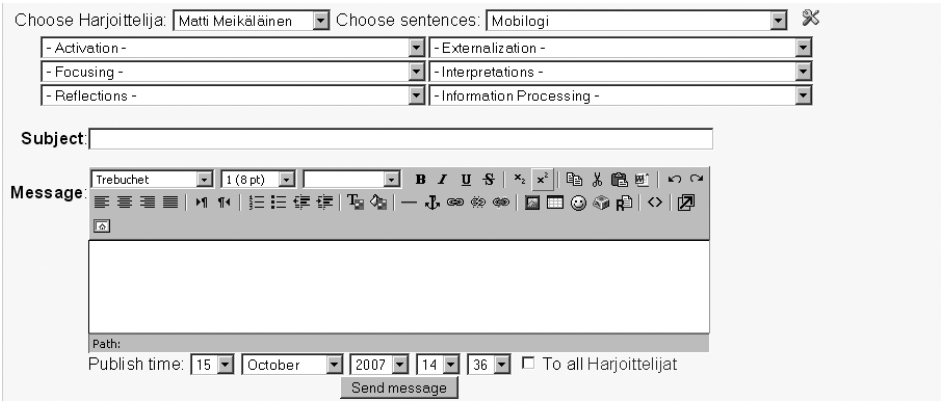

Figure 1. Mobilogi, manual feed (http://www.lanita.org/~eltom/tiff/kali_en.tif).

Alternatively, the teacher can also choose default tutorial sentences that they have added in advance. In this case, the teacher will first choose a category and groups of tutorial sentences linked to the category will then appear on the screen. The actual tutorial sentences can be found below the sentence groups. The selected tutorial question will appear as text in the 'Message' field. If required, the teacher can also edit or add to a pre-fed tutorial sentence in the 'Message' field.

Categories, sentence groups and individual tutorial sentences are managed in separate management views. All categories can be found on the 'Manage categories' tab.

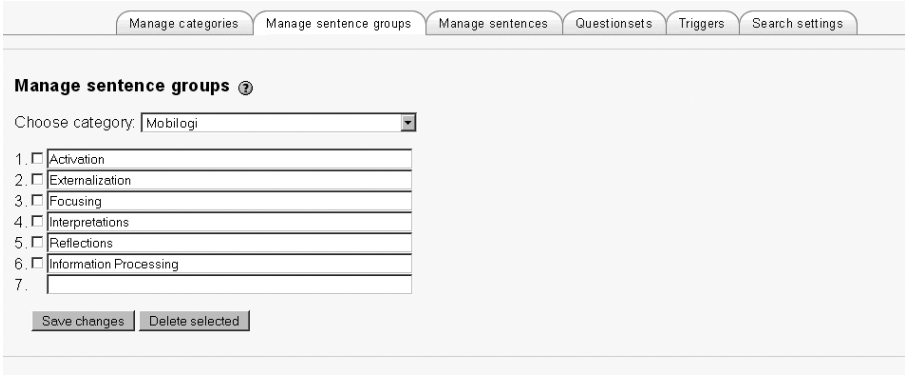

Figure 2. Managing sentence groups (http://www.lanita.org/~eltom/tiff/sentencegroups.tif).

All tutorial sentences can be found on the 'Manage sentence groups' tab. The teacher will choose the category with the sentence groups that they want to edit, add or delete.

The tutorial sentences are managed in a similar way as sentence groups. The teacher will first choose the correct category from the drop-down menu and the tutorial sentences will then be shown on the screen by group.

Figure 3. Managing sentences (http://www.lanita.org/~eltom/tiff/sentences.tif).

Mobilogi functionality – recipient

The recipient receives a message on their mobile phone in the format 'log 35 (= log-specific number) sender ID Subject (Sender's whole name): Message'. It should be noted that the mandatory entries take up the bulk of the maximum number of text message characters. The message will therefore be divided into several different text messages, unless the user's phone supports concatenation of text messages sent in parts.

The recipient can answer the message either such that it is only stored in the log or such that the reply is also sent to the teacher's mobile phone. Using 'Log log number reply' only sends the message to the log, while 'Log log number teacher ID reply' also sends the message to the teacher's mobile phone. The teacher can also use the same method to send a message to a student from their own phone, by simply using the student's ID instead of the teacher's ID.

Mobilogi functionality – functional infrastructure

When the teacher writes and sends a message, the application will send it over a phone connected to the server to the SMS Centre, which will redirect the message to the student.

Figure 4. Delivery (http://www.lanita.org/~eltom/tiff/toiminto.tif).

When a student replies to a question on their mobile phone, the text message is sent to the Mobilogi number and the message is thus delivered from the student's phone back to the Mobilogi server via the SMS Centre. The Mobilogi server again forwards the message, sending the reply to the log and to the teacher via the SMS Centre.

Implementation of the study

Work placement for nursing and social services students at HAMK

Perceptions of using the Mobilogi application were collected during work placement periods involving students on Degree Programmes in Nursing and Social Services at HAMK University of Applied Sciences (HAMK).

The objective of work placements in nursing is for students to analyse theoretical knowledge received as part of their studies through practical experiences and to

reflect on ethical issues, emotions and attitudes related to work. In addition, each work placement period has its own more specific objectives, such as in-depth and broad understanding of therapeutic interaction. Students draw up their own learning objectives and examine and assess the progress made in these objectives together with their workplace supervisor and teacher. In support of on-the-job learning, students keep a learning diary. There are 1 to 4 work placement periods during an academic year, mostly lasting 4 weeks each. (HAMK WWW 2007; HAMK opetusmoniste [handout] 1, 2007.)

The objectives of work placements for students in social services are very similar to those determined in nursing. Work placement periods are divided into 1) orientation placement, 2) specialisation placement, 3) advanced placement, and 4) administration placement. The duration of placement periods varies between a few weeks to ten weeks. Each student draws up a work placement report, which should be submitted within a month of the end of the work placement period. (HAMK opetusmoniste [handout] 2, 2007.)

Tutoring and supervision are provided by the teacher involved and designated workplace supervisors. The objectives of tutoring and supervision have been defined as follows:

1. To convey an idea of professional practice and factors determining it
2. To help students to perceive their relationship with the profession and professional practices; to support development of students' professional identity
3. To consolidate students' learning process by helping them to reflect on and ask questions about the underlying factors of various phenomena. (HAMK opetusmoniste [handout] 2, 2007.)

The Mobile tutoring project

When developing forms of work-based learning, it is of the utmost importance that practical work, theoretical contemplation of work and reflection on work experiences become an essential part of work-based learning (Hulkari 2006, 32–33). Competence is not only about knowledge and skills; the final phase of the learning process comprises reflection on what has been learnt and on the learning process (Koli & Silander 2003).

The Mobile tutoring project has examined how to support students' learning process in authentic learning environments by means of mobile tutoring. During the pilot phase, the project investigated how students perceive tutoring of work placements by means of the Mobilogi application and whether pre-fed tutorial messages can promote students' learning on the job. The aim of mobile tutoring was to get students to reflect on on-the-job learning assignments during their work placement period. The tutoring resources available to teachers do not give them a chance to tutor workplace learners on a daily or even on a weekly basis. Mobilogi was used

with a view to extending tutoring into different phases of the on-the-job learning process without exceeding the time resources available to teachers.

The pilot study involved two teachers responsible for tutoring work placements and ten students on work placements. The group involved in the study consisted of students in the field of health and social services at HAMK University of Applied Sciences, who were completing their curricular work placement periods. Tutoring of work placements followed the tutoring model used at the educational institution. Instead of replacing any of the traditional tutoring methods with mobile tutoring, it was introduced in addition to other forms of tutoring.

Students were introduced to the use of Mobilogi before they started their work placement periods. They also received Mobilogi user instructions, which included step-by-step descriptions of how to receive and send messages and log on to the Moodle log website. The Moodle Learning Management System was already familiar to all students.

The teachers were introduced to the use of Mobilog and the AEFIRIP model (Silander & Rytkönen 2005). They were given a tool for planning mobile learning situations and tutoring developed in accordance with the AEFIRIP model, which examines the learner's and tutor's activities in different phases of tutoring (see Figure 5 below). The tutorial process and questions were prepared in co-operation with teachers and in compliance with the AEFIRIP model. The questions supported the objectives specified for work placement in terms of content and they were timed in advance, such that they were sent to students in different phases of work placement and supported the learning assignments set for students.

Phase of the AEFIRIP	Describe what the student/ teacher is doing or has done before for this phase (such as learning assignments). (How is the mobile device being utilised?)
1. Activation How to activate the learner's prior knowledge and cognitive strategies by context creation (such as presenting activating questions)? What are the roles of the mobile device, the tutor and the authentic learning environment?	

2. Externalisation How do learners externalise/make visible their prior knowledge and thinking models? Learners should become aware of their prior knowledge by making it visible and exposing it to reflection.	
3. Focusing How to focus learners' perception and cognitive (i.e. thought) processes in an authentic learning environment according to the objectives of the learning situation (such as by focusing questions or learning assignments)?	
4. Interpretations made by the learner How to get learners to make their own interpretations (based on perceptions of the environment) explicit? How to make situational factors explicit? How do learners share their interpretations or the meanings that they have created relating to the authentic environment and situation where they work?	
5. Reflection How do learners reflect on their own interpretations and situational factors? How do learners reflect on ideas and thoughts presented by other learners/parties?	
6. Information Processing In what ways are learners required to process information in order to learn something? How is this being supported and guided? How is it created? How is reflection connected to it? (Information Processing may be comparison, synthetisation, problem solving, elaboration, etc.)	

Figure 5. A tool for planning mobile learning situations and tutoring, examining the learner's and tutor's activities in different phases of tutoring (Silander 2005).

Students on work placements were tutored during two four-week periods of research making use of Mobilogi's automated SMS messaging function and log. Students complied with the guidelines issued for their own Degree Programme in work placements and when reporting on them.

Use of Mobilogi in tutoring was first tested in the spring of 2007 with one student and one teacher responsible for tutoring during a four-week period of work placement. The student was completing a supervised work placement period, 'Promotion of mental health in nursing, 8 cr.', as part of the Degree Programme in Nursing at HAMK University of Applied Sciences. During the first two weeks, tutoring took place using tutorial questions added and timed in advance to Mobilogi (automated messages). Over the following two weeks, the teacher tutored the student without automated functions and timing. The student and the teacher were provided with mobile phones by the DLL project, which they used to send and receive tutorial messages.

Once the work placement period was over, both the student and the teacher responsible for tutoring were interviewed. The interviews were conducted as thematic interviews with questions divided into the following four themes: 1) perceptions of tutoring of work placement in general terms and with support through Mobilogi; 2) content assessment of Mobilogi tutorial questions; 3) replying to tutorial questions; and 4) technical functionality of Mobilogi. In addition, the research data also included the on-the-job learning diary drawn up by the student in accordance with the curriculum and the tutorial dialogue stored within Mobilogi.

In August 2007, Mobilogi testing involved nine students and the teacher tutoring their work placements. These students were either completing a specialisation (1 student) or an advanced (8 students) work placement period, both with a scope of 10 credits, on the Degree Programme in Social Services at HAMK. The work placement period lasted 10 weeks and Mobilogi-aided tutoring was studied over the first four weeks. During this pilot period, students used their own mobile phones to receive and reply to tutorial messages.

Halfway into the placement period, user perceptions were collected from students using a questionnaire. At the time of writing this article, students were still continuing their work placements. The study was carried out as an electronic questionnaire and students were informed of it via Mobilogi. The questions included on the questionnaire were mostly open-ended and divided into the same main themes as those used in the spring interviews. Six of the nine students filled in the questionnaire. All responding students were women aged between 20 and 25 who had started their studies in 2005 and 2006. All students were completing their work placements at day-care centres and their duties included providing children with basic care, guidance and education as part of the day-care centres' daily functions. The data was analysed by means of qualitative content analysis.

Results of the study

The results of the study have been compiled on the basis of the student questionnaire and one student interview as well as from interviews and discussions with teachers.

Student perceptions of tutoring of work placements

At HAMK, tutoring of work placements typically includes an information meeting organised for students prior to their work placements, the teacher's visit to the workplace and a final meeting held after the work placement period. Each student has a designated workplace supervisor at the training place. However, this research did not focus on the role of workplace supervisors, but on how the teacher could better support trainees' learning process in learning assignments specified in their curriculum.

Almost all students who participated in the study were satisfied with the tutoring received during previous work placement periods. They felt that they had always been able to ask their teacher for help and support whenever necessary, by means such as e-mail. All students who participated in Mobilogi tutoring considered that SMS tutoring was useful and complemented other forms of tutoring in a sensible manner. The responses indicated that tutorial questions helped students to analyse their own thoughts about work placements and their objectives. Students felt that the questions helped them to reflect on the theoretical objectives of work placements during actual training situations.

> *'...I thought about things related to my work placement more diversely, from several perspectives.' (A student on the questionnaire)*

> *'I found Mobilogi tutoring to be very positive. You started to think about things more during the actual placement and not only when writing the report, which is what usually tends to happen. I perceived receiving messages as being a very clever and worthwhile thing and I'd go along with this kind of experiment again without hesitation. I think it would be a good idea to offer this to others too. As, even though you didn't always answer the messages, you did always start thinking about them.' (a student on the questionnaire)*

> *'I have given more thought to my placement objectives and situations than during my previous placements.' (A student on the questionnaire)*

When asked whether tutorial questions created a feeling that the tutor was present more than on previous placements, answers varied. Even though tutorial questions were perceived as being useful, not all respondents felt that they brought the tutor 'closer'. One reason cited for this was the fact that the sender of text messages appeared to be Mobilogi rather than the teacher. In addition, they felt that a message sent to a mobile phone was completely different from meeting a tutor face-to-face. Nevertheless, some respondents perceived tutoring as being quite personal.

