[abs ID] PAPER TITLE

Author ID : PC
Name : Per
E-Mail : Christiansson
Affiliation : Aalborg University, Denmark
Postal address : Sohngaardsholmsvej 57, 9000 Aalborg

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CONTENT

IT IN DISTRIBUTED OPEN LEARNING ENVIRONMENTS

Per Christiansson [1]

ABSTRACT
The paper accounts experiences, and analyses ongoing open IT supported education's at Aalborg University. The requirements and properties of distributed learning systems are explained as well as available IT-tools support and requirements on underlying application and user models. Pedagogical models are developed to support project organised problem based learning environments. Students are situated at different places in Denmark and meet in person once a month during a weekend seminar. New learning IT tools are introduced to support self study, project work, self tests, project delivery, and course administration. The open Master of IT education and IT courses in the Civil Engineering and Architecture&Design curricula are used as examples for discussions on course information content, structure, and personalised IT tools and their properties. Our conclusions are that we are only in the beginning of development of cross-disciplinary university courses in a global setting with highly communicative IT tools in contrast to traditionally open environments. It is also concluded that IT supported distributed learning provides us with excellent possibilities to advance the learning methodologies suitable for life long learning and to render existing courses more effective. There is a great need to raise the IT competence of the teachers to meet the needs for and carrying through of the changes in education on all levels. We will in the future see a closer natural collaboration between universities in course development and experience exchange.

KEYWORDS: distributed learning, IT, experiences, project work

1 INTRODUCTION

Computer tools were introduced in the education during mid 1960s. At that time we used paper tape input and got 10 character per second print output on the Teletype. During the late 1960s main frame computers were introduced as well as punch card I/O devices. Computers were used in research and Master Thesis works. Around 1970 mini computers (e.g. Hewlett Packard, Digital Equipment) were installed at the university departments. In 1971 we were roughly 5 mini computer owners at Lund University. Our first computer, 1971, at the department of Structural Engineering was a HP 2114A with 8 kwords (12 bits) of main (core) memory and 0.5 Mhz processor speed. The cost in today's price was 30.000 US dollars. The price performance relation at that time was thus 30.000/0.5=60.000 and is today 1000/400=2 i.e. a factor 30.000 (30 years with doubling in 18 months gives 2**15 = 32768 according to Moore's law).

The learning process has not changed to any considerable degree during the latest centuries. A big shift came when the art of printing was introduced during the middle 1400

[1] Prof. IT in Civil Engineering, Dept. of Building Technology and Structural Engineering, Aalborg University, Denmark. http://it.civil.auc.dk, pc@civil.auc.dk

(Guthenberg) and it become practical and less expensive to pack and distribute information to a large audience.

The most important changes due to introduction of IT in the learning process are (or will be),

- higher emphasis on *learning* (and learning to learn) than teaching,
- the teacher becomes more of a *tutor* (coach, facilitator) than an information disseminator,
- higher possibilities for *distant learning* (not in a physical but in a virtual class room),
- *life long learning* perspective becomes an important issue (time independent learning),
- new types of *interactive learning material* with more realistic and user adapted interfaces,
- greater possibilities to combine courses from different universities (*virtual universities*),
- possibilities to adapt and/or develop *new pedagogical methods* with respect to learning material, learning modes (exploration, discovery, problem based learning etc.), student competence and intelligence profile, collaboration, teacher roles, and social contexts,
- higher demands on *client competence* in connection with specification of distributed learning system and tools.

and

- IT in itself does *not* improve pedagogy and learning methods,
- high accessibility to vast information and a great variety of IT-tools puts higher demands on teachers to model learning contexts and users expectations and abilities – *situated action* (Suchman 1987),
- IT-tools and knowledge representations used must be (at least implicitly) *described* to the learner.

The paper accounts experiences, and analyses ongoing open IT supported education's at Aalborg University. The requirements and properties of distributed learning systems are explained as well as available IT-tools support and requirements on underlying application and user models.

