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Use of Scientific Information Resources among Medical and Dental Students

Aims: The aim of the study was to survey how original resources of scientific information are utilized by medical and dental students in the Medical Faculty of the University of Helsinki. The students of the faculty were asked to assess their frequency of use of electronic information resources and software. Additionally they were inquired the accessibility of resources. The results of the survey are being used to develop the support for and training of the use of information and communication technology in research-based teaching and studying in the faculty.

Data: The data were collected in November 2004 by using electronic self assessment questionnaire via electronic form, which contained both multiple choice and open ended questions. The survey was addressed to 924 students, of which 418 (45.2%) responded to it during the survey period of two weeks. Two reminder messages were used to promote the response.

Findings: 23.6% of the students searched information from Medline for their studies twice a month or more frequently. 30.4% searched information from Medline for their own scientific work twice a month or more. 41.6% of the students never used original electronic medical articles in their studies. 12.0% of the students utilized nor Medline or original articles. The results show that the students use original scientific materials only to a moderate extent.

Contact: Research & Development Unit for Medical Education of the University of Helsinki

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Research-based Chemistry Teacher Education

Within the Department of Chemistry, the Centre for Chemistry Education has subject-matter responsibility for preparing chemistry teachers and also elementary teachers, conducting research in chemical education, and co-operating with schools and other units of teacher education at the University. The main purpose of chemistry teacher education is to educate enthusiastic, confident, effective, and skillful teachers in chemistry. These prospective teachers are thus prepared to find, use, and apply appropriate research in chemistry and chemistry education in their professional work at school.
Research is an important aspect of chemical education (Gilbert et al., 2004) and chemistry teacher education,with many areas of emphasis: (a) Research explicitly intended to inform subsequent development of new policy or practice within a specific area, (b) Evaluation of existing policies or practices intended to inform subsequent decisions and actions, (c) Action research, intended to achieve educational improvement in a particular context and to generate understanding of that and similar contexts, (d) Research intended to identify practices that are distinctly effective for achieving particular educational goals, (e) Research aimed at generating new knowledge, the impact of which on practice is uncertain, diffuse, or long-term, and (f) Research undertaken from a particular psychological perspective carried out within chemical education as an exemplary domain.

Research is used (a) for planning goals and contents of courses for prospective teachers, (b) as course content: increasing prospective teachers' awareness of research (prospective teachers reflect on different kind of research papers as a part of every course), (c) involving prospective teachers to conduct research in chemistry education for their Masters Thesis (some of that research concerns teaching in the Department of Chemistry), (d) prospective teachers present their research results in a seminar open to chemistry teachers and faculty in the Department of Chemistry and their work is published in www-pages of the LUMA Centre (http://www.helsinki.fi/luma/english), and (e) prospective teachers who attend to research during their courses. These courses have been guided by research results regarding them: Introduction to Chemical Education (2 credits), Chemistry in the Community (3 credits), School-Level Practical Work (3 credits), School-Level Computational Chemistry (2 credits), Seminar in Chemical Education and its Research (2 credits), and Central Areas of Chemical Education (3 credits). This presentation will present -an example of research focused on these courses—a case study of the course called School-Level Practical Work.

Reference:

Gilbert J.K., Justi R., Van Driel J.H, De Jong O., and Treagust D. F.(2004). Securing a future for chemical education, chemistry, chemistry education. *Research and Practice*, 5(1), 5-14.

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NetLab –Web-based Learning Tool for Organic Chemistry
Introduction
The Laboratory Organic Chemistry is one of the seven laboratories providing teaching at the Department of Chemistry in the University of Helsinki. The main research field of the laboratory is organic synthesis. Subfields include synthesis design and the development of practical synthetic methods for the synthesis of target compounds. Since chemistry is an experimental science, learning laboratory practice is an essential part of it. One of the fundamental tasks of our laboratory is to provide practical laboratory courses in the field. They are a part of compulsory undergraduate studies, which all chemistry majors and minors undertake. Laboratory courses are arranged throughout the year with approximately 40 students taking each course. The annual throughput is ca. 160 students.

The project is aimed at helping the students to overcome the difficulties in understanding the language of chemistry, the invisible world of molecules and discerning the three-dimensional shape of molecules. NetLab enables the visualisation of three-dimensional molecular structures and organic reaction mechanisms. Additionally, NetLab provides introduction to laboratory procedures eg. proper handling of various chemicals, laboratory equipment and the correct use of laboratory instruments. Special attention has been given to safety in the laboratory.

Unlike before, access via web enables students to prepare themselves to the actual exercises performed in the laboratory and revise their knowledge. This is particularly helpful for science students from different campuses participating in the laboratory courses.

NetLab was developed in connection to The Helsinki University Teaching Technology Award programme and won the first prize in 2003.

Description of the project

NetLab provides a web-based interface where students can find the instructions to perform syntheses, guidelines and necessary forms for reporting, instructions on product analysis equipment and national and international material safety data sheets of the chemicals. Reaction mechanisms describe the formation of compounds at molecular level. Traditional teaching materials describe molecules and reaction mechanisms in two dimensions, which is not the case in reality. NetLab provides three dimensional models of the molecules synthesised to help students discern spatial structures. Animated reaction mechanisms help students to understand electron transfer in reactions between two molecules.

Until now, identical laboratory exercises were performed by the students. NetLab will include a database of exercises that enables the creation of an individually tailored exercise package for each student. Each exercise combination will include essential working methods and core knowledge of chemistry involved in the course. This hopefully encourages discussion and interaction between students working with different exercise packages. With the help of these discussions, the students will find it easier to see a connection between lectures and practical work and learn scientific thinking.

NetLab is a web-based interface, which consists of several modules including various fields of chemistry and laboratory work. These modules include instructions for laboratory exercises, safety regulations and guidelines, animated reaction mechanisms, descriptions and instructions of laboratory instruments and characterisation procedures, interactive self-testing tools and instructions for reporting the results of the exercises (Figure 1). In NetLab, molecules are visualised using Java technology to enable three dimensional representations of synthesis products.

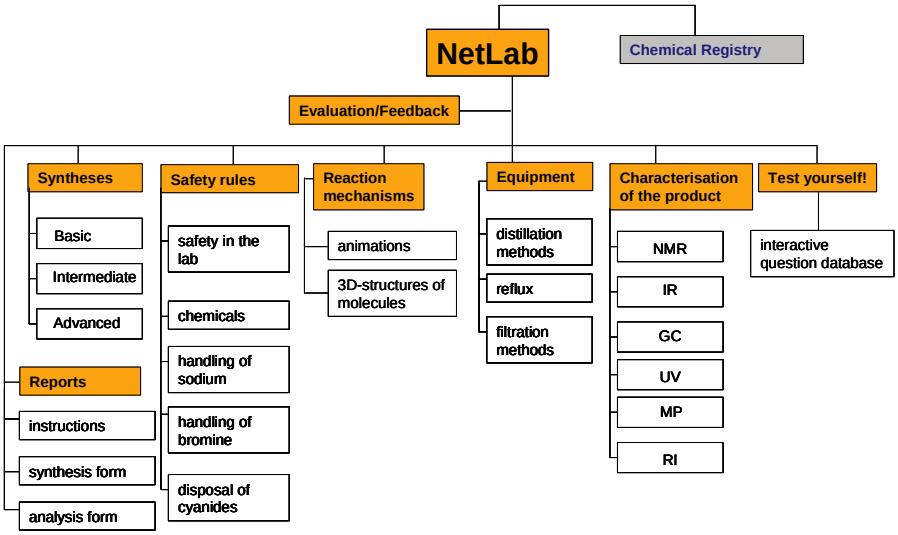

Fig. 1. Schematic diagram of the NetLab

NetLab also provides an access to a web-based reagent database, developed in collaboration with Vienna Technical University. The database contains all the chemicals and glassware available in

the Department of Chemistry storerooms. The students can plan their exercises with the help of the database. While planning the laboratory work students can check in advance the availability of the chemicals and glassware needed.

Summary
NetLab is a web-based self-learning tool for chemistry students providing a linkage between campus areas. It supports practical laboratory work and offers a connecting link to organic chemistry lectures. Consisting of several modules including various fields of chemistry and laboratory work, NetLab provides assistance for students undertaking organic chemistry laboratory courses. Currently end-user experiences are being collected in order to evaluate and to further develop the features of NetLab. The future challenges include enhancement of usability and optimisation of the technical solutions used in NetLab. NetLab offers a platform for introduction of new computer aided methods and applications for chemistry teaching.

Acknowledgements
Jenny and Antti Wihuri Foundation is acknowledged for financial support.

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Green chemistry for organic chemists

Our current research into ‘green chemistry’ involves a range of novel technologies. This includes the use of ionic liquids or solvent free conditions to promote new selectivities in industrially important reactions. More importantly this helps to minimize the use of chemicals that are damaging to us and our environment. Other techniques that we commonly use are microwave irradiation and sonication. With these methods we can shorten reaction times, improve reaction selectivities and achieve higher energy efficiencies.

The ‘Green Chemistry for Organic Chemists’ course was designed for all students at advanced level of the natural sciences. The course was held once a week, in English, for one academic semester. The lectures were given by experienced researchers, in their fields, from the University of Helsinki Chemistry Department, covering the relevant areas of ‘green chemistry’, as detailed in the course program. Included with the information passed on during the lectures, it was compulsory that the students prepare computer presentation on a chosen current literature topic or reference, relevant to recent advances in green chemistry. This was presented by the students at the end of the lectures and feedback was given by both lecturers and students. In addition a written report, in the style of a scientific journal reference or review, had to be prepared. The students were kept up to date on the course development *via* a website, which was specially created for the lecture course. Other functions of the website were to make available the course lecture information for each lecture and also links to important green chemistry research sites.

The students have benefited primarily by getting a good insight into the world of ‘green chemistry’ and in particular the current research in the Wähälä group. In addition they have also gained experience in research-based literature searching, presentation of their investigation followed by critical discussion in English, the common scientific language.

Marcelino Cabrera Cuevas, Antonio Cobos González and Jorge Pérez Rubio
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E-learning platform for research-based teaching aims
-Adding expert system features to a distributed system

In the following lines we will try to explain how Information Technology's (IT) Innovations fits into knowledge transfer between research and teaching.
In 2000 we were focusing on apply Artificial Intelligence (AI) researches to education. In this context the following paragraph briefly summarize Paper Abstract written for Inno2000's congress:

"Expert System capable of acknowledge musical forms.
An Expert System is a computer program that represents knowledge and reason using that skill. Is a system based in the knowledge dedicated to specific tasks that needs greatly knowledge of a topic. Is pretended that an Expert System knows about a topic like an Expert in the same topic ... our work ... innovates in the education, ... develop an Intelligent Tutor, that, after give the lessons, performs a test to the pupil and check what section of the lesson necessitates a reinforcement..."

Taking a look back at Inno2000's article, we realize that IT has evolved to a more wide connectivity, from local applications to distributed platforms. As local application, our first Expert System project, only offered the possibility to interact using a nonupdateable expert knowledge. Right now we have chance to offer an expert knowledge from a common place (knowledge platform), this way let an expert share his researches to the platform's users. Of course, this kind of share systems implies the definition of different access roles from readers to creators.

On taking another look, more and more people enlarge their skills in a virtual way, this way let either tutor and student not to be tied up a place and/or a schedule , and therefore allowing knowledge roadmap updates on the fly (a real-time knowledge transfer).

Our current work play around these technical and behavioural evolutions.
We are developing an e-learning platform where students can access a library of asynchronous E-learning Courses, or participate in synchronous E-learning Sessions.
Synchronous sessions enable students to interact in real time with an instructor and other students, via messages (chat) and video. The instructor can also send messages to any or all of the students, decide if the messages received will be viewed by the instructor only, or by the entire group, and whether to enable the students to download the session's messages at its end.

Instructors can either create or edit a-synchronous courses using authoring tools, or third-party courses. The system includes a search engine, which enables users to search for any material on the platform.

On the other hand remark that we take advantage of the latest programming technologies: n-tier architecture application (distributed and scalable), SOA connectivity (easy integration within other platforms) and web clients (Universal access).

In conjunction, we are talking about a E-learning Platform where the use of a common distributed Knowledge Bank in an effort to create course material and research's knowledge exchange , and ensure that the information posted is the most relevant. Where users assume one or more roles, the Role defines the privileges in the platform and therefore in the Knowledge Bank. Where E-learning Courses and Sessions are created by Creator Role, a Tutor Role monitor how apply it to a Student Role and all that process and, the system integration and management is responsibility of an Administrator Role. From our point of view a try to join the best of both worlds.

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What is or can be the basis for linking research and teaching in research-intensive universities?

Research-intensive universities such as the Katholieke Universiteit Leuven (Belgium) traditionally argue in favour of a close link between research and teaching. Not surprisingly the League of Research-intensive Universities in its first position paper re-affirms the co-location of research and teaching to be a unique feature of research-

universities with great benefits for society, academics and students. While the link between research and teaching is repeatedly re-affirmed, it does not remain unquestioned. During the last decennia ample (qualitative and quantitative) research on the relationship between research and teaching was published. The studies showed that although most academics would intuitively acknowledge the beneficial effects of the teaching research nexus, such effects are not intrinsic to a co-location of research and teaching. To identify more precisely where research and teaching do meet and how in teaching the link with research can be more firmly established, has been the object of several more recent research endeavours (e.g. Brew & Boud, 1995).

In a recent study at Katholieke Universiteit Leuven individual (n=8) and group interviews (n=3) were taken of academics teaching both undergraduate and graduate levels in human, exact and bio-medical sciences programmes in order to find out how they themselves conceive this link. The answer to this question was considered extremely important in order to answer another university-specific question. It was hoped that gaining insight in how academics conceive and enact the teaching research nexus, might help to understand the implementation of the university's educational concept 'Guided Independent Learning' (GIL) (Elen, 2003), that explicitly argues for research-based teaching.

Not surprisingly and in line with other studies it was found that teachers do regard the link between research and teaching to be important. They confirm that the co-habitation/ co-location of research and education are a unique feature of universities with potentially great benefits for society, researchers and students. At the same time, academics see various problems with respect to establishing the link. These problems can be summarized as follows:

- Research has become highly specialised. From the perspective of the individual teacher a growing discrepancy between one's research and one's teaching is experienced. This is certainly the case in bio-medical and sciences faculties, bit is also reported in social sciences and to a lesser extent in humanities.

- The increasing specialisation of research sometimes results in specialised studies as well. At this level the link between research and teaching remains clear at the content-level.
- Research and teaching become increasingly independent. Whereas research becomes increasingly specialised, the educational curricula become increasingly influenced by employability concerns. Rather than being influenced by changes in the disciplines, the curricula are affected by changes in the professions. Research and teaching follow their own logic.
- Teaching becomes increasingly professional. The standards are continuously increased. Good teaching requires specific attention and a lot of time that cannot be invested in research. It becomes doubtful that a good research can be assumed to be a good teacher as well. Both tasks have becoming increasingly demanding.
- Large groups of students in combination with increased specialisation of research and professionalisation of teaching increase the tendency to interpret GIL as being an educational method that can be used at a specific moment only (in one specific course, methodology).

Further analyses of the data revealed that the problems teachers point at in making the link between teaching and research refer to two very specific and more fundamental approaches of the teaching research nexus. Both these approaches can also be retrieved in the literature and have their own problems as well as clear implications for (research-based) teaching.

A first approach can be called classical or idealistic. Reference is made to the old 'idea' of a university as formulated by von Humboldt. Teachers taking this stance, argue that the university has an exceptional role to play because research has an edifying dimension. This dimension of edification or general education (*algemeine Bildung*) is related to research because the research process is guided by 'the truth' (i.e. research as *Wissenschaft* aiming at what is general). Studying at a university therefore implies participating in a research community and becoming (by looking for "the truth") educated in a general way. In this approach researching and studying are one, or in von Humboldt's words: at the university, the teacher is not there for the sake of the student, but both are there for research (as *Wissenschaft*). And it is this unity of research and study that grounds the exceptional role of the university, the academics/staff and the students. Within this approach academics think of education (and their relation to students) from the viewpoint of doing research, i.e. the edifying value or Bildung-potential of the research process.

Approaching research and education from this idealistic position has become problematic due to several challenges. A first important challenge is related to major changes in our epistemological beliefs. Research is no longer regarded to be looking for 'the truth', existing independently from the researcher. Moreover, academics are nowadays faced with the pressure to engage in (specialised) research that is guided by principles such as technological application. No wonder that in the last decennia various authors have tried to reformulate the grounds for the *Bildung*-potential of universities. These reformulations hold the assumption that research and studying are one and that research participation is not a teaching method but the core of studying itself.

A second approach can be called functional. In this approach two perspectives are being related: an external educational perspective reflecting on the function of higher education in society and an internal educational perspective focusing on good learning. In the first perspective the emergence of a knowledge society is taken for granted. It is accepted that the knowledge society determines what the main aims of higher education should be. While it is acknowledged that in a knowledge society, not all students have to become researchers, it is stressed that all graduates need research competencies. From this perspective the role of research in the learning

environment is highly valued and linked to a specific perspective on good learning (and teaching). Good learning is regarded to be a process in which students construct knowledge themselves (in collaboration with others) and good teaching is about supporting learning processes (Elton, 2001). Since learning processes are about constructing knowledge, learning processes can be described as research processes. Research participation is seen here as functional towards both improving learning and achieving educational goals relevant to establishing and fostering the knowledge society.

Our analyses make clear that there is ambivalence at least at the level of the discourse. Most academics argue in favour of a clear link between research and teaching by referring to the unity of teaching and research. At the same time however, they recognize that times have changed drastically and research has become highly specialised, oriented towards application and that more fundamentally its epistemological basis has shifted. These changes result in formulating goals that are relevant to the knowledge society and the introduction of research-like activities as a teaching method.

Our search for the reasons of this outspoken ambivalence urged us in first instance to make a thorough analysis of the university's teaching concept GIL itself. This analysis demonstrated that the above mentioned ambivalence between the idealistic and the functional approach is already present in the GIL-concept itself. Whereas the emergence of the knowledge society is recognised and the new ideas about learning are acknowledged in GIL, the link between teaching and research is based on the idealistic idea of a university. The ambivalence in the GIL-concept is reflected in the conceptions of academics.
These observations induce multiple new research questions with regard to the basis and nature of the research teaching nexus. Some of these questions are:

- What is the impact on teaching (and research) in research intensive universities of a more functional basis for linking research and teaching?
- Do universities still have a unique role to play by combining research and teaching or are they rather becoming 'simple' institutions for higher education?
- How can the research-teaching nexus be conceived both at the level of courses and individual subjects to reflect the role of research-intensive universities?
- If universities have a unique role and are more than service-providers to a knowledge society (if the knowledge society does not overlap with the knowledge economy) what then is the basis and the impact of that role for both teaching and research?

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Leiden University and the concept of research-based education – a case about policy, research and education

Introduction
This paper links up with the conclusion of the seminar's organization in Helsinki that, on one hand, the concept research-based education is not clearly defined, whilst on the other hand there are all sorts of practical examples in education that could serve as examples of this concept. Because in Leiden a great deal of importance is attached to the nexus between education and (staff) research, two research projects will be embarked upon this year with the objective of gaining a better grasp of (1) the concept of research based-education related to different disciplines, (2) implications of this concept to the competencies of lecturers who provide research-based education, and (3) the manner in which these competencies can be acquired.

This paper firstly expounds on the importance placed within Leiden University on research-based education on the basis of the system introduced in 2002 for monitoring the quality of the programmes. This is followed by a description of one of the research projects mentioned. Finally, an example is provided of a research-based approach to education.

During the Round Table Session participants are asked to portray a first-year course from the curriculum at their institute, in which the nexus between research and education is strongly present. By sharing these good practices, a discussion is initiated about the concept 'research-based education', its dilemmas and advantages.

The Leiden University Register: attention to coherence between education and research
With an eye to guaranteeing the quality of education provided at our institution, Leiden University has decided to limit registration in a Leiden University Register to those programmes that meet specified standards of quality. The Leiden University Register has been effective since 2002. It presupposes standards of quality with regard to (1) academic education, (2) effective didactics, (3) increasing degree of difficulty with regard to both contents and didactics, (4) broadening of the academic horizon, (5) selection of students and (6) a university and faculty system of quality assessment.

In the framework of this paper, it is the quality standard for academic education that is the most interesting. Features of academic education – according to the Leiden University Register – are:

- education and research are interwoven (i.e. there is a nexus) from the first year onwards
- academic skills are trained from the first year onwards
- the programme reserves time for students to reflect on the philosophical principles of the field of study, or else, more generally, it reserves time for a subject such as philosophy of science

The first quality standard: *education and research are interwoven from the foundation course onwards*, indicates the importance placed on the relationship between education and research by the University.

There are different manners in which to do justice to the relationship between education and research in the curricula. The Leiden University Register does not express an opinion on the precise manifestation of research in education that, also dependent on the discipline concerned,

provides the scope for the Departments to determine their own interpretation and content. However, it will be clear that this scope also raises certain questions as, once again: what exactly are these possible manifestations of research-based education?
In the professional literature on this subject,[1] a number of manifestations of research-based education come pregnantly to the fore. For example education that provides students with the results of an institute's (staff) research. The acquisition of elementary research skills in education and the demonstration of discipline-specific research methods by lecturers are also examples of the relationship between education and research. However, this relationship can be even stronger when, on the basis of methodology provided to them, students themselves either carry out their own small research projects or participate in research that is already in progress.

Many manifestations of the relationship between education and research can be found in education provided by Leiden University. However, the relationship is not always made explicit. For example, students are not always instructed *explicitly* in the common research methodologies, and lecturers are not always aware of the importance of making explicit their way of doing research.

What is clear is that attention is being paid to the problems related to research-based education at Leiden University. Apart from what is stated in the Leiden University Register, this awareness to problems concerning the nexus between research and teaching is apparent from two research projects which were initiated this year. One project focuses on the education at the Faculty of Arts, the other at the Faculty of Mathematics and Natural Sciences. One of the objectives of these projects is to provide lecturers with more tools which enable them to apply the concept of research-based education within their teaching practices. Currently these tools are not available. Hereunder a description is provided of the research project at the Faculty of Mathematics and Natural Sciences.

Research-based education in the Faculty of Mathematics and Natural Sciences: developing the competencies of university teachers
The educational programmes of the Faculty of mathematics and natural Sciences introduce students to research activities in various ways. The overall aim is not only to make students familiar with the skills and techniques which are typical of scientific research, but also to let them experience what it means to participate in a scientific community. In addition, students participate for some time in activities of research groups of the faculty. However, for university teachers it is not always evident how to design and teach their courses from a research oriented perspective. In this context a PhD-project is organised which will focus on the development of competencies of university science teachers. During the process of experimenting and implementing various forms of research-based education over a couple of years, data will be collected on the experiences of the participating teachers. Factors which either promote or hinder this development will be identified, leading to conclusions with respect to design of professional development activities in this area.

The main research question in this project is:

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[1] Jenkins, A., & Zetter, R. (2003). Linking research and teaching in departments. Oxford: Learning and Teaching Support Network, Oxford Brookes University.

Jenkins, A. (2004). A guide to the research evidence on teaching-research relations. Heslington: The Higher Education Academy.