> *'It felt as if someone was constantly urging you to think.' (A student on the questionnaire)*

While almost all students were satisfied with tutoring of work placements offered by their educational institution, they wished that the teacher responsible for tutoring would provide more support during work placement periods. For example, they wished to have an interim debriefing with the teacher halfway through the period, either over the phone or via e-mail. They perceived that Mobilogi improved

tutoring. With the exception of one student, all respondents were also willing to use Mobilogi during their future work placement periods.

> *'...the student should also be woken up during the placement and not only at the beginning and end.' (A student on the questionnaire)*

Content of tutorial questions

The tutorial questions were developed together with teachers responsible for tutoring work placements. The content and timing of questions were designed to support the objectives specified for work placements within the curriculum. The questions were structured in compliance with **AEFIRIP** (Silander & Rytkönen 2005), the pedagogical model for mobile learning and tutoring, and teachers had access to a tool for planning mobile learning situations and tutoring, developed according to the model. During the spring work placement period, questions were sent on a daily basis, while the frequency for the autumn period was three times per week.

Tutorial questions for the work placement period in autumn 2007:

Activation: Hi! Enjoy the start of your work placement. What kinds of expectations do you have and what kind of mood are you in as you start your placement period?

Focusing: Please make a note on a piece of paper or in the log when you face a challenge at work or feel that you've achieved something. Make use of your notes when writing your work placement report.

Activation: Hello! Please reflect on how motivated you are to learn new things during your placement. Have a great weekend!

Focusing: Please go through the placement objectives and plan how to best achieve them at your training place. Go through the plan with your workplace supervisor.

Interpretations by the learner: How well have you managed to agree on arrangements relating to your learning agreement, such as your role as a trainee, your assignments and supervision?

Reflection: Do the learning objectives that you have recorded feel relevant to your work? Can you think of any other types of knowledge/skills that you would need in your work?

Focusing: Please reflect on why the clients of your training place are using its services. Does the service provide them with the help that they need?

Externalisation: How does working at your training place meet your expectations?

Interpretations by the learner: Do you feel capable of helping clients; if yes, how; if not, why not?

Reflection: Please reflect on what things are important to the client when they need help.

Information processing: Please reflect on what would be the best way for you to learn from the experiences gained during your placement.

Reflection: What types of observations have you made about yourself during your placement? What are your strengths; how about your weaknesses?

All respondents perceived that the contents of the questions were sensible and understandable. They were able to apply the questions to their own placements and training places. Each message always focused on one specific topic at a time and the contents of questions were considered to be useful in terms of work placements.

> *'The questions have nevertheless been basic questions, which it is good to consciously think about during the placements.' (A student on the questionnaire)*

> *'The messages asked about things that you were supposed to think about anyway during the placements. They didn't let you forget to think.' (A student on the questionnaire)*

> *'I had no problem finding answers to them from the day-care centre's daily activities.' (A student on the questionnaire)*

Students had already specified their personal placement objectives prior to the beginning of their work placement and Mobilogi tutoring. However, they perceived that tutorial questions clarified and consolidated these objectives.

> *'Of course, the questions did expand my thinking, for example in relation to my training place's clients.' (A student on the questionnaire)*

> *'...but perhaps they have helped me to think about new things and have influenced my objectives in this way.' (A student on the questionnaire)*

Respondents felt that the number of questions and their delivery time were mostly good. The questions were timed to be sent at the beginning, in the middle and at the end of each week.

Replying to tutorial questions

In the pilot study, students were free to decide how to reply to tutorial questions. The options available to them were to text a brief reply to the Moodle log via Mo-

bilogi, reflect on the questions in their on-the-job learning diaries or final reports; discuss things with the teacher or workplace supervisor and to reflect on the questions on their own.

The spring work placement period involved keeping an on-the-job learning diary. The student involved in this pilot had, indeed, reflected on all the topics of tutorial questions in her daily diary. In addition, she had also texted brief replies to the Moodle log via Mobilogi. However, the student had not visited the log to view the questions or her answers, but had written them with the teacher in mind. Since she wrote the on-the-job learning diary regularly at the end of each training day, she did not need the log to jog her memory.

> *'It sort of remained a bit unclear to me there, like, you were supposed to reply, like if I was supposed to reply with this phone about what I was thinking, or then I thought that, no, I guess I should just add this in the diary. At first, I tried replying by message, but then you couldn't really fit much in it. Then I just wrote, OK, I'm thinking about this. I then reflected on it in the diary.' (Student interview)*

Students involved in the autumn work placement period did not keep a diary; instead, they were due to write a final report on their work placement and related learning assignments. In this group, the brief replies stored in the log could have functioned as a good way of recalling the things that had been dealt with, but none of the students made use of this option. Everyone reported that they had reflected on the things presented in the questions in their minds, while some had also written their reflections down on paper. Three students wrote that they would also go through the questions in their final reports.

> *'...I believe that they [Mobilogi replies] will have an effect, because I can, for example, compare what I thought about things while on placement with what you think after the placement. I think that they will help to structure things.' (A student on the questionnaire)*

In their responses, students highlighted the fact that they perceived that reflecting on the thoughts stimulated by the tutorial questions had consolidated their learning process during their work placements.

Timing of tutorial questions

During the spring pilot period, the teacher wrote and timed the tutorial questions in advance for the first two weeks. Over the second two-week period, the teacher logged on to the Logi tutoring tool to write and send questions in real time. Over the first two weeks, tutorial questions were timed to be sent to the student on a daily basis. When sending tutorial messages became a real-time activity, the number of messages decreased significantly: the teacher only sent one tutorial question during the latter period.

> *'Well, this obviously happened at that bad time when I was away for a week, so I had a desk full of work. And this spring hassle at any rate – don't know if I managed to send one or two questions over during the last two weeks.' (Teacher interview)*

Following discussions with the teacher responsible for tutoring the autumn work placement period, participants decided to devise all tutorial questions in advance and time them to be sent according to the schedule agreed in advance. It was easier for the teacher to think over the entire tutorial process and its questions at once, rather than compile tutoring 'bit by bit' during the placement period. The teacher was also certain that he would not have found time to ask the tutorial questions at all due to other urgent matters and duties, had he been supposed to send them in real time.

Students did not perceive any problems with pre-set questions.

Technical functionality of Mobilogi

All students in the pilot group had their own mobile phones and they were seasoned texters, so they found it easy to receive tutorial questions and send replies. Replying was, however, slightly complicated by the log identifiers to be written at the beginning of messages. A few students actually wished that they had clearer instructions for using the Logi tutoring tool.

During the first pilot period, both the teacher and the student were provided with Sony Ericsson P990i phones. The phones had subscriptions paid by the DLL project and they were free to use the phones for testing purposes. However, neither of them took to the phone but felt it awkward to carry two phones around with them. Both owned a Nokia phone and felt it a bit difficult to use a Sony Ericsson. In addition, both the student and the teacher pointed out that carrying two phones was not practical anyway. During the second pilot period, students were allowed to use their own familiar phones. This made it possible to avoid problems related to using a strange model of phone.

There were some problems with the timing function of Mobilogi during the second pilot period; timed messages did not reach trainees. However, the teacher or students did not notice the problem, since the messages were forwarded in real time by the research team according to the schedule agreed in advance.

Conclusions

Tutoring

The pilot study aimed to establish ways in which it would be possible to support students' learning process in authentic learning environments by means of mobile tutoring. The research involved collecting information about how health and social services students perceived tutoring carried out through the Mobilogi application.

The aim was to get students to reflect on on-the-job learning assignments during their work placement period, while also developing their metacognitive skills.

Objectives set for work placement in the field of health and social services indicate that work placement can no longer be simply about practising mechanical skills and learning from a model. As part of their work placements, students are supposed to analyse their theoretical knowledge and practical experience as well as relevant ethical issues, emotions and attitudes (HAMK WWW 2007). However, students require support in building their reflection and assessment skills. Perceptions of Mobilogi-supported tutoring among students involved in the pilot study were encouraging. Their responses indicated that they perceived that reflection on the tutorial questions had expanded their thinking, thus also influencing their own learning objectives. The questions helped students to reflect on things related to work placements more diversely and from new perspectives. The tutorial questions functioned as kinds of 'open-ended questions that open up the train of thought' as presented by Aarnio and Enqvist (2001, 60), helping to make students' own thought and learning process explicit. A text message is not the best possible way of replying to such open-ended questions. The aim of the Mobilogi project was therefore that the questions would stimulate thoughts and actual replies would take place in each student's mind, promoting the learning process. While replying to the questions was not monitored in any way, all students reported that they had reflected on them on their own or with their workplace supervisors. Consequently, they considered reflection on the tutorial questions to be a useful activity that supported learning.

In teachers' stories cited in Hulkari's study on work-based learning, high-quality tutoring was associated with the number of tutoring contacts between the teacher and student. Availability of tutoring, in turn, was directly linked to the time resources allocated for this purpose. (Hulkari 2006, 103.) At HAMK, as at many other educational institutions, teachers' tutoring resources are not sufficient to organise several tutoring contacts for each individual student. Based on the experiences of the teachers involved in the pilot study, planning the tutorial process as a whole and timing the tutorial questions enabled utilisation of Mobilogi. Mobilogi allowed teachers to build a pre-planned and scheduled tutorial process that continued regularly throughout the work placement period. Teachers were able to use the tutorial questions to make students aware of the curricular learning objectives during the work placement period.

Mobilogi tutoring allowed tutoring to be brought right to the training places using mobile phones. Responses indicated that reflection on work placement and its objectives would often take place only after the period when writing the final report. The tutorial questions allowed students to deal with and reflect on their on-the-job learning and learning assignments on a daily basis while working at their respective training places. Mobilogi was particularly useful in work placements that included writing a final report, instead of a learning diary, as part of their learning assignments. However, the tutorial questions had also been considered useful when writing a daily on-the-job learning diary.

In support of planning the tutorial process, teachers used the AEFIRIP model for (Silander & Rytkönen 2005) mobile learning and tutoring, which focuses specifically on the critical phases of the learning process taking place in an authentic environment and on tutoring of these phases. The teachers found the model helpful

when planning tutoring: the model facilitated the tutorial process and timing the tutorial questions. However, they did consider the AEFIRIP planning tool to be difficult to understand in some respects, which means that there is still room for further clarification of the tool. In this case, not all the different phases of tutoring described in the model opened up in practical terms.

The questionnaire asked students' opinions on each specific tutorial question, with a view to investigating which phases of the learning process included the questions that were considered to be most useful. However, all respondents ranked the questions equally useful. Consequently, this research question should be investigated in more detail through interviews at a later date.

This small pilot study indicated that students require reflection and tutoring to promote their metacognitive skills in support of their on-the-job learning. Automated mobile tutoring makes it possible for teachers to provide students with the additional support that they need with minimal extra time invested.

The Mobilogi application

The functional idea of Mobilogi is good, but its technical usability is not as yet at an adequate level. The pilot study also revealed the unreliability of the timing function. From the students' perspective, Mobilogi functionality is relatively simple and easy to understand. Conversely, from the perspective of a teacher who writes and sends tutorial sentences, there is still room for further improvement of its ease of use.

Mobilogi allows sending text messages to one or all members of a tutorial group. The teacher does not have the option to send messages to certain members of the group; nor can the writer see how many characters have been used or how many messages the text will be divided into while writing a text message. In terms of the content of text messages, there are far too many mandatory entries coming from the log. This means that one message can only accommodate one or two short sentences in addition to these identifying entries. Due to possible message delivery errors, it would also be a good idea for the teacher to be able to check message delivery reports to see whether students have received the message. At present, the teacher does not receive any error messages in the event of Mobilogi malfunctions.

The teacher should also have the opportunity to choose whether they will receive a copy of a message that they have sent or scheduled for sending. When the teacher wants to receive replies to a message on their mobile phone, it is difficult for them to remember which specific question students are answering, if they have not received a copy of the question on their phone. This is a problem with pre-set messages in particular.

At present, all messages are stored in the Logi tutoring tool in order of delivery. If a student replies to a specific question, it would be a good idea for the answer to appear under that question. At present, it is difficult to pick out questions and related replies, especially if the teacher has sent several questions.

With further improvements of its usability and functional reliability, the Mobilogi application will become quite a useful tool for mobile tutoring. As students are

already familiar with mobile phones and text messaging, Mobilogi will function smoothly as a tool for conveying tutoring.

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Merja Snellman

Future prospects of e-learning and learning technologies

Abstract

E-learning is a complex and constantly changing phenomenon that does not allow stagnation. This article examines the future prospects of e-learning, focusing on the types of learning technologies that will be required in the future. The field of learning is increasingly moving towards holistic learning. Learning takes place everywhere and technologies make it possible to support the learning process in many ways. In addition, collaborative learning networks, on the one hand, and individualistic and learner-centred approaches, on the other, create needs to develop new applications of learning technology. Web 2.0 applications appear to be the next major trend in the field of learning technologies. E-learning means different things depending on the context and the users. What is currently part of everyday life for some is still in the future for others.

Introduction

People have used aids for teaching and learning through the ages (Lehtinen 2006). Development of printing technology and the introduction of note-taking supplies are still key inventions, but the significance of technologies is also increasing all the time. The use of learning technologies for teaching and learning is here to stay and it is almost difficult to imagine a future where information and communications technologies (ICT) would not be used in support of the learning process in some way. In this context, learning technology refers to those learning tools that enable studying with a variety of interaction and guidance tools and methods without strict dependence on time or place (Saarinen 2007). Some applications of learning technologies have been especially developed to support learning and teaching, but applications not specifically designed for this purpose are also frequently employed.