Our IT education experiences are based on course and education systems development as well as teaching from around 1970,

- 1972 course in "Computer Controlled Measurements and data manipulation and presentation" at Lund University, Sweden,
- 1983 courses in "Cad, and 3D- and database modeling using Medusa", (Christiansson and Herrera 1985). Workstations were expensive (25.000 US$),
- 1986 post graduate course in "Knowledge Based System",
- 1992 "New tools for knowledge transfer - development of hypermedia systems", (Christiansson et.al. 1992),
- 1995 "To use and evaluate MultiMedia". " and "Make your own MultiMedia Application"
- 1996 design and development of Lund University Virtual Interactive learning Tool, LUVIT.

and from 1998 courses and educations at Aalborg University in Denmark see also http://it.civil.auc.dk/it/education/

- courses in IT in the building process for civil engineers
- modeling and digital presentation for Architecture & Design education

- human computer interaction in Master of IT, MI, open education in Distributed systems (a three year half time education with specializations in Building, Control, Real time systems, Production and Systems administration. See also http://it.civil.auc.dk/it/education/master_it_open/index.html http://www.mi.itorg.auc.dk/

2 LEARNING CONTEXT. THE AALBORG EXPERIMENT

The learning process has not changed to any considerable degree during the latest centuries. A big shift came when the art of printing was introduced during the middle 1400 (Guthenberg) and it become practical and less expensive to pack and distribute information to a large audience.

The PPBL, Project and Problem Based Learning, methodology was introduced 1974 at Aalborg University. From (Kjersdam and Enemark 1994): "The curriculum in engineering as well as in the natural science is project-organised from the day the freshmen arrive until their graduation. The first year the freshmen learn to work in project-groups. The next two years in the undergraduate programmes the project work is mainly design-oriented. The last two years in the graduate programmes the project work is mainly problem-oriented (Problem Based Learning). ..... The duration of each project is one semester. In the programme half of the time is distributed to the project work, 25% to courses related to the project and 25% to courses related to the curriculum."

The system is resource demanding in office-space, supervision, constantly changed or renewed lecture contents due to high adaptability to University external and internal demands. But it is also an effective model. 80% of the students pass their examination at the prescribed time.

IT-supported open MSc education has been run since 1991 at Aalborg University. The project/problem based learning pedagogic method is reported to strongly support new ideas on life long learning, (Bygholm and Dirckinck-Holmfeld 1997). The same authors also report that it is very favourable to start the education with a (partly guided) pilot project for the students to get acquainted with new ways of working and collaboration, project group forming, using new IT-tools etc. It is also important that a pedagogical dramaturgy is defined to support positive experiences and engagements to avoid student emotional blocking. Dramaturgy is closely linked to *user models* supporting user action, roles, emotions, cognitive processes and language.

PPBL will also provide the fundaments for a beneficial development of creative and critical student thinking techniques as well co-operative and collaborative learning with WWW support, see (Bonk & Reynolds 1997). The prerequisites are there for the open minded creative collection and exchange of ideas within groups and with tutors, collaborative problem solving, reflection, evaluation, and efficient visualisation of the processes.

The 'IT Innovation at Aalborg University' project concentrates on the university application of information and communication technology in teaching, research and administration and is intended to make visible and utilise the experiences already gained by the departments of the university and its students, see http://www.iti.auc.dk/English/. Other collaboration initiatives are European University Network for Information Technology in Education (EUNITE), and European Consortium of Innovative Universities (ECIU) http://www.eciu.org/.

3 THE DISTRIBUTED LEARNING ENVIRONMENTS

3.1 Definitions and context

First let us make a *definition* (Christiansson, 1999)

> "Distributed learning takes place in a virtual learning space that expands the conventional study chamber and classroom in time and room with regard to learning style and interaction modes as well as learning material and learning methods".