How can the concept 'Research University' be put into practice in mathematical and science education at university level?
Pertaining to this central question are the following specific research questions:
1. *Which aspects of "Research-Based Education" (pedagogical and subject-related, organizational) can be identified?*
2. *Which competences do lecturers need, to apply "Research-Based Education" in their courses?*
3. *How can lecturers best be facilitated to develop these competences?*

Various methods will be applied in the research project in order to provide an answer to the first sub-question, including, *inter alia*, literary research, discussions with experts in Leiden and making an inventory of forms of research-based education at other universities.

During the second phase of the project, a number of study groups of lecturers will be formed. In their own teaching practices, these lecturers will experiment with several characteristics of research-based education. Their experiences with these experiments will be analysed systematically, and will be discussed with the lecturers. On the basis of their experience, new instruction activities will be developed, which are related to research-based education. Lecturers will work with these activities once again.
The third phase of the research project consists of the development of competencies of lecturers through professional development approaches. These approaches will be applied to larger groups of lecturers. During this PhD-project the professional development of this second group will be analysed.

Research-based education – Good Practice from Leiden University
Although the concept research-based education requires further specification, this does not mean that there are not already examples to be found of strong relation between (staff) research and education.
One example of such a relation can be found in the first year physics bachelor programme at Leiden University. Already during the first year students are familiarised with staff research. During a kaleidoscopic course various scholars clarify the linkage between their research and topics from the domain of modern physics. One of the major advantages is that students get highly motivated to broaden their perspectives on research in the field.

A description of this course is presented in a format, which will also be used during the Round Table Sessions.

Course name:
Kaleidoscope

Institute:
Leiden University; Faculty of Mathematics and Natural Sciences

Discipline and year:
Physics, first year bachelor

Instructional format and student activities:
During nine sessions different lecturers will explain various topics from the domain of modern Physics. Groups of 2 or 3 students are expected to write an essay or make a web-page accessible for secondary school pupils. Each group must choose one of the topics treated during the sessions.

Assessment:
Essays and web-pages will be assessed based on structure and lay out, incorporation of physical concepts, use of additional sources, reflection on scientific and social consequences and relevance, self-sufficient working attitude and use of correct language.

Relevancy to research-based education:

1. Students become acquainted with topics from modern physics.
2. Students become familiar with various staff researchers.
3. Students acquire various academic skills, such as:
   - Clear writing and structuring a text
   - Writing for a specific target group
   - Analysing scientific literature
   - Reflection on ethical and social consequences of scientific research

During the Round Table Session participants (working in couples) are asked to portray a research-based first-year course from one of the couples' institutes, by filling out the above format. By sharing these good practices a discussion is initiated about the concept of 'research-based education'. Hopefully dilemmas and advantages concerning the relation between research and education can be made more intelligible.

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Louis Pasteur University, France

The EUREA and e-LERU projects: the implementation of active collaboration between LERU universities in terms of higher education and teaching through ICT

Both the quality and international profile of higher education are improved when it is delivered by teaching and research staff who are up to speed with the latest researches, and innovations and who are aware of the importance of transferring their results to the society: this fact is now widely accepted in all developed countries, particularly in Europe, where universities are endeavouring to structure their post-graduate training around research and, better still, a quest for excellence.
However, a worrying general trend is beginning to emerge, affecting even the major European research universities: an increasingly obvious lack of student interest in scientific disciplines and research professions. This trend is even more worrying since prospective analyses of demographic changes and training systems demonstrate that developed countries will have to cope with a shortage of managers within the next 10 years if they do not urgently modify their higher education systems. Enhancing the capacity to train qualified managers and attracting high-quality students from developing countries are increasingly vital prerequisites for social development and maintaining the economic growth of developed countries. The United States and Japan were quick to appreciate this and have already developed an active strategy to strengthen their higher education systems and promote this system in developing countries. With the advent of information and communication technologies, which are releasing the geographical brakes on the export of knowledge, European universities are increasingly having to face up to this context of international competition between higher education institutes. The stakes involved in this international competition go well beyond the issue of economic development since, ultimately, it is a matter of defending the cultural and linguistic identities of our European countries. The Bologna process, the knowledge society and the construction of the European research area are Europe's responses to this threat. Through these European projects, the countries of Europe have set themselves a common objective of increasing the attractiveness and

efficiency of their higher education systems, by structuring them around a quest for excellence, improving their quality and raising their international profile by multiplying the number of collaborations and partnerships between European universities. However, whilst European universities have traditionally worked together when it comes to research, notably with the framework programs, collaborations in the field of higher education are still rare: high quality higher education supported with research of the highest standard has to become one of the European priorities.

How can we rise to the challenges represented by higher education in Europe today, and nurture a quest for excellence in higher education while at the same time improving the quality and attractiveness of this education? It is in an attempt to answer this question that the LERU universities, with the support of the European Commission, have decided to join forces around two collaborative projects in the field of higher education: EUREA and e-LERU.

With these projects, respectively scheduled to begin on 15/01/05 and 01/02/05, the LERU (League of European Research Universities) universities aim to raise the international profile of their educational programmes, by pooling their academic digital resources (in particular their courses) and equipping themselves with joint mechanisms for developing these resources using ICT. Ultimately, these projects are intended to promote the construction of trans-national European training programmes and act as a catalyst to the emergence and adoption of attractive innovative teaching practices.

Although the EUREA and e-LERU projects ultimately have the same objective, they are adopting different approaches to achieve it. But in both cases, the success of the projects will be dependent on the mutual knowledge of the partners in terms of higher education (teaching practices, range of training programmes offered, quality insurance such as evaluation) and on exchange and discussions to detect common synergies in terms of developing a higher education system supported by a quest for excellence. And for both projects, the issue of protection of intellectual property will also be studied in detail, in partnership with the Faculty of Namur (CRID), internationally renowned for its expertise in this field.

EUREA:
9-month feasibility study
Start: 15 January 2005
Funded by the European e-Content programme.
Consortium: ULP Strasbourg ; University of Geneva ; UHEI Heidelberg ; University of Helsinki ; University of Leiden; KU Leuven ; Unimi Milano ; KI Stockholm ; LMU München ; Faculté de Namur (CRID)
Coordinator: ULP Strasbourg
Contact person: Anne Goudot, project manager

Objective: To identify the best conditions for implementing and sustaining a high-quality system for pooling the academic digital resources (computerised lectures, digital teaching resources, audiovisual documents, etc.) of LERU universities in extensive, interoperable and multilingual European multimedia databases.
In addition to developing mature technical and managerial models, the project's partners will answer the following questions:

- Which tools and services need to be developed to promote the pooled resources and ensure the durability of the mutualisation system? In particular, the creation of a LERU publishing house will be considered;

- If applicable, which private partners would be the most suitable for implementation of the mutualisation system?
- Under which conditions could the consortium be extended to other European universities?

Market research will be conducted and a business plan will be drawn up. The feasibility study should lead to an implementation project.

E-LERU:
2-year implementation project
Start: 01/02/05
Funded by the European E-learning programme.
Consortium: ULP Strasbourg ; KU Leuven ; University of Milan ; UHEI Heidelberg ; KI Stockholm ; University of Leiden ; University of Geneva ; Université de Namur (CRID)
Coordinator: ULP Strasbourg
Contact person: Anne Goudot, project manager

Objective: To create a virtual campus, in the form of a pool of e-learning modules that each partner university will be able to use to offer its students virtual mobility in addition to physical mobility. Each partner will be able to award national degrees with a LERU label certifying their European dimension and excellence, on condition that a predefined number of ECTS (European Credit Transfer System) credits has been obtained through this virtual mobility.
The project itself will begin with a comparative analysis of the course programmes offered in the various LERU universities involved in the project, to reveal synergies and identify those courses most suitable for digitalisation and mutualisation. A common programme of e-modules will be defined and implemented by the partners during the course of the project. Priority will be given to language teaching. In parallel, as with the EUREA project, market research will be carried out, with the drafting of a mature business plan and a search for private partners if required.

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The use of the Progressive Inquiry Learning in legal education – case: "Intellectual Property Rights in Insolvency"

Introduction
The aim of the study was to explore whether Progressive Inquiry Learning could be used to improve research skills of the students in legal education. The participants in the study were 17 law students attending a project course "Intellectual Property Rights in Insolvency" in year 2003. Ten of the students were from University of Helsinki, five from University of Turku and two from the Swedish School of Economics and Business Administration (Hanken). Three of the four teachers were from University of Helsinki. The project it self was a part of a bigger project "The Insolvency and Licensing of Intellectual Property Rights" funded by the Academy of Finland

The paper tries to answer to the following questions:

- What are the problems of legal education that need to be solved one way or the other?
- Whether, why and how Progressive Inquiry Learning could be used to improve research skills of the students in legal education in theoretical level?
- How did the "pilot project" work out?

- What were the practical problems and what are the potential solutions?

Framework for the Study

In legal education so-called “advanced special studies” include a seminar about methodology in legal research and more importantly, an entity called project. The project lasts one year and it includes lectures linked to the subject of the project, a written exam about the subject, seminar work and first of all, the master's thesis. The subject of master’s thesis is usually closely connected to the project. The extent of thesis is about 60-80 pages.

The aim of the advanced special studies is to guarantee, that the graduating lawyers are competent for the specialized positions in society and also have the basic skills of legal research.

The other courses, meaning the first 80 percent or the first 4 - 5 years of legal studies do not develop the basic skills of independent and critical thinking, legal problem solving and doing legal research. Students are not used to writing and they don’t have deep-level understanding of the legal methodology and theory. In the “pilot project” “Intellectual Property Rights in Insolvency” the teachers tried to solve the problem by the use of Progressive Inquiry Learning.

The principles of Progressive Inquiry Learning rely on an idea of knowledge building. It means that students are working together to create their own, and from their perspective a new conception about subject. An important aspect of progressive inquiry learning is to guide students in setting up their own research questions and working theories. In best cases learning is like a research process leading to new knowledge and information. The Progressive Inquiry Learning model has the following phases: setting up the context, presenting research, creating working theories, critical evaluation, searching deepening knowledge, developing deepening problems and distributed expertise.

The use of the Progressive Inquiry Learning in the pilot projact: “Intellectual Property Rights in Insolvency”
In the project “Intellectual Property Rights in Insolvency” the idea was to emphasize those features of project and master’s thesis process that imitate the normal research process of producing new knowledge.

For example the students were encouraged (if not pushed) to choose their research themes (master’s thesis subjects) themselves after the introduction period of lectures, written exams of the basic research and newest research of the subject, and the more general seminar work. Also the topic of the project was chosen so that it was difficult to find a theme that would have made it possible to just descriptively copy the existing knowledge. The teachers tried to emphasize the nature of master’s thesis as a small research project, which in legal education is not self-evident.

Critical attitude towards legal knowledge: Progressive Inquiry Learning was also used to change the students’ conception of legal knowledge. The idea was to show the students or even better, let the students see, that legal knowledge if any is uncertain, complex, relative and context bound. The students were explicitly encouraged not to respect any authorities, and to question the information given to them. The idea was to show that in most cases the first available answer is not always the best one and certainly not the only possible one. Conceptually and from the students’ point of view this idea could also be described as a shift from simple factual questions towards explanatory questions.

The book: After the project the legal faculty of University of Helsinki published a book including eight articles written by the student on basis of their master's thesis. The goal was to motivate the students in their work, teach them how to write an article, to underline the research nature of the work and to bring the substantive information, the result of the project, within reach of other experts.

The Problems

In short, the biggest problem probably was that the expectations of the students and the teachers did not really meet. The students had already taken a different, more simple view of what being a lawyer and dealing with legal knowledge actually is. The situation was not really helped with the fact that the students seemed to think that their view of legal knowledge and being a lawyer is the one respected by employers outside the university.

The methodical and theoretical questions would probably have been a key to take proper advantage of research based learning, and those aspects should have been more properly focused on in the beginning of the project. However, theory should be taught during a longer period of time as a part of other studies.

For many of the students it was very difficult to find a research theme for the thesis. This is probably a symptom of an uncritical attitude towards received information and focusing on the factual questions instead of explanatory questions.

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The timetable was also a problem for some of the students. Most of the students were working at the same time and seemed to prioritisize the paid work. That did not seem to be only a result of economical but also value-related reasons. The students had the (possibly right) idea that the employers value practical experience more than academic achievements.

Potential Solutions

It might help, if the method of Progressive Inquiry Learning as well as the goals of the project and the expectations of the teachers were more clearly introduced to the students.

Motivation could also be improved by connecting the research work and research world more closely to practical legal work and the potential future employers. Law firms could be somehow integrated into projects – not only as places to visit but as real partners committed to the goals of the project. The Law firms could benefit of the methodological updating education as well as of getting connected with potential recruits.

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Prior knowledge assessment as a tool for supporting learning

According to many educational psychologists, it is undeniable that prior knowledge is a key determinant of learning performance. Prior knowledge is often viewed as a spring board for future learning and its assessment offers valuable information as to the guidance and instruction most useful for individuals (Dochy 1992). Prior knowledge state assessment can enhance learning and it can be a valuable method of student support (Martens&Dochy 1997). That is why it would be useful to create a prior knowledge assessment tool. This tool would give the teachers an opportunity to recognize the students' potential lack of knowledge and skills which might harm the learning process and to recognize the possible need for further support.

The aim of the first part of this research and development project is to make a pilot study using the assessment tool and to test if it measures the prior knowledge in a valid way. Another aim is to find out whether the prior knowledge level is an effective predictor of learning outcome. The second part of the project concentrates on the ultimate aim of the research and development project, that is, to create a web-based evaluation tool which helps teachers and students to recognize and assess the level of prior knowledge needed in the course. The objective is to provide an interactive structure into which teachers can flexibly produce contextual question- and test patterns in the beginning of the course. The idea is to direct the learning towards deep learning and to provide individual learning paths for the students.

The pilot questionnaire of the assessment tool has been created in order to test its structure. It is based on theories of the structure of prior knowledge (Dochy 1992; Portier&Wagemans 1995; Biggs 2003). The prior knowledge has been conceptualized as the whole of persons' knowledge that includes the content knowledge and metacognitive knowledge (Dochy 1992). Knowledge and understanding is also seen as proceeding from stage to stage increasing in structural complexity (Biggs 2004). The pilot questionnaire includes the *content part* and the *metacognitive part.* The content part includes subject-matter questions differing in their complexity level and they have been created by the teachers of the courses using the provided theoretical approach to knowledge. The metacognitive part includes questions concerned with self-knowledge, cognitive knowledge and strategic knowledge.

The data will be collected using the assessment tool during the spring 2005 from 400 university students and it will be quantitatively analysed. In addition, the qualitative data will be collected through interviews which aim to find out students' views of the meaning of prior knowledge in learning. After analyzing the data the tool will be elaborated and the final web-based tool will be created in the spring 2006. This study is an integral part of the development of support tools for quality learning in virtual learning environments.

Round table discussions
The identification of prior knowledge and its structure is a complex issue and poses many challenges to the creation of the assessment tool. Some preliminary results will be presented in the seminar. Objectives for further exploration are:

- development of a tool that is sensitive enough to identify the prior knowledge needed in the course and to give individual support for students
- discussion of how to make this tool as user-friendly as possible
- discussion of other possible ways of exploring the prior knowledge

It is the aim of the round table session to activate the discussion about the previously presented points.

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Compulsory language studies for university degrees: The challenge of decontextualisation in language learning

Abstract
The present paper discusses the decontextualisation of learning in a case of compulsory Swedish language studies for university degrees. In this case learning Swedish is mostly disconnected, not

only from the everyday lives of the students in a way typical of formal learning in general, but also from the study activities and contexts that students engage in their subject major studies. Learning has been transferred to a specific context, the University Language Centre Swedish courses, where the main purpose is to learn Swedish for possible future needs. The study explored the correspondence between Finnish-speaking students' own learning goals and the formal objectives set for these compulsory studies (i.e., learning Swedish for educational and occupational purposes). The sample consisted of ten student groups from different subject majors. The results suggest that all students do not necessarily share the prescribed formal objectives. First of all, students expressed goals, which are highly contradictory to the formal objectives, namely, goals of learning only discrete words or grammar rules. In addition, only four of the ten groups mentioned learning goals related to their present studies (educational domain), and only five groups discussed learning goals from the point of view of their future professions (occupational domain). The paper discusses ways to overcome the problems of decontextualisation in compulsory language studies for university degrees.

Introduction

The question of de- and recontextualisation of institutional learning has been raised in the framework of sociocultural theories. According to Säljö (2000) decontextualisation of learning means that learning is disconnected from other activities and the contexts that people live and work in everyday life. Instead, learners live in an indirect relationship with the outer world. Recontextualisation means that learning is transferred to a new context, where learning itself becomes the purpose of action. During primary socialisation the learning of conceptual knowledge and different skills takes place in a context that children live in through observing and engaging in daily activities, whereas the process of learning is significantly different in formal educational environments (Vygotsky, 1997; Säljö, 2000). Säljö argues that living in a text-based reality and talking about the world, instead of acting in it, is characteristic of formal learning environments. As learners often lack personal experience of the phenomenon under study, for example a foreign language, they have to familiarise themselves with it through written and spoken texts in the classroom context. Learning is mostly preparation for the possible future use of the language skills.

The specific nature of recontextualised instruction, i.e., teaching and learning being ends in themselves, produces typical modes of social interaction and learning processes that are seldom found outside these contexts (e.g., Gustavsson, 1988; van Lier 1988, 1996; Säljö, 2000). One of these forms Säljö discusses is teacher-centred instruction, in which learning objectives and the processes of learning are mostly determined by a pre-planned curriculum, and learners' present needs do not necessarily have any connection to the activities they are engaged in.

One formulation of the sociocultural approach, activity theory, has been applied to language learning (e.g., Donato & McCormick, 1994; Lantolf, 2000; Lantolf and Pavlenko, 2001) with special interest in learners' motives, which are realized in goal-directed actions under particular conditions. Thus, within a language class, learners with different histories may have different reasons for being there and different learning goals (Donato, 2000; Lantolf & Pavlenko, 2001). What students focus on - and hopefully learn - may or may not relate to how teachers have constructed the formal learning objectives (Gillette, 1994). According to the recent educational research (Bowden and Marton, 1998), the nature of learners' own goals and the degree to which they share the formal learning goals is related to the effectiveness of learning. Prosser and Trigwell (1999) argue that in order to develop teaching and learning in universities we need to find about the variation in how students perceive and understand the subjects they are studying and the courses they are attending.

The present paper discusses the decontextualisation of learning in a case of compulsory Swedish language studies for university degree. In this case learning Swedish is mostly disconnected, not only from the everyday lives of the students in a way typical of formal learning in general, but also from the study activities and contexts that students engage in their subject major studies. Learning has been transferred to a specific context, the University Language Centre Swedish courses, where the main purpose is to learn Swedish for possible future needs. The present study explores what kind of learning goals Finnish-speaking students construct for their compulsory Swedish studies. Students' expressed goals are compared to the formal objectives of Swedish studies, namely, learning Swedish for academic and occupational purposes. Learning goals are defined in the present study as statements of personal needs, wishes, or desired and/or obtained learning outcomes concerning the Swedish language.

Method

The research reported here is part of a larger evaluation of education carried out in the Language Centre in 2001-2002. Students' experiences of language learning were collected through group discussions, which is an efficient method of obtaining information from several participants in one session (e.g., Krueger, 1988; Oppenheim, 1992) Students were asked to talk about a) general needs for language skills in their present studies and future professions, b) teaching and learning at the Language Centre courses, c) what kind of competences they wanted to acquire during their language studies, and d) on a more general level, their conceptions of language proficiency and language learning. Discussions were guided by these general questions and follow-up questions probing of the answers provided. Participants were allowed to give particular emphasis to the topics they felt were the most relevant to their learning experiences. Care was taken to ensure that each participant had the opportunity to describe his or her personal experiences.

The first author interviewed ten groups of students from eight faculties. A total of 23 academic affairs coordinators in the student organisations of different disciplines were asked to convene a group of students for an interview. The disciplines were chosen to provide a wide range of subject majors. Ten student organisations agreed to compose a group. Those interviewed included students of theology (5 students), law (5), medicine (1), veterinary medicine (3), logopaedics (3), history (3), geography (3), political science (3), food science (4), and forestry (4). Eleven men and 23 women, a total of 34 undergraduates took part in the interviews. Two of the participants were just finishing their first study year, 7 participants were second- year students, 13 third-year students, 6 forth-year students, 4 fifth-year students, and 2 sixth-year students. Ten students had attended the Swedish course during the ongoing academic year, 18 had finished it within one to three years, 4 were planning to take the course in the near future, and 2 had passed the proficiency test without taking a course. The interviews lasted 1.5 - 2 hours, and were recorded and transcribed.

The total student interview material ranged over a variety of topics but the analysis was carried out on the relevant parts of the verbatim transcripts of the interviews, namely, talk on the goals of learning Swedish. Qualitative content analysis (e.g., Weber, 1985; Patton, 2002) was used to analyse and interpret the data.

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Research based practice: on the role of action research in the context of developing an on-line module in an international MSc programme

This poster focuses on a module of the International MSc in eLearning, Multimedia and Consultancy and aims to illustrate an approach taken to action research and the incremental development of the module. It highlights the design aspects of the course and research methodology building on ongoing research by Hudson, Hudson and Steel (2002) and Hudson and Pountney (2004).

In designing and planning the module considerable emphasis has been placed on enabling collaborative activity in multinational teams. In relation to this aspect we share the general perspective offered and the distinction between co-operation and collaboration made by Lehtinen et al (1999). The approach emphasises social interaction between students and tutors, combining active-learning and on-going action research to inform teaching.

The module, Digital Media Applications (DMA), enables the students to gain a critical appreciation of the development process and an understanding of the potential and limitations of digital media applications in educational contexts. Student activity includes working on-line in international project teams to produce a DMA prototype. The activity is used as the basis for research, development and personal reflection, the outcomes from which are presented in a digital portfolio for assessment. The emphasis on project-based learning and portfolio for assessment combined with personal and professional development planning provides a framework which enables students to collaborate, share knowledge and experience, study, research, reflect on learning and focus on personal and professional goals.

The theoretical framework underpinning the course design owes its influence to the ideas of Vygostsky (1962 and 1978) and Lave and Wenger (1991). The framework has also influenced the approach taken to associated research which is underpinned by an emphasis on the social aspects of computer mediated learning and the affordances of technology.

Data has been collected from students and tutors using a variety of approaches which include end of module questionnaires, focus groups and the analysis of critical incidents and reflective diaries. The analysis of feedback has helped to inform the research strategy and to develop the data gathering process. For example at the end of each module students are asked to fill in an on-line questionnaire. The questionnaire is a means of collecting data on the student experience and seeks to investigate personal context and expectations, guidance and support, feedback from tutors and peers, the international dimension, student satisfaction and the importance and meaning of being part of a learning community. Over a four year period all students have indicated that they felt part of a learning community. The questionnaire has subsequently been developed to gather more in-depth information regarding the conditions that contribute to the meaning of a learning community.

A reflective diary is used in the DMA module as a means to support formative and summative assessment. The students are asked to provide an account based on personal reflection in relation to individual roles within the team producing the DMA prototype. It involves reflection on the processes of planning, time management and the appropriateness of approaches and techniques to DMA development. By reflecting systematically on experience at an individual level, the aim is

to help link theory with practice at the social level. Having agreed a statement of research ethics at the outset of the project, the diaries have been used as a source of data collection.

The systematic action research involving students and tutors has helped to develop the module and the programme and to better recognise those pedagogical practices which are fundamental to achieving the aims of the programme and meeting the needs of the students.