This article examines the future prospects of e-learning, focusing on the types of learning technologies that will be required in the future. Future prospects have been explored by means of studies, surveys and articles dealing with future scenarios and trends and topical phenomena in e-learning. Studies and surveys concerning

future scenarios and trends of e-learning are being carried out within many institutions and projects. In addition to researchers, the future prospects of e-learning are also of interest to learning communities. According to a study conducted as part of the DLL project (Snellman 2007), the three most interesting topics, about which business and public sector organisations making use of e-learning require research information, are

- the future prospects of e-learning,
- the impact of learning technologies on the learning process and
- field-specific e-learning applications.

Learning technology in support of the learning process

The function of learning technology is to support the learning process. In this article, the learning process refers to a pre-planned development process progressing gradually in time with a view to achieving a specific type of competence. The learning process is the development process as a whole, not an individual learning event. The learning process enables learning, where in turn the key is an individual's thought process. In addition to actual information, knowledge is considered to cover the skills to use information and solve problems, inference rules, metacognitive skills, and consciousness of the content of one's own memory, i.e. metamemory. In other words, learning is knowledge building. (Koli & Silander 2002.) Knowledge is built through the learner's own processing and requires cognitive processing, which refers to the learner's information processing, thinking and problem-solving efforts. All new knowledge is based on prior learning. (Koli & Silander 2002; Lipponen, Lallimo & Lakkala 2005.)

In order to plan a learning process and support for it through learning technologies, it is crucial to know how a human being learns and what factors influence this process. As Jarvis (2005) points out, learning is such a complex combination of different processes that the concept is difficult to define. Jarvis (2005) defines the concept of learning as follows: 'Human learning is the combination of processes whereby the whole person – body (genetic, physical and biological) and mind (knowledge, skills, attitudes, values, emotions, beliefs and senses) – experiences a social situation, the perceived content of which is then transformed cognitively, emotively or practically (or through any combination) and integrated into the person's individual biography resulting in a changed (or more experienced) person.' In addition to an individual's personal attributes, the learning process is influenced by factors relating to the learning environment, such as the teaching event, learning assignments, the teacher's guidance, group dynamic in the learning community, methods and learning technologies employed, and general cultural factors. Due to the complexity of the process, it may be challenging to verify the effects of any one single factor on the learning process.

The learning process may be promoted by guiding the learner's thought and problem-solving processes. A thought process, for example, may be easier to understand when it is made visible through writing or other methods. The teacher may influence learners' learning process and direct them towards processing information in depth by selecting methods that are relevant to the situation and support efforts to process information. Various learning technologies can be used for this purpose.

(Koli & Silander 2002.) Learning technology can be employed in diverse ways to support learning, but use of technology calls for a specific need to do so. The benefits are very much dependent on how technology is used in support of learning. (Osborne & Hennessy 2003.)

It is also necessary for developers of learning technology to understand the learning process and factors that influence this process. According to Lipponen, Lallimo and Lakkala (2005), the two extremes in development of ICT-supported learning environments are the technical and the pedagogical approaches. When the technical approach is taken as the basis for designing learning environments, the assumption is that a carefully designed technical environment facilitates development of pedagogical and social practices relevant to studying. The challenge, however, is to translate non-technical properties, such as cognitive and social factors, into technical features. The approach at the other extreme is a well-founded pedagogical need, which may, for example, require a learning technology application in order to be fulfilled. In this case, the basis is learning rather than what technology can accomplish. The authors suggest that pedagogical design also needs to allow for the complex interactions between practices and technology. When designing infrastructures for a learning environment, it is important to take into account the new forms of operation stemming from interactions between social and technical elements. Lipponen, Lallimo and Lakkala (2005) argue that one reason why experiments with learning technologies do not deliver on their promises or meet expectations is that people attempt to use technologies as systems that are separate from and independent of practices.

While research has shown that learning technology as such does not have any specific impact on learning, it does have situational effects (Lehtinen 2006). Learning technology may influence the learning process in that it makes learning possible in the first place. Technological applications, such as simulations, enable practical training in fields where it would be difficult to organise in authentic conditions. For many people, distance learning is the only chance to study, which means that courses built on an online platform or lectures communicated to students using video technology make the learning process possible. Based on studies conducted as part of the DLL project, experiences of using learning technologies in support of learning have been so positive as to lead to implementation of entire online degree programmes (Saarinen 2007).

Learning technologies also influence the learning process in the sense that they make it possible to visualise the learning process. Learning processes built on online platforms, in particular, require the process to be planned from start to finish. In addition, learning technologies may diversify the learning process and facilitate concrete arrangement of the learning process. At present, typical learning technology applications include traditional learning platforms, audio systems, web-conferencing and online meeting systems and video-conferencing systems (Saarinen 2007). By means of various media elements, it is possible to support the content-related objectives of the learning process and its different phases, but excessive use of media elements may also overload information processing and thus complicate learning (Lehtinen 2006).

According to Lehtinen (2006), the issue of the effectiveness of information technology is problematic, because learning effects are always linked to a specific way of

using technology as part of the learning environment, which means that, instead of technology, the focus should be on how a specific use of learning technology influences the learner's cognitive processes.

The opportunities provided by technology to promote learning will also form an important theme in the future. It is likely that technological developments will enable things that we cannot as yet even begin to imagine. When considering the possible future of learning technologies and the possible applications that will be required in the future, it is necessary to examine the issue from a broader perspective, i.e. what the field of learning and teaching will look like in the future.

Research into the future of e-learning

Studies and surveys concerning future scenarios and trends of e-learning are being carried out within many institutions and projects. This article presents a few studies that have charted the future and scenarios of e-learning and learning technologies. The review is based on a survey about the future scenarios of learning technology (Kujala et al. 2005), which was conducted by HAMK University of Applied Sciences, Mediamaisteri Group and the University of Tampere Hypermedia Laboratory in 2005. The survey aimed to chart the current status of the use of learning technologies in Finland and to investigate the perceptions of Finnish experts concerning the future of learning technologies. The data included expert interviews, responses to a multiple-choice survey conducted among participants of the Interactive Technology in Education '04 Conference and panel discussions organised for a group of key experts. Based on the data, the researchers created four scenarios of future learning technologies, which are briefly summarised below. The scenarios were divided into a quadrant with the two axes describing the 'technology focus vs. human focus' and the 'developing vs. declining learning technologies' dimensions respectively.

Intelligent learning technology. In this scenario, the Finnish field of learning technology has become clear and all learning is linked to technology. Technology is ubiquitous and terminal devices are ergonomically designed and, as a result, the use of technology in support of learning is seen as being a natural part of everyday life. Development of the field is vigorous and innovative. In particular, intelligent forms of learning support have increased and learners are not required to exercise considerable self-regulation. Simulations and games motivate learning. Machines perform functions on behalf of users. Learners' personal needs and knowledge can be integrated more and more effectively as part of studies. Work, education and leisure cannot be clearly distinguished from one another. Distance learning related to work and interests has become more popular. (Kujala et al. 2005.)

Globally collaborative learning technology. Collaboration has assumed a major role in society and learning increasingly takes place in interaction with other learners. Learner communities have collective material repositories. Integrated video and audio learning platforms support development of experts and knowledge sharing within online communities. Systems relating to reflection and knowledge management processes support interaction. Internationalisation has diversified provision of education and has led to increased competition between educational institutions. Communication between different nationalities can be accomplished by means of intelligent translation systems. (Kujala et al. 2005.)

Crisis-prone learning technology is an undesirable scenario, where the field of learning technology is characterised by fragmentation and lack of organisation. The lack of standards has led to dissemination and distribution problems in the area of content production. Tribalism and knowledge hoarding prevent development of the field. Schools' operational cultures have become closed and they neither support collaboration, nor invest in the use or pedagogical quality of learning technology. Intelligent systems are seen as being a threat to free thought and creativity. It has not been possible to produce scientific evidence of any measurable benefits that could be achieved by means of learning technology, which has undermined belief in its potential to support learning. (Kujala et al. 2005.)

Learning technology bound to individual abilities. This scenario highlights people's inequality as users of learning technology and members of the learning community. Society has become divided into those who know and those who know little. The so-called excluded people include older age groups, immigrants and disabled people, whose needs have been ignored as technology has been developed. Some of the younger population consciously choose to stay completely detached from technological society. Major companies have seized the market and SMEs have been trampled in the process. (Kujala et al. 2005.)

The critical factor in all these scenarios is the basis for developing technology. The shape of the future will be very much determined by whether technology is developed for people to meet their real needs or whether it is the technology that drives development and uses. The 'globally collaborative learning technology' scenario emphasises learners' active involvement and the social nature of learning, such as collaborative working methods and development of expertise in online communities, as well as openness. One of the threats involved in the other three scenarios is that learners become passive as intelligent systems perform functions on their behalf. Other threat scenarios include the field's plunge into crisis and people's inequality as users of learning technology or members of the learning community. According to Kujala et al. (2005), the market for learning technology is currently fairly undeveloped, which may either result in crisis or in development of the field. Technology will be used in support of learning in one form or another and, based on the survey; it would appear that technology will gradually fade to the background as people focus on the main point, i.e. learning. However, this requires technology and infrastructures to be effective.

One of the objectives of the **Education Intelligence** (Tulevaisuusluotain 2006) project was to provide a vision of competences required in the future world of work. The specific dimensions of competence – such as knowledge, skills, values, attitudes, networks, and quality – constitute the very foundation of our competitiveness and welfare. Technology will be harnessed to serve the learning process by combining virtuality with personal interaction in the context of various learning, occupational and free-time environments. Learning will increasingly become a permanent part of daily life. The Education Intelligence project contends that close interaction is required between the educational system and other preconditions for learning and proposes the following eight measures to achieve this goal:

1. Development of education must be based on competence needs. The content of education should provide basic qualifications and support competence-building, innovation and creativity through various methods.

2. In the future, learning must be perceived broadly; in other words, education should be closely linked to the other prerequisites of learning and special effort should be made to develop networks. The educational system will network with other service providers and stakeholder groups, such as business life institutions.

3. New structures supporting lifelong learning have to be created for education. All-round education is the basis upon which the competence required in the world of work will be built. What is needed in Finland in the future are strong professional skills as well as diverse competence focusing on building networks concentrating on development, research and added value. Learning will not stop when school is finished, because the skills and knowledge acquired at any time will inevitably be outdated.

4. Learners must be involved in the hub of learning. The Education Intelligence project argues that the status of students must be improved in order to highlight the importance of lifelong learning, to personalise the learning process, to improve learning results, to reduce the drop-out rate, and to make better use of the resources available. (Tulevaisuusluotain [Education Intelligence] 2006.)

5. The fifth measure outlined by the Education Intelligence project is creating a new role for teachers. Technological innovations will revolutionise learning, but the teaching profession will remain important in the future network society as well. Teacher identity will, however, be understood in broad terms, while the teaching profession will also be internationalised. Future virtual and other technological applications will free up the teacher's resources for personalised teaching and creativity.

6. Information and communications technologies in support of learning. A new term is the ubiquitous society in which information technologies become an almost inconspicuous part of everyday life. In the future, various applications will become seamlessly compatible and applications serving the user in the best possible way will be developed for a range of situations. In terms of learning, this would mean that every citizen can develop and produce learning content irrespective of time and place. Virtual communities will assume an increasingly significant role, while communications may be based on hearing, vision or movement, regardless of the geographical location of users. Learning processes can be made more efficient by means of new technologies and some processes may be completely automated.

7. Sustainable development must become an essential part of education and training and be at the core of society, which means that it will be central to learning and action and that our educational competence will promote sustainable development.

8. Strategic competence management must be forward-looking and future-oriented. Competence remains our most important competitive tool, which means that educational policy planning and monitoring of the results should be overhauled to develop a comprehensive strategic competence management system. (Tulevaisuusluotain [Education Intelligence] 2006.)

In its report, the committee on **learning environment research** (Opetusministeriö [Ministry of Education] 2004) presents future trends, needs and priorities in research into learning environments as well as scenarios for education that it has created. The committee argues that learning technologies will form part of future learning environments, while its scenarios highlight the significance of technologies, in particular those relating to intelligent products and services. Rapidly developed and implemented technologies may, however, involve the challenge of being difficult to manage and use. The scenarios outlined by the committee on learning environment research are based on the underlying idea of holistic learning, which is lifelong and lifewide and which is actively supported by means of information and communications technologies. The threats identified as part of the scenarios include holistic learning becoming a burden and people's unequal position as learners and members of society.

The **LEONIE project** (Learning in Europe: Observatory on National and International Evaluation) has collected views about change drivers influencing development of learning and teaching in Europe. The survey was conducted in 2004 with the aim of investigating future trends over the next ten years. The survey involved more than 250 experts in the field of education and training and the data was analysed using the Delphi and weak signals techniques. The LEONIE survey indicates that e-learning will increase in the future and will emphasise a learner-centred approach. In the future, learners will have more and more control over the way in which they study. The use of new technologies is influencing the processes of teaching and learning by creating new opportunities, models and innovative tools. Individual learners will take greater responsibility for their own development, self-training will become more common. A teacher's role as a facilitator of the learning process will become more prominent. Efforts will be made to take different learning styles and needs into account right from the design of the learning process. Collaborative learning will become more common, both face-to-face and through video and other technologies. (Delrio & Dondi 2005.)