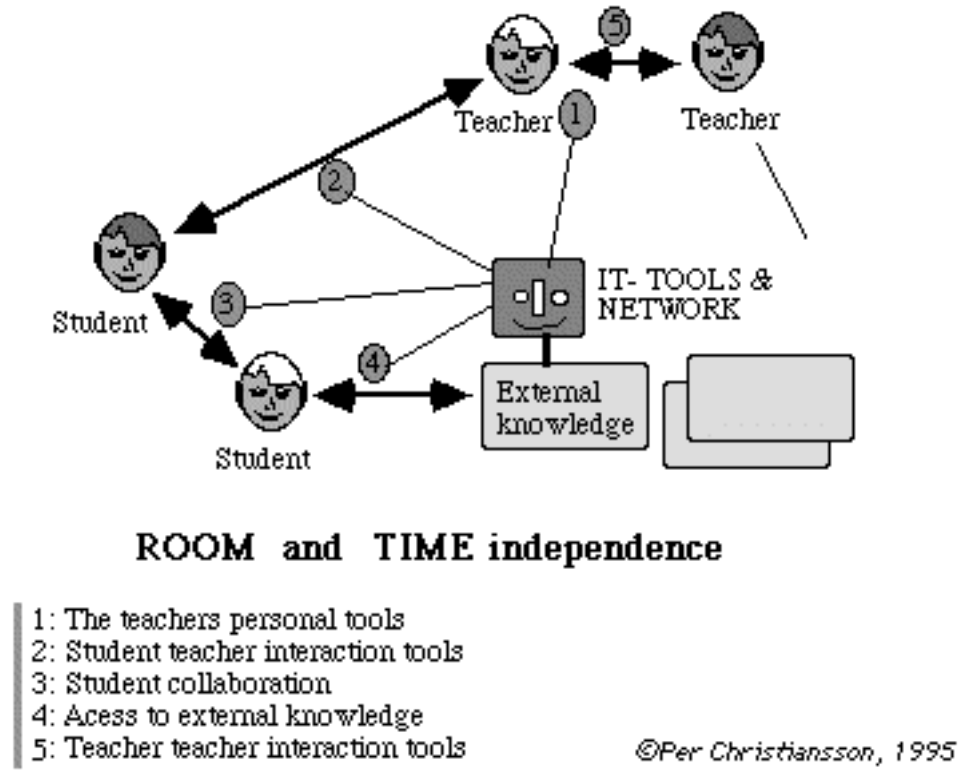

Figure 1. IT tools (new and existing) will support collaboration and information access support in a distributed learning environment.

Figure 1 provides a map for how IT can support communication in a distributed learning environment. The learning activities goes on in rooms/spaces aimed for personal work, group work, lectures and whole course/class activities. IT-tools will support personal communication and provide communication support with educational artifacts. It should be possible to

- create personal, group, and course *rooms/spaces* (physical and virtual) as well as social meeting places.
- create *working areas* for the mentioned spaces
- ensure *communication* bandwidth capacity and network functionality (QoS, *Quality of Services*) for chosen information contents and communication requirements,

- provide *access* to physical and logically shielded nets from home, company, permanent/temporary university group workplaces
- provide mechanisms for personal, methodological, course, and system *developments* (easy feed-back mechanisms, help functions as wizards/agents, self tests, transparent system structure, client computer platform independence, expandable and flexible system, history recording of document and software changes, versioning, etc.),
- provide course, group and personal *administration* functions (e.g. planning, calendar, external database connections).

3.2 User models and learning styles

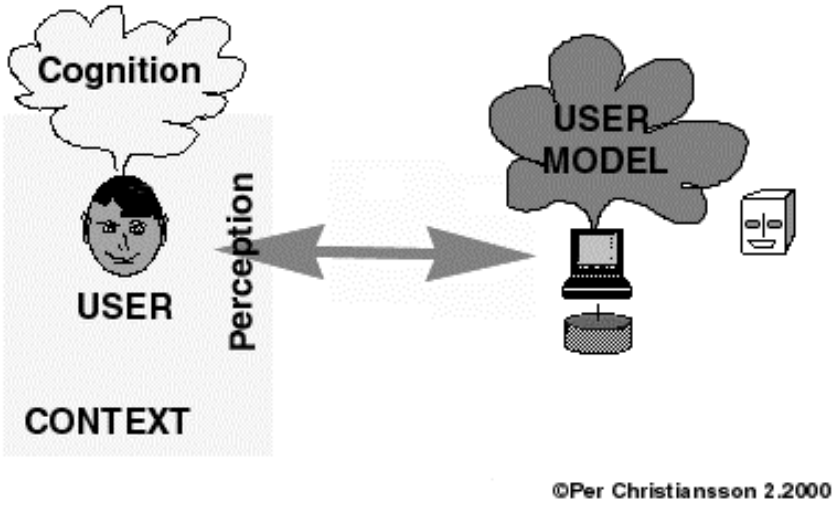

Figure 2. Computer systems explicitly or implicitly contains models of the user

From Merriam Webster:
Cognition = the act or process of knowing including both awareness and judgement; from co- + gnoscere to come to know