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Research-based practice: on the relationship between action research and design research in the context of the development of an international on-line MSc programme

The background context for this poster is the development of the international MSc *e-Learning Multimedia and Consultancy* that arose from the TRIPLE M Advanced Curriculum Development (CDA) Project supported by the European Commission under the SOCRATES programme (1998-2001). The poster will aim to outline our approach to the use of action research in supporting this development and the relationship with design research, a central aim of which is "evaluation for impact" (Banan-Ritland, 2003). Furthermore it will aim to provide an overview of outcomes from activity in relation to the development of this programme over a period of several years which can be seen to have led to impact within the broader community.

In considering the nature of action research it firstly needs to be acknowledged that it is contested and is the result of a number of waves of advocacy over a period of several decades in the English-speaking world. Each wave has been shaped by the particularities of its time and to some extent reflects specific cultural and historical conditions. It is possible to identify differing traditions with distinguishing characteristics. The approach that we have sought to develop with

both colleagues and students (Hudson et al, 2003) can be described as "critical" action research, as advocated by Carr and Kemmis (1985). This approach takes a strong stance on action research as a critical social science, rather than simply as some form of practical reasoning, seeing it as connected to social action and social movement. This connection between social research and social life is intrinsic to research as an activity. An overriding goal is the aim to change the social world for the better. If such change is to be achieved then it will come through improved shared social practices, the shared understandings of these social practices by the community and also the shared situations in which these practices are carried out. Accordingly such research is always critical in the sense that there is a relentless striving to better understand our current situations in order to improve them. However it is also critical in the sense of being "activist" in a professional sense. By this I mean the very processes through which we learn i.e. collaborative learning through joint activity in which communities of learners set out to learn from change through the very process of making changes whilst at the same time studying the process and consequences of these changes. The aim is based on an understanding of ourselves engaged in shared social practices (both students and tutors) as the agents, as well as the products, of history.

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

Particular attention will be given to the role of design, in terms of both development and research, and in particular to thinking around the notion of a systemic-evolutionary “design science” (Wittman, 1995). The poster will aim to illustrate outcomes from activity in relation to research and development from a stage of informed exploration in 1998 to that of broader impact in 2005.

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A multidisciplinary, international sea ice course at the Tvärminne Zoological Station, University of Helsinki, Finland

Multidisciplinary, international field courses on the research methodology of the Baltic Sea ice geophysics and biology have been organised at the Tvärminne Zoological Station (SW Finland) since 1997. The background, and thus motivation, for these courses was originally the active research collaboration between three PhD students (and, simultaneously, university teachers) in Finland and in Germany. This collaboration began during an arctic expedition on R/V I/B Polarstern to the Greenland Sea in 1995. In 1997, the first sea ice course was organised, and the following courses took place in 1999, 2001 and 2003. The next course will be in February 2006. Since the first course, all three original teachers have dissertated and have now permanent positions at their universities - and the developing of the courses goes on...

The main "ingredients" of each sea ice course are the following:

- both sea ice geophysics (abiotic part) and biology (biotic part) are taught
- based on literature and discussions with their supervisor, students must prepare a short presentation on a given subject related to the course (theoretical part)
- during the course, all students must participate in all parts of field, experimental and laboratory work, as well as data analysis and the final seminar
- students and teachers are mainly from the Univ. of Helsinki (Dept. of Geophysics, Dept. of Biological and Environmental Sciences) and Christian-Albrecht-University, Kiel, Germany (Institute for Polar Ecology). Additional geophysics students are often invited from Estonia, and biology students from the Univ. of Oulu (Finland), Sweden or Norway
- teaching language is English

Teaching is based on the teachers' self-gathered knowledge and experience on sea ice related issues. The responsible teachers are active in sea ice research and well-known in international fora, their assistants during the course are typically PhD students. For the PhD students, teaching one's own speciality is very educational.

During an sea ice course a student will:

- learn to collaborate with foreign students, in a foreign language (English)
- learn the basics about sea ice geophysics and biology (theoretical part)
- learn the basic methodology for sampling, processing, data collecting and analysis of both sea ice geophysical and biological material (practical part)

- learn the process of how sea ice research (and any research, for that matter) is done, starting from the research plan, through field and laboratory work, ending to the final seminar and the course report (publication)

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Research-based teaching course organised by the post-graduate students at the Department of Church History

During November and December 2004 a pilot lecture course founded firmly on the research-based teaching was held at the Department of Church History. The course was called *Suomen kirkko ja kylmä sota* (The Church of Finland and the Cold War) and I was its coordinator and one of the presenters. The program started with three lead-in lecturers held by professor Seppo Hentilä from the Department of Social Science History and was continued by the lectures held by the post-graduate students of the Department of Church History. Their lectures were based on their ongoing dissertations, which are all somehow connected to the Cold War. They all are members of the Professor Aila Lauha's postgraduate seminar working currently on the Cold War era.

Topics of the seven individual sessions given by the postgraduate students were for example *Relations between churches of Finland and the DDR, Communism in Christian Literature and The Church of Finland and the crisis in Finnish foreign relations.* As an exception the last lection was held by docent Riho Saard. His topic was based on nearly finished study about ecumenical doctrine discussion between The Finnish Church and the Russian Orthdox Church in 1970s. Also this lection was based on the recent findings in the church historical research. The course was finished by a panel discussion.

The course was intended both for the graduate and postgraduate students of all history departments at the University of Helsinki. Special attention was given for "marketing" of the course and eventually about 20 students representing all history departments participated. As an organiser I was positively surprised by the large number of political history students that were interested in the course. This became an interdisciplinary course not only in theory but also in practice.

The Church of Finland and the Cold War course received mainly positive feedback from the students and as well as from the lecturers. There was also some constructive criticism in feedback forms, which was discussed in our post-graduate seminar after the course. For some of our postgraduate students this was the first time, when they spoke about their research in front of an audience. For them it was a positive experience, which also benefited their studies.

On the background of this course was more than five years of long term work in seminars and research projects at the Department of Church History. In late 1990s graduate seminars on Churches and Cold War topic were started at the Department. Previously the Cold War period had been mainly unexplored in church historical research. One of the reasons for this was the fact that many important Archieves were classified until that period. Success of the graduate seminars to produce several young people interested to continue their studies to postgraduate level has been mainly due to active guidance work done by the teachers at the Department of Church History. This course was only one of the results of the ongoing postgraduate research in this topic.

Previously some of the presenters of this course have participated in the EU funded Churches and European Integration project. This project was coordinated by the Department of Church History and lead by Professor Aila Lauha. It combined the efforts of five European universities and analysed the political role of the European churches during the Cold War and within the process of European integration. In over all Research-based teaching has been an ongoing trend in the Department of Church history for many years also by lecturers of elementary courses and also in lecture courses given by the Docents.

In my presentation at the seminar on Research-based Teaching in higher education I will introduce this pilot course held at our department. I will mention something about both strengths and problems, which we encountered in this project. In general the main purpose of my presentation will be to give a positive example of research based teaching given by the postgraduate students.

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Everyday life at university teachers' standpoint
Case: Faculty of Social Sciences, University of Helsinki

The focus of this presentation is on the every day life of university tearcher's at the Faculty of Social Sciences at the University of Helsinki. The perspective is the faculty in the net and the everyday practises in the faculty. Information and communication technology (ICT) is used at the faculty for everyday practices at education, research, administration and services. Most of the faculty's texts are in the net: study guides, course registration, course materials, some parts of the teaching, educational administration and the interaction between faculty members.

In this study I am interested about university teachers' social relations and the main interest area is university teachers every day life in faculty and in the net. I use here the term social relation like sociologist Dorothy Smith (1987). They are not relations between people, like teacher and student or mother and child. For Smith social relations of every day life actually organize what goes on (Cambell & Gregor 2002, 27). Social relations are in many case texts. In this presentation I investigate which and how texts co-ordinate the local practices of university teacher's work. The main texts are from Ministry of Education: Ministry of Education Strategy 2015, Education and Research 2003-2008, Information strategy for Education and Research 2000 – 2004, implementation plan (Ministry of Education).

The main question in this presentation is

- what are social relations that links Higher Education policy with local practices

The sub questions are:

- What are practices of the every day life that university teachers' do?
- What are the texts that affects university teachers every day life?
- When the interaction is at net, how it affects to university teacher's practices?

The method that I am using in this presentation is Dorothy Smith's (1987, 1990) the institutional ethnography. I am looking the every day life of the faculty at the standpoint of the university teacher. The standpoint means starting from the actual lives of particular people, and looking for social relations which make the life understandable. Standpoint is not a bird's view but is

available to the sociological inquiry only through standpoints of particular groups (Vehviläinen 1995, 7). From standpoint of university teachers I am looking the every day life of the faculty.

The focus is to look university teacher's social relations. In this world there is the local world and the extra-local setting and both are the part of the social relations of experienced actuality (Campell 2003). At university teachers' world the local is at the university and the extra-local is the world outside the university. The extra-local appears to teachers' everyday life by text (documents, research, books, etc.). Texts mediate, regulate, authorize and coordinate peoples' activities (Smith 2001, 159). Most of the texts are from Ministry of Education. Texts can also be many kinds of studies, research, plans etc. But somehow these texts affect university teachers' every day practices.

The data is from focus group interview at June 2004. At that interview were four university teachers of the Faculty of Social Sciences. I have analysed the material at the standpoint of the university teacher and there arose three problematic cases for them:

- the use of new information systems in every day life practises: libraries, learning environments, internet
- student's and university teacher's interaction by e-mail: textual guidance and tutoring
- time and place: where, when and how to work: home, workroom or at new places like internet

Conclusions

The every day life for university teachers' is not the same that appears in the texts like Ministry of Education Strategy 2015 and at the local world at the faculty. There are many situations where problems arise, e.g. , like new kind of interaction, new working practices, information overload, hurry, demands that affects university teachers' every day life can create problems in adaptation to the working practices. Those problems are not necessarily permanent. In many cases only the organization of work is enough, some times is needed net "etiquette", or organization of work places.

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Research- based -teaching as consulting for professors

The Faculty of Biosciences aims to educate qualified experts and researchers in the fields of science it represents. The goal is that the students complete Master's degree, and the faculty encourages graduates to pursue postgraduate studies. Approximately half of the graduates in the faculty continue to complete a Ph.D. degree. The Department of Biosciences is also responsible for the education of subject teachers in biology. Mostly the employment prospects for the graduates are good. At the faculty, instructions are also held using foreign languages and student exchange programmes are very active. High-quality research and links between research and teaching are strongly supported. To sustain the level of activity the faculty has a tendency to develop linkage between scientific expertise and teaching. The aim of the paper is to share experiences and to explore the challenge and possibilities posed by the increasing need for pedagogical development in university teaching and learning as it relates to research-based-teaching at various levels of the university system. Particularly, we attempt to meet the following objectives: how to train university professors in pedagogical skills, how to clarity the concept of "research-based teaching", describe consulting teaching for professors in pedagogical skills, and advance research activities also on higher education pedagogy among the faculty staff. We also discuss these topics in the light of past and ongoing experience of developing research-based teaching in practice.

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The development of epistemological beliefs in higher education

This study investigates students' academic thinking and the development of their epistemological beliefs. Its purpose is to deepen our understanding of what epistemological beliefs individual students hold about knowledge and knowing, and to link it with the aim to improve students' cognitive processing and academic learning in the university context. The theoretical framework is phenomenological and cross-sectional data is collected. From second-, fourth- and sixth-year students the sample consists of 60 randomly selected psychology students who have participated in an individual interview.

Open-ended questions were used to allow the interviewees to provide free and open responses. The questions focused on the sources and the nature of knowledge and the elements in the knowledge acquisition process. Responses are categorized, grouped, and tallied on the dimensions of beliefs as identified in earlier studies and epistemological theories especially by Barbara K. Hofer and Paul R. Pintrich.

Preliminary analyses confirm the hypothesis that students' epistemological beliefs affect learning and students' perceptions of teaching, such as approaches to studying and study strategies. Further, the development of epistemological beliefs interacts with teachers' actions and practical implications. The educational environments and academic practices influences on the shaping and development of students' epistemological beliefs.

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How to use concept mapping as a facilitating tool in order to identify and learn to solve complex problems in research-based teaching-studying-learning processes?

In this workshop the basic idea of improved concept mapping is introduced to the participants. They are encouraged to draw concept maps of their own during the session. The academic problems used as triggers for the activities are mostly dealing with implementing education for sustainability in the fields and disciplines of higher education represented by the participants. The applications are discussed and reflected on practice.

A free of charge software for creating concept maps, the Cmap, is demonstrated and actively used during the workshop if computers are available for the participants.

The idea of improved concept mapping
There are different versions of concept mapping. There are differences in definitions of concepts and in ideas of how general or specific a concept mapping tool should be. However, it is commonly known that concept mapping was developed at Cornell University. Most articles published describing the use of concept mapping refer to Novak and Gowin (1984) In their book, the most common version of concept mapping is as follows: There are circled concepts with links connecting them, and the links are labeled or phrased in order to create meaningful statements. Elaborating this idea further, the main elements of an improved method for concept mapping introduced by Ahlberg (1993 - 2004) are clarified by ten statements:

1) All concepts are interpreted as main elements of thinking and learning, and they are always inside frames.
2) There is no accurate limit on how many words may be included in a concept label. In an improved concept map as many words as are needed are used to name the concept accurately.
3) In order to have a meaningful proposition, all links between concepts have arrowheads to show in which direction the connection from one concept to another is to be read.
4) The expressions connected to links may be short or long, but they must accurately express the thinking of the person whose thoughts are concept mapped. The essential point is that the link includes a verb expression and the resulting proposition is meaningful and more or less true, plausible, probable, et cetera.
5) You may connect pictures, videos, sounds, et cetera to concept maps.
6) Whatever learning theory is used, you may still use concept mapping because it is as general a method as is speaking or writing. Everything that is spoken or written may be transformed to concept maps, and all good concept maps may be easily transformed back to ordinary speaking or writing.
7) Novak and Gowin (1984) and Novak (1998) argued that concept maps should always be hierarchical. This is often sound and economical, but not always. There are also ontological and epistemological reasons why good concept maps may not be always hierarchical. The world is a system, and therefore, the best conceptual representation of it is a conceptual system, a concept map, which may not always be hierarchical.
8) In a good concept map each concept is mentioned only once, similar to a good geographical map in which each place is named only once.
9) If each concept is only mentioned once on the concept map, then it is easy to count how many links each concept has to and from other concepts. The number of links with other concepts is a good estimate of centrality of that concept in the thinking of the person whose thoughts are concept mapped.

10) Sometimes it is useful to be able to read a concept map only in the order that you intend it to be read. It may not always be from top to bottom. For example, it may be a transformed part of a textbook, and the order in which propositions are read is important. Then you may add to each link a number showing the order according to which the propositions should be read.

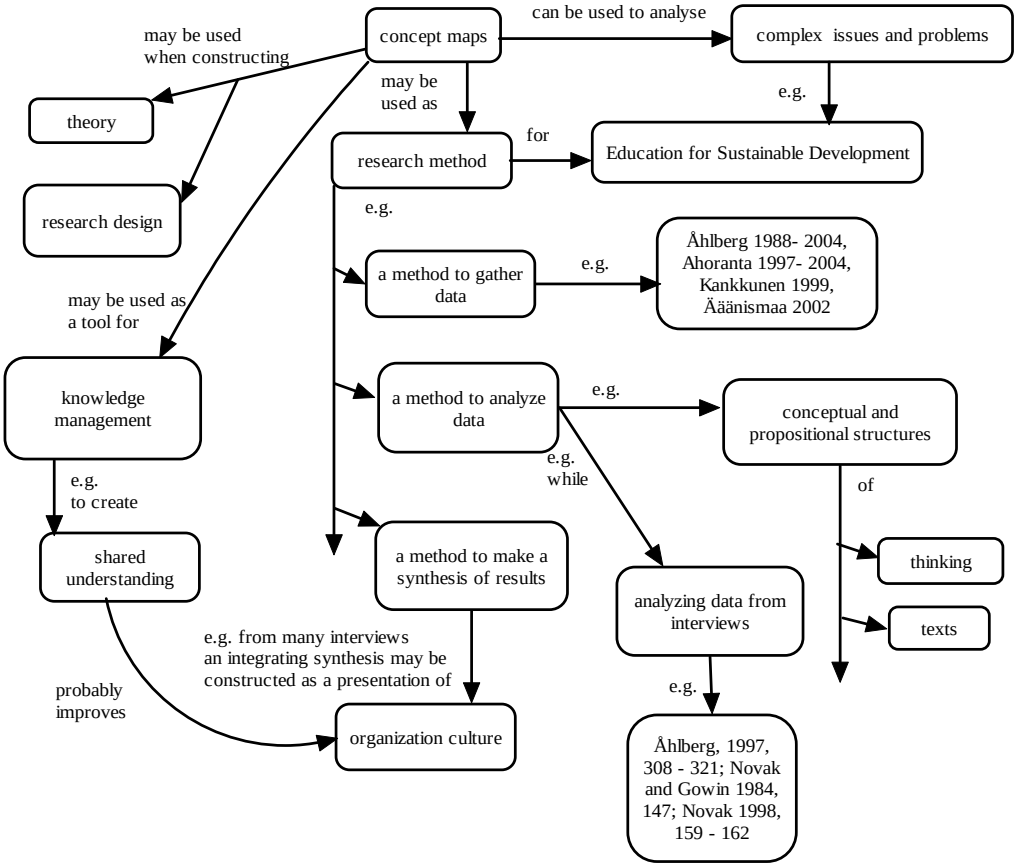

Fig 1. Improved Concept Mapping as a research method (Source: Åhlberg 2004)

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Assessing the quality of pharmacy education – a study proposal for developing the pharmacy education and teaching in bachelor's degree

Background

Previous studies regarding the pharmacy education indicate that there is a need to improve teaching and the quality of teaching. Pharmacy students have problems in applying their theoretical knowledge in practical situations. They also experience problems in recognizing the significance of the studies and in understanding how the courses are related to each other. At the moment, the pharmacy curriculum is fragmented and consists of many separate courses. This kind of structure is likely to lead to formation of fragmented knowledge base among the students.

This may also lead to difficulties in the application of knowledge, because the fragmented knowledge is rarely useful. Pharmacy students have also strong superficial orientation towards their studies, and they have strong dualistic epistemologies, which develop only little towards relativistic epistemologies during the studies. On the other hand, teaching and assessment methods can be described as being teacher-centred and they encourage for fact-remembering instead of understanding and applying the knowledge.

The challenges described have been found to be more common in natural science studies than for example in humanistic disciplines. However, effective, well-understood theoretical knowledge in pharmacy is necessary for professional work. Pharmacists have to be able to use their theoretical knowledge in practical challenges effectively when facing problems in work and when acting as true professionals. Graduates must acquire good learning skills to reconstruct their knowledge in the ever-changing pharmacy field.

Developments in curriculum

Because of these challenges, the Faculty of Pharmacy at the University of Helsinki is committed to develop the pharmacy curriculum in order to foster the quality of students' learning. Also the Bologna process, which is currently changing the degree structure in Finland and across the Europe, is paying attention to the quality of teaching. In fact the development of evaluation, assessment and quality assurance systems are among the primary aims of the Bologna Process.

The Faculty of Pharmacy is currently developing its' whole curriculum as a part of this Bologna process. The structure of the curriculum is going to be improved. The aim of this process is to integrate the separate little courses to larger entities, which would be more coherently integrated to each other. The aim of the new structure is also to integrate the theoretical courses better in order to minimize needless overlapping of the courses. Pharmacy curriculum comprises a six-month practice period. Until now, the practical training has been located separately at the end of the studies. It has not been well utilized as an integral part of pharmacy studies. As a part of this developing process, the practice period will be planned to take into account the theoretical studies, and it will be more intensively integrated to the theoretical studies. The practice period will also be divided in two three-month periods, the first of which will be already during the second-study year.

The structure of the curriculum is going to be constructed to six broader integrative entities, so called strands, which last throughout the whole curriculum. Within these strands, the teaching given by the different departments has been combined. Stands are labelled as: 1) Scientific thinking and professional development, 2) From the molecule to drug preparation, 3) Patient and medical care, 4) Medicine and society, 5) Interaction and communication, and 6) Optional studies. Each of these strands (modules) consists of courses related to these themes. The aim is to construct the courses to larger entities (courses), which include different pharmacy disciplines related to the theme. The central idea is to develop teaching methods. The aim is to relate the theoretical aspects better to the practical challenges in order to foster the application of knowledge. The purpose is also to improve the assessment methods by replacing the ordinary exams, which measure the recalling of facts with different learning tasks, like learning diaries, seminars and essays. Furthermore, portfolios will be used during the education: students will be required to collect and update a portfolio of each module. These portfolios will then be assessed in the end of the studies. The idea of portfolios is utilized in order to help the students to find the relations among different courses in the modules and in order to foster their learning skills.

Aims of the study

It is important to study the effects of the planned changes. Because the curriculum will change a lot, it is also important to study how the different modules support students' learning and how they could be improved in order to foster students' learning. Furthermore, it is important to study how to develop teaching and integrate the theoretical courses, as well as how to foster the integration of theory and practice. The aim of this study is to assess the changes in new curriculum and to find out tools for improving the quality of pharmacy education.

Methods

This study includes two parts. The first part is a follow-up study. Students' experiences of pharmacy curriculum and their learning in the old curriculum will be studied by a questionnaire in spring 2005 among those students, who are about to graduate as pharmacists (B. Sc). A new questionnaire for these students will be sent in spring 2006, one year after their graduation. The purpose of this is to study the new-graduates' experiences and attitudes of the curriculum, how the education corresponds to the needs of practical work, and what aspects should be emphasised more in the theoretical studies. This same procedure will be conducted among students who start their studies according to the new curriculum, in autumn 2005. They will be asked to fill up the same questionnaires regarding to the curriculum in spring 2008, when they graduate. The correspondence of the studies and working life will be studied in spring 2009, one year after their graduation. By comparing the results of the questionnaires among both courses, it is possible to get information and aspects regarding the curriculum and the changes made.

In the second part of the study, the learning process of the students will be studied in a more detailed fashion. The learning process of the students in the new curriculum in autumn 2005 will be studied in more detail to find out, which factors help them to learn, and which aspects make their deep-level learning difficult. The students in the new curriculum will write a learning journal throughout their studies as a part of their personal study plan. The summary of these journals will be collected every six months. The journals consist of open-ended questions, and in the journals the students are asked to evaluate their learning, their difficulties in studying, and unclear things in their studies. Students are also asked to assess how the strands supported their learning. A random sample of journals will be qualitatively content analysed. For example, it will be possible to study in more detail the learning journals of those students who do well in their studies and of those students who have difficulties in their studies. By researching and comparing the learning journals, it will be possible to find out tools for developing the pharmacy education and for modifying the teaching to better encourage students' deep-level learning.

The inform-consent from the students for studying their learning journals will be collected at the beginning of their studies, autumn 2005.

Time-table

The questionnaire for assessing the pharmacy curriculum will be developed and tested in the spring 2005. The students in their final stage of studies will complete the questionnaire in April 2005 and the questionnaires will be analysed during the late spring and summer, 2005. The questionnaire, which consists the questions related to how the education and practical work correspond to each other will be developed and tested in spring 2006, and will be sent to the graduates in April 2006. These questionnaires will be analysed during the late spring and summer 2006, and the results will be utilized to pharmacy education. The same questionnaires will be used among the students in the new curriculum, in April 2008 and April 2009. The results of these questionnaires will be compared to the questionnaires among the students in the old curriculum, in order to find out possible differences or changes.