The LEONIE survey (Delrio & Dondi 2005) suggests that, in the future, training and learning will increasingly become a business activity, following the business models describing them as knowledge-based services. The boundary between learning and work will blur. Attempts will be made to meet work-based learning needs through learning on-demand and to avoid unnecessary training. Learning will become more and more just-in-time learning, which can be fulfilled by means such as mobile technologies. Access to digital sources and learning networks will become easier with development of technology, but there is also a risk that this will create a division between privileged learners, whose opportunities are virtually unlimited due to access to equipment and their own skills, and less privileged learners, whose learning opportunities will continue to shrink in constantly changing conditions. In addition, the focus on self-directed learning styles may also result in leaving a large number of people without any possibilities of achieving the skills required in the

future. Learners' inequality will be a threat that learning researchers, developers and decision-makers need to take seriously. The LEONIE project has also compiled a toolkit for analysing the future of e-learning. The project website provides models and detailed instructions for building scenarios.

HELIOS is a research project supported by the European Commission, aiming to create the European e-Learning Observatory, an effective observation model to support the progress of e-learning in Europe and produce future e-learning scenarios. The key observation made in the HELIOS project, which also has a bearing on the future, was to examine e-learning as smaller elements in lieu of one vast mega trend. If e-learning is perceived as being an integrated whole, the phenomenon becomes vague. The HELIOS consortium has defined 'e-learning territories' (Figure 1), while also reiterating that e-learning is a constantly changing phenomenon and that new territories and divisions are being created all the time. (Delrio & Fischer 2007)

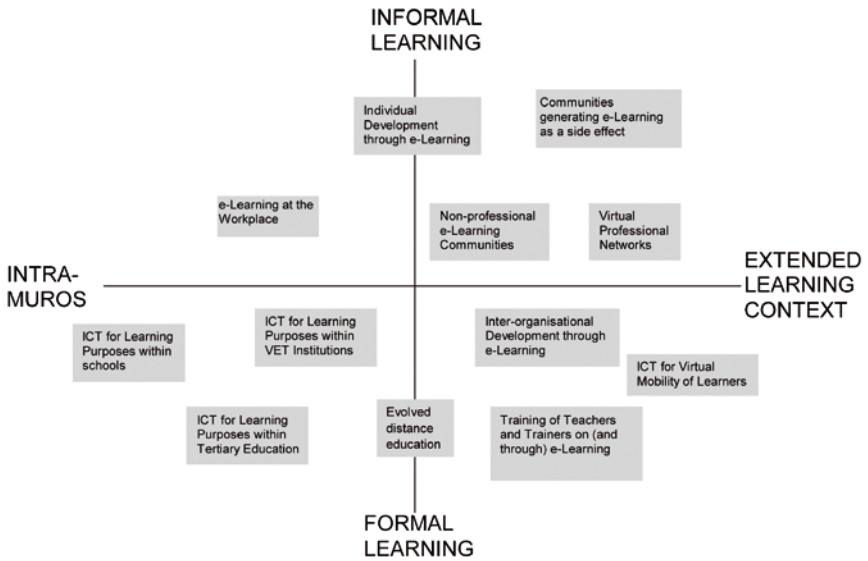

Figure 1. HELIOS Map of e-learning territories (Delrio & Fischer 2007).

The HELIOS consortium argues that the map of e-learning territories helps to illustrate the diversity of e-learning application areas, instead of only examining e-learning as being one large phenomenon. According to Delrio and Fischer (2007), definition of e-learning territories is useful for several reasons. Territories help to overcome views on purely functional differentiations of e-learning. In addition, it makes it possible to focus on e-learning development within a specific territory, because e-learning is at very different evolutionary stages in different territories, which makes it difficult to examine the phenomenon as a whole. It is this specific aspect that should be borne in mind when examining the future of e-learning. E-learning means different things in different contexts.

The HELIOS consortium argues that the majority of policy-makers, e-learning researchers and developers currently concentrate on reproducing formal teaching environments with support from technology, while more attention should be focused on how technological applications could be utilised in different ways for learning informally. Technological applications specifically designed to meet the needs of learning have had some effect on learning in formal and corporate settings, but the effects of so-called generic technological innovations, such as the television, the computer, the Internet and Google, are much more significant. According to Dondi (2007), the fact that a large number of learners currently have immediate access to virtually unlimited sources of information puts the education system in a totally new situation.

Futurelab carries out studies and surveys relating to the future of e-learning. In their article entitled *Towards new learning networks*, Rudd, Sutch and Facer (2006) approach learning scenarios through examining the types of institutions, spaces and places where learning will happen, and with whom. The researchers argue that, 'if we are interested in achieving a fully personalised education system designed around the needs, interests and aspirations of each learner, then we need to challenge a number of fundamental assumptions which have historically underpinned the organisation of education'. (Rudd et al. 2006.)

Rudd et al. (2006) suggest that, firstly, we need to challenge the assumption that expertise and knowledge reside only within the walls of educational institutions, and to ask instead, what might be gained from tapping into the resources that exist within the networks that people are already connected to. Secondly, we need to ask what different models of and approaches to learning people also use in their leisure time. In addition, we should bear in mind that, as digital resources increasingly offer opportunities for networked and collaborative learning and interaction, we need to challenge the assumption that the easiest and most cost-effective approach to organising learning is within the walls of a school. The researchers argue that we need to move away from institutionalised learning to the networks of learning communities. They justify their view by the fact that life outside formal learning is increasingly organised around networks, that learning is already about networks, collaboration and connection anyway, and that social capital and social mobility are achieved through building and mobilising networks of expertise.

Futurelab's scenarios focus on the school world and highlight networks of learning communities. The researchers argue that this is the direction in which learning communities will be moving in the future. At one extreme of the range of different scenarios, the focus is on the significance of formal learning, where educational organisations overlook learning occurring outside their walls, pleading lack of time, for example. Rudd et al. (2006) contend that the current education system is very much in line with this scenario. If we continue to follow this line of action, opportunities to build links between learners, between school and community are clearly being missed and there is a risk that formal education may remain increasingly abstract. The scenario at the other extreme places greater emphasis on informal and non-formal learning. In this approach, people recognise and value these learning experiences and build collaborative links between these experiences and formal learning. Such environments celebrate diversity and highlight tailored learning and teaching methods. However, this scenario tends to be the exception rather than the rule. Formal education rarely reaches into the realms of informal and non-formal

learning practices, let alone to such an extent as to use these as a basis for learning development. Futurelab's scenarios emphasise the blurring of boundaries between formal and informal learning. The fact that learning occurs everywhere and all the time should also be exploited in formal education. Digital and other such tools form a natural part of learning and enable diversified learning that supports different learners.

The future of learning technologies

It is likely that, in the future, we will have access to technological applications that we cannot as yet even begin to imagine. If we examine the near future of e-learning, the applications of learning technology also likely to be used in the years to come include at least online learning platforms, video technology applications, virtual workspaces, intelligent technologies, simulations, mobile applications, personal learning environments and Web 2.0 applications. The above-mentioned technologies are already being used today, but when the field of e-learning is examined in the light of research and other topical writings, it is fair to assume that there will also be demand for them in the years to come in the form of new applications, which means that they will also play a role in the future of e-learning.

In addition to using technology in support of learning, it also appears that electronic services relating to learning and studying will become increasingly common. The University of Tampere working group on utilisation of information and communications technologies (Tampereen yliopisto 2007) contends that this calls for harmonisation of electronic services and information systems, because electronic services in student administration must function smoothly, enabling students and teachers to focus on their main job. Development of new systems must allow for smooth data transmission between different systems so as to ensure that data only needs to be recorded once. The University of Tampere, for example, has already advanced quite far in terms of developing electronic student administration services. Students actively make use of electronic services and consider them to be useful. Electronic services allow them to register for exams, browse exam results and credits and change their contact information, etc. The future challenge for electronic support services for learning and studying is to develop the interoperability of systems. Diversification of services will be topical in the future. (Tampereen yliopisto [University of Tampere] 2007.)

Learning platforms

It is likely that online learning platforms will also be used in the future, because researchers such as Saarinen (2007) argue that a learning platform similar to the current one will probably be the best place for creating a learning process in the future as well, complemented with media elements and tools to enrich the process as required in each specific situation. While online courses are already part of everyday life in many educational institutions and organisations, an information network is still a new type of learning environment for many teachers and students (Kullaslahti & Friman 2007). It is also possible to draw inferences about the continued popularity of learning platforms from user volumes. By way of example, the user volumes of the Moodle Learning Management System used at HAMK Univer-

sity of Applied Sciences have doubled over the last two years. At present, there are about 10,000 usernames. At the University of Tampere, which has used Moodle since 2003, the number of usernames is almost 19,000. Learning platforms play a role in formal education in particular as interactive environments, material banks and enablers of distance education, which indicates that it is likely that they will also be used in the near future.

The IT-Peda network co-operated with the Finnish Virtual Polytechnic to conduct a survey of the current status of learning platforms (http://www.jyu.fi/erillis/thk/itpeda/yhtjarj_k/alustakysely1 [*in Finnish*]). Finnish higher education institutions seem to have committed to open source-based development in learning platforms, as Moodle was used in 18 out of the 38 institutions that responded to the survey. Other platforms currently used at higher education institutions include WebCT/BlackBoard and Optima. The survey indicates that higher education institutions intend to stick to their current choice of platform for the foreseeable future, because any change of platforms would involve high transition costs in terms of training and support.

The most popular learning platforms, such as Moodle, Optima and WebCT, are not bound to any specific pedagogical model. The turn of the 21st century saw development of learning technology applications, such as KnowledgeForum, Belvedere and Fle3, which were based on a specific pedagogical approach or included learning processes, such as functions to support argumentation or problem-solving. Fle3 (Future Learning Environment) software, for example, was developed on the basis of the progressive inquiry learning model and it includes functions that support cognitive learning processes. Not many such learning platforms developed to provide functional support for learning processes are available on the market and it would appear that their use will remain marginal compared with so-called generic learning platforms.

Video technology

Use of video technology in support of the learning process has increased considerably over the last few years. For instance, when the University of Tampere started to support the use of video technology in 2005, 93 classes were organised in 2006, while the figure for 2007 was already up to 130. In other words, streaming lectures online for distance groups to view or uploading them as videos for students to watch online regardless of time and place is already part of everyday life.

Video technologies are being complemented with applications that make it possible to support and diversify the learning process. Educational use of video recordings can be made more interactive by means such as a video annotation system. A joint project involving Tampere University of Technology, the University of Helsinki, the University of Tampere, the University of Lapland, the IT-Peda network and the VideoFunet project has developed the VICTOR video annotation system, which allows users to annotate video clips with time-sensitive comments, classifications and media elements. A student can comment on a lecture or time his or her comments to point to a specific moment in the clip. The teacher or other students can continue giving comments using the system. The annotation system makes it possible to increase the pedagogical value of video clips and support interactivity instead of just

viewing the video. (VICTOR video annotation system, http://matriisi.ee.tut.fi/victor/ [*in Finnish; a brief English introduction available at* http://matriisi.ee.tut.fi/victor/english.php]).

Collaborative working environments

HAMK University of Applied Sciences has developed and already partially introduced the Virtual Computer Lab, which is an example of the kind of collaborative working environment that may attract demand in the future. In this context, the Virtual Computer Lab refers to an online resource that can be scheduled for remote study. Online resources that can be used via a Virtual Computer Lab are computers, operating systems, programs and learning objects. A Virtual Computer Lab offers the same opportunities for study as a real computer lab, but it enables remote studies either independently as individual work or collaboratively in small groups. In addition, the teacher can supervise learners in real time. (Yläkoski 2007.)

Yläkoski (2007) suggests that the most significant benefit of the Virtual Computer Lab is its economy, because it enables more efficient use of facilities, computers and software licences. By means of remote access to a Virtual Computer Lab, the different units within an organisation can use each other's software licences, even when based at different locations. Another significant benefit is the fact that a Virtual Computer Lab makes it possible to support real-time interactivity of the learning process, the shortage of which has been a problem in adult learning in particular.

Other collaborative working environments worth mentioning include Adobe Acrobat Connect Professional, which is a web communications system for real-time web meetings, online studies or online presentations. The system is based on the use of virtual meeting rooms, which allow organising meetings, lectures, seminars for hundreds of people, local support and online appointments produce content such as training materials in remote collaboration and manage administrative duties related to studies.

Personal learning environments

Personal learning environments (PLE) have been attracting interest since 2005. Wikipedia defines personal learning environments as systems that help learners take control of and manage their own learning, in particular in terms of setting their own learning goals, managing both content and process and communicating with others in the process of learning (Wikipedia 2007).

The current situation is such that, once an online course ends, the materials, discussions, etc. located on the learning platform will become unavailable to students. A personal learning environment would also make it possible to continue the learning process after the course has ended. The idea of personal learning environments is for students to have access to the tools that they need and to give them the opportunity to download any course materials that they consider necessary into their own learning environment at the end of the course. At present, some applications are available, but they are alpha or beta versions (such as Elgg and PleX) (Parikka 2006).

According to Parikka (2006), institutions' future learning environments should include a connection to a personal learning environment. Key players in the field in both commercial and open source sectors perceive this as being an important development trend. If personal learning environments become popular in the future, a specific issue will be to resolve which body will be responsible for user support for applications. There are currently many different opinions about whether it is the duty of the educational institution to organise support for or even maintenance of personal learning environments, because use of applications is not limited exclusively to formal education.

Intelligent technologies, mobile technologies and simulations

An increase in the use of intelligent technologies emerged in various scenario surveys (such as Kujala et al. 2005; Tulevaisuusluotain [Education Intelligence] 2006; Opetusministeriö [Ministry of Education] 2004). It is likely that the role of virtual technology, mobile applications and simulations will increase in vocational education and training (VET) and on-the-job learning in particular. As people are more and more frequently on the move, mobile technologies are also expected to be useful in future learning (Danish Technological Institute report 2004). In addition to interactivity, mobile technologies can meet people's needs to access information quickly and just in time for each specific demand. Mobile applications make it possible to increase interaction between students and supervisors during on-the-job learning periods and to support students' learning process by sending supervision messages to students' mobile phones.