Different learner characteristics can be defined. From (Montgomery 1995)

- *Processing* (Active/Reflective)
  Active learners learn best by doing something physical with the information, while reflective learners do the processing in their heads.
- *Perception* (Sensing/Intuitive)
  Sensors prefer data and facts, intuitors prefer theories and interpretations of factual information.
- *Input* (Visual/Verbal)
  Visual learners prefer charts, diagrams and pictures, while verbal learners prefer the spoken word
- *Understanding* (Sequential/Gloabal)
  Sequential learners make linear connections between individual steps easily. While global learners must get the "big picture" before the individual pieces fall into place.

The results of the survey of student learning styles are also reported

- 67%of the students learn best actively, yet lectures are typically passive;
- 57%of the students are sensors, yet we teach them intuitively;
- 69%of the students are visual, yet lectures are primarily verbal;
- 28%of the students are global, yet we seldom focus on the ``big picture.

The example as expected emphasises that we have to harmonise the course material to different types of students minds and learning styles. Our possibilities to provide tools that suites different learning styles should be taken into account as we develop ICT, Information and Communication Technology, supported learning material. The user models are explicitly or more often implicitly hidden in the computer system providing different pedagogical approach and human computer interaction.

3.3 Distributed learning systems. Basic functionality

A distributed learning environment must support a number of functions. As we set-up such an environment we can either try to find a complete system which fulfills our needs or ourselves build a system from existing components, se figure 3.

Before the start of the Master of IT education under the IT-Vest University in Denmark different systems to support distributed learning were investigated such as WebCT (http://homebrew.cs.ubc.ca/webct/), Lotus Notes (http://www.lotus.com, FirstClass (used for a long time at the Aalborg University) (http://www.softarc.com/), and the LUVIT system developed at Lund University in Sweden. http://www.luvit.com/. The choice fell on LUVIT though it was not specially geared towards group collaboration in project work.

Below some general experiences from educational IT-support systems development and use are recorded, see also (Christiansson, 1999)

- *client competence* to support requirements formulation is often low (both on IT and methodological issues),
- actively *involve end users* in the requirements phase from the start of the project and onwards. Though be aware that non-linear thinking required for hypermedia design as well as knowledge on the influences of new IT-tools on learning methods usually are under developed (use learning by doing and best practice dissemination),
- follow up *costs* is often underestimated (e.g. new skills needed, change of working methods and organisation structures, server maintenance, long term course material and student documents storage),
- strive for client computer *platform independence* (Mac, PC and Unix). Today possible through use of WWW and Java Virtual Machines,
- it may be necessary to differentiate between video (ISDN) and shared workspace (TCP/IP) *physical communication channels* . TCP/IP today best handles sound and still images only,
- be aware of the very different requirements posed by learning *context*, pedagogical *methods* and knowledge *content*,
- create *four user levels* for the learning environment - students, teachers, course administrator, system,