The learning diaries will be collected among the students in the new curriculum throughout their studies in the end of academic terms (December and May), altogether six times during their studies. These diaries will be analysed as soon as possible after collecting them.

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The role of physics departments in developing student teachers' expertise in teaching physics

Abstract
In physics teacher education the challenge is to promote the development of expertise needed from physics teachers. In that close collaboration between physicist and physics education professionals is needed. This, however, poses many challenges, which are not easily met. We describe here some guidelines, based on our own experience from a pilot course for pre-service physics teacher education. We discuss how physics departments can meet these challenges by designing a special course and working models, which takes into attention the aspect of expertise expected from physics teachers. The positive results and feedback received is presented.

Physics teachers are in cross-roads of two different but intimately connected fields; the "scientist's science" and "school's science." Prospective physics teachers are usually taught by physicist, and on this basis - after some pedagogical and practical training in department of teacher education and in training schools - they are expected to become professional teachers [1]. The task of physics teacher education is, however, more complicated than that, because the ordinary university teaching at the Departments of Physics with its traditional structures [2] gives seldom a good example how physics should be taught at school. Moreover, traditional teacher education is often inefficient to create the required coherence to learned subject contents, instead student are left with bits and pieces of fragmented knowledge. These notions warrant a closer look on question, what actually is the role and responsibility of physics departments in student teachers' education.

When teaching physics to student teachers it is necessary to see "physics teaching" (understood here as any instructional or learning method that helps students to acquire new concepts, ways of thinking and related skills) from wider perspective than is usual in physics departments; what is needed is not only competence in physics subject knowledge but also competence in its didactics and pedagogy (pedagogical knowledge) [3, 4]. In the following, with subject knowledge we mean knowledge about physics subject matter (domains and structure of physics and its epistemology). With pedagogical knowledge we mean the knowledge a teacher is using when thinking, reflecting, pondering or contemplating decisions or justifying them in an instructional situation. It is obvious that for example knowledge about teaching and evaluation methods, and possibilities to represent subject matter (i.e., knowledge of teaching particular topics), knowledge about the purposes of teaching physics and understanding common learning difficulties and students' conceptions concerning physics belongs to the teacher's pedagogical knowledge [5].

The solution to educate physics teachers so that physicist and physics education professionals take a joint responsibility of it is obvious, but astonishingly difficult to realise. According to recent inquiry by European Physical Society (EPS) [1] physics teachers (for grades 7-12) in most European countries are educated in physics departments, with physics education (PE) professionals and physicists involved. As indicated by the EPS inquiry, the contribution of both PE professionals and physicists is needed, but on the other side there is very little contact between

these groups. The situation and problems in physics teacher education in University of Helsinki, Finland, has been in most cases essentially the same ones as brought forward by the recent EPS inquiry. However, during recent years we have found overcome many of these problems, leading to better practical solutions in teacher education and better control over the achieved learning results. We discuss here, how the questions concerned with physics subject knowledge can be effectively connected to requirements of creating teaching methods with purpose of better organisation of physics knowledge. We report here our experiences from a pilot course for student teachers, where we have attempted to meet these goals and increase the fruitful collaboration between physicists and PEs in teacher education.

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The scholarship of teaching as a form of research-based teaching

Two of the four chief aims of this seminar on research-based teaching are to "*clarify the concept of research-based teaching*" and "to *advance research activities on higher education pedagogy"*. This conceptual study attempts to address both of these.

The links between teaching and research at research-intensive institutions have been conceptualized in various ways. Healey (2004), for example, submits that teaching can be primarily research-led, research-tutored, research-oriented or research-based. The difference between the four conceptions he explains in terms of two dimensions. The two poles of the first dimension are defined by a focus on the *learner* versus a focus on the *teacher*. The two poles of the second dimension are defined by a focus on research *content* (the knowledge of the discipline) versus the underlying research *process*. The greatest difference he observes between research-*led* teaching and research-*based* teaching in that the former is content-oriented and focussed on the teacher whereas the latter is process-oriented and focussed on the learner.

According to this latter conceptualization, research-based teaching can be observed when the curriculum is structured in ways that engage students directly in *inquiry-based learning*. Under such a framework students are not simply taught the discipline-based content knowledge that has been generated through research, nor are they simply taught the process of knowledge construction within the discipline or subject; instead they themselves become *generators* of this knowledge.

Research-based teaching, thus construed, is student-centered and inquiry-based. The advantages of such an approach to university teaching are immediately obvious: students learn to identify and solve problems, substantiate claims, and interpret evidence. They learn the concrete procedures of data gathering, analysis and report writing. Often they will need to work in teams and learn how to communicate and negotiate effectively. When research problems are *authentic* (as opposed to fabricated) students have the added opportunity to recognize the complexities but also the connections between the subject they are studying and the larger issues faced by society. One may think of poverty, intolerance, violence, illiteracy, hunger, environmental degradation and disease, natural disasters such as Tsunamis and the implications for the economy, activities aiming at the development of peace, to mention just a few examples – most of which, of course, would require cross-disciplinary approaches but the point made is that the subject students are studying informs the debate in unique ways).

Quite a different conception of research-based teaching is achieved by shifting the lens to those who are doing the teaching. According to this perspective, teaching that is research-based is

teaching that is characterized by *inquiry into the process of teaching itself*. Academic staff who pursue research-based teaching thus construed are motivated by how to best help students to fully engage with the subject. The inquiry, or research, they engage in is *pedagogical* research and directed at better understanding how the knowledge of the subject can best be bequeathed upon students. Advocates of this view contend that discipline-specific scholarship is found not exclusively in work that leads to further advancements or discoveries of knowledge in the field (American scholar Ernest Boyer [1991] called this the *scholarship of discovery*). It can be observed also in work that focuses on the processes by which the knowledge of the discipline is best taught and acquired. The insights from such pedagogical inquiry are interpreted in light of already existing findings (that is, they are *research* or *evidence-informed*) and shared with the wider community through conference presentations and peer-reviewed articles in appropriate journals. It stands to reason that only a few enthusiasts within research-intensive institutions would be willing to take up such activity as long as rewards for such work remain scarce. One may think only of the relative weight typically attributed to articles published in main stream discipline-specific journals compared to those that are published in pedagogically-oriented discipline-specific journals. However, Angela Brew (2003) reports on successful initiatives that have been launched in this regard at the University of Sydney in NSW.

An assumption that underpins this essay is that pedagogical research within the subjects or disciplines, if engaged in seriously, could significantly enhance the learning environments for many students as well as teaching staff and would ultimately contribute to healthier, more effective and more probably also more efficient university functioning. Notwithstanding the value inherent in such subject-specific pedagogical research, it is doubtful that requiring *all* academic staff, who "care about students and teaching", to become involved in pedagogical research is particularly meaningful let alone feasible. I will link these discussions to the notion of the *Scholarship of Teaching*.

"*The scholarship of teaching*" is a term typically attributed to the late Ernest Boyer (1990) and his colleagues at the *Carnegie Foundation for the Advancement of Teaching* in the United States (e.g. Cambridge, 2000; Glassick et al, 1997; Huber & Morreale, 2002). Over the past decade is has become evident that the idea of associating teaching – and not just ground-breaking discoveries in the discipline -- with *scholarship* has intrigued academics also internationally, most notably perhaps in the United Kingdom (e.g.,D'Andrea & and Gosling, 2002; Elton, 1992; Healey, 2000), Australia (e.g., Andresen, 2000; Trigwell et al., 2000), and Canada (e.g., Kreber, 2000, 2003; Weston et al., 2001).

A chief motivator behind the idea of the *scholarship of teaching* in the United States was the observation that teaching was undervalued especially at research-intensive universities (e.g., Boyer, 1991). Specifically, Boyer, then President of the Carnegie Foundation for the Advancement of Teaching, suggested that "excellent teaching is marked by the same habits of mind that characterize other types of scholarly work" (Hutchings & Shulman, 1999, p. 3). Likewise, British scholar Elton (1992) argued that scholarship, "the critical interpretation of what is already known" (p. 253) needs to be recognized as "an activity that is necessary for good research as well as good teaching" (p. 253). However, over the years it has become apparent that the "*scholarship of teaching*" means very different things to different people.

A dominant view suggests that "we develop a *scholarship of teaching* when our work as teachers becomes public, peer-reviewed and critiqued. And exchanged with members of our professional communities so they, in turn, can build on our work. These are the qualities of all scholarship" (Lee Shulman, 2000). This definition, despite its scope for being interpreted more broadly, is typically taken to mean that academics do *research* on their teaching—the very conception of

research-based teaching discussed earlier. An alternative, and more inclusive, conceptualization of the *scholarship of teaching*, or *research-based teaching*, will be introduced next. This alternative conception is not *restricted* to the idea of academics engaging in pedagogical research and publishing the results of such work in traditional ways. However, it should be pointed out that engagement in discipline-based pedagogical research is a much welcome opportunity for *some* academics as can be observed in increases in membership at conferences such as the International Society of the Scholarship of Teaching and Learning (ISSOTL, 2004).

Following a cognitive-developmental perspective, academics' engagement in the *Scholarship of Teaching* (or "*research-based teaching"*) can be conceptualized as a process of knowledge construction in the fields of student learning and teaching. By reflecting on personal *teaching experience* and on what they know about teaching and learning from exposure and engagement with *educational theory or research* (for example, through evidence-based professional development on teaching) academics subject the conceptions they hold about teaching and learning to critical scrutiny. The thinking processes involved in testing the validity of implicitly held knowledge claims are then documented in ways that make them public and open to peer-review. Teaching portfolios allow for the documentation of *indicators* of reflection.

These *indicators* can be developed for each of three important domains of teaching knowledge:
(1) What constitute significant and meaningful goals and purposes of teaching in my field and how do these interact with the wider purposes of university education?
(2) What do I know about student learning and development in relation to these goals?
(3) What do I know about designing teaching that would help to bring about desired forms of academic learning and development?
(Kreber & Cranton, 2000).

Thus construed, the notion of research-based teaching (or the scholarship of teaching) implies that academics approach their teaching practice with the same sense of skepticism that guides their research. As researchers, they habitually provide arguments or reasons for their assertions. Depending on their discipline or subject area, they engage in the process of hypothesis testing, interpretation or critical analysis routinely. Moreover, they recognize that it is important to share with colleagues the evidence generated for their point of view and invite them to follow, and possibly critique, their lines of argumentation. Traditional ways of sharing our new knowledge (e.g., through conferences and journal publications that require direct involvement *in educational research*), are but two of several possibilities, however.

The longer essay builds on these observations and discusses explicitly how the *scholarship of teaching and learning* (as a form of *research-based* teaching) may be developed as academics construct valid pedagogical knowledge through reflection on their experiential *and* research-informed (or evidence-based) knowledge about teaching and learning. The underlying learning processes, in this form of research-based teaching, are *transformative* in nature (Kreber & Crantron, 2000; Mezirow, 1991;

Questions further explored in the longer essay include:

- How is reflection on teaching and learning valuable and how is it linked to research-based teaching?
- What role do experience and educational theory play in research-based teaching?
- What is meant by "transformative" learning?

- Is any kind of reflection equally conducive to fostering development in teaching?
- How can research-based teaching thus construed be demonstrated and reviewed?

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The case of teacher education as a variation of research-based teaching

The research-based approach has traditionally been the main organizing theme of the teacher education at the University of Helsinki. Like the general information of the LERU seminar clarifies, research-based teaching concerns the relationship between research and teaching in research-intensive universities. In teacher education we deal with a special case of research-based teaching because what we teach and what we investigate is teaching itself and the pedagogical context of educational institutions, including curricula, in general.

The idea of teacher education is to educate autonomous and reflective teachers who are able to make use of research in their work and who can be characterized as pedagogically thinking teachers. Teachers' pedagogical thinking means to be able to conceptualize everyday phenomena, to look at them as parts of a greater totality and to justify decisions and actions made during the instructional process. Becoming a teacher presupposes studies in three crucial content areas: theoretical studies of education, studies in content knowledge and in pedagogical content knowledge as well as in practice. (Kansanen, Tirri, Meri, Krokfors, Husu & Jyrhämä, 2000; Kansanen, 2003; Krokfors 2000). All the parts of the teacher education program are justified by a systematic totality and a focus on a teacher's thought process that may be characterized by the criteria used in research work. Educational competence, on the one hand, requires knowledge of research methodologies in order to be able to receive new knowledge. That means the ability to read and discuss, and, further, to apply one's reading and discussion to one's own thinking and work. . On the other hand, the active role presupposes specialization in one or a few methods when doing one's own practical research. Pallas (2001, p. 9) calls the first type of research competence "consumer" competence and the other style "producer" competence. The practical application of this two-sided theory is that all students participate in common research method courses and specialize when doing their own research in seminars.

An emerging theme of the research-based approach is to study while working. A number of students (120 at the moment) of the Department of Applied Sciences of Education at the University of Helsinki participate in a multimode teacher education program in which they study at the same time as they work as a class teacher in their own class somewhere in Finland. For research-based teacher education this kind of link between theoretical studies and practice provides an opportunity to develop a student's pedagogical thinking in an authentic environment. Students face the reality of a teacher's work and the teacher education program makes efforts to provide them with theoretical tools to conceptualize the everyday phenomena they meet. Working in a school as a teacher (without an official competence because of the shortage of teachers in Finland) offers an opportunity to locate these phenomena in a greater educational totality.

In this poster session we discuss the research-based teacher education and the link between theory and practicefrom the point of view of the relationship between studies and work, or more precisely, teacher education and teacher's work. We can speak about integration and learning while working. It is also characterized with the expression 'learning in one's own class', including practice, which describes the special connection between learning and working. A wider theoretical perspective concerns research-based teacher education which is the main organizing theme for teacher education. Teacher's pedagogical thinking, in turn, is an essential part of research-based approach of teacher education. The research design is illustrated in the Figure 1.

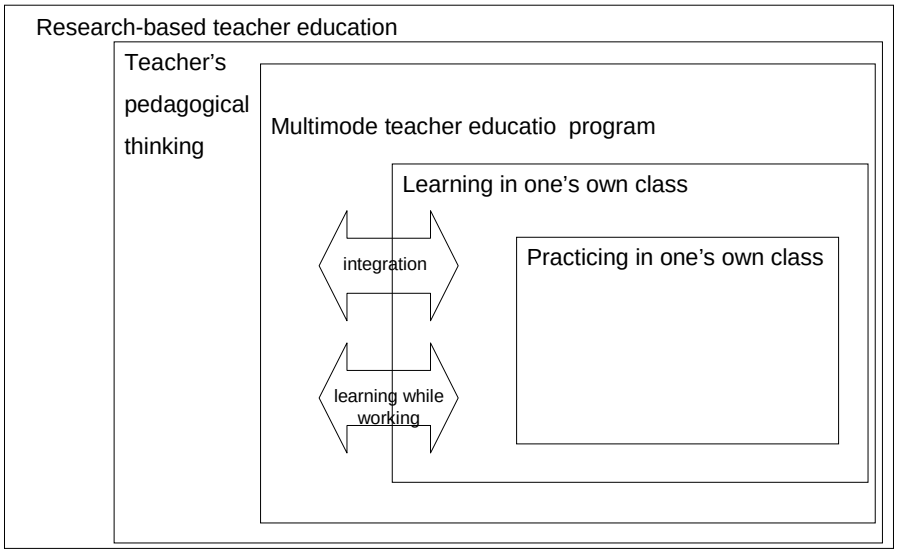

Figure 1. Research-based teacher education from the point of view of the relationship between studies and work.

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Saija-Leena Laaksonen
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The keys for learning in lectures. Case in the faculty of biosciences.

The aim of the study was to assess the factors that effect the quality of learning in lectures. In order to put theory into practice the aim also included to give some proposals for improving the lectures

as well as to consider possible differences between major and minor students. The Basics of Biosciences 1 -lectureseries, was used as a case in the study. The research combines quantitative and qualitative data. The data was collected through observation, interviews and questionnaires in the fall 2003. The target group consisted of students that attended the lectureseries. The theoretical part consists of discussions on the meaning of improving, planning and evaluating higher education. Additionally both the effects of the students own work and the factors that could affect the quality of learning at the lectures, were discussed.

This research is a part of the project at the Faculty of Biological Sciences at the University of Helsinki. The projects goal is to determine the faculty´s level of teaching and learning in order to make improvements to the overall teaching at the faculty. The research is slanted from the conceptions that the students and teachers have about the learning and teaching as part of their work. The results of the project will be used as a tool for improving the overall quality of teaching and learning.

Especially the observation material and the material from the videotaped lectures was used in the interviews with the teachers that had taught in the lectureseries during the years 2003 and 2004. A pedagogic consulting has been organized for the lecturers, during which every teacher has been met individually. Those teachers that have wished have made improvements for their teaching on the base of the results and the feedback. The teachers have developed for example the visibility, audibility, clarity and the definition of the concepts. The reconstructed lectures have been observed and the teachers have been given feedback of their lectures after the changes have been made. An instruction on university pedagogy for the professors has also been organized in Viikki.

Based on the results the teaching in the lectures is still pretty traditionally organized. Nevertheless improvements that pay more attention to the needs of the students, have been implemented. One example of these is the lectureseries held by 13 internationally well-known experts. Some proposals for improving the lectures are; determining the differences in pedagogic skills between the lecturers, paying more attention to the differences between major and minor students and finding more ways to activate the students.

Because of the heterogenity and the large amount of students from various faculties, it is also possible to apply these results to other lectureseries. Hence, it ahas been possible to both create a wide picture of the factors that affect the quality of learning in lectures and made it possible to compare the quality and differences between various lecturers.

Antonio Lagana, Antonio Riganelli and Osvaldo Gervasi
University of Perugia, Italy

A metalaboratory to develop grid e-learning activities in chemistry

The integration of collaborative and neworking activities with problem solving environments and web technologies on the grid allows the development of advanced e-learning environments. This contribution illustrates the work being carried out by ELCHEM (a Metalaboratory of the D23 Action of Cost in Chemistry) using the outcome of the activities of the multimedia working group of ECTN to develop and implement grid technologies for Chemistry and Molecular Science education. ELCHEM operates at three levels. The first (basic) level of activity is that of internally supported research on teaching and learning approaches and materials with free circulation of new ideas and good practices. The second level of activity is that of externally funded projects in which educational activities are coordinated within the Metalaboratory by one of the member

laboratories. The third level of activity is that of the production of web services concerned with virtual campuses and virtual laboratories. In particular, activities carried out at research level focus on the use of markup languages for managing scientific knowledge and on the development of semantic web technologies for e-learning in chemistry. Activities being carried out at project level are those concerned with the design and implementation of virtual practice laboratories. Activities being carried out at service level are concerned with the implementation of technical supports to assessment on the web and on the implementation of tools useful for structuring e-learning as a web service.

Lena Levander
University of Helsinki, Finland

How do we know what we should teach?

The restructuring and harmonizing of degree programmes during the higher education Bologna process has put forward some new demands for the transparency and documentation of curriculum design. A degree programme usually has a general description of goals and list of contents. But the individual teachers are not normally required to document in detail their teaching goals, contents or working methods of the courses. There is a potential danger that the contents are implicit internalized knowledge and may thus form a hidden curriculum (Barnett 2000).

How does one know what to teach? The goals and the content of teaching are often a collection of knowledge that has been passed on and evolved during the times (Charlton 1991; Barnett 2000). The research-intensive universities maintain the principle of teaching based on the teacher's own research or on theoretical base derived from others' research. The students, employers and indeed the teachers themselves would benefit from the analysis and documentation of the core contents. It is not the question of the individual course contents only but also how the different courses form an area of expertise. What is taught should not be put forward from the single discipline's point of view but in connection to the entire degree programme (Charlton 1991).

In past years research on student learning has shown that in order to foster meaningful learning there has to be consistency in learning objectives, methods of working and assessing learning (Biggs 2003). However, this point of view does not explicitly elaborate on the content of teaching; where is it derived from or how it is presented. We need to pay attention to this aspect also.

The concept of core curriculum has been used in basic medical education since 1960s in North America (Bandaranayake 2000). There are several interpretations as to what is core. According to Bandaranayake (2000) the core curriculum should be defined as what common the students should learn. The core can be presented from different points of view such as institutional, national and global levels. Blight (1995) provides a framework for core curriculum; it should refer to why, how, when, where and with what (includes educational philosophy and the broad goals of the course).

Core curriculum analysis can be described as disciplinary knowledge management applied in higher education setting. Further, the analysis process could be characterized as research into the discipline's internal knowledge base. The curriculum is analyzed according to agreed dimensions and the documents created make the contents of the teaching visible for colleagues, students and

prospective employers. The teacher (and even better a group of teachers) systematically outlines what is taught in terms of propositional knowledge and skills to be learned. The outcome of this process makes explicit what the novices should know about the discipline so that they will be able to solve research questions related to the discipline.

Plan for the workshop: Outline of the experience of core curriculum analysis at the Faculty of Agriculture and Forestry, UH. Consider and discuss various methods for core analysis. Involve participants to develop approaches to participatory curriculum design.

Jarmo Levonen, Jere Majava and Timo Harmo
University of Helsinki, Finland

Weblogs as a tool for learning in a research university

Weblogs are a new web-based publication system which possesses interesting characteristics of rapid self-publication and interactivity. Weblogs have also new possibilities for learning and instruction and for open discourse between learners and researchers. In a sense, learning in a research university could be supported with new open publication environment witch can provide a transparent exchange of information between different participants of a research university.

Weblogs present also challenges for university teaching. The focus of discussion, the challenges of utilization of the distributed communication, and the ethics of self-publication are new emerging concerns which are needed to be elaborated when using weblogs in educational settings.

Weblogs are a web-based publication systems where messages on a web page are being updated in a chronological order and which are operated with a simple publication system. A weblog is basically a web-page which is a window to a semi-systematic publication system. The simple publication system of the weblogs makes it possible to update the weblog dynamically from any computer on the net without sofisticated technical knowledge.

Weblogs are highly interactive means of publishing. They are easily updateable and simple techniques in constructing comment forums or streaming news makes it possible to distribute discourses and exchanges between different weblogs. This distributed discourse supports networked and open communities for sharing information.

The current weblogs have evolved from two different forms of web publications. The first weblogs were, as the name “weblog” represents, logs of web surfers. These logs were used to collect interesting web-links and to annotate these links with comments and personal observations. The second form of weblogs was web-based diaries, which are new merged to be a more common web-log format. The contents and the formats of the weblogs can vary greatly. The common characteristic of weblogs is the diary-like format, easiness of publication and the interactivity between the author and the readers.

The proposed workshop will introduce the main principles of using weblogs in a research university with hands-on experiences using these weblogs. In addition, we will elaborate on the experiences of using weblogs, present pedagogical models developed at the faculty of social sciences for using weblogs in instruction and in supporting communities of learners. Finally, we will address the methods and results of studies on using weblogs in education.

For more information on the workshop: http://www.valt.helsinki.fi/blogs/leru05/

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Weblogs at the Faculty of Social Sciences (http://www.valt.helsinki.fi/blogs/) at the University of Helsinki

Jarmo Levonen, Raimo Parikka and Taina Joutsenvirta
University of Helsinki, Finland

The challenge of blended learning in a research university

Blended learning is suggested by many scholars to be one of major transforming movements of research universities. The concept of blended learning refers to the current and continuously increasing ratio of utilizing different kinds of virtual learning environments and web-based systems with learning and instruction in a research university.