In the future, technological progress and reduced equipment costs will enable wider uses of simulations in different fields. Even now, simulations are already used in certain VET fields, such as for training pilots and forest machine operators, but computer simulations are expected to become more widely popular both in VET and in workplace training. They allow people to visualise and practise situations that would be difficult or expensive to implement in practice. (Danish Technological Institute report 2004.)

Web 2.0 and social media in support of learning

Web 2.0 applications have recently become a strongly emerging trend in the field of learning technologies. Since 2005, the term assigned to the trend in Internet development has been 'Web 2.0', which refers to a shift towards more functional web-based applications and a more social approach to content production and distribution, with emphasis on open interaction, distributed authority and free sharing and reuse of information (Wikipedia 2007). Social media means media content generated or shared collaboratively online. Social software applications can be characterised by the fact that they support interaction between users and enable networking between people with the same interests, for example (Owen, Grant, Sayers & Facer 2006). By 'Web 2.0 applications', people mean blogs, wikis, discussion forums, games and other social media services. Blogs and Wikis are text-based formats, although they can also contain audio and images. Audio-visual software applications include services based on transmission of images, audio or video clips, such

as Flickr, MySpace and YouTube. The most popular applications are user-friendly, so they have a very low threshold for use.

Although not designed specifically for use in education, Web 2.0 applications are helping to make learning more personal, social, and flexible (MacManus 2007). For instance, the key result gained as part of the HELIOS project on the future prospects of e-learning was the arrival of 'e-Learning 2.0'. Delrio and Fischer (2007) believe that Web 2.0 will influence learning methods and practices, even though traditional learning will not disappear. There is strong belief in the e-learning 2.0 phenomenon, but the researchers advise prudence, because its use also involves many challenges. Owen et al. (2006) prefer using the term 'c-learning' instead of 'e-learning 2.0', because c-learning (collaborative learning) highlights the key idea of social media to bring people together to learn from one another, whereas 'e-learning 2.0' places emphasis on the technology employed.

Wikis

A wiki means a website with content edited by users themselves. The most well-known wiki is probably Wikipedia, the web encyclopaedia available in more than 40 languages. The most extensive Wikipedia version is the English version containing more than two million articles. The Finnish-language version currently comprises over 130,000 articles. The number of new articles and additions to existing articles is growing in different language versions every day. Wiki software applications can be used as knowledge management systems, where everyone can access and edit the information. Wikis are widespread in leisure activities, but they have also attracted interest at schools in support of the learning process and in businesses as knowledge management systems.

According to Loudermilk and Hern (2005), wikis can be used in support of learning and they have specifically been used to teach writing. Where a blog is suitable for individual writing, a wiki is specifically a collaborative tool. The idea is that users can edit wiki text that they have written themselves or that has been written by other users. The Moodle Wiki tool tested as part of the study by Saarinen (2007) did not work as desired: poor technical usability resulted in problems such as previously written text vanishing. Such problems may diminish motivation to learn. Regardless of technical problems, students felt that the Wiki idea was useful. Wikis are developing all the time and a newly emerged phenomenon is a widget, which refers to a functional element added to a wiki. Widgets make it possible for a wiki to become more resemblant of online learning platforms in terms of functionality. In other words, widgets allow wikis to be personalised by adding just those functions that the learning process requires at each specific time. (Parikka 2007.)

Blogs

A blog is an abbreviation of 'web log' that refers to easy-to-update, personal web pages mostly used as personal online journals. The idea of blogs is that they are public and readers can comment on entries. Blogs are typically used to write about topics such as hobbies or other interests and they bring together people with the same interests. Blogs dealing with needlework, and knitting in particular, are espe-

cially popular in Finland (http://www.blogilista.fi [*in Finnish*]). Blogs are written by people of all ages, because they are easy to use. Blogs by children and young people often contain quite personal details, which creates the threat of abuse of such information.

Use of blogs in support of teaching and learning is expected to increase in the future (Downes 2004). The spread of blogs also became clear as this article was being written, because some of the articles used as sources were found in blogs (such as Downes 2004; Farrel 2003; Majava 2007). Farrel (2003) presents five ways of using blogs in support of the learning process: 1) Class web pages are implemented as a blog, which makes the necessary information, such as timetables and any changes to them, easy to update. 2) A blog is used to collect materials and links in support of learning, on which students can also comment. 3) Students can engage in post-lecture discussions in the course blog, which enable interaction even for mass lectures. 4) Students are assigned to write texts relating to certain themes and post them to the class blog. 5) Students have their own blogs where they write course assignments and process their learning. This method has been used in training within the Finnish 'TieVie' project focusing on the use of ICT in education, for example, where students have used blogs as portfolio tools, compiling their assignments and processing their learning within their personal blogs.

Majava (2007) has assessed opportunities for using blogs for teaching. The greatest difference between blogs and traditional learning platforms is publicity. Blogs are usually posted online for anyone to read, which places restrictions on using blogs in education in terms of data security and confidentiality. Bloggers' privacy can be safeguarded by means such as password protection or blogging under pseudonyms. At the same time, however, public blogging may also be rewarding, especially if the texts are commented on by others. Blogging requires a certain degree of public writing skills, which can be considered useful and to which students should become accustomed. Blogs are characterised by their process-like and personal nature, discourse orientation and creation of network-type communities.

There are some experiences of the use of blogs for educational purposes. Krause (2004) argues that blogs are excellent tools for writing and publishing individual texts, but they are not suitable for collaborative writing. Krause tested the use of a blog as a collaborative writing tool on a writing course, with poor results. The application chosen for the purpose was easy to use and the technology did not cause any problems. The teacher's starting point was curiosity to test a blog as a collaborative writing tool and the objective was for the blog itself to inspire students to contribute. Since the students involved were graduate students, Krause assumed that they would write actively and creatively in the blog space, without the need for motivation. However, their posts were short, merely links to other documents, or text that was 'cut and pasted' from another source. Participation was also uneven and some students barely posted anything at all. Nevertheless, there was active discussion and exchange of messages on the class e-mail list. Krause contends that a blog works well for the purpose of publishing individually written text and receiving comments on it, whereas an electronic mailing list is the right tool for conveying a message to a certain group of people and fostering discussion within a specific target group. As evidenced by Krause's experiences, it is important to determine how learning technologies will be used in support of learning even before putting them to use. The blog was clearly not effective as a collaborative writing tool, but as an

individual writing tool, it provided the opportunity to publish and comment on the text, thus supporting individuals' learning process.

Conclusions on the future prospects of e-learning

E-learning is a constantly changing and evolving phenomenon involving creation of new technologies, pedagogical approaches, practices and needs, which means that there will be plenty of challenges in the future as well. What requirements do these above-mentioned e-learning prospects place on future learning technologies? First of all, since the use and the number of different users of technology are increasing, resources will be needed to guarantee all learners an equal position as learners to use learning technologies. Technology must also be easy to use and accessible to everyone, while also being compatible with different applications. Another issue concerns application management and administration: for instance, who is responsible for maintaining personal learning environments? The future of e-learning involves many challenges and threats. Researchers and learning communities are clearly wondering whether lifelong learning will become a burden, whether human life will become too heavily determined by technology, and whether people will find themselves in an unequal position, because not everyone has opportunities for using technology or learning. Of course, scenarios are usually exaggerated descriptions of possible futures, but they do make it possible to address drawbacks and possible threats before they become real.

Based on research into the future of e-learning and the scenario surveys summarised above, the following passages provide a collection of themes relating to the future of e-learning, which can contribute to what the future of e-learning will look like and what kinds of learning technologies should be developed to meet e-learning needs.

Holistic learning

It appears that the future trend is to move more and more towards holistic learning, which refers to the whole of lifelong and life wide learning (Opetusministeriö [Ministry of Education] 2004). In the future, learning must be perceived broadly and formal education should be linked to the other prerequisites of learning (Tulevaisuusluotain [Education Intelligence] 2006). This calls for a holistic approach to learning, which means that it is also necessary to recognise learning that occurs outside the walls of traditional educational institutions. Learning takes place in very different environments at schools, at work and in leisure time, by combining face-to-face and online teaching. Learning in leisure time and at work will increase, which may result in blurring of boundaries between work and leisure. (Kujala et al. 2005; Opetusministeriö [Ministry of Education] 2004; Punie & Cabera 2005.) In the future, learning technology will blend into the environment and will be used more and more naturally as part of everyday work. E-learning will establish itself in the sense that technology will become a natural part of future learning environments. Technology will be in the background, while attention will focus on the essentials, i.e. learning. (Kujala et al. 2005.) This obviously requires there to be a functional infrastructure in place.

Holistic learning also means that user volumes will increase and technology will be increasingly used by different types of learners. This will also need to be borne in mind when developing learning technologies, because everyone should have equal opportunities to use learning technologies in support of learning irrespective of personal background, geographical location, etc. Everyone needs to have an opportunity to learn to use ICT in support of their learning. As the use of technology becomes more common and as the variety of users increases, people need more and more user-friendly technologies (Punie & Cabera 2005).

Collaborative learning networks

Collaboration in support of learning has been a topic of discussion for a long time now. It is still being endorsed in studies and surveys concerning the future of learning (Rudd, Sutch & Facer 2006; Tulevaisuusluotain [Education Intelligence] 2006; Kujala et al. 2005). Initially, learning technology applications were devices used by learners to work on their own without interaction with other learners or the instructor. Nowadays, a key role of technology is to bring people together rather than isolate them (Kujala et al. 2005). Technology is especially seen as providing support for collaborative learning and work, because it is considered to contribute to creating natural networks (Tulevaisuusluotain [Education Intelligence] 2006). At the same time, the focus is on the social nature of learning: people learn in interaction with other people and, at least in theory, collaboration leads to better results than working independently, based on the available resources alone (Rudd et al. 2006). Lehtinen (2006) indicates that there is also plenty of evidence of practical situations where collaborative learning has failed or been inefficient. While collaborative practices cannot be an answer to everything, it is obvious that they will increase as part of future education and learning.

Individualist and learner-centred approaches

In addition to collaboration, research emphasises a learner-centred approach. According to the Education Intelligence report (Tulevaisuusluotain 2006), for example, learners should be moved centre-stage when planning education. Kujala et al. (2005) suggest that formal basic education will retain its current position, but a trend visible in other forms of education and training is that learning will increasingly be bound to individuals' personal needs. It is likely that future degree programmes will be compiled from several different modules, instead of everyone completing a uniform programme of study. In addition to individualism, from the perspective of organisations providing education, customisation of studies often means network-based collaboration as well. Network-based practices, in turn, will bring about challenges to the use of learning technologies, since the greater the proportion of activities built on electronic services becomes, the more central role the effectiveness of services will play (Tampereen yliopisto [University of Tampere] 2007). Individualism can also be seen in development of different solutions, such as e-portfolios and personal learning environments to support learners' learning process occurring in formal education but also in their leisure time.

E-learning is used in different ways in different contexts. The map of e-learning territories devised as part of the HELIOS project (Figure 2), illustrates the extent of

the phenomenon. The map can also be examined from the perspective of learning technologies, which would seem to indicate that social media applications could have a lot to offer in terms of informal learning and extended learning context in particular. Collaborative practices and genuine collaboration become particularly prominent in learning occurring in leisure time and interests. Virtual workspaces, intelligent technologies, simulations and mobile technology applications are especially suitable for supporting VET and on-the-job learning. The application territories of traditional online learning platforms focus on the intra-muros/formal learning axis. Video technology and personal learning environments, in turn, would appear to be suitable for all e-learning territories. The division is very rough, but it allows us to examine what types of learning technologies are being and could be used in different territories.

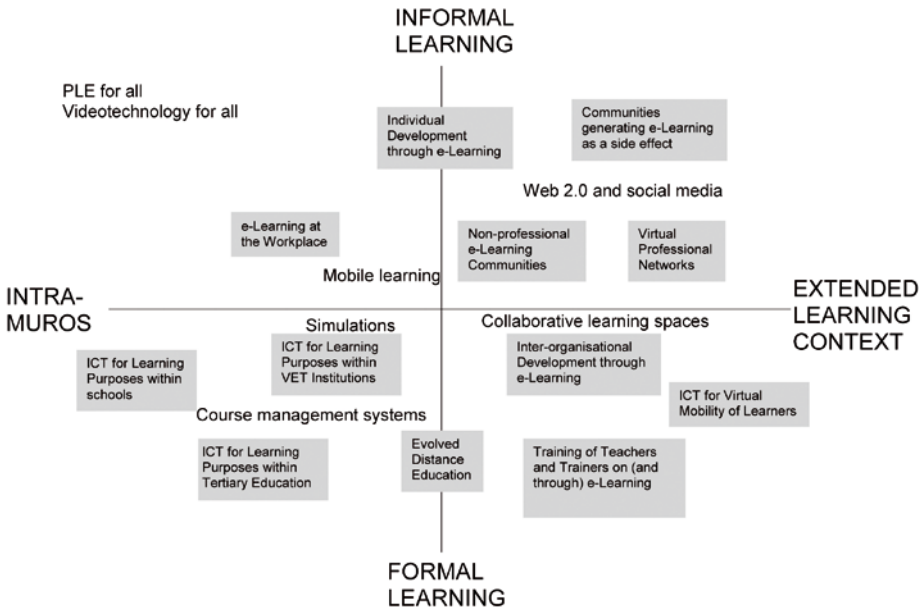

Figure 2. Learning technology in the map of e-learning territories.