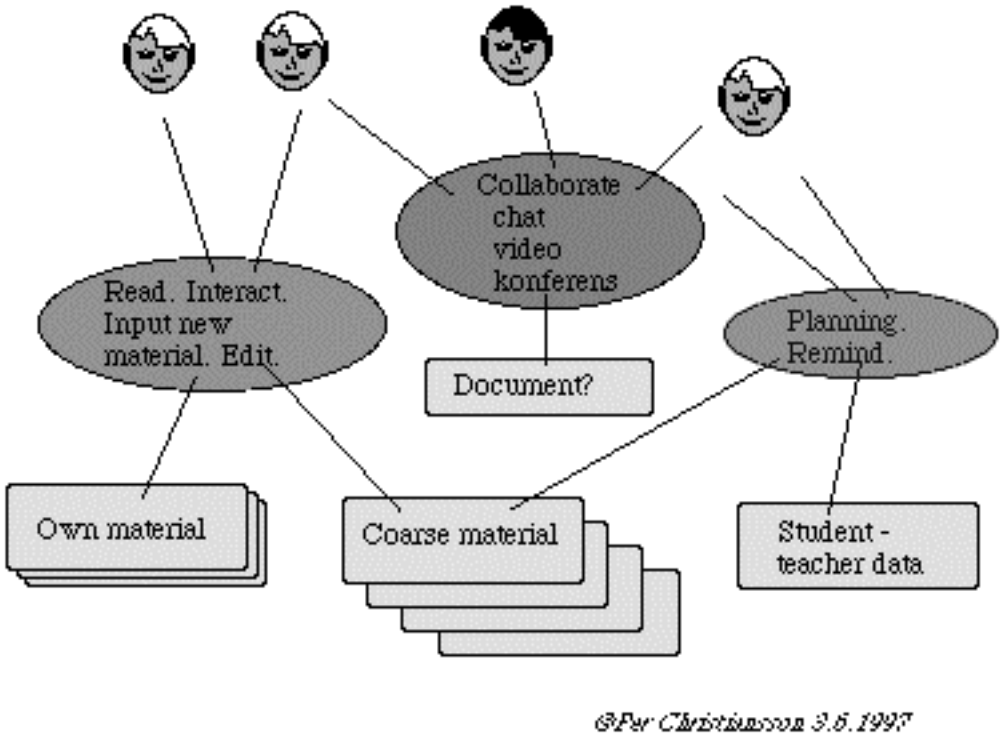

Figure 3. Main services in the distributed learning environment.

- *course material* should typically support self study and tests, lectures, individual and group exercises, project work, and social contacts,
- *teacher HTML knowledge* is required for optimal course development performance (high level WYSIWYG HTML editors are not good enough),
- *student HTML knowledge* is required to make project webs (not enough with copy-paste from good examples on the WWW),
- system *administration domains* are typically - student personal, student group, teacher, teacher group, department, university internal and university external,
- be open for using English instead of your national *language,*
- create good user *feed-back* facilities,
- system *availability* must be100%.

4 EXPERIENCES FROM DISTRIBUTED IT SUPPORTED LEARNING

4.1 Communication, project work, and virtual classroom

In the Master of IT, MI, course students are situated at different places in Denmark and meet in person at Aalborg University every six week at a *weekend seminar* for deeper social contacts, personal contact with course tutors, collective questions answering, guest lectures, group works, and final examines. New learning IT tools are introduced to support self-study, project work, self-assessments, project delivery, communication and course administration.

Experiences are reported earlier in (Christiansson, 1999) for example concerning remote teacher - student group interaction. In one case two parallel communication channels were used namely ISDN based video and shared application over Internet. Some experiences concerning collaborative work from this and earlier activities at KBS-Media Lab at Lund University are,

- video/sound connection over *Internet*, e.g. over a CuSeeMe reflector (Modin 1995) is only adequate using very low image update,
- very good *social connection* may be achieved with the teacher/coach who though wished to have better eye and body language contact with the students (video cameras can be controlled remotely and should be pre-set at different positions),
- *shared applications* work very well both for collaborative production work and creative sketching (Timbuktu from Farallon Computing Inc. and Netmeeting from Microsoft Corp.)

When group communication takes place outside the University and the students sit at home or at their companies (as is sometimes the case in the MI education) high quality synchrounous multimedia communication is harder to achieve due to bandwidth limitations. Email is used extensively with references made to documents and project works at group project webs. The communications with teachers/tutors are also done with email. Some tutors (mostly as listeners) participate in the group communication. Some project work are preferably done at the weekend seminars, typically conceptual system modelling , creative design, job scheduling and overall time planning.