The challenge in the concept of blended learning is in one hand the development of related blended learning approaches which are mainly concentrating on business oriented training practices and on the other hand the specific challenges of research universities on the educating of future scholars and citizens.

The research universities have a need for fast and economic training of scholars, a need to integrate the research practices and research based education. These processes may be supported in reconstructing methods of blended learning in the following way:

- Supporting the transparency of research practices in the educational processes
- Integrating authentic instructional practices with blended learning
- Constructing open archives of local scholars publications and data
- Providing open access and open source information in terms of scientific publications and pedagogical practices.

Blended learning provides new opportunities for integration of the major players in research universities, scholars and students, into a open and transparent practices.

The presentation will critically review the latest studies on blended learning from the perspective of learning and instruction in a research university. In addition, case studies on blended learning on social sciences will be presented. The goal in the presentation is to elaborate and develop models of utilization of blended learning in higher education.

Jarmo Levonen and Juha Puranen
University of Helsinki, Finland

Learning with dynamic visualizations of statistics

The current web-based visualization techniques provide new means for educational material to be presented for supporting university courses and for self-supporting learning. Dynamic visualization is an approach of representing information visually and especially with visual displays that outline the elements and relations essential to a particular phenomenon.
Experiences presented in literature on dynamic visualization have shown a promise for improving learning. Displaying mechanical, biological or otherwise complex phenomenon can be presented in a way that is concretization abstract information, taking into account the cognitive limitations of humans and making invisible visible.
Dynamic visualizations in statistics have multiple possibilities for presenting conceptual and procedural information which would be difficult to conceptualize if it was represented verbally or mathematically. In addition, the use of multiple representations to present the information can provide multiple views to the concepts and make the phenomenon in question more understandable. Here are two examples on the uses of dynamic visualizations for learning statistics. The visualizations were developed by Juha Puranen (Puranen,1984, 1997-2004).

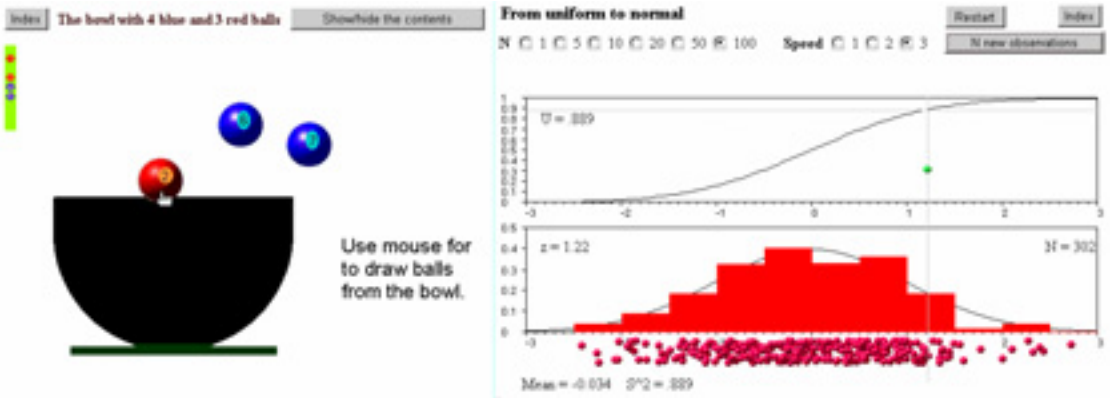

FIGURE 1. Simulation on with or without replacement

The figure 1 displays how a simulator can demonstrate the process of drawing balls from an urn “with” replacement or “without” replacement. The drawing is represented with diagrams (right hand side) on the distribution of random variables.

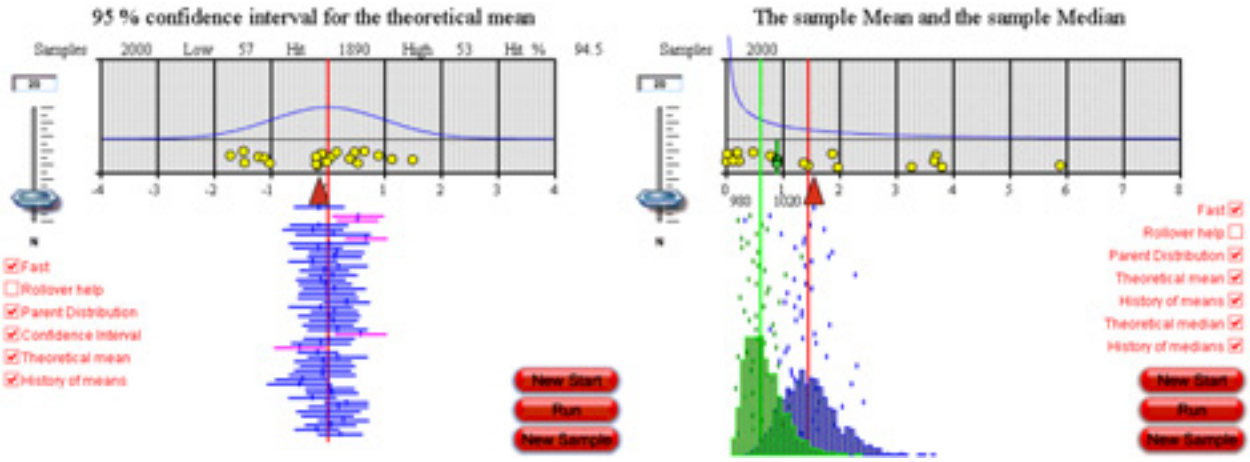

FIGURE 2. Simulations of the confidence interval.

The figure 2 presents a simulation of t-confidence interval (left) of a normal parent population and a distribution of the sample mean and the sample median of an extreme skewed parent population.
In both examples the students have possibility to manipulate central characteristics of the phenomenon and interactively follow and restructure the simulations based on the preview runs.
Experiences in using these simulations as part of the teaching material during a course have been encouraging and based on students feedback, quite successful. Further studies to investigate closely the students processing of information and constructing understandings are currently being planned.
The presentation will address the design principles in constructing dynamic visualizations for learning statistics, outline the experiences in using visualization in teaching of statistics, and finally, report results of the ongoing studies on understanding dynamic visualizations.

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Workshop proposal for the LERU 2004 Conference at the University of Helsinki

Kristina Lindström, Leena Suominen and Saara Repo-Kaarento
University of Helsinki, Finland

A new dimension to graduate studies and researcher training in natural sciences

The curriculum of graduate studies in microbiology is focussed on preparing the student for scientific work. The coursework, seminars and lectures are mainly aimed at mediating technical skills and useful scientific information to the students. Supervision is seen as means of helping the student to reach the scientific aims (published papers and the thesis) according to a pre-set plan and nowadays also following an often rigorous schedule. The efforts of the individual universities, faculties, departments, graduate schools and supervisors have been severe and honest. Many graduate students have greatly benefitted from the new touch, especially if it has also meant proper funding.

However, so far it has often been neglected that graduate studies are part of a dynamic process of individual growth and development. The emotional component of learning has not been taken into account. In order to make visible the hidden components of graduate studies, we devised a programme for the graduate students and supervisors of one research group in the Viikki Biocenter. The PhD students of this group were not members of networks such as graduate schools or centers of excellence, and were thus dependent on their group leader for funding and supervision. They belonged to communities of practice such as the research group and the Biocenter, and they were becoming integrated into the international scientific commutity of their research field. In order to properly grow and integrate into these there was a need for the students to have a more immediate social support on their way into the research community.

The new activity, which started in 2003, was called Tohtoritarha in Finnish (Doctor Garden or Nursery). Initially six PhD students and two supervisors participated in the regular meetings of the Nursery, held on the last Friday afternoon of the month.

The idea was to give the student and the supervisors a safe and friendly environment to discuss questions related to scientific aims and work, study planning, coursework etc., and to integrate these into one concept or line of develoment. The activities and reflections of personal growth are documented in a Nursery portfolio, which is quite similar to an extensive Personal Development Plan (HOPS), which next study year will be compulsory for undergraduates and master's students. The Nursery portfolio was devised as an aid for development of the identity of the young researchers through reflection and competence building, and the final portfolio will give part of their credits in microbiology for their final degree. In the autumn of 2004, three new master's students of the research group were involved in the Nursery activity as well, whereas three PhD students temporarily were absent (naternity leave, another job) and one had left because of lack of funding. The size of the group did thus not exceed 10 persons.

The theorethical framework for the activity is a social theory of learning. The students are seen as memebrs of communities of practice and the Nursery helps them grow from junior scientists to scientific experts. Both for students and supervisors the group is threre to share knowledge, experiences, fears and drawbacks, but also the good things in graduate academic life. The activity has improved the constructive interaction between all of its members by allowing everyone to express and share feelings as well as skills in a secure context. It has also helped the senior supervisor to focus more on this side of graduate supervision, which she earlier felt she had neglected.

The activities of the group and the means of implementation are developed by the group. On our poster we shall display the idea, how it relates to Wenger´s (1998) social theory of learning, various tools we use to to nurse our students and give them a safe and supportive environment to develop their own personalities and scientific profiles, and some results from the portfolio work.

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Jan Lundell and Maija Aksela
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Computational chemistry emerging as a novel stronghold in research-based chemical education

Computational chemistry is the fastest evolving discipline in chemistry. Traditionally chemistry has been considered as an experimental subject but due to the vast growth and development in computer technology, the computer-based approaches are becoming more widely adapted in research and education. In many areas of chemistry, theoretical predictions of chemical properties can rival experimental measurements - they are more safe to perform, they can be performed much faster, and they are of experimental accuracy. Computational chemistry (molecular modelling) has grown up in the wave of development of computer software that is increasingly easy to use, even in chemical education. Using a suitable theoretical (and educational) model to describe a chemical phenomenon, computers can be used to visualise a chemical process starting from the molecular level all the way to bulk material. Computer-based visualisation acts also as a catalyst, which helps students to understand and to gain more profound insight on chemical phenomena at hands.

At the Department of Chemistry, a special molecular modelling training course for chemistry educators has been developed. The course stems from the new educational programme introduced in Finnish secondary and high schools by the National Board of Education. The course introduces computational chemistry and computer-assisted visualisation as a modern research and educational tool to enlighten energy, stereochemistry, chemical bonding and chemical reactions – all concepts and phenomena appearing in the new educational programme but being traditionally considered very difficult and complex subjects even at university-level chemistry education. The computational methods used are based on modern state-of-the-art
computational chemistry research approaches but they are applied with strong educational bias.

The “computational chemistry for chemistry education” –course have been taught three times in the last two years. Additionally, a training course for in-field teachers was offered in summer 2004. The course is repeated in summer 2005 again in collaboration with the Finnish Association of Natural Science Teachers (MAOL). The impact of the course and the methodologies presented and trained for are assessed by an extensive research project concentrating on learning and evolvement of chemical thinking, chemical visualisation skills and skills on using computational chemistry as a pedagogical tool of the attending teachers and teacher trainees. Upto-date, the research conducted during all the courses clearly indicate that the skills and practices are extremely helpful and efficiently transferred into subsequent chemistry studies and into
secondary and high school chemistry education.

The key concept of enforcement of computer-based techniques in research and teaching at all levels of education is their application to solve and demonstrate concepts that are beyond traditional educational means. This idea relies on the solid cornerstone of proper ICT education and knowledge of teachers. The crucial question is how ICT and its chemical applications could be used to enhance the teaching and understanding of chemical processes and phenomena. The poster will give an overview of measures taken to promote computational chemistry in student and teacher education, web-based teaching material and in public awareness. The goal is to give chemistry educators a first hand experience and training to use computational chemistry methods as well as ICT in studying and teaching chemistry. The course and all its ideas originate from longstanding excellence in computer-assisted chemistry research. Now this knowledge is emerging in chemistry education as a standard educational tool with a strong emphasis of more efficient and more comprehensive understanding of chemistry. The “computational chemistry in school education” course represents a synthesis of high-level scientific research and wide educational experience, which will modernise chemical education on every national and international educational frontier.

Pascal Mimero[1], Anthony Smith[1], David Cardin[2], Juan Antonio Renuncio[3], Kristiina Wähälä[4], Miltiades Karayannis[5], Tapio Hase[4]
[1]ESCPE, France, [2]University of Reading, U.K., [3]University Complutense of Madrid, Spain, [4]University of Helsinki, Finland, [5]University of Ioannina, Greece

"EChemTest", the European Chemistry Test, an evaluation tool allowing to bridge the academic and the research fundamental knowledge needs

The European Chemistry Thematic Network (ECTN) and the ECTN Association represents over 130 major university chemistry departments, from 30 countries. Each ECTN member is involved in various fields of investigation dealing with the European chemistry education in the European Higher Education Area; one of these is the European Chemistry Test called "EChemTest", an evaluation tool in Chemistry based on a common core chemistry curricula agreed within the European Union.

Originally dedicated to the academic public and the student exchanges, EChemTest will enables Universities and Candidates to have a clear evaluation of the student's knowledge level, and a clear understanding of the University's pre-requisite level. The potential value of the common core approach is to give a ruling on the equivalency of levels between both the host and guest. One of the issue of EChemTest in a close future, is the use and the dissemination of the Chemistry Eurobachelor according to the recommendation of the Bologna declaration. The two other targets are the professional career evolution and the life long learning process. Obviously, the industrial world represents a challenging target for us, having either broad and sharp needs depending on the industrial sectors and departments.

We will present an overview of the development of the European core curriculum approach at pre-university and university levels. And as an example of application, the use of EChemTest in the professional context, focusing on the organic chemistry and the analytical chemistry tests both at university level. Both could help to evaluate the knowledge while creating a bridge between the academic learning process and the R&D understanding needs.

A qualitative survey will be given after analysing the results of several sessions of continuous education dedicated to the organic synthesis. In this context, the organic chemistry test at level 3, equivalent to the Eurobachelor level, was chosen to evaluate the understanding of our trainees at the end of the session, and successfully used as a final examination tool. We will then introduce the analytical chemistry Euro-curriculum recently approved by the Division of Analytical Chemistry of the FECS.

During the LERU conference and workshops, all attendees will have an opportunity to run trial sessions of tests, and share his/her feeling.

We provide free access to our demonstration tests online after individual registration; new translations are regularly added. EChemTest is currently running a wide beta-testing phase for the whole question bank, and is officially planning to release it at the next ECTN Plenary meeting to be held in May 2005 in Thessaloniki (GR). For further details on EChemTest, visit our website at : www.EChemTest.net

Terry Mitchell
Universität Dortmund, Germany

Starting research earlier: the chemistry eurobachelor

In traditional (mainly five-year) "long" degree courses research was generally only experienced in the last year, if at all. The transition to Bachelor and Master degrees, if carried out properly, will mean that students will come into contact with research in their third year of university studies. In addition, good Master programmes will often incorporate a larger research element than the traditional programmes.
The chemistry Eurobachelor framework incorporates a Bachelor thesis which is recommended to carry 15 credits, i.e. half a semester's work. As an alternative, industrial placements are proposed. Because of its flexibility, however, the framework permits the introduction of research elements at any time in the course. Thus the practice at, for example, an institution in the Netherlands where the student is first introduced to research in the first year can be built in without any problems.
In this context it is interesting to note that the American Chemical Society has recently introduced proposals for improving the quality of undergraduate programmes, one of which is to increase the emphasis placed on undergraduate research!
A look at the Dublin descriptors for a Bachelor qualification will help us to see where research can come in:

Bachelor's degrees are awarded to students who:

have demonstrated knowledge and understanding in a field of study that builds upon and supersedes their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;

can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;

have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues;

can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;

have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.

The first descriptor makes it clear that they will have used "advanced" (research-based) textbooks, and in some cases will have been confronted with knowledge gained from contemporary research.
The second is compatible with research, the third almost presupposes that research is involved as an element of the curriculum. The fourth can be interpreted in such a way that there is an oral defence of the Bachelor thesis or at least a poster presentation of its results.
The fifth, finally, requires a research element so that the gradiuate can proceed to a Master or PhD programme where research becomes a much more dominant element.
In the same way we can relate the Dublin descriptors to research in Master and PhD programmes.

Mari Murtonen and Mirjamaija Mikkilä-Erdmann
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Conceptions of research on the basis of the research-based teaching and learning activity

Research-based teaching is claimed to be of key importance for students, because it provides them with opportunities to join the work of research groups at an early stage in their studies. According to current learning and expertise theories, taking part in an expert group promotes learning and fosters deeper understanding than more traditional forms of instruction.

The concept "research-based teaching" is still not very well clarified among the academic instructors, but certain questions arise regardless of how it will be used in the future. The basis of the research-based learning is in research: both teachers and students are involved in an activity that is claimed to be scientific research. One of the core questions here is that what is research? According to Brew (2001), every conversation about research in universities, every research project, and every discussion in research committees rests on the underlying ideas researchers have concerning what research is and what researchers are doing when they carry it out. It is assumed that researchers mostly agree about what research is, at least within specific disciplines. Further, it is assumed that teachers of research courses know and agree about what research is and know how to teach it. Research students are then assumed to learn what research is without explication of the possible and varying conceptions of research. (Brew, 2001.)

A study by Brew (2001) showed that researchers have varying conceptions of research. In *the domino conception*, research is viewed as separate techniques and activities and the goal is to synthesise these separate elements to solve a problem or answer or open up a question. In *the layer conception*, hidden meanings are sought and research is interpreted as a process of discovering, uncovering or creating underlying meanings. *The trading conception* emphasises products, end points, publications, grants and social networks. Research is thus understood as a kind of social market place where the exchange of products takes place. In *the journey conception*, the researcher considers personal existential issues and dilemmas. Research is thus interpreted as a personal journey of discovery, possibly leading to a transformation.

Meyer, Shanahan and Laugksch (in press) studied university students' conceptions of research and found that they also had several types of conceptions of research and several misconceptions also occurred. Kiley and Mullins (in press) found that supervisors had very similar types of conceptions that the researchers in the study by Brew (2001), and that the conceptions were partly conflicting with the students conceptions. Murtonen (in press) found that Finnish students appreciated qualitative methods much more than quantitative methods, which may reflect the researchers division into two camps, namely, the qualitative and the quantitative. It can be further questioned that do academic community teach these harmful conceptions? Students are also showed to posses different kinds of mystical conceptions or misconceptions on research. For example, a student may think that research is dull and mysterious and not very useful. It does not offer a good starting point for research-based learning if the word "research" evokes negative conceptions in student's mind.

This presentation draws on several studies conducted in 1996-2004 with Finnish students on their methodology learning. At the teacher education department at the University of Turku, an experiment called a "researcher workshop" has been conducted since the late 90's, aiming at combining the teaching of research and other studies, and helping students to understand why research is important in a teacher's work. The researcher workshop continues through the education and uses the problem based approach. A three-year follow-up study with questionnaires was conducted with a group of "researcher workshop" student teachers, aiming at study their conceptions of research, science and learning. Also their motivational factors and difficulties experienced in learning were studied. In the phase of their masters' theses, an interview will be conducted (N = 6) in the beginning of 2005, aiming at study their conceptions of research and

benefits of the researcher workshop in more detail. The results and implications for instruction will be discussed in this presentation.

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Exploring metaskills

The purpose of the workshop is to discuss and explore the new requirements placed upon university education to teach skills and competencies needed in future society and knowledge work. One important research finding regarding higher-order expertise has been that an individual's ability to develop his or her content-specific knowledge and apply it in situations often co-evolves with the development of general thinking skills and metacognitive strategies (Davidson & Sternberg, 1998). The present investigators have argued (Muukkonen, Hakkarainen & Lakkala, 2004) that even if learners' expertise is bound to a specific field of inquiry, there are many skills and competencies, which are, at least to a certain extent, generalizable and provide intellectual resources for managing new problem-solving situations. For instance, university education should provide students with skills and competencies required in purposeful collaborative knowledge creation practices, needed equally in scientific research and knowledge work.

Higher-order skills that emerge through sustained efforts of advancing knowledge may be called metaskills. The development of metaskills is proposed to constitute a long-term goal for higher education. We suggest that metaskills extent the concept of metacognitive capabilities (related to planning, monitoring, and regulating comprehension-related activities), by addressing also the collaborative and epistemological aspects of inquiry. Whether in studies or in research, it is equally advantageous to understand the purpose and phases of an inquiry process, and learn to cope with the uncertainty and feelings of taking part in a chaotic process that are often related to a multi-actor undertakings and the true advancement of knowledge.

Taking part in collaborative inquiry activities is foreseen as a means to facilitate development of metaskills during university studies. The present researchers have participated in the development of the *progressive inquiry* pedagogical framework. In progressive inquiry (Hakkarainen, 2003; Hakkarainen, Lonka & Lipponen, 1999; 2004; Muukkonen, et al., 1999; 2004), the aim is to engage in a deepening question-explanation process, in which students and teachers share their expertise and build new knowledge collaboratively with the support of information sources and technology.

The workshop will be organized following progressive inquiry methods. The aim is to benefit from the participants expertise in order to address the pedagogical implications of metaskills development. The workshop begins with a short introduction of the new challenges of university education, the framework of progressive inquiry, and pedagogy for knowledge creation. The main emphasis is on a collaborative problem-solving process to explore implications of metaskills and how to foster metaskills in university education.

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From fragmented to structured knowledge in physics teachers' education: a course about physics' conceptual structure

Physics teacher is, in many ways, at a same time an expert in physics as a discipline, in its didactics and in pedagogy. For physics teachers expertise means not only content knowledge of subject matter but also paying attention to students knowledge and conceptions as a starting point for instruction, and monitoring students' changing conceptions as instruction proceeds (Bransford et al. 2000, Mestre 2001). Furthermore, the teacher has to facilitate those processes needed to interpret scientific concepts, uses of quantitative and qualitative descriptions and ways of organising scientific knowledge. Ability to think and solve problems depend strongly on a rich body of knowledge about subject matter. This "usable knowledge" is not the same as a list of disconnected facts, instead it is *'connected and organised around important concepts'* (Bransford et al. 2000, Mestre 2001). These views are in agreement with the notion that essence of any conceptual system is in its inherent organisation as a hierarchical structure. In hierarchically organised structure the integration of new knowledge by linking it as a part of network becomes easier (cf. Bagno et al 2000, Mestre 2001). Moreover, instructional strategies that helps students to create a hierarchy seems to be advantageous to learning (Trowbridge and Wandersee 1989). Quite often, however, the traditional physics teaching leads to a fragmented structure of knowledge; students are concerned with the factual content of physics and definitional knowledge and they have had no opportunity to build a picture of physics as a whole (cf. Mestre 2001, Bagno et al 2000, Reif 1995). In physics teachers' education helping students to organise their knowledge should be, therefore, a priority.

The approaches or instructional strategies teachers choose are known to depend on their conceptions and beliefs on structure of physics, its epistemology and the nature of science in general (Brickhouse 1990, Pajares 1992). Therefore, the viewpoints emphasising the hierarchical nature of knowledge in physics can be also expected to be reflected in teaching and in planning of the instruction strategies and lead to more structured teaching approaches. As noted by Mestre (2001) *'there is an interaction between knowledge of the discipline and the pedagogy for teaching that discipline which results, for experienced instructor, in a 'cognitive road map' that guides the instructor while teaching* '. Owing to the significance of this interaction, the idea of the importance of conceptual hierarchy in physics and epistemological role of experimentality in building up this hierarchy has been one of the main themes of physics teacher's education in Department of Physical Sciences in University of Helsinki (Koponen et al 2001, Hämäläinen et al 2001). These themes have been of also of practical utility in physics teachers' education (Hämäläinen et al 2001, Jauhiainen et al 2002).