E-learning means very different things in different operating environments, which also means that the future of e-learning looks very different depending on the context. Use of technology will, however, become more popular and ubiquitous. It is not possible to determine any one single all-inclusive future trend; instead, different perspectives are required to meet different needs (Lehtinen 2006). E-learning is a broad phenomenon and the pace of change varies in different e-learning territories. The speed is highest in informal learning environments, still relatively high in the corporate environment and lowest within formal and continuing education and training (Dondi 2007). Dondi (2007) actually asks controversially: 'Are high speed territories those in which professional teachers and trainers are less involved? Or are they those in which education policy makers and formal curricula have little to

say?' In order to succeed, organisations should be capable of learning and renewing themselves at least at the same pace as their operating environment.

For the education system, the challenge is even greater, because it is supposed to be leading the pack in terms of learning and renewal. The forces for change affecting education and training include at least an ageing population, change in the global division of labour and increased mobility, sustainable development, technological development, social change in new values, and a continually changing operating environment. (Tulevaisuusluotain [Education Intelligence] 2006.) The challenge for educators and technology developers is to apply new pedagogical trends and technologies so as to ensure that learning is at the same time highly situated, personal, collaborative and long term; in other words, truly learner-centred learning (Naismith et al. 2004).

The near future of e-learning and learning technologies does not appear to differ very radically from the current situation. However, we need to bear in mind that the transition from traditional methods to online teaching may be radical in many organisations and learning communities.

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Merja Snellman

Exploitability of research and improvement of R&D project collaboration – the perspective of e-learning research

Abstract

The 'Research to Innovations' project was set up to study how e-learning R&D projects support the operations of different organisations and how R&D project collaboration should be improved. The study involved interviews with 18 representatives of business and public sector organisations operating in the Häme Region of Finland. The interviews were carried out as semi-structured thematic interviews. From the data obtained, it was possible to identify four perspectives on how these organisations can benefit from e-learning R&D projects, including products, information, process development, and networks and contacts. In terms of improvement of project collaboration, two themes were identified: firstly, efforts should be invested in finding partners and common interests and, secondly, projects should be better organised. The trend of improvement of collaboration appears to be away from traditional co-operation towards doing together.

Key words: e-learning, exploitability of research, innovation, R&D project collaboration

Introduction

R&D project collaboration between higher education institutions and business and industry is considered to play a significant role in producing innovations. An innovation means an unprecedented value-adding product, service, technology, process or organisational reform, or combination of existing ones in a new way (Ståhle & Sotarauta, 2003). Innovations are created through education and training, research and product development, and knowledge-intensive business operations.

Creation of innovations is linked to exploitability of research results. Discussions on exploitability of research results focus in particular on the perspective of commercialisation, but it should be examined in broader terms, because innovations are not necessarily about commercial products. An innovation is created as part of people's activities and experiences. In this study, exploitability of research results

is understood in the sense that research results are exploited by the research team and its collaborative partners or they may be exploited in general or commercial terms.

Research results should be presented in a form that is easy to exploit, which usually requires a degree of commodification, i.e. defining the content and intended application of the results. By way of example, a pedagogical model created as a result of e-learning research may ideally be a social innovation with far-reaching implications. On the other hand, such a model may also remain unexploited if people do not know how to commodify it, i.e. lay it out in a proper way.

In addition to the exploitability of research results, another starting point for creation of innovations is effective R&D collaboration between higher education institutions and business or public sector organisations. Project collaboration may be challenging, because it is carried out at interface between very different operational cultures.

The Research to Innovations project (WP9 of the DLL project) set out to study how business and public sector organisations can exploit e-learning research results in their own operations and how R&D project collaboration should be improved. Research data was collected by interviewing 18 representatives of business and public sector organisations operating in the Häme Region of Finland. The target groups selected for the study were: 1) **enterprises specialising in e-business**, with operations linked to e-learning in some way; 2) **large companies** which are significant employers in the region in quantitative terms and where e-learning is an option used for areas such as development of staff competence; and 3) **public sector organisations**, which are also significant employers. The interviews were carried out as semi-structured thematic interviews and the data was analysed by means of qualitative content analysis. This article presents the key results of the study.

Research collaboration between higher education institutions and organisations

Co-operation between higher education institutions and business or public sector organisations aims to achieve competence and results that cannot be reached by one single party alone. Major forms of R&D co-operation include collaboration through joint research projects; commissioned research; so-called sponsored research; consultation and expert assistance; and the application of research results made within higher education institutions by businesses and public sector organisations (Suomen Akatemia [Academy of Finland], 2005).

Research conducted at higher education institutions influences the national economy in many different ways: by producing information, developing equipment and instrumentation, creating prototypes for new products and processes, training experts and networking (Mowery & Sampat, 2004). In this context, 'higher education institutions' (HEIs) refer both to traditional universities and to professional higher education institutions known as polytechnics or universities of applied sciences, although they play different roles in research activities. Polytechnic R&D is oriented towards the world of work and aims to promote regional development, whereas the role of university research is to produce scientific information. Despite

their different roles, both sectors aim to meet society's needs through their respective R&D activities.

Many of today's Finnish knowledge-intensive companies are leaders in their own fields of expertise; their know-how is sometimes more advanced than that offered by higher education institutions. In many cases, however, the know-how of businesses is highly specialised and focuses on their core area of business. This needs to be complemented by know-how from adjacent fields of expertise, which they often seek in collaboration with other companies and higher education institutions. Higher education institutions, in turn, are expected to maintain and develop know-how on a much broader front than is possible within business. Co-operation with business and public sector organisations makes it possible to generate innovations, which are often created at the interface of various different disciplines, by linking and developing know-how from new vantage points in equal interaction. (Suomen Akatemia [Academy of Finland], 2005.)

International trends in development have accelerated the science, technology and product development cycle. Intensive interaction between higher education institutions and businesses speeds up the innovation process and bolsters competitiveness. Close contact and connections between higher education institutions and business and industry facilitate immediate application of public sector research results in general and commercial terms. (Suomen Akatemia [Academy of Finland], 2005.) For higher education institutions, R&D project collaboration with business and public sector organisations means opportunities to develop their research activities to meet society's needs better. In addition to new technologies and innovations, the world of business and industry is familiar with market needs, whereas the public sector brings the perspective of social, business and civic services to this co-operation.

Challenges to collaboration and exploitability of research results

When people speak about the exploitability of research results, they generally mean commercialisation of results, i.e. introducing products to commercial markets. Finland has invested in the exploitability of research results through various measures for the last fifteen years. Several surveys and reports have been produced on commercial exploitation of university-level research (such as Lampola 2002, Kiviniemi 2003, Sitra 2005, Opetusministeriö [Ministry of Education] 2006) which, however, mainly contains recommendations. According to Kankaala, Kutinlahti and Törmälä (2007), the performance of R&D investments initially appears to be reasonable when examined through quantitative indicators, but more in-depth scrutiny reveals that outcomes are modest and that there haven't been many success stories. They suggest that the key problems are fragmentation of activities and the fact that exploitation of research results is not managed at any level within central government, even though the significance of leadership in success stories has been generally acknowledged. Units working with commercialisation of research results at the level of higher education institutions occupy the middle ground between administration and the world of research. In addition, willingness for and commitment to commercialisation varies between individual higher education institutions. The authors also identify the lack of business know-how as another essential shortcoming. If re-

search is expected to meet high international standards, people should also require an equally high level of competence in its exploitation.

Miettinen et al. (2006) suggest that combining scientific and business activities is not free of problems, because the structures and procedures of university organisations do not currently support innovation activities in the best possible way. Operating at the frontier between the academic world and business and industry is difficult in terms of legal ground rules alone (Lampola 2002). 2007 saw the entry into force of a new Act on the Right in Inventions made at Higher Education Institutions (369/2006), which aims to clarify intellectual property rights issues and promote recognition, protection and exploitation of inventions. The Act allows higher education institutions to acquire the right in inventions, even though researchers retain their intellectual property rights in principle. (Virkkala 2006.) The purpose of the Act is to promote innovation activities, not to increase the patent portfolios of higher education institutions, but the actual effects of the Act remain to be seen over time.

While legal factors affect R&D collaboration, the most significant obstacle is the fact that different parties do not know enough about each other, their ways of working, their goals and competencies. This lack of knowledge leads to cultural clashes and prejudices. (Suomen Akatemia [Academy of Finland], 2005.) Nieminen and Kaukonen (2004) have studied university-industry co-operation from the perspective of university research. Their study also indicates that challenges to co-operation are related to interaction and cultural differences caused by partners' different backgrounds. However, they did not perceive this problem as being insurmountable, but saw it instead as being an opportunity for partners to learn from one another. Their study also identified intellectual property rights in research results as the single largest cause of conflicts in co-operation. Research communities still know too little about intellectual property rights and protection of research results.

Innovation centres – different operating models

Interaction and interactive learning play a key role in creation and practical application of innovations. Interaction between different parties is being supported by means such as industrial clusters, business incubators and various development programmes. Close-knit networks and collaborative forms of operation also improve communication of important tacit knowledge between partners. (Suvinen et al., 2006.) The following paragraphs present some operational concepts aiming to support the innovativeness of co-operation between research institutions and business and industry.

The Centre of Expertise Programme is a special programme aiming to create innovations, products, services, enterprises and jobs based on high-quality knowledge and competence in accordance with the Regional Development Act (602/2002). The Centre of Expertise Programme is an umbrella for a variety of projects funded from different sources. The first Centre of Expertise Programme was launched in 1994; the second programming period started in 1999 and the third started in 2007. The third Centre of Expertise Programme has been revised such that centres of expertise are now formed on a cluster basis and centres within the same cluster are encouraged to engage in national and international co-operation.

Regional centres of expertise and national clusters of expertise provide businesses with a co-operation channel, expertise and contacts in order to develop new products and business ideas together with universities, polytechnics, public administration and funding bodies. (http://www.oske.net; Lemola 2006.)

Among Finnish companies, **Nokia** invests heavily in research and development and actively collaborates with academic institutions such as the Massachusetts Institute of Technology (MIT) and Stanford University in the USA, Helsinki University of Technology in Finland and the University of Cambridge in the UK. Recently, the Nokia Research Center has also intensified its collaboration with Tampere University of Technology (TUT), with a view to developing new technological solutions. Nokia has collaborated with Tampere University of Technology for years now, but with the establishment of a new Nokia Innovation Center, they aim to create more systematic operating methods and more collective research collaboration. Two thirds of researchers and postgraduate students will come from the University with one third working at the Nokia Research Center. The mission is based on working together and on the fact that new innovations are created when researchers spend time together in the same facilities. (Nokia and TUT press release 2007.)

The United Kingdom is home to **Futurelab**, an R&D laboratory operating on a not-for-profit basis with a mission to develop new ways of using technology in support of learning. Its aim is to turn innovative ideas into practical solutions by developing both prototypes and ready-for-market products. Futurelab's Call for Ideas service allows any individual, corporation or organisation to submit ideas for Futurelab projects, as long as the idea is original and innovative and has not been implemented before. Futurelab supports innovative activities by providing clients with experts to develop ideas into practical applications, by funding activities, conducting research and publishing reports and helping clients to find suitable partners. Intellectual property rights will be retained by the inventor, who also has the right to use anything developed over the course of the project. Where projects have commercial potential, Futurelab will negotiate a royalty with clients. (http://www.futurelab.org.uk/index.htm)

Futurelab is a consortium comprising some of the top UK corporations and organisations in the software, hardware and creative industries. Collaboration benefits partners in that research results are at their disposal and they have direct contacts with a network of learning experts. In addition, partners can present their own technological and new media solutions to other players involved in the Futurelab network. Futurelab also works as an intermediary network with the task of encouraging the business sector to commercialise prototypes developed within Futurelab. Futurelab mobilises collaboration by providing information about product development projects, finding out about business partners' needs and matching suitable partners, thus enabling fast progress and mutual benefits. (http://www.futurelab.org.uk/index.htm)

The US-based **Intel** research network combines academic research and industrial expertise. The network consists of three research laboratories located in Berkeley, Pittsburgh and Seattle and they are owned by Intel. Research subjects include ubiquitous electronic media, their use and development. The Intel network of university laboratories is based on the open and collaborative research (OCR) model, which aims to remove intellectual property disputes concerning exploitation of research.

Activities are based on openness and research results are not legally protected. Research results can be exploited and developed further and although results may not generate immediate financial profits, the operating model makes it possible to achieve innovative solutions over the longer term. (Tennenhouse 2004.)

Openness is also visible in concrete terms, because the Berkeley Lab, for example, is located in the proximity of the UC Berkeley campus, which benefits both Intel and the University. As well as Intel researchers, students also work as researchers at the research laboratory. Students have free access to the laboratory and their involvement is considered to be extremely valuable. Laboratory researchers meet their university colleagues on a daily basis, which fosters community spirit and casual interaction. The University benefits from collaboration through projects that would otherwise be hard to come by, while Intel can make use of collaboration to remain at the forefront of academic research. (Tennenhouse 2004.)

Himanen (2007) has studied 'glocal' innovation centres, with **Silicon Valley** as an example. Glocal innovation centres refer to local clusters of innovation that are globally connected with one another. Such innovation centres have three elements in common that seem to boost creation of innovations. Firstly, there are creative experts, i.e. university research teams exploring and developing new solutions. The second element constitutes producer/manager structures, which take care of commercialisation of research results. These structures are located geographically close to universities and this appears to be significant in terms of effective co-operation. The third element is a culture of enriching interaction, which means inclusive and competitive interaction between different parties that challenges them to come up with new ideas. Such a culture also supports working communities; it motivates individuals to produce more results and also to perceive their work as being more meaningful.