Learners demand on communication is on

- efficient *navigation* in the learning material (available on Internet and sometimes CD)
- distributed *group communication* (messaging, direct communication, and documentation of communication)
- possibility to flexible *project web* access (possibly protected)
- *bandwidth* (strongly influences group collaboration)

4.2 Student view on learning material

The coarse material accessible from the education web consists of

- education and courses descriptions
- weekend seminar contents (if applicable for the education)
- lecture notes
- books and paper references
- papers and other course material
- exercises
- self assessment tools
- evaluation forms

In the MI courses the student group have access to separate servers for implementation and test of for example web-database application developments with applet-servlet technique to prevent fatal errors on education servers.

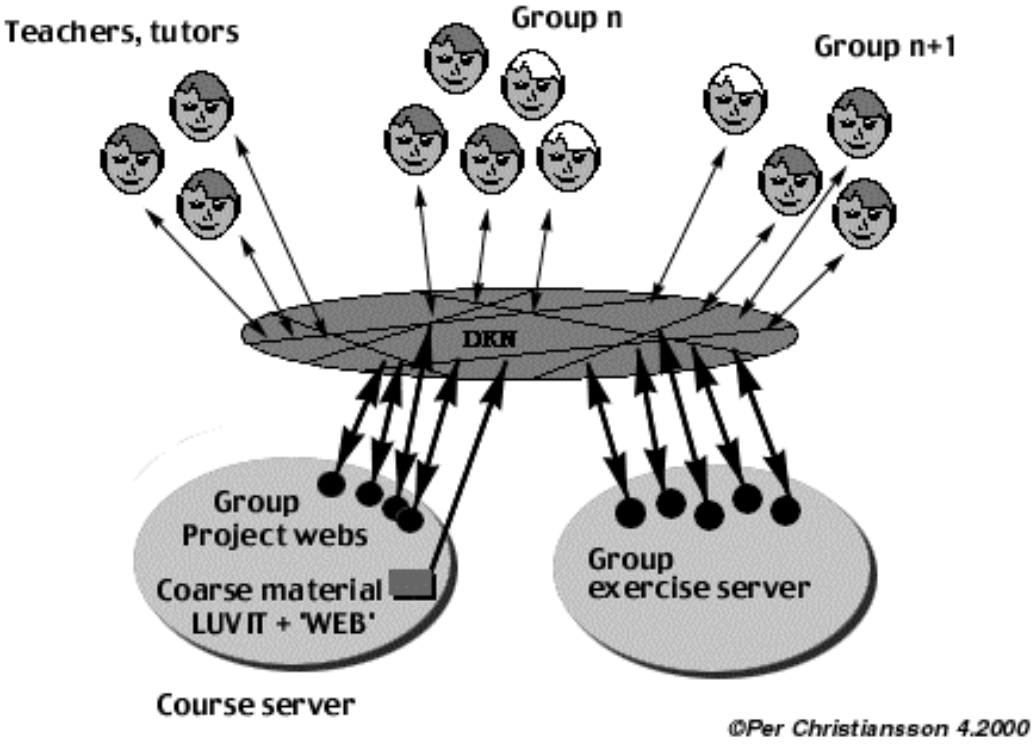

Figure 4. MI students have access to a protected course material server and separate exercise web servers. Student communication is mostly done via email and to some extent via chat and Internet video/application sharing (Netmeeting).

Project webs are increasingly used also in the University located courses. The project webs typically contains project group member presentations, project descriptions, continuos project documentation and collaboration material, time plans and schedules, links and references to project resources and results, exercises results, and communication documentation (chats, emails etc.)

Figure 5 shows a typical example on lecture notes in this case from one of the courses, Human Computer Interaction, HCI, in the MI education.

4.3 Teacher view to system

The distributed IT-supported learning environment poses new challenges to teachers in developing new courses and re-engineering old. New working methods are introduced as well as new routines for course maintenance, changes in learning methods and pedagogics, and development of efficient collaboration within and between universities.

It is tempting to create a web of learning material that continuously is improved based on updates of a only low level information chunks. Ordinary books forms a self contained unit where presentation and storage medium is static and as a whole revised to new versions (editions). Figure 6 indicates that a teacher can create chunks of general slides and learning material that independently can be updated and together form/link to a dynamic 'book'/course material (the CN node).