In this report we focus on the themes of conceptual hierarchy and the role of experimentality in creating it. It is described here how the themes are introduced and discussed during the one-year course for pre-service teachers. Attention is also devoted to ways representing the conceptual hierarchies as different kind of organised networks. This is done graphically in form of hierarchical network representations, which students can use to represent network of concepts or organise knowledge (concepts, laws and theories). We give evidence that the course has helped pre-service teachers to shift from fragmented to more organised knowledge structure and to build up their expertise in content knowledge of physics. As an example we discuss how the physical meaning of concept temperature is builded up through ascending the hierarchy and how it takes a part of larger conceptual network of heat and energy. In both cases, focus is on the students' process of building up the understanding of the network-like structures of physics concepts.

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Perceptions of quality in online education in LERU universities – An interactive workshop

Abstract. This workshop is created as a result of a set of surveys mapping out the state of online education at the University of Helsinki, and investigating what the quality-enhancing elements of virtual teaching and learning are. In light of the findings from the surveys, it is the aim of the workshop to activate discussion about existing quality standards for online education, and to identify characteristics of quality of online education in Higher Education institutions at a European level.

Introduction

This workshop is created as a result of a set of surveys mapping out the state of online education at the University of Helsinki, and investigating what the quality-enhancing elements of virtual teaching and learning are. The surveys were conducted as a part of a Virtual University project, the aim of which is to enhance quality awareness and skills as well as strengthen networking among teachers, support staff and experts working with e-Learning issues. An important part of the research process is to incorporate quality tools in the every day work of teachers, support staff and administrative staff alike. According to the University's Virtual University Strategy one third of all the teaching will be offered online by the year 2004. The basic idea of the strategy is to make learning and studying more flexible for students and enhance learning.

The quality of online education – why an issue?

Post modern societies are characterized by the simultaneous, yet seemingly contradictory trends of globalisation, regionalism, homogenization, and pluralism. For Higher Education these trends entail massification of education, and simultaneous centralization and decentralization tendencies. In Europe, the entire field of Higher Education is undergoing change due to the Bologna Process. The discussion on equity and equal educational opportunities, market influences, and an overall question of how to finance Higher Education, are major dynamics in the field. With the growing costs of Higher Education in general, focus is directed towards financing and the quality of service (education). National boundaries are blurred, standardization sets in. In the midst of the changes in the field, educators and researchers ask what the sufficient quality criteria are, and how these may be met without brushing aside the discussion of the role and purpose of Higher Education.

The quality of online education in Higher Education has emerged as the main topic in the development of virtual environments for university teaching and learning. Teaching does not directly cause learning but indirectly, with students' efforts to achieve learning goals, and with the support of organizational structures through management and assistance. The quality of teaching can be defined as the quality of the learning process, meaningfulness of learning, and the quality of learning outcomes. Quality learning can be defined mainly as transformative process, which enhances the learner to achieve learning goals. During the learning process, the learner is empowered as the teacher facilitates and helps the learner to achieve the zone of proximal development (Vygotsky 1978). Harvey and Knight (1996) have argued that the key issue in the quality of Higher Education is student learning. They propose a Transformative Model for quality management in Higher Education. Transformative learning requires a transparency in the learning process, which means that the aims, the processes, and the methods of teaching are aligned and discussed with students (Harvey and Knight 1996). Laurillard (2002) emphasises dialogue between teachers and students as the main element of university teaching. Dialogue requires that the teachers and the students participate actively in the learning process and negotiate the learning goals.

The use of information technology has constantly increased and forced educators to view online education as a normal activity of the university. Teaching is one of the university's core tasks, but the role of the teacher is changing as online environments develop (Laurillard 2002). The pedagogical and technical knowledge needed for teaching online, however, are not yet generally viewed as a teacher's core competence. This discrepancy raises the question, what is quality in teaching and learning, and what do these mean in the context of online environments? In order to answer these questions we first must understand the state of practice and how it affects those involved.

Theoretical perspectives on online education

In this study, the central actors are the institutional leaders, the support staff, the teachers and the students. In the following section a theoretical point of departure is outlined from the perspective of each group of actors.

From the perspective of institutional leadership strategic planning is the method for steering the teaching activities in congruence with the aims and visions of the institution. Online education changes the activity and the methods of teaching, which has to be taken into account in the institution's strategies for teaching (Bates 2000, 21). The essential question is how and to what extent information and communications technology actually changes the activity of teaching (Conole 2001, 4). The central task of strategic planning is how to successfully integrate ICT into existing teaching structures and practices.

Central elements in executing change are well-defined goals, the commitment of all parties involved, a collegial culture, and the mastering of necessary skills. The teacher's role in implementing innovations in teaching is crucial. Innovations do not translate into practice if the organization is not prepared to provide necessary support for those actually doing the reform work. In determining what the necessary skills are, the core competencies required of the actors need to be determined. This is where the importance of training as well as the assistance of pedagogical and technological support staff plays an important role. Core tasks, such as research and teaching at universities can be broken down into processes. For each process there are the core competencies that need to be defined. These should be strongly tied to the organization's strategies. (Hamel & Prahalad 1994, 223-224.)

Teaching as a core task can be broken down into its constituent parts, such as defining the learning objectives, the core substance and contents, and choosing appropriate methods for teaching and evaluation. According to the principle of constructive alignment (Biggs 1996) all components of teaching ought to support each other as well as the same objectives. From the teacher's perspective the virtual environment brings forth the challenge of presenting the contents, choosing appropriate media, facilitating collaboration in the virtual environment, and evaluating the students' quality of input and learning outcomes.

From the student's perspective the experiences of relevance and meaningfulness are central facilitators of learning. Learning, however, is situational, implying that learning contents do not necessarily transfer from one context to another reducing the student's experience of relevance. Theories of situated cognition (Brown, Collins & Duguid 1989; Lave & Wenger 1991) emphasize the importance of connecting learning content with authentic contexts. Online education provides the opportunity to combine theoretical content with multimedia applications, animation and simulation with different aims of learning, such as understanding, exploring, applying, and producing new knowledge (Laurillard 2002). However, in learning in traditional classroom settings things generally follow a certain order. No such script as for how to function in the virtual environment yet exists. Upon entering a virtual environment, the student first has to form a cognitive map of that environment and then grope the way towards a suitable practice. Only after this can the students start to utilize what Jonassen (2000) describes as mindtools, that is, tools for cognitive learning, and begin to construct knowledge as a collaborative activity.

The research method

The research and development project follows the principles of action research. A set of surveys were conducted as a part of the research process in order to map out what the state of online education is at the University, and to investigate the characteristics of quality in online education. The respondents of the study were deans and institutional leaders, pedagogical and technical ICT support staff, students and teachers of Web-based or blended courses. Data analyses strategies included the computation of descriptive statistics, correlations, and means comparisons through analysis of variance.

The deans and the institutional leaders (N = 76, response rate 74 %) represented all eleven faculties of the University. The focus of the questionnaire intended for this sub-sample was on Virtual University strategies and strategic planning, leadership, resource allocation, monitoring and partnerships. Forty-five members of support staff (response rate 70 %) responded to the questionnaire, in which focus was specifically on the support provided to teachers and support staff's experiences of teacher's competencies and preparedness to utilize ICT in their teaching. Further, seventy teachers (response rate 48 %) responded to the survey focusing on teachers' competencies, experiences of web-based teaching and meaningfulness of learning, and evaluation of learning in web-based courses. The students (N = 144) for the survey were identified through the teachers in the sample.

Multiple perspectives – divergence and convergence

Overall, the strategic planning of the Virtual University has proceeded well, and the institutions are following the faculties in preparedness to utilize ICT in teaching. The fact that the use of ICT in teaching is acknowledged in the institutions' other strategies and development plans is a good indication of that ICT is not regarded as an aim in itself, rather, it is seen as a means for enhancing teaching and learning activities. All institutions monitor the use of ICT in teaching despite the fact that not all institutions had a ready strategy for the Virtual University. As the need for national and international comparison increases, it is important that certain central criteria are selected, which the institutions report upon on a regular basis.

The fact that most institutions had utilized basic funding for financing ICT related teaching indicates that the use of ICT is to a large extent viewed as an integrated part of ordinary teaching and the common responsibility of institutional staff (see Bates 2001). The training available to teachers is perceived in general as adequate. Training needs, however, are generally not mapped out. In the future, it is essential that the core competencies of teachers, including the ICT skills necessary for teaching online, are defined and training needs are mapped out accordingly. It is also important that teachers are provided opportunities to participate in training. The lack of time was regarded as the main obstacle for participation in training. In the long run, the constant experience of insufficient skills may lead to fatigue and ultimately can contribute to burn out.

The difference in ICT skills between teachers and students is not significant, however, the difference between males and females is. From the point of view of equal learning opportunities, it is important that all students are provided with a basic set of skills necessary in order for them to fully take advantage of the learning opportunities provided in virtual environments. Students' training needs are in general not mapped out, however, the "ICT license" that is currently being developed at the University should bring relief to the situation as the license will be an indication of the students' level of ICT skills.

Two basic functions of web-based teaching are distinguished: 1) distribution of course material, and 2) creating interactive and collaborative learning opportunities. Overall, the teachers rated students' learning experiences higher on all the dimensions of meaningful learning. The selection of web-based courses is the largest within basic studies decreasing as the studies progress towards subject and advanced studies. However, it is particularly important in the beginning of the studies that the students become connected to the academic institutions and to their fellow student peers. Therefore, it is important to keep a substantial amount of the basic teaching and learning activities in more traditional face-to-face situations.

The workshop

The quality of education in increasingly complex and diverse academic systems, especially with reference to increasing educational opportunities and a growing number of students through information technology poses a global challenge. The quality discourse, to a large extent adopted from the corporate world, may not be sensitive enough to the nature of academic disciplines and university cultures. Objectives for further exploration are

- discussion and development of quality discourse suitable for educational contexts and purposes,
- identification of the characteristics of research based quality tools that are sensitive to the assessment needs of Higher Education institutions, and
- development of quality tools that are sensitive to the unique features of institutions and national educational systems and yet internationally comparable.

In order to facilitate the exploration of the points presented above, it is the aim of the workshop to activate discussion about existing quality standards and to identify characteristics of quality of online Higher Education at a European level. Results from the survey conducted at the University of Helsinki are presented as an introduction to the workshop. Participants are divided into discussion groups. In light of the findings from the surveys and the experiences of the respective group members of online education, standards and quality criteria, each group will discuss quality standards for online education and identify characteristics of quality of online education. The group work is documented and utilized as informative data in the Virtual University project at the University of Helsinki.

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Forestry research as a basis for GIS related teaching at the University of Helsinki

Introduction

Research based teaching has an important role of the teaching strategy in the University of Helsinki (UH), Department of Forest Resource Management (DFRM). The department has eagerly been following the strategic plan of UH (2003) to develop as a research university. During the past decade the introduction of new educational technology and innovative teaching methods have further enhanced the close ties between research and teaching. Our slogan “Science for direct application”, emphasizes the systematic and meaningful character of the scientific education. The department involves its teaching staff actively in pedagogical training, resulting in a more innovative and creative course pallet.

The aims in using a research based teaching approach have a positive effect on the creating more realistic learning experiences for the students involved. The courses strive to produce student awareness on complicated matters by using concrete day-to-day research problems. The courses also require a new level of student interactivity, leading to a more flexible problem solving construct in comparison to the more individual learning model used in the past. Introducing students early on in to peer assessment and peer review methods as commonly used practices within the scientific community will strengthen the students’ ability to function in their future career. Social and cultural aspects of learning (e.g. Hakkarainen 2003) are present here. Both

types of interactions help students in formulating research oriented questioning and gaining reflective skills. The use of research methods in teaching includes common practices of preparation of article reviews, presentations and establishment of personal networks to achieve collective expertise. The existence of combined individual and collective expertise, as defined by Bereiter & Scardamalia (1993), is a general goal.

The teachers and researchers act as supervising colleagues and mentors instead of acting as monologous fact spewing authoritarian lecturers. The knowledge is passed from one link in the chain to another through multidirectional interaction between different involved participants. Such practice is a deliberate projection of Bandura's (1977) social learning theory. The earlier a student is guided towards the scientific way of questioning and formulation of problems and possible solutions, the faster he/she is able to adopt a scientific way of seeing ones surroundings. Similarly the use of a adopted version of the "zone of proximal development theory" has been adopted in the teaching strategy to ensure that necessary skills for networking within a group are developed early on (Vygotsky 1978). The development of group working skills is critical in student development to ensure the necessary working methods for the future.

Most students are involved in active research projects during their studies. The possibility to contribute in the solving of real-life problems gives the students a more holistic understanding of the research topic being taught. It is not uncommon that courses mimic common practices of research projects with separate phases for planning, analysis and reporting.

The roots and the growth

The development of methods involving the use of geographical information systems (GIS) helping in the sustainable management of natural resources, especially forest resources, have increased significantly in the last ten years at DFRM. The development of these methods began already in the 1980's with the use of remotely sensed imageries and mapping software in forest inventory and wide scale forestry planning. Since that time it has been common that the students have taken part in the scientifically remarkable research projects at the department. In the late 1990's the faculty appointed a professorship for geoinformatics. This started the era of research oriented teaching of geoinformation sciences in the department and faculty. In order to develop the use of GIS in Finnish forestry, the Forests in Geographical Information Systems Graduate School was established at DFRM in May 1998. In the first year, 15 researchers were chosen for admission to the school, which is financed by the Finnish Foresters Foundation, the Finnish Ministry of Agriculture and Forestry, and the Academy of Finland. Postgraduate studies can be pursued in the University of Helsinki, University of Joensuu, or in the Helsinki University of Technology. (Holopainen & Laasasenaho 2002)

The graduate school developed methods for planning and maintaining forest information systems, for forest mapping, inventory and monitoring. The main fields of teaching and research included acquisition of GIS data and improvement of GIS analyses and applications for forestry purposes. The framework for GIS teaching was established during the four years of the graduate school (1998-2002). Forests in Geographic Information Systems graduate school had an essential role in developing new GIS and remote sensing methodologies for forest mapping, inventorying, visualization, and monitoring in Finland. This is also the first attempt to develop co-operation between surveyors and foresters at this highest education level. The establishment of a Graduate School also provided an opportunity to create a new GIS curriculum within DFRM, which formed an excellent starting point for future efforts of this kind. The graduate school program and other related research activities were instrumental in the establishment of a new professorship of geoinformatics at the department in 2001. (Holopainen & Laasasenaho 2002)

The robust stem

Forestry is a subject with concrete needs for applications linked with daily routines affecting the work done in the forests and at various levels of industry. Forestry applications and innovations are developed to satisfy certain needs and to answer a specific questions. Hence, the teaching is also based upon concrete topics and research questions. At a philosophical level our teaching strategy is to stimulate students towards a critical and networked way of problem solving. Enough room for exploration is given not forgetting the need for supervision and direction. The principal aim is to offer students real-life problems to be solved in a safe, guided and creative atmosphere with the aid of scientific way of thinking. Our principles to perform research based education can be summarised as follows:

1. The studies include solving of concrete research problems
2. The role of teachers is to act as supervising colleagues
3. Scientific way of questioning and answering is encouraged in the learning process
4. Interaction and peer assessment have a central role in problem solving
5. Presentations and article reviews are common working methods
6. Students in advanced level can take part in real research projects

Living branches - successful examples

GPS in Agriculture and Forestry

The Global Positioning System (GPS) has been one of the most interesting and rewarding topics to teach. The different global navigation systems have several applications in forestry that are an essential part of everyday research activities. Accurate navigation in the field and the positioning of sample plots ensure the repeatability field experiments and the adequate spatial analysis of collected data. Hands-on exercises during the course are similar to field activities carried out by actual researchers. Ongoing research projects are used as examples when teaching how GPS devices should be used in different field conditions and how common problems may be resolved. During the course a projects such as "GIS data capture by using harvester-mounted GPS", which aims to combine the use of highly accurate timber harvester measurement instruments with satellite-aided positioning (GPS) devices in order to produce cost-efficient timber resource data for forest management purposes, are presented and discussed with the students. During these discussions new relevant research questions arise from the group of students. That may be a signal of a change in the students´ way of thinking, which is a significant goal of the research based education at the department. It has shown to be useful to have first hand knowledge on possible problems encountered in actual field research, unfortunately during exercises devices tend to work better than during measuring actual field measurements.

Virtual University, Principles of GIS

As one of the basic courses in the GIS curriculum, the Principles of GIS (GIS4), has a unique way of using research datasets and forestry functions in teaching of ArcGIS software and the basic GIS analysis methods. Large datasets from around Luukkaa (Espoo, Finland) are used to show how research questions are solved using GIS analyses. The students have an opportunity to simulate real GIS analysts when performing their analysis. The exercises use both basic principles of forestry and GIS and combine them in a problem solving environment. The student is given a task and he/she must successfully use the common formulas and analysis techniques to derive an answer and visualize the results cartographically. The analysis results are corrected using a newly developed instant feedback system. The feedback system is a java applet module that corrects the given results and gives instantly feedback to the student on how well the analysis has been performed. The system can be seen as an expansion to the social network of the feedback-giving fellow students. Methodologies and statistical GIS analyses developed to evaluate accuracy in forest mapping and inventorying are used to answer important questions in the use of GIS in

forestry are what numerical information are needed, how multisource information can be combined effectively.

Remote Sensing courses
Remote sensing has an essential role in GIS data acquisition. The teaching of remote sensing techniques has a long history at DFRM. The knowledge of mainline remote sensing techniques helps a forester to have a sound overall knowledge of the forest structure. However, there are several problems which should be resolved before effective use of new satellite and airborne imageries 1) Selection the scale of the inventory or monitory, i.e. tree-, plot-, compartment or area-wise measurements, 2) The suitable image resolution for forest mapping and inventorying, 3) The geometric and radiometric accuracy of single images and aerial photo mosaics, and 4) The estimation accuracy when combining multisource and multiscale remotely sensed imageries in forest mapping. These questions have been studied as a part of the graduate school and the findings have been converted to suitable topics used in the lectures and applied in the exercises. New methodologies for field measurements and visualization have also been taught using research.

Some of the GIS and remote sensing courses have been designed to work as stand-alone courses for use in the Geoinformatics Virtual University network. All the exercises are explained in detail and are available though the WebCT-study environment for all enrolled students. Additional study notes and lecture slides are given as well. The lecture topics familiarize the students with all the essential topics and terms needed to successfully pass the final exam. Since the practical experience and repetition of learned events are important in mastering of any method, the course builds a solid base on which further more applied courses build upon.

Results
Student feedback has generally been positive. Virtual study environments have given more flexibility as well as increased the amount of materials available for the students. The chosen strategy has worked well from the teacher's point of view. An increasing number of students have enrolled and finished the courses successfully. It seems to be critical to have enough stimulating and concrete examples during lectures and exercises to ensure the benefits of the knowledge exchange. However, with the increased popularity group sizes have increased and as a direct result the amount of individual assistance has diminished. This has been also noted by the students in their feedback. The basic level knowledge base has grown, this may be seen from the popularity of higher level GIS and remote sensing courses. However, it seems that the increased popularity has not yet produced many research oriented students.

Shoots and buds: Future plans
Research at the Department of Forest Resource Management has been instrumental in the development of new courses in the past. A similar trend will be continuing in the future as the research in forest inventory, analysis methods, the development of forestry specific software for mobile data collecting devices progress, and the use of other mobile devices and more accurate GPS devices are being used for tracking harvesters, lumberjacks, and measuring field sample plots. Research has long a history of being the corner stone in teaching of new and sometimes experimental methods to the new generation of foresters. The future will bring more challenges as the technological abilities of the students' increases. A significant role will be set towards the use of problem based teaching which has proven to bare fruits in these past years. Adequate problem solving skills ensure students ability to compete for jobs in the demanding employment market of the future. All students will be encouraged to take part in research projects and produce presentations and articles on researched topics. This will require support from the department to ensure that the relevant knowledge and know how is passed on to the students. Courses and

curriculum's need to be updated regularly using results from current research and trends of future research topics.

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Research-based environmental chemistry teaching at the university level

Introduction

Environmental chemistry is a key topic area in the Department of Chemistry at the University of Helsinki. A completely new environmental chemistry teaching programme has been planned for the department. As a part of this programme, one new course called Environmental Chemistry I will begin in 2005. The course will be conducted in co-operation with the university's Laboratory of Analytical Chemistry and Chemistry Education Centre. The new course serve three main purposes: to impart a basic knowledge of environmental chemistry, to make students understand its meaning in society, and to help teachers take a more concrete approach based on sound research and practice. Educational research serves as the basis of course development, especially in the case of environmental chemistry.

The aims

This study has three goals. Firstly, to develop a modern and meaningful environmental chemistry course for the Chemistry Department at the University of Helsinki. Secondly, to examine how authentic learning experiences, reflectivity, and metacognitive skills affect the understanding of environmental issues. Thirdly, to find out what is a meaningful learning environment and how it affects student learning.

Methodology and research design

This study will be triangulated and design-based. Each student's knowledge base will be tested at the beginning and at the end of the new environmental chemistry courses in 2005 and 2006. Questionnaires containing several multiple-choice and open-ended questions will be administered to the students. The multiple-choice questions will be analysed quantitatively, and open-ended questions qualitatively. The students' learning experiences and their understanding of environmental issues will be studied through learning diaries, which they write during their studies. The contents of the diaries will be categorised into different learning groups, and one

random student from each group will be interviewed. The preliminary results will be introduced in this presentation.

Pirjo Nikula-Ijäs and Lotta von Ossowski
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Development of the protein binding assay by students at the protein chemistry course

At the protein chemistry course we had a need to remove a method that was no longer in use at any research group of department and on the other hand there was a need for a more quantitative biding assay for protein-ligand interaction by molecular neuroscience group. Before the course a set of preliminary tests were made to confirm the chemical compatibility of the reagents.

The learning objects were to understand a) protein-ligand interaction, b) indirect detection methods, and c) purification of recombinant proteins. The course took 2.5 weeks including laboratory works, seminars and expert lectures. Students were instructed to study relevant literature and to keep a combined research notebook and learning diary. During the first week students purified the proteins that they were going to use for the binding assays. An expert lecture on protein-ligand interaction was held before any binding assay was made. Half of the students continued to do the binding assay: each protein was diluted into 16 different concentrations (more than plenty) and the ligand were allowed to bind with these protein dilutions. Result of the tests were that the ligand did not bind to any protein. At the second week, after the instructor had consulted the students, retested the chemicals and done some detective work, the second group of students made the binding assay with refined instructions. Result of the test was: high levels of binding was detected with the specific binding protein and very low levels of binding with non-binding protein (negative control). Dissociation constant (reflects the strength of the binding) was calculated. All the results were discussed together.

Due to successful results we were able to determine quantitatively the strength of the binding (dissociation constant) between the ligand and binding protein. These positive results affected on students attitude in regard to mathematical equations of protein binding kinetics. Equally important was the failure at fist week, since the students became the experts of there own work and the instructor was dependent on them at problem solving process. These students also had to go through the theory of the experiment very carefully in order to understand what went wrong and thus reinforcing there knowledge in indirect detection methods. At teacher's point of view it is possible to organize small research projects for laboratory courses but one must be ready to take a risk to fail and turn the failure into a successful learning process.