Creative experts, producer/manager structures and a culture of enriching interaction can also be found in the operations of all the innovation centres outlined above. Joint research laboratories and networks appear to be an effective way of working together. The key aspects are open and informal interaction and doing things together. In addition, solutions to any intellectual property rights issues that may cause conflicts in exploitation of research results have been sought through arrangements such as transferring rights to a certain partner or making results freely available without protecting intellectual property rights by legal means.

E-learning markets and product groups

The Research to Innovations project examines the exploitability of research results and project collaboration from the perspective of e-learning research in particular. In this context, 'e-learning' is understood in a broad sense: e-learning covers all those forms of learning that make use of electronic media for competence development, teaching, dissemination of learning materials and/or interaction between participants.

Parties making use of e-learning include various educational organisations, businesses and public sector organisations. Educational organisations often implement e-learning as multiform instruction, making use of information and communica-

tions technology (ICT) in different ways in support of direct contact teaching. Education intended for children and young people can make use of online digital materials or games, for example. In vocational education and training, learning can be supported through simulations in situations where practical training in authentic environments is challenging or impossible to organise. Adult education and training, in turn, emphasises the opportunity for independent study on online courses. In many fields of study, people are exploring the possibilities offered by social media for areas such as teaching, learning and stakeholder co-operation.

Businesses and public sector organisations use e-learning in support of staff development and external training, such as customer or stakeholder training. E-learning means challenges to the organisation of education or training, because the priority shifts from a traditional instructor-driven approach to self-directed work-based learning and self-development. The use of e-learning can be related to support of an organisation's learning, information management or operational and resource management. The development needs of business and public sector organisations can be met with educational technology solutions, but also with other digital work support systems or interactive solutions. (Markkula 2003.) In terms of e-learning business, in-service training of public sector organisations is a broad field that offers plenty of opportunities due to the impending extensive transfer of knowledge from employees approaching retirement age to their younger colleagues.

Applications in educational organisations and the business and public sector vary considerably depending on the size, field and values of the organisation. According to Markkula (2003), the benefits of e-learning for business and public sector organisations can be examined from the following perspectives:

1. **Economic perspective:** investment in e-learning leads to growth in turnover or productivity.
2. **Customer perspective:** e-learning enables organisations to deliver higher quality or added customer value.
3. **Internal process perspective:** e-learning activities result in operational effectiveness or innovativeness.
4. **Community perspective:** investment in e-learning fosters cultural cohesion, social interaction or perceived justice.

E-learning needs to be deliberate and justifiable and needs to support the organisation's basic mission. In addition, the organisation's members need to understand why e-learning is used and to see the benefits that can be achieved through use of e-learning.

The challenge to e-learning is that the resulting benefits are not necessarily immediately visible, but will only emerge after a longer period of time. It is necessary to provide users with a better insight into the benefits of e-learning products and into the effectiveness of e-learning in more general terms. The Research to Innovations project has explored the commodification of e-learning research results and, as a

result, has listed five characteristics of e-learning products which should be taken into account when considering commodification of research results. E-learning products can be divided into four product groups: technologies, content products, services and packaged solutions made up of these. In this context, a 'product' may refer to a prototype, a service concept or an operating model developed in an e-learning R&D project, for example, that is characterised by the following attributes:

1. **The purpose of e-learning products is to support learning.** Regardless of whether it is a technological product, content product or service, the purpose of an e-learning product is to support learning in some way. Learning is a personal process requiring the learner's active involvement and the e-learning product aims to promote this process.

2. **E-learning products are always related to technology in some way.** In addition to technological products, content and service products are also linked to technology and used by means of technologies. Service products are services that support not only learning but also the use of technologies. Technologies are how these products are used and interpreted, which also sets certain requirements for development of technologies.

3. **E-learning products will only find their final shape through being used.** E-learning products usually require users' active involvement, which means that a product will adapt to its use.

4. **E-learning products have different users and applications.** It is typical for users of an e-learning product to use it from different perspectives: a teacher uses it from a teaching and guidance perspective and a learner uses it from a learning perspective. In businesses, users may be business representatives, staff members, trainers and customer or stakeholder groups. An e-learning product is unique to each user based on intended uses, previous experiences or lack of experience, prejudices, working communities and organisational values, etc.

5. **E-learning products change people's working methods and operational culture.** Introduction of a new e-learning product may be challenging, because working methods may change, working phases may be eliminated, interaction within the working community may change, etc. E-learning products may have significant impacts on people's actions and even on the operational culture.

Implementation of the study

The Research to Innovations project involved interviews with 18 representatives of business and public sector organisations within the Häme Region (Table 1). The target groups selected for the study were: 1) enterprises specialising in e-business, with operations linked to e-learning in some way; 2) large companies which are significant employers in the region in quantitative terms and where e-learning can be used for areas such as development of staff competence; and 3) public sector organisations, which are also significant employers in quantitative terms. In addition,

the project interviewed two representatives from so-called intermediary organisations that are linked with e-learning or e-business. Intermediary organisations brought up the perspectives of organisations operating in the industries that they represented. These answers have been represented in the group of enterprises specialising in e-business.

Table 1. Organisations involved in the study.

Organisations
Enterprises specialising in e-business and intermediary organisations: - Ambientia, http://www.ambientia.net - Makno, http://www.makno.fi - Mediamaisteri, http://www.mediamaisteri.com - Mikrolinna Oy, http://www.mikrolinna.fi - Opiferum, http://www.opiferum.com - Technology Centre Innopark Oy, http://www.innopark.fi (intermediary organisation) - Association of Finnish eLearning Centre and elTrio network, http://www.eoppimiskeskus.fi (intermediary organisation)
Large companies: - Nordea Bank, http://www.nordea.fi - Sako, http://www.sako.fi - Valio, http://www.valio.fi - Würth, http://www.wurth.fi
Public sector organisations: - City of Forssa: HR Unit, http://www.forssa.fi - City of Hämeenlinna: Educational Services, http://www.hameenlinna.fi - Häme Hospital District, http://www.khshp.fi - City of Riihimäki: http://www.riihimaki.fi o School Services o HR Unit - Riihimäki Signal Regiment, http://www.mil.fi/maavoimat/joukot/viestir/ - Social Development Co. Ltd. (municipally owned not-for-profit company), http://www.sosiaalikehitys.com/

The interviews were carried out as semi-structured thematic interviews with the following key themes: 1) e-learning within the organisation; 2) exploitation of e-learning research; and 3) R&D project collaboration. The data was analysed by means of qualitative content analysis. The study aimed to identify elements that would make it possible to improve the exploitability of research results and collaboration between higher education institutions and business or public sector organisations so as to serve different parties more effectively.

E-learning in organisations involved in the study

The first interview theme was e-learning in organisations. Business and public sector organisations involved in the study made use of e-learning in very different ways. The one thing that these organisations had in common, however, was that

they were all interested in e-learning to some extent. E-learning was most commonly understood to mean studying through the use of computers and information networks, which meant in practical terms that training and information materials were available online, for example. An e-learning environment was used by 14 of 18 of the organisations involved in the interview process. In addition, some organisations used an e-learning environment for individual training courses purchased from external providers. Interviewees from organisations that did not use any e-learning solutions indicated that they did not have enough knowledge of how their respective organisations could make use of e-learning. Representatives of those organisations where e-learning solutions were used in activities such as instruction or staff training felt that it was important to develop these activities further.

E-learning – or, in a broader sense, e-knowledge – forms part of the operations of **enterprises specialising in e-business**, which provide their customers with technologies, content products, services or packages of these in order to support competence development. In their own operations, e-learning was visible in areas such as use of electronic information management solutions. In other respects, they were interested in e-learning from a business perspective. Two of the **large companies** involved made use of e-learning in development of staff competence, while another two companies had no experience of e-learning in staff development. Both of the latter two companies, however, considered it possible for e-learning to be used in the future. Two of the large companies also had experience of electronic services or products offered to customers. One of these companies had organised online product training for customers and the other offered customers an electronic spin-off product in addition to their primary product. Even though e-products did not necessarily result in any immediate financial gains, they were considered to be important from the customers' perspective. Electronic spin-off products can be used to improve customer satisfaction and attract more customers.

Public sector organisations made use of e-learning to varying degrees. E-learning was used most extensively within the Finnish Defence Forces and municipal school services, while it was also used to some extent for in-service training within hospital district organisations. Municipal school services have made considerable investments in equipment and they aim to continue development of these activities. Classrooms have been equipped with network connections and laptop computers, as well as data projectors for teachers to use in instruction. Another aim is to develop the use of e-learning environments. Precise information on use of e-learning in the municipal sector was not available, because staff development is mostly organised separately within different service sectors and the HR development unit is responsible for general training courses. Representatives of the municipal sector perceived staff development as being challenging due to organisational diversity. Municipal employees work in very different occupations and environments; a large proportion of them work outdoors or at clients' homes, which means that they may be difficult to reach via electronic media.

Information sources and media through which e-learning research reaches organisations

Since the aim of the study was to improve the exploitability of research, interviews also explored how e-learning research reaches business and public sector organi-

sations, i.e. what are the key sources and channels of information through which research influences their operations.

Information on e-learning research is obtained either through services or independently by actively seeking it from different media. Interviewees felt that the best channels to reach them were **electronic media or personal interaction**. In addition to meetings, conferences and other organised events, informal interaction is one of the most important means of influence. Interviewees suggested that researchers could present their research to different organisations. Key electronic media through which people followed developments in e-learning research included e-mail and the Internet. Interviewees followed e-learning research by means such as the Association of Finnish eLearning Centre, Finnish Digibusiness and DigiToday portals and various RSS feeds. Portal services collect research information on their sites and convey it via e-mail newsletters, but interviewees believed that a large amount of useful research was excluded from portal services. Public sector organisations also followed doctoral theses and other research reports to some extent.

Interest in e-learning research is particularly high in those business and public sector organisations with operations related to e-learning or learning in general, but also among other parties, as long as the subject is of topical interest to them or if the title of a study appeals to them. Most interviewees indicated that they were interested in e-learning research but did not have enough time to read studies and extensive reports. In general terms, they thought that it would be a good idea to offer concise information on studies in order for readers to form a quick overview of the key points and judge whether a specific study would be useful for them. Authors should pay attention to their choice of title, because it is often the title that decides whether readers want to know more about the study or not.

Significance of e-learning R&D projects to business and organisational operations

All those involved in the study had a positive view on R&D project collaboration with higher education institutions. 14 of 18 of business and public sector organisations that participated in the study had collaborated with higher education institutions on R&D projects. The range was broad in this respect too, because experience varied from extensive EU projects to occasional small-scale product development projects. Collaboration had not always resulted in financial gains, but respondents did indicate that they appreciated the experience gained from projects and that they would be able to work differently in future collaboration projects. Those organisations without any experience of such projects perceived R&D collaboration relating to e-learning to be possible in the future, as long as the subject and timing were suitable.

The interviews aimed to find out about the types of benefits that business and public sector organisations expected to gain from R&D projects. Interviewees stated that the starting point for successful collaboration was to be familiar with partners' operational objectives. **From the perspective of businesses, R&D projects with higher education institutions should support their business operations.** E-business organisations, in particular, as well as large business organisations, aimed to benefit from collaboration projects that could be directly or indirectly turned into financial gain. **From the perspective of public sector**

organisations, the objective of R&D project collaboration is to develop organisational operations, such as improving staff competence, increasing the flexibility of work processes or reducing costs.

Data could be divided into four different perspectives on how e-learning R&D projects can support business and organisational operations (Table 2). In the following paragraphs, these perspectives are examined in terms of the target groups of the study, i.e. 1) enterprises specialising in e-business; 2) large companies; and 3) public sector organisations.

Table 2. Benefits to organisations of e-learning R&D projects.

Benefit from R&D project:	1. Products	2. Information	3. Process development	4. Networks and contacts (indirect benefit)
Enterprises specialising in e-business				
Research result applied in practice:	Prototype, new product or concept	Trend and technology analyses	Operating model, technical solution	Networking with other players
Enterprise's objective:	Turning research result into turnover	Business management	Increased productivity, efficiency	Business development and new business contacts
Large companies				
Research result applied in practice:	Electronic spin-off product, customer or stakeholder training	Argument for major policies and decisions	Operating model, technical solution	Competence and resources for product development, etc.; new customers
Company's objective:	Added value, customer satisfaction and new customers	Business development	Increased productivity, efficiency	Getting missing resources and new customers
Public sector organisations				
Research result applied in practice:	Electronic product or service	Argument for major policies and decisions	Operating model, technical solution	New employees recruited to the organisation
Organisation's objective:	Operational effectiveness and customer satisfaction	Operational development	Operational efficiency	New competence and resources

1. Products

The objective is for a project to make it possible to offer customers a new product or service. The project may be a product development project or some other type of R&D project with results that can be turned into a product with minimal effort.

Enterprises specialising in e-business may aim for a collaboration project to develop a prototype for a new product, a ready-for-market product or service concept that allows them to develop their business operations.

Large companies may aim to offer customers a new electronic product or service, even though their business operations were not related to e-learning. The electronic product or service may be related to customer, stakeholder or product training or it may be a spin-off product offered to customers. Products do not necessarily result in immediate financial profits, but they may be a means of developing customer relationships, improving customer satisfaction and attracting new customers.

Public sector organisations may aim for a collaboration project to enable them to provide customers, such as municipal residents, with a new electronic product or service that makes operations more flexible and services more accessible.