Ritva Näpänkangas, Satu Lahti, Eeva-Liisa Hietala, Kyösti Oikarinen University of Oulu, Finland

Employer feedback in evaluating the dental curriculum at the University of Oulu

The dental curriculum at the University of Oulu has recently been evaluated and thoroughly revised to reflect the concepts of modern pedagogies. During the revision process the dental key competency (DKC) areas as well as competency levels were defined for the curriculum and the assessment of the students. To continue the revision process a feedback programme was launched to systematically collect curriculum assessments also from the graduates and their employers. Heads of the municipal public dental service that employ and supervise dental graduates from University of Oulu as well as dental graduates were invited to give their evaluations through the

Finnish Dental Journal and e-mail lists. The assessment was carried out as a questionnaire in the Internet. In the questionnaire following key areas according to the DKC model were evaluated: prevention and patient motivation, administration, treatment of the patient, handwork and communication. In the treatment area the anamnesis, status, diagnosis, treatment plan, decision making and prognosis were distinguished as own areas. Assessments were also asked related to clinical disciplines. The scale used in the evaluation was "insufficient skills, basic skills, advanced skills and excellent skills" according to the competency levels of the clinical assessment rubrics.
By December 2004 nine heads of the municipal public dental service and 29 dental graduates had replied to the questionnaire. In most of the areas the skills were reported to be at basic level by both the heads and the dental graduates. In periodontology and cariology the skills were assessed to be on a higher level than basic skills. In administration and in orthodontic, pedodontic and gerodontologic treatment the skills were between insufficient and basic skills.
It seems that the employer feedback can be used in evaluating the dental curriculum. Preliminary results seem to propose areas where more emphasis should be paid in the curriculum. However, more replies are needed in order to make further decisions.

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The divided thinking: A developmental project of the education of teacher education

Abstract
The Divided Thinking -model (attachment) is a developmental project of the education of teacher education which started in the autumn 2004 at the University of Jyväskylä. The starting points for planning the model have been the experiences acquired from a science study project, which is a part of the class teacher studying. The realization of the study project is based on research data acquired from science instruction.

In the divided thinking -model the students' learning processes are long-term journeys to their habits of interpreting information and using it to solve arising problems; habits that guide their thinking. During the study, the students learn to consciously evaluate and develop the competency of their pedagogic content knowledge on the content themes that they study, by interacting with different quarters representing different areas of expertise. The sharing of expertise is done on several different levels. It is inner activity of student groups operating in flexible assemblages, or seeking help from a special expert whenever it is required for deepening the knowledge or checking the accuracy of information. The expert network available for the development project is comprised of experts representing different fields including teacher educators and of students at different stages of study.

The problem-based approach supports the fact that the acquired information is interpretative, as well as the fact that this information also needs to be tested for its validity in solving new problems. At the same time, it increases the students' trust in their possibilities to learn new things in a new way when their know-how needs reconstructing.

There are many ongoing study entities in the experiment of the divided thinking -model that integrate scientific expertise. As a result of the integration many study teams have been formed, such as co-operation groups of class teacher trainees and subject teacher trainees, co-operation groups of people taking part in the basic teacher training and in-service training, groups

integrating native language education and science education, and co-operation groups of different teacher educators.

Why reconstruction model?
Better awareness about one's own learning process and growing confidence in the own possibilities to become a skilled teacher and a researcher of one's own work.

Introduction
The responsibility of teacher training in the development of school culture

The social well-being that makes a physically and mentally sustainable development possible starts from how an individual experiences himself/herself as a part of social reality. People, who have learned to learn, feel themselves able to handle new challenges. They are ready to interact with their environment in order to become aware of the beliefs that guide their actions. They are also prepared to look for creative solutions to change their own operational culture. The school assessment studies show that the amount of pupils that fail or are displaced at school is increasing. This shows that the modern school culture is no longer able to rise to the challenge of the society. Teacher training is the key in changing the situation. Education must influence so that the knowledge of teachers prepares the way for different learners and especially pupils of different cultural backgrounds to make progress according to their own potential.

Teachers who have learned to evaluate the proficiency of their expertise have the courage to critically evaluate their own way of thinking and acting, and they act to find new perspectives to view the school's reality comprehensively. If self-criticism makes the teachers feel unsure about their ability to respond to the need of change in their own teachership, then also the teachers are in danger of displacement. According to studies especially commencing teachers experience the comprehensiveness of teaching situations as chaotic – concentrating in the things they teach and keeping up with the syllabus diverts them from seeing how the pupils experience the lesson and the things they are taught. To develop and increase the use of the reconstruction model in teacher training is one way of making the students and teachers more aware of their learning process and of giving them more confidence in their possibilities to develop into skilled teachers.

The support the learning process provides led according to the reconstruction model in developing the teacher training as a part of the science community at the university

The reconstruction model promotes pedagogical development of the curriculum according to the goals of the Bologna process. Already during basic studies that are a part of the pedagogical studies the student is able to carry out a small study project that fulfils the criteria of scientific work and leads towards scientific writing. Students can make the method studies more influential and meaningful by integrating them with their own research theme and study process. The offerings of theoretical method studies and the actions aimed to understand teaching in practice become organized and the teachership of the student develops into practical wisdom. With practical wisdom is here meant the teacher's skill to apply the theoretical knowledge they have acquired to situation control which is needed in teaching in practice. Opintoprojektissa todentuu myös tarve eri tieteen alojen tekstien ja tiedon erilaisille vastaanottajille suunnattujen tekstien ymmärtävä lukutaito ja tiedosta kertominen. The study project also verifies the need for an understanding ability to read and tell about texts and information from different fields aimed for different recipients. The reconstruction model project along with the project aimed to develop the education in mother tongue and literature support and complete one another both in their aims and in their operational culture.

The reconstruction model enables the reduction of contact teaching in accordance with the recommendations of Bologna. Even though the realisation of the learning process is well organized, the model gives room for students' spontaneous acquisition of information, interpretation and reconstruction of their own understanding according to the socio-constructivist learning conception. The model also increases problem-based cooperative learning done in peer groups, where the new information produced in the problem discussion directs the reformulation of the problem. This activity does not support the naive constructivist interpretation of learning as inventing but instead guide to find and test information in a scientifically acceptable way.

The research approach to teaching is emphasized in the work of the teachers who use the model. Learning processes of the pupils bring problems that lead teachers to find answers to problems that are new to them.

The model can be a help in developing the research strategy of the department as a part of the tripartite cooperation of teacher training. The ever growing group of postgraduates is easier to manage when the guidance needed for theses and further studies on different levels is linked. Research teams that add and divide expertise and do basic and further studies are needed also because it is desirable that the reform of the teacher training curriculum is developed into a process that is more dynamic and more strongly based on scientific research.

In our development project the reconstruction model is the aim and the tool of learning. The model has been tried out in the department of teacher education at the University of Jyväskylä and the format of the model has now formed as functional at the very least. Developing the model further and its extensive application to teacher training is an alternative to be reckoned with in finding the means to integrate the education of teacher training and produce information about the impressiveness of the education. To reach the goals also education of the people who are responsible for teacher training is also needed as teams that divide their expertise – acquiring the reconstruction model means a change in the paradigm of educational practices.

The aim written into the pedagogical idea

to develop the teachers' basic and in-service training so that it will increase the teachers' preparedness to modify theoretical mastery of subject knowledge and pedagogy into practical wisdom the teaching situation requires.

The possibility to apply clearly over the limits of subjects and training models

A Research

- The model is based on research and is controlled by the socio-constructivist frame of reference of learning and teaching.
- The model is fully formal so that it can be applied to different learning contents
- The model guides to understand the relationship between learning and teaching.
- The meaning of the model for the quality of learning and teaching that promotes learning has been researched and there is published international information available.

B Tripartite principle

- Using the model supports the tripartite cooperation that is required by the Ministry of Education between different faculties, departments of the faculty of education and Normaalikoulu.

- The model guides to profound learning by teaching to understand the interaction between theoretic knowledge and practice. Being more confident about their mastery on the subject and having research knowledge on learning difficulties that can be expected, students get better ability to concentrate on supporting the learning.

C Regional impressiveness

- The model is suited for teachers' spontaneous professional development and for sharing expertise in their work community guided by the socio-constructivist frame of reference – the same frame of reference that is the basis of the modern national curriculum. Implementing the goal requires in-service training. The model works as a tool and by using it the teachers can make their learning process visible and explicit so that people with different expertise can influence it directly or indirectly for example through research literature.
- A network of field schools will be established in the region of Jyväskylä network city. It will be an effective way to create a living connection between the discussion between the scientific development of the university and the experience of the field.
- In the project the teacher trainees produce educational entities that can be demonstrated on different theme days at the schools in the region

D The personnel strategy of the university

- The project provides a social and theoretical frame for the teachers in the teacher training unit to promote post-graduate studies and writing of scientific articles. The cross-scientific knowledge is united.
- The personnel of the department of teacher education and Normaalikoulu get current substance know-how from the best experts of subject departments. Respectively, the subject departments get support for pedagogically emphasized research and for instructing theses.

E Integrated basic education

- In the projects people who are training to be class teachers, subject teachers and/or special education teachers can function in an integrated group. This is a highly valuable experience for future teachers, since Finland has an integrated basic education. Working together promotes the development of extensive knowledge and good co-operation starting as early as in basic education.

F Ensuring the quality of teacher training

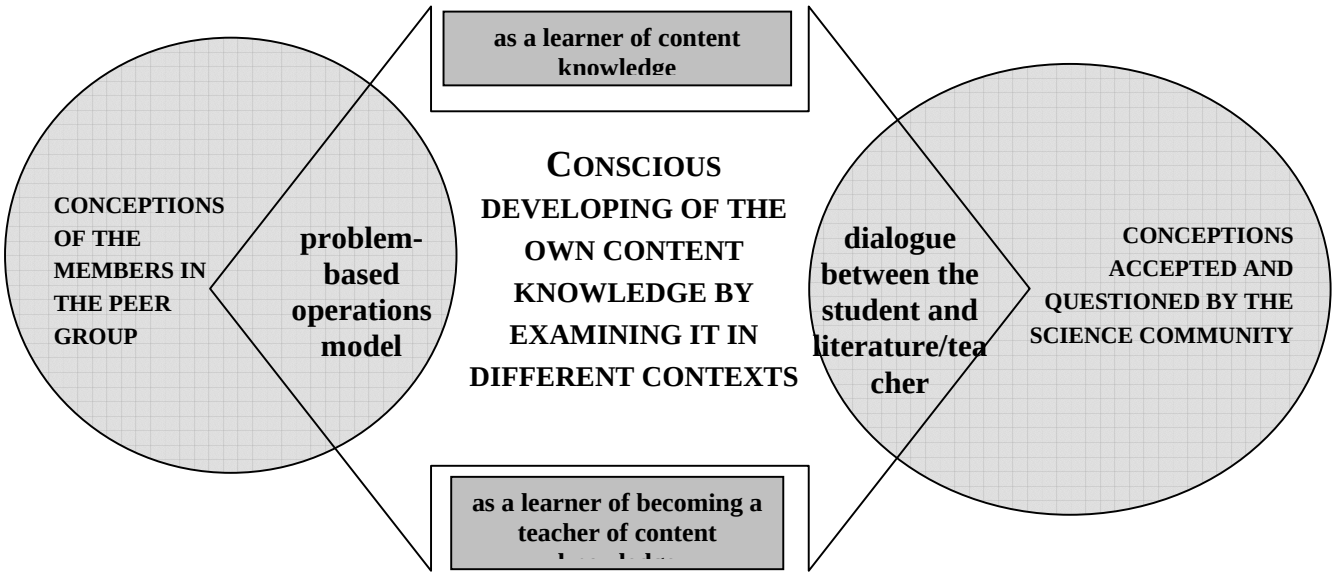
- Teaching and guiding the research process is an inseparable part of the implementation of the reconstruction model. It is done so that it develops the students' understanding about researching. The ramifications of carrying out a study project can be seen in the rise of the quality level of teacher trainees' theses.
- The new degree does not include a pedagogical pro seminar in subject teacher training. Pro seminar has been an important part of pedagogical studies when the teacher trainees have been initiated into research of education and learning. A research project done according to the reconstruction model can replace the pro seminar.
- Reconstruction model contributes to the realisation of the principle of participating education.
- The model makes teachers aware of the factors that can hinder pupils' learning, and act so that these would be eliminated. From the point of view of a project leader in the centre of the learning process are the learners – teachers, students or pupils – and guiding their learning so that it is possible to achieve the goals set for learning.

- The educational reconstruction model can be applied on many different levels from a basic course all the way to doctoral thesis and international article.

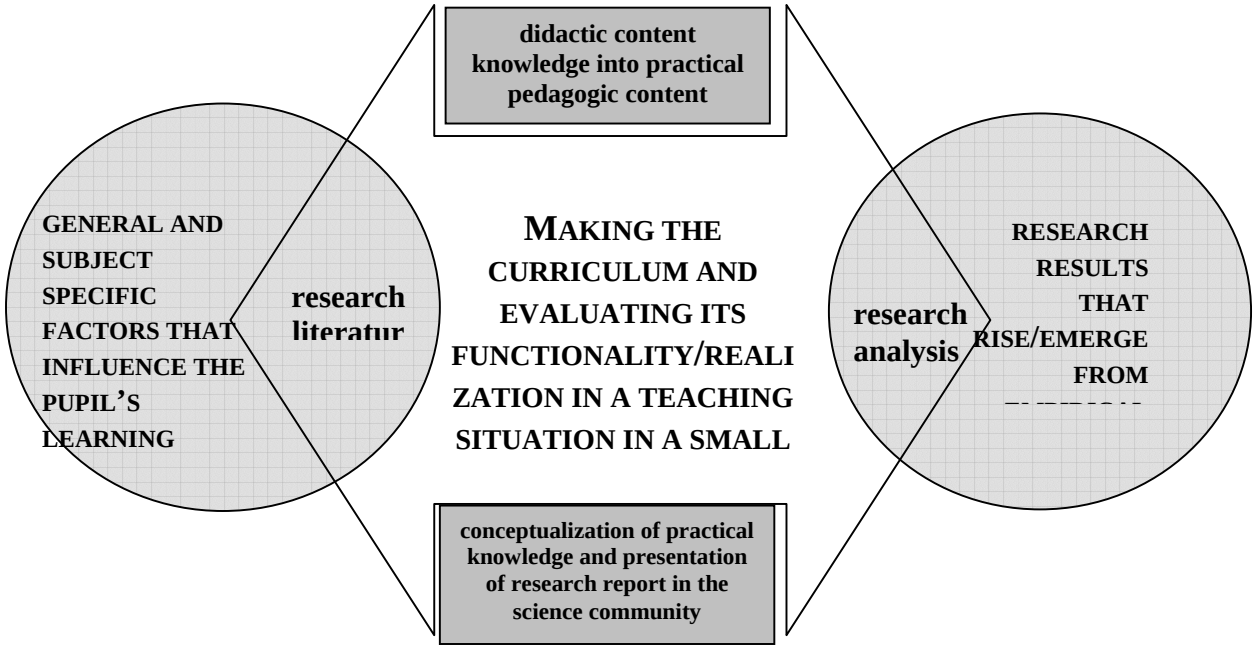
Summary

The reconstruction model has been applied in a small scale in the basic education of science as well as in teaching history and economic science. The experiences encourage continuing to develop the model and to use it more widely. The educational project is a process of scientific activity: It guides the students to systematically collect information on a subject of their choice and to analyze it from different angles – information as their own knowledge and divided in a group, as accepted in the science community, as presented in the learning material and as something the pupil needs to learn. A synthesis is done based on the different analyses. The model becomes less used as a format; during the process, the model that is learned through individual thematic entities or themes transforms into the users' way of thinking and taking over new things.

The next page shows a diagram on how the reconstruction model can be applied to the education of subject teacher or class teacher studying.



critical analysis of the information presented in the learning material pedagogic theoretical knowledge of the content knowledge taught knowledge in the classroom – guided observation of teaching



distribution of expertise acquired in study projects in a seminar

FIGURE: An example of applying the reconstruction model to subject teacher training or to the

diversified studies of class teachers. In addition to the contact education thas has been agreed beforehand the students have a possibility to get individual and group guidance. Small-scale seminar sessions are also a part of the process.

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Quality and quality enhancement in university teaching

The current political debate on how to enhance and assure the quality of university teaching concerns the whole European higher education area. A study concerning academics' work with quality has revealed that there are difficulties in converting policy intentions into realisable outcomes (Newton 2002). That's why it is very important to ask what is quality or good teaching from the teachers' point of view?

This study focuses on exploring university teachers' conceptions of *good teaching* in four different disciplines: medicine, theology, arts and political science. The study also explores what means are used to enhance teaching in these different contexts. The theoretical background of this study is based on recent research on university teachers' approaches to teaching, which has shown that teachers may approach teaching in two different ways. These two approaches to teaching are teacher –centred/content-oriented and teaching as student-centred/ learning-oriented (Entwistle & Walker, 2002; Kember, 1997; Prosser & Trigwell, 1999). Kember & Kwan (2002) found that approaches to teaching were influenced by the teacher's conception of good teaching.

The other part of this study explores teachers' ideas of quality enhancement in their department. The theoretical background of this research is based on quality enhancement consisting of three different elements: 1. constructive alignment in teaching, 2. the ways of enhancing quality (e.g. support from the department) and 3. the quality impediments (e.g. institutional priorities) (Biggs 2001).

The data were collected by interviewing 23 university teachers, four to five teachers in each participating discipline. The interviews were semi-structured, concentrating on the teachers' teaching, on how they plan it, how student learning is assessed, what it is like to be a teacher in their department and on how they learn. They were also asked how they would teach in an ideal situation and what their conceptions of good teaching were. These questions preceded the questions about their aims in teaching, what they consider as important in teaching, how they experienced teaching.

The preliminary results showed that teaching practices in these disciplines vary. This may have an influence on what is considered as effective teaching. There may also be shared features of what is considered good teaching. It is also interesting to examine the relationship between teachers' approaches to teaching and their conceptions of good teaching. The results are vital when developing a quality assurance system for higher education, as it is necessary to define the quality of Higher Education before focusing on its assurance. This study will enlighten the definition of quality in teaching in higher education.

Round table session in LERU conference
Preliminary results of teachers' conceptions of good teaching will be provided at the LERU conference. In the second part of the study (the quality enhancement in the departments) I will conduct narrative analysis of the teachers' answers about what is it like to be a teacher in their

department. The narrative analysis will provide interesting results of how teachers talk about quality work in teaching in their department.

Leila Pehkonen and Aino-Maija Lahtinen
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"Students as researchers" - new ways of approaching research in early phase of studies

As the theme of this conference suggests, the integration between teaching, studying and research has to be developed. Traditionally, research methodology courses have been taught separate from the actual research work, and teaching has based on the assumption that one must proceed gradually from simple to complex questions. This kind of approach lacks both the authenticity and the student's active involvement. More generally, educating academic experts requires that the learning environment is constructed in a way that enhances students' high quality thinking and deep learning. On the other hand, the time students take their degrees should to be shorter, and the recourses of teaching seem to be constantly decreasing. In this paper, we address the challenges for the development of research studies.

The ability to do research does not refer to a mere technical skill to use research methods but to complex cognitive, affective and social capacities too. Learning to do research, for example, includes the ability to ask relevant research questions, to understand research methodology, to use research methods correctly, and to write a research report. In addition, doing research requires for curiosity, creativity, persistence, conceptual change, as well as a lot of personal involvement. To become a member of an academic community is a long process of socialization and includes learning of various forms of knowledge. In this process student need to think, read and write, but in addition, they need opportunities of practicing academic discussion and cooperation.

Traditional research method courses seem to give students too simple picture about the research practice as whole. By reading research reports and articles students do not get hands-on experience of tacit skills and knowing how, since most papers report on successful research. Published texts do not tell about failure, dead ends and wrong paths, which are very common in practice. In addition, methodological textbooks seem to present research as a fixed and linear process without pointing sufficiently to its recursive and uncertain nature. In order to enhance students' ability to cope and deal with problematic in this complex field teachers should base their pedagogical decisions on the nature of the learning process and organize students' learning activities in line of this process.

Learning to do research, as the research work itself, causes the feeling of uncertainty. Therefore, we believe that teaching should be experimental and encourage students to act in doubtful situations. According to the sociocultural views of learning the students themselves support each other's learning when negotiating ideas, searching information and formulating arguments. However, the role of the teacher is still important.

Some years ago two lecturers in the Department of Education were responsible for teaching a compulsory introduction course on research methodology (120 hours in total) to 140 first-year students. 40% of the students were taking their major studies on Education or Adult Education and 60% were minor students from various faculties. The recourses consisted of two classrooms (each for 30 – 40 students) and 12 hours lecturing time. In this situation teachers have to be enthusiastic and motivated to find new ways of organizing the studies, at least, if they want to teach as the recent research on learning and teaching in higher education suggests.

In the workshop we would address the following questions:

How to deal with the problem of the increasing number of heterogeneous novice students in relation to limited recourses and to the quality standards?
How to integrate the research work of the staff and postgraduates in teaching?
How to teach research work in an authentic way to make research lively for students?
How to facilitate and challenge the individual student's critical and analytical thinking, to foster collaboration between students and to give them necessary support and guidance?

Eeva Pyörälä
University of Helsinki, Finland

Research-based teaching in communication skills studies in medicine

Aim of the workshop: The aim of this workshop is to bring together different traditions of research and teaching on medical communication and to promote a dialogue between them. This interactive workshop also includes demonstrations of communication skills teaching and assessment in order to familiarize the participants with these practices. The target-groups of the workshop are those working in the field of communication studies both in medicine and in other academic disciplines.

Background: Research on interaction in health-care settings has rapidly expanded in recent decades. Simultaneously, programs on communication skills training have been established in medical faculties and interest in communication skills teaching and assessment has arisen in higher education.

Teaching ideology and practices: Undergraduate medical education plays a central role in the professional development of the physicians. Medical faculties today are challenged to provide a consistent study program on communication skills. Such a program entitled *Growing to be a physician* was started at the University of Helsinki in 1994. It contains several modules on doctor-patient communication. It forms part of the core curriculum and covers all the study years. Learning takes place in small groups at the campus and in health-care environments, and it advances step-by-step. Learning methods are learner-centered, reflective and experiential. Some modules of the communication skills program are organised with actors playing the roles of patients. After each such patient simulation with an actor a feedback discussion follows. Instructions for giving and receiving constructive feedback have been given to the teachers, actors and students. The continuous formative assessment is emphasised in learning communication skills. At the end of the curriculum the summative assessment takes place in the OSCE (Objective structured clinical examination) in which actors play the roles of the patients. In the OSCE the clinical skills and performance as well as the communication with the patient are assessed by clinical teachers by using checklists and global-rating scores.

Program of the workshop:

1. **Interaction studies on medical consultation, Diagnosis delivery:** Professor Anssi Peräkylä (Department of Sociology, University of Helsinki)
2. **Applying research results in communication skills program:** Senior Lecturer Dr Eeva Pyörälä (Research & Development Unit for Medical Education, University of Helsinki)

3. **Demonstrations on teaching communication, giving constructive feedback and assessment:** Senior lecturer Dr Eeva Pyörälä, Clinical teacher Pirkko Heasman and Clinical teacher Dr Leila Niemi-Murola (Research & Development Unit for Medical Education, University of Helsinki)
4. **Studies on communication skills teaching and assessment:** Clinical teacher Dr Leila Niemi-Murola and Clinical teacher Pirkko Heasman (Research & Development Unit for Medical Education, University of Helsinki)

Wouter Schallier
K.U.Leuven University Library, Belgium

Information literacy in the digital learning environment

Since July 11, 2002, the K.U.Leuven Association is a fact. This group of thirteen institutions of higher education in Flanders (Belgium) was founded "in order to occupy a position of strength within the new European educational landscape and to work together towards quality improvements in education"[1].

In this context, a library working group was established to intensify collaboration between the libraries of these institutions. Information literacy and/in the digital learning environment were listed as absolute priorities.

Most teachers, researchers and students of institutions of higher education are nowadays aware of the necessity of information skills in the basic curriculum. The libraries usually have a long experience in information literacy and can give important support in setting up packages for teaching. However, not all libraries of the Association are familiar with this role. On the other hand, teachers, researchers and students do not necessarily expect active participation from the libraries.

The challenge of the Association, with its variety of scientific domains, education, staff and cultures, consists in finding an appropriate answer to the different realities in the partner institutions. Information literacy means something different for students of medicine, researchers in medicine, students of nursing, students of French literature, etc. Recently, a project proposal was made to explore the use of learning objects for teaching information literacy in the digital learning environment. Can we define small learning entities that can be used in a modular way, in different curricula? K.U.Leuven and three other institutions participate in this collaborative project between libraries and teaching staff.

Kaisa Sinikara
University of Helsinki, Finland

Significance of Library and Information Services in Research-Based Education,

Efficient and diverse library and information services are essential for learning and the smooth progression of studies, especially at universities. The importance is accentuated by the emphasis in university education on versatile skills in information literacy (mainly information retrieval

[1] http://associatie.kuleuven.be/eng/index.htm

and utilization). Co-ordination, current, readily available and reliable content and efficient and dependable library and information services are needed.

Goals of the workshop

- to evaluate the role of libraries and their development goals in advancing high-level research-based education
- to clarify the present situation and the essential targets for the near future (2006 - 2009)
- to recognize possibilities for cooperation and joint ventures between the LERU universities

Working methods

Presentations

- University of Helsinki Libraries supporting Research-based Education (*Kaisa Sinikara*, University of Helsinki)
- Experiences of the Relation/Collaboration between Library and Education (*Wouter Schallier*, Universiteitsbibliotheek K.U.Leuven
- The Role of University libraries in the EUREA-project (*Mikael Vakkari*, University of Helsinki)

Group sessions with the following themes

- areas in need of improvement
- focal points (max. 5)
- ideas for developing the LERU cooperation

Concluding discussion

- summary of the group sessions

Presentations

University of Helsinki Libraries supporting Research-Based Education

Strategy:

The Ministry of Education Development Plan for Education and Research 2003 – 2008 stresses the importance of the willingness of libraries to contribute to the development of teaching and study methods, and thus, on their part, to ensure that university and polytechnic graduates have good information literacy. The situation varies by university and discipline. While some universities provide only a minimal amount of information literacy, some universities have progressed far beyond the present recommendation[1].

At the University of Helsinki the strategy of electronic research and study environment for 2007 - 2009 is being drafted in co-operation by six committees. The new strategy will be a synthesis of

[1] http::/www.minedu.fi/julkaisut/koulutus/2004/opm08/opm08.pdf

several previous strategies by partaking committees. Key issues in the future strategy will be the integration of customer needs, provided services and infrastructure in a comprehensive vision of development of library and information services and education at the University of Helsinki.

Changes in organization and services:

The development needs of the libraries at the University of Helsinki have been assessed by two international evaluation panels in 2000 and 2004. As a result of implemented strategies and recommendations of evaluation panels, two large segments have emerged from 150 separate libraries. These sections are:

- The Helsinki University Library (the National Library of Finland)
- A networked organization called the University of Helsinki Libraries comprising the campus libraries of Kumpula, Meilahti and Viikki, the Undergraduate library and 5 faculty libraries.
- From 2002, a coordinating unit for developing information and library services has been in operation at the administration office.

The national and university-wide development has also produced the following results:

- High quality library facilities and learning centers
- Accumulating electronic library with over 10,000 journals and close to 300 databases available for research and education
- Centralized services and funding for electronic library financed by the Ministry of Education and the University of Helsinki (50 % centralized funding)
- Implementation of national information retrieval (Metalib) portal Nelli (2005)
- A Digital Objects Management System for long term storage and preservation of electronic material by the National Library – development projects started by HU (2005)
- National program for information literacy curriculum, coordinated by HU (2004-2006)
- Assessment of service quality of the University of Helsinki libraries (2004-2005)
- Development of university-wide support and process for publication, distribution and management of electronic material (2004-2006)

Co-operation:
The need for university-wide, national and international co-operation is emphasized when essential facilities, high quality content and services for the support of research-based education are being developed.

In order to meet the needs of modern research based education, co-operation of different units in the university network (IT-departments, libraries, educational centers and faculties) and coordination of activities are needed. The actors, whose co-operation is required, are librarians, teachers, researchers and the members of administration. Also, the commitment of the university leadership is crucial for development.

Questions and problems:
Most of the LERU universities are alike; traditional and established institutions with large and diverse library organizations with huge collections and several different service units with separate facilities. This means, that the universities also have similar challenges in developing their infrastructure, collections and services to meet the needs of research-based education.

Some important issues for discussion at the workshop:

- How well the libraries and learning centers of the LERU universities support research based education?

- What are the essential development needs in the library and information services sector in the near future?
- How to develop the co-operation of library and teacher as part of the process
- Opportunities for co-operation between LERU universities

Library and information services are a prerequisite for study, both regarding information, substance and learning environments; these services can, when efficient, be a substantial factor in promoting studies[2].

Leena Suominen, Kristina Lindström and Saara Repo-Kaarento
University of Helsinki, Finland

Research-based learning in microbiology at the Master's level

A microbiologist is a professional who should be able to combine theoretical and practical, "hands-on" work in an innovative and creative way, being at the same time critical and without losing touch to everyday life. The scientific field is nowadays moving very rapidly, and a huge amount of new information becomes available constantly. On the other hand the basics of our science rely heavily on the old "Koch´s postulates". In constructing a good microbiology curriculum for our students, we need to take all these facts into account.

Hierarchy of learning in Microbiology
Biggs' (1999) presentation of the hierarchies of learning is very well applicable to education in microbiology. The students should proceed from learning basic techniques, bacterial metabolism and their names to solving challenging methodological and theoretical problems, from quantitative to qualitative learning. They should grow from being novices to become junior experts in their field. Similarly, they should become aware of the life-long learning process and reach the elementary learning skills to become a real expert in their own field.
When studying the microbiology curriculum critically, we became aware of the lack of this progression. The emphasis on all coursework was too much on how to do things without asking why. The students were trained to rely on the teachers' knowledge instead of becoming confident with their own expertise. They were taught to learn how to use advanced equipment without understanding the underlying principles of how it works. The result of this training was seen in difficulties at the master's theses level.

Adopting the student-focused teaching in microbiology
We responded to this challenge when we got the chance to teach a 10-study-week master's course for a group of 16 microbiology major students. The research-based and student-focused approach fitted well to this educational level, when students are supposed to understand the practical methods in a more abstract framework.
The task given to the students was very simple: Isolate a bacterial strain, characterise it by available methods, write a report of your work and also present the results on a poster.

A high scientific level of the contents of the course was achieved by connecting the work to the research done in our own group. To complement the expertise of the main course teachers, we involved a few extra scientists who were experts on the methods used. In addition, we invited as a consultant an expert on accreditation of microbiological laboratories. We also hired two student tutors to help with practical matters related to teaching, and we relied heavily on the department

[2] Kaunismaa E., Student Union, Univ. of Helsinki Library and Information Services Annual Report 2003

technicians for growth media, reagents and equipment. All the main teachers contributed to the pedagogic themes of the course.

Introducing a new learning culture in microbiology

The main challenge for us was to facilitate learning in the students. It required a conceptual change in the thinking of the teachers. From being persons answering the questions asked by the students, we switched to support and to challenge the students to ask their questions and to find the answers themselves. Instead of making the working schedules for their work, we devised a schedule with room for the students to plan their own work. Instead of telling them how to maintain a high standard in the quality of their laboratory work, we guided them to create a quality handbook and to collectively take responsibility for the laboratory according to their own rules. The shared responsibility is a problem in large groups. Therefore, we created teams with different laboratory responsibilities.

Ten weeks is a long time both for students and for teachers. Therefore, we scheduled the course in two periods with a one-week break in the middle of the course. Each week had a scientific theme whereby new methods were introduced and discussed. A regular schedule for the group to meet three times a week was included in the course programme. During the common sessions we studied theory and did exercises related to data treatment and presentation.

At the end of each week we regularly employed group discussions as means of learning and sharing new knowledge. We also devised time for making short reports on experiments done, and plan for the next steps in the work. On Fridays we also collected feedback from individuals and teams which was discussed by the teachers at Friday afternoon coffee and with the students the following Monday. The teachers and the tutors met informally every day discussing matters related to the course, especially to learning.

Pedagogic aims and practice

Immediately at the beginning of the course the students were informed about the pedagogic theories behind our teaching methods. ‘Learning by doing’ is a well-known means to adopt microbiological skills, and this teaching method was readily accepted by the students. However, the research-based approach combined with the active learning introduced by Lonka and Lonka (1991) was new to students and for many of them, caused confusion, anger and distress. Students wanted to have more precise guidance and felt abandoned. We overcame this problem by intensive reflection and support to develop 1) metacognitive awareness in students, 2) ability to solve practical problems in teams and 3) to share knowledge within the group.

Pedagogic outcome

At the second period of the course the introduced pedagogic thinking resulted in well-qualified literary assessment of university learning. The topics that students considered were: what is scientific thinking, how does learning at the university differ from learning in other educational systems, and is this course different from previous ones in microbiology, how, and is it good or bad for learning. The students were also asked to evaluate their present educational position according to Biggs’ model and what would be their ability to perform the advanced studies that follow this course. The readiness and interest to critical self evaluation was surprisingly high among the students after the pedagogic training. Great variation between the interest of the individuals in metacognition was apparent, but in general the students claimed that this pedagogic understanding helped them to understand better their studies.

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Teaching qualitative research methods for students of educational sciences

Aims:
Having worked as a university lecturer for less than half a year, I for the first time face the question: what is research-based teaching? What should it be and how to develop activities of a kind? Considering the context, that is, teaching in higher education, it is clear that research should have a say in it, shouldn't it? However, a brief look at the field shows that a large proportion of research-based teaching focuses on education outside universities and colleges. I'm referring to the application area of research-based instructional strategies, specifically to their implementation in teachers' work at all educational levels and fields of specialization. Within the higher education, we can conceive also another form of application of research-based teaching. According to it, research or researching is seen as a skill graduates equip themselves for working life and for their careers mainly outside the university. Thus, the concept of research-based teaching addresses above all application areas, methods and meta skills, which do not touch the topical issue of integrating teaching and students with the research activities carried out in higher education. My first contribution to the discussion will therefore be to suggest the term *research-based* to be replaced by closely related, sometimes synonymously used *research-led* teaching.

Research design:
It is often pointed out that not all students are meant to become researchers. But "to become a researcher" can be defined so as to point at the core of the higher education possibly differentiating it from other spheres of education. The ideal conditions for providing students with opportunities to join the work of research groups at an early stage in their studies may keep us waiting. Nevertheless, what we already do is creating situations in which the students are challenged to take a role of a researcher and carry out their own mini projects. In the poster presentation, I will report of the planning, implementation, and outcomes of one such training course for the second year students, dealing with qualitative research methods in educational sciences. The course was carried out collectively by four teachers at the department of education. However, the focus of my interest will be on the students' way of talking about their projects when presenting them in a poster format to the rest of the group. Can we discern characteristics of talk which can be labeled as "research-led", or are there some problems manifest in talk revealing the inadequacy of making the students researchers on their own?

Findings:
The findings of my exploration are preliminary and still in the process of making. The emphasis of the presentation will be on the teaching process itself and in its subsequent phases. The talk of the students when presenting their research projects will be reported and analyzed in more detail trying to tackle the questions of my research design. A couple of the students' posters reporting of their projects will be attached to the presentation.

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Fiction and learning – searching for the connection

Introduction

Academically educated person ought to have an extensive knowledge of a particular discipline but in addition he or she needs cooperative skills, creativity and ability to change (Programme for the Development of Teaching and Studies, 2002). The role of various personal skills is essential among the professions such as physicians and teachers in which human interaction form an integral part of the work. A vertical study module called "*Growing up to be a doctor*" has been developed to meet these needs at the Faculty of Medicine in the University of Helsinki. The main aims of the module are to support the professional growth of the students by improving the understanding and control of personal emotions in communication, and by enhancing the capacity for empathy. The aims of the study module are in large part concurrent with the aims of many medical humanities programs in Britain and USA. These programs take advantage of humanities and social sciences as well as of various art forms. Integrating literature in the curriculum is thought to have both intrinsic and instrumental educative value (Greaves et al 2000).

The ways of approach to literature in teaching are manifold, as is the potential of literature for learning. Literature has the special power in drawing the reader into experience (Langer 1995, 7). Moreover, the disorienting dilemmas that literature presents promote self-reflection in the reader and have the potential for developing the reader's meaning perspectives, i.e. beliefs, values, theories, through which we perceive, think and interpret the world (Mezirow 1990, 18). In the medical context, Squier (1998, 131) argues that, "the chief value of literature is the inherent complexity and holism of the story medium which reflects the complexity of real people living real lives, thereby allowing the student to reach a deeper and more comprehensive appreciation of the patient's predicament." Although much is written about the pedagogical value of literature, there is still a need for theoretical and empirical research, especially in the context of university teaching.

How did we do it?

In this paper, we describe and analyze a literary seminar for medical undergraduates, and discuss the function of literature in the research-based medical teaching as well as the challenges of literature teaching for educational research. In autumn 2004 an optional literature seminar of three hours was offered to the eleven sixth year medical students as a part of the study module "Growing up to be a doctor". The students read Raymond Carver's poem *What the Doctor Said* and Franz Kafka's novella *The First Sorrow* before the meeting. In the beginning of the seminar the students wrote down their feelings and expectations, next they talked about the texts, and in the end they wrote down the immediate feedback of the meeting.

Data and the results

Our data consist of the students' writings and the transcript of the audio-taped group discussion. Based on the qualitative, thematic analysis of data we found four main process elements that seem to be beneficial for the future doctors. First, the students valued the discussion itself as a rare opportunity during the medical studies. For them it was instructive to formulate and defend arguments in the group as well as to get to know the ways other students ponder over their reading experience. Second, the students saw that sharing thoughts about the texts both broadened and deepened their personal interpretation and set their personal views into a new context. Third, the seminar helped the students to get an insight into the relevance of subjective experience in

general. Fourth, they had an occasion to deal with the themes of ambiguity, uncertainty and incompleteness of life that were drawn to the discussion from the fictional texts.

The ability to cope with ambiguities is highly relevant for future doctors. Moreover, the implications of subjectivity in medicine and in the clinical work of a doctor are manifold. The recent discussion has, for instance, focused on the expiring of patriarchal attitudes of doctors and the importance of patient's perspective in health care.

Basing on our results we claim that during a short literature seminar various cognitive, affective and social processes got started in the students. These processes are clearly linked to reading the texts, to talking about texts, to listening to others, and to sharing ideas with others. It is noteworthy that in a literature seminar, like in literature itself, the form and the content are inseparable. From the pedagogical point of view this means that both the content and way of expression of the texts, as well as both the topics of the discussion and the discussion per se has potential for learning and development. Dealing with two ambiguous and complex fictional texts in the 'experience-near' context enabled the students to develop their understanding about themselves and other human beings.

For the round table we want to open following questions:

How would you describe learning in this case study?
How would you evaluate learning in this case study?
What theories of learning are relevant to literature teaching?
What would be the role of arts and literature in research-based university teaching?

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Working group on chemistry and cultural heritage, European chemistry thematic network - Joint European educational initiatives

Several educational initiatives undertaken by the Working Group on the diagnosis of European cultural heritage are now available. The presentation will include:

(a) An e-course designed for undergraduate students interested in applying chemistry in the preservation of works of art; and dealing with the materials and techniques used by ancient craftsmen and artists.
(b) The interrelation of the above mentioned e-course and the satellite monitored distance course IKONOS on in safeguarding Mediterranean cultural heritage on Cultural Heritage.
(c) the web site of the activities of the Working Group partners.

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Teaching electrophysiological measurement techniques to students with little knowledge in electronics or electrophysiology

Electrophysiology is a method-based branch of physiology and biophysics, where electrical signalling of excitable cells (mainly neurons and muscle cells) and the underlying molecular mechanisms are studied using microelectrodes. Experimental approaches include passive monitoring of electrical signals as well as active methods, in which the cell's membrane potential is fully controlled by the investigator and his/her equipment.

Electrophysiological measurement techniques may be fairly easy to learn and understand, provided that the student has a strong background in physics and/or electrical engineering. However, in such cases, students rarely have even the minimum required knowledge in cellular physiology, which is a prerequisite for understanding the aims of electrophysiological experiments. On the other hand, biology students very seldom know anything about electronics and their limited skills and experience in mathematics prohibit teaching based on circuit analysis.

A two weeks lasting hands-on course (5 hours / day) in electrophysiological measurement techniques has been arranged at the Department of Biological and Environmental Sciences, University of Helsinki, annually since 1984. The teaching methods used on the course have been continuously developed, and the purpose of this presentation is to report results obtained during these 20 years.

After the course, students should know and fully understand the following:

1) Basic concepts and laws needed to describe and analyse electrical circuits, i.e. the "language of electronics". Mathematics is kept at the minimum.
2) Using the common language of electronics, a description of i) the biological preparation (usually a single cell), ii) microelectrode(s), and iii) key features of amplifiers and other equipment.
3) Equivalent circuit representation of various real measurement arrangements. In other words, description of the cell, electrodes and equipment with a single equivalent circuit.
4) The widely-used current passing and voltage clamp methods and applying these methods to reversal potential measurements.

Our everyday life does not provide us with experiences that would give us an intuitive understanding of electrical phenomena. During the course, such missing empiric knowledge is compensated for when the student is introduced to a number of representative simple cases that serve as references for the student's own mental processes of learning. The cases are chosen so that each of them can be presented in parallel with an analogous case where electrical parameters

are replaced by more familiar ones, such as water flow or pressure. When students find these analogous examples self-evident, they can shift their non-verbal ideas of understanding to the electric case. At his stage no practical hands-on exercises are performed and teaching and learning takes place in five steps:

1) The question concerning a given electrical structure and signal is defined briefly and visualised with a schematic drawing.
2) An analogous case, familiar from everyday life, is presented and illustrated with a schematic drawing where functional elements have positions matching their equivalents in the other figure.
3) The two cases are compared and discussed until the students tell the easily find an evident functional similarity between the two cases.
4) The above steps 1 to 3 are repeated while varying the cases studied. New examples of electrical phenomena are compared to analogies as well as previously discussed electric cases.
5) Step 4 is repeated again and again and the use of non-electric analogies is gradually decreased.

With most students, the strategy described above generates a feeling of understanding resistive as well as RC (resistor-capacitor) circuits in a few hours of time. This understanding is next put to a test when the students are asked to construct some of the circuits and to carry out simple measurements. Frequently, the simple circuits consisting of a few resistors and a capacitor and constructed by the students differ from the corresponding circuit diagrams drawn on paper. Although the differences are often accounted for by simple mistakes, they sometimes indicate basic misunderstandings which at this early stage can be easily corrected by returning back to the above 5-step learning process.

The purpose so far has been to facilitate learning of the principles of circuit analysis while fully avoiding mathematics or keeping it at the minimum, i.e. learning an intuitive understanding of electrical phenomena in well-defined circuits. The next and more demanding step is to shift this thinking to real cases with cells, electrodes and amplifiers. The above approach takes place in a reversed order and starts again with theoretical examples: In real cells and electrodes, resistors and capacitors are distributed properties of volume conductors. Therefore, these properties are first identified in simplified hypothetical examples and an equivalent circuit is drawn that is then used to analyse the case.

Finally, measurements are carried out using state-of-the art equipment (borrowed from research laboratories). However, an active cell model (specially designed and constructed for this course) is used instead of biological preparations such as brain slices or muscle cells. The model cell generates electrical responses that closely mimic those seen in living neurons. With real living preparations, most of the day would be spent trying to get stable microelectrode recordings from cells and a single mistake when adjusting the equipment could easily make a microelectrode tip fall out from a cell. With a model cell, the students are free to use a trial-and-error approach, since there is no risk of loosing or killing cells upon inadequate use of the amplifier settings.

Students need to learn a lot during the course. Novel ideas are introduced first using simple examples and thereafter repeated in gradually more complex forms several times during the course, i.e. redundance is used to facilitate learning. Therefore, new knowledge builds up in the students' minds as a multilayer structure. Very little or no mathematics is used or needed and the emphasis is on intuitive understanding.

This course is followed by another hands-on course, where the students learn how to prepare microelectrodes and use them in experiments on living preparations.

Feedback from students has been very positive and the learning results have been excellent. However, the teaching strategy used in this study has not been systematically compared to other possible strategies. Therefore, the results, although very promising, only suggest that the strategy has advantages compared to other approaches.

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EchemTest: Question Types in electronic testing testing

EChemTest is a testing platform in chemistry developed by the ECTN Association. Its aim is to evaluate knowledge and skills in Chemistry. EchemTest working groups were set up to design a question database of chemistry and to carry out electronic testing through web. The questions are meant for students from secondary schools and universities as well as for anyone who are interested to test his knowledge in chemistry. The beta version of the web-based test is now in operation. The each of the tests in **EChemTest** is a one hour session composed of up to 30 questions of different types, taken at random from a large question bank, covering the European Core Chemistr y Program at three different levels of study:

1) end of compulsory education (General Chemistry 1),
2) beginning of University studies (General Chemistry 2)
3) end of University Chemistry Eurobachelor studies (Analytical Chemistry 3 ; Inorganic Chemistry 3 ; Organic Chemistry 3 ; Physical Chemistry 3)

Most common question type in electronic testing seems to be multiple choice. The EChemTest working groups created and collected suitable test questions from different sources. Initially most of the submitted questions were multiple choice though there other types, such as fill in blanks, text match, numeric, pull down lists with true/false or yes/no choices, and ranking questions. The submitted tests were converted and adapted to electronic form. The choice of question types was also limited by the commercial software used (Question Mark). At the proofreading stage it became evident that some types such as essay, fill in blanks, text match, ranking, yes/no questions were considered unsuitable. The EChemTest organization decided to recommend the multiple choice or multiple response questions (with 5 choices) as well as drag and drop or numeric questions.

Drag and drop type is very well suited for questions involving reaction equations. A novel question type was introduced (using the software developed at the Technical University of Vienna). This allows the answer to be entered as a structural formula., a feature especially suited for organic chemistry questions.

The evaluators of EchemTest seemed to accept the use of multiple choice questions but suggested that there must more than three detractors in a question. Also they recommended the use of feedback. In the pretesting the multiple choice /response questions did not produce any problems.

In conclusion, the preferred questions type in the EchemTest in multiple choice. For instance in General Chemistry 1 question bank there are 53 % multiple choice, 25 % multiple response, 11 pulldown and 4 % drag and drop questions