2. Information

One objective of R&D projects is to produce new information. The data revealed that research information is a resource that steers organisations' operations. People consider that research information is influential and works as an argument for major decisions. On the other hand, many organisations felt that converting theoretical information into practice was a challenging task. Scientific studies are also used to find information that can be put to concrete use in areas such as development of staff competence. Research information produced by higher education institutions is characterised as being neutral when compared with information produced by companies, which interviewees consider always to be based on a commercial agenda. Research information on e-learning provides business and public sector organisations with guidelines for the future. By producing information, R&D projects can also support those organisations that are not involved in projects as participants.

Enterprises specialising in e-business are interested in the future prospects of e-learning in particular. They consider that trend and technology analyses have some effect on product development decisions.

Large companies and public sector organisations use research information as an argument for major policy decisions, i.e. as 'evidence' to present to the management. Research-based information on the benefits of e-learning, for example, may be the decisive factor when an organisation is considering the use of e-learning in staff development.

3. Process development

Business or public sector organisations may aim to increase productivity or operational efficiency, which means that they wish to develop staff competence or work

processes. In such cases, the objective may be for the R&D project to plan and implement an operating model or a technical solution that meets the organisation's practical needs.

Enterprises specialising in e-business introduce new operating models or technical solutions through projects in order to develop staff competence or work processes, which will in turn increase productivity and efficiency.

Large companies may make use of e-learning in work-based learning in many ways. For instance, there are work assignments within the manufacturing industry and the health care sector where practical training in authentic situations is difficult to arrange due to conditions. In such cases, various simulations modelling authentic conditions may be a good solution for development of staff competence.

Public sector organisations place emphasis on operational rationalisation and organisational development. Projects are expected to develop instruction, staff competence and work processes and this is pursued by introducing new operating models or technical solutions. Projects should also create new practices and reform operational culture.

4. Networks and contacts

Benefits obtained from R&D projects may also be indirect, which means that organisations participate in a project even though its content cannot be exploited directly in business or other operations. The objective of collaboration may be to make new contacts that benefit the organisation's operations.

Enterprises specialising in e-business consider that collaboration projects support their networking efforts. Project participants include interesting businesses with which e-business enterprises want to establish relations. Collaboration projects with higher education institutions can also function as references to boost the enterprise's image and brand, because some customers value contacts with higher education institutions. In addition, collaboration projects are considered important in terms of recruitment. Enterprises want projects to involve students that they can later recruit as employees.

Large companies benefit from R&D projects by acquiring missing competence in areas such as product development. Companies are loyal to partners and would prefer to work with the same partners for long periods of time. In addition, companies wish to gain new customers through electronic spin-off products and services developed in projects.

Public sector organisations consider R&D project collaboration with higher education institutions to be an important recruitment channel. Public sector organisations have plenty of research topics relating to e-learning and competence development, which provide opportunities for students to conduct Bachelor's or Master's level research and, subsequently, for organisations to offer them jobs upon graduation.

Business and public sector organisations may have quite different expectations when participating in R&D projects. It is important to clarify the expectations and objectives of different parties, in order for co-operation to work in the best possible way and for the project to achieve the desired results.

Improvement of R&D project activities

The Research to Innovations project also examined how project activities should be improved in order for projects to serve the operations of business and public sector organisations most effectively. Interviewees brought up critical factors in terms of the success of collaboration projects, which fall into two different theme areas. Firstly, more efforts should be invested in forging collaborative relationships and, secondly, projects should be better organised.

1. Operating methods should be systematised in order to find partners and common interests.

Networking and information on research projects

Interviewees felt that they did not have enough information on ongoing or forthcoming projects, which would prevent co-operation even if there was sufficient interest. In addition, interviewees considered it problematic that they did not know research institutions and their operating methods. They felt it important for partners to be aware of each other's contexts and operating methods, such as what a municipality or the Defence Forces may be like as employer organisations or what a business enterprise's operational policies are. Based on the data, it is fair to say that business and public sector organisations are loyal to long-term partners. They like to collaborate with existing partners and, due to these existing close relations, it may be challenging to establish new collaborative relationships. Loyalty was thus also seen as being a factor that hinders new collaborative relationships.

Personal nature of collaborative relationships

Interviews revealed that collaborative relationships were very personal in many organisations. Co-operation is based on trust, which is also strongly influenced by interpersonal chemistry. Some interviewees stated that collaboration means co-operation between people who share an interest in a specific topic and the role of the background organisations is irrelevant. The personal nature of collaborative relationships was also revealed in that collaboration may depend on certain individuals' contacts and their active efforts to make new ones. Contacts may be haphazard and cannot be exploited by the organisation as a whole. This is a factor affecting collaboration that organisations might want to address. In terms of organisational development, it is useful to know what kinds of collaborative relationships and networks individual employees have.

Common language

Although higher education institutions are attractive and valued partners, their scientific approach is, however, perceived as being an estranging feature when seeking new partners, in particular. How a research institution or project appears to outsiders may have a bearing on creation of collaborative relationships. The different operating methods of higher education institutions and business and public sector organisations puzzled many interviewees, who also considered it important to find a common language and level of communication. All organisations have their own jargon, which may sound foreign to outsiders. Representatives of business and public sector organisations felt that academic language, technical terminology and use of the English language create a distant impression of higher education institutions and may even estrange different parties from each other, even if they were specifically looking for collaboration. The lack of common language was also raised at interviews when respondents were asked to assess the attractiveness of research themes in the DLL project. They felt that terminology used in research descriptions was difficult to understand and that assessment of the attractiveness and applicability of research was therefore challenging. This is a point that research institutions need to address. Research projects should also be presented in standard language in order to make the topic understandable even to those not familiar with the field, which would perhaps also lower the threshold for contacting the research institution.

Range of influence of higher education institutions

Interviewees also considered the range of influence of higher education institutions from the perspective of collaboration. Business and public sector organisations not located in the same towns as higher education institutions believed that they may be more easily excluded from collaboration than those operating in the same towns, even if they were both willing and had the necessary resources for collaboration. It should therefore be noted that higher education institutions can also find potential partners outside their immediate surroundings.

2. Efforts should be made to organise projects so as to benefit all parties

Value for investment

All interviewees stated that they expected R&D project collaboration to result in practical benefits for their business or other organisational operations. However, they reported that concrete gains from such collaboration had been modest. They felt that e-learning research that would meet practical needs was not being conducted to any significant extent. Interviewees wished to be able to participate in project planning and, consequently, to influence exploitability. For a business or public sector organisation, participation in a project is an investment which should also pay off. An individual project may involve many business and public sector organisations with different objectives in terms of the project. In order for the project to succeed, these objectives must be realistic and known to all parties and it must be possible to apply the results to real situations. Indeed, when planning R&D

projects, special effort should be made to ensure that collaboration benefits all parties.

Roles of partners

Project success is also influenced by the types of roles played by different parties. Both e-business enterprises and large companies shared the desire to participate in R&D projects in active roles and even as part of research teams, in order to be able to make the most of their projects. Two interviewees pointed out that, in reality, many collaboration projects were not collaborative, but simply research activities funded by businesses and conducted by higher education institutions that did not result in any practical benefits to businesses. This is something that interviewees would like to change and where active involvement may be a natural solution. Businesses could bring their own expertise to the project, such as designers, implementers of practical applications or customer cases. Public sector organisations felt that they were able to provide real opportunities for research and co-ordinate projects. Municipal school services have focused resources on e-learning through considerable investments in equipment in recent years and would need both qualitative and quantitative research data on the effectiveness of these measures. In addition, public sector organisations can also offer topics for Bachelor's and Master's level research. Each partner should play an appropriate role in a project, because collaboration calls for commitment, which in turn requires the project to motivate partners to participate.

Reconciling different operating methods

Interviews also raised the issue of different operating methods in higher education institutions and business or public sector organisations. In addition to the lack of common language, challenges to collaboration were caused by factors such as partners' different time perspectives. From the business perspective, research activities at higher education institutions are slow; by way of example, people mentioned prolonged periods spent on doctoral theses, while business and public sector organisations would prefer relatively short-term projects that would yield faster benefits. It is understandable for business and public sector organisations to expect results in a short time span, whereas long-term R&D projects are more desirable from the perspective of higher education institutions. In some cases, it is challenging to reconcile these perspectives, because R&D work is often by nature a long-term activity. Interviewees suggested, among other things, that research results could be presented to businesses at an early stage, before they are 'ready according to scientific criteria'. In addition, they proposed that collaboration should be intensive and should include regular meetings every couple of weeks, which would enable everyone to keep track of progress and hear about results as soon as they are obtained.

Agreeing on exploitation of research results

In addition to making sure that the project is well-organised, people should also pay attention to the exploitability of research results. Partners should agree on exploitation of results as early as at the project planning stage, even if the end results

were not completely definite, in order to avoid confusion about intellectual property rights and to make the most of results.

Summary and conclusions

The aim of the study was to examine how business and public sector organisations can exploit e-learning research results in their own operations and how R&D project collaboration should be improved. Data could be divided into four different perspectives on how e-learning R&D projects can support business and organisational operations:

1. **Products.** Research results can be transformed into products that organisations can offer their customers, thus developing their own operations.

2. **Information.** The project produces new information, which can be exploited by business or other organisational operations.

3. **Process development.** The project develops operating models or technical solutions to meet the organisation's own needs. Development of competence or work processes may lead to increasing productivity or efficiency, for example.

4. **Networks and contacts.** The project helps to create new contacts that can be exploited by business or other organisational operations.

Partners working on the same collaboration project may have differing objectives: the ultimate goal for businesses is to make financial gains, whereas public sector organisations aim to develop their operations. It is important to be aware of partners' objectives in R&D projects, in order to guarantee optimum success.

The results concerning improvement of R&D project work are in line with previous studies on this theme, which goes to show that there is still room for improvement in R&D project collaboration. Business and public sector organisations feel that collaboration with higher education institutions is important but that more efforts should be made to improve collaboration to make sure that it will serve its purpose better than it does at present. Two key areas for improvement are systematisation of operating methods to find partners and common interests and investment in organisation of projects.

Previous studies have linked the most significant challenges to collaboration with interaction between partners and with the fact that different parties do not know each other. This was also the case in this study. Although higher education institutions are valuable partners, their scientific nature may also estrange potential partners. This is especially significant when collaborative relationships are being forged. Collaboration may break down on the use of different terms when speaking about the same thing, which makes it difficult for parties to understand each other. By way of example, educationalists speak about e-learning in development of staff competence, while a business may speak about knowledge management or mana-

gement of human capital and immaterial assets through electronic solutions. They cannot see the common ground, even though they work around the same phenomenon. In terms of effective collaboration, partners need to find a common language and be capable of reconciling differences in their operating methods. Prejudices and cultural clashes can be eliminated through open and constructive interaction, which allows people to see diversity as a resource.

Based on research results, the trend in improvement of project collaboration appears to be doing together. Data revealed that businesses, in particular, want to play active roles in projects. An active approach is indeed desirable in e-learning R&D projects, because the success of e-learning products, operating models and technical solutions specifically depends on the user's operations. In practical terms, however, implementation of active roles may be challenging due to limited labour and time resources.

It would also be a good idea to model R&D project collaboration in line with the operations of innovation centres. The characteristic that innovation centres seem to share is that partners concentrate on their own areas of expertise. Innovation centres have: 1) creative experts who concentrate on research, development and innovation; 2) producer/manager structures with solid business know-how and relations required to turn research results into commercial products; and 3) a culture of enriching interaction, which in practical terms means open, inclusive and informal interaction that challenges participants to do their very best. The structures and operating methods of innovation centres encourage people to do things together across traditional organisational boundaries.

It would also be advisable to emulate the interactive nature of innovation centres. The basic idea of their operations is that interaction between partners is so open and even informal that it lowers the threshold for innovative brainstorming. In order to work, innovative interaction requires the right space and environment, which can be supported through collaborative operating methods. Partner organisations are often located geographically close to each other, which makes interaction easy and regular. However, it is not always possible to arrange for partner organisations to be located so close. In such cases, the interactive space that encourages innovativeness needs to be organised by means such as collaborative online work supported by face-to-face contacts, such as joint workshops. On the whole, the aim should be open and unprejudiced interaction with existing and potential partners, in order to develop operations to cater for all parties more effectively.

Doing together covers project planning, implementation and the end result, such that partners are motivated to participate in the project. A joint project is planned together to meet the needs and objectives of different partners. A meaningful project provides higher education institutions with research challenges and organisations with solutions to practical problems. Work is goal-oriented and committed and progresses according to schedule. Different parties are seen as resources and collaboration creates synergies that individual partners could not achieve on their own. Interaction is open, the atmosphere is enthusiastic and inclusive, which makes it possible to find common language and operating methods. An ideal R&D project is planned and carried out together, which means that all parties will feel that they have benefited from collaboration. On the other hand, as pointed out by one interviewee, participants will also have to accept the fact that whenever something new

is being developed, there is always the risk that the end result is not what they set out to achieve.

Tips for research institutions to improve collaboration:

- Advertise your ongoing or forthcoming research project through various networks.
- Find out about key publications in a specific field and suggest an article about your research.
- Make sure that your research and that you as a researcher are easily accessible. Present things in an interesting way, using standard language, and summarise the key points of your research. Also remember to include contact details or a link to further information.
- Also seek partners beyond your immediate surroundings.
- Familiarise yourself with the operations of a potential partner organisation before contacting them and consider the benefits that the potential partner may gain from the project.

Tips for business and public sector organisations to improve collaboration:

- Chart your organisation's networks and collaborative relationships. Discuss with your partners whether you could improve the effectiveness of activities that support collaboration.
- Contact your local intermediary organisations to obtain information about ongoing research projects and various research institutions and networks.
- If you are interested in collaboration, contact a research institution even if your ideas are not fully crystallised.

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