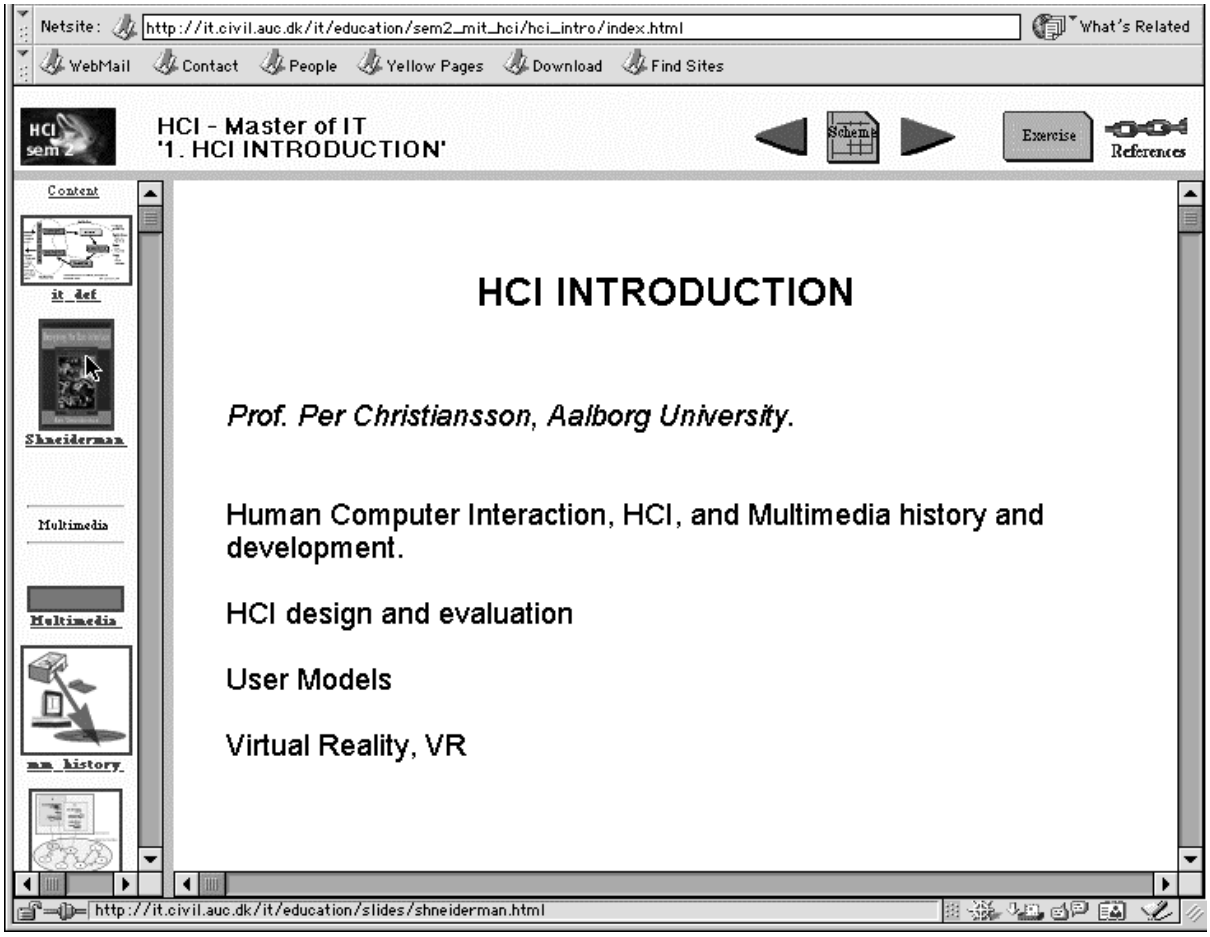

Figure 5. Lecture notes are organized with course specific 'content' page, exercises, references and scheme. The 'slides' are picked via link from a slide repository.

My personal view is that it should be possible to trace the development of courses and that learning material should be dated to reflect what students learned at a certain time, That is the course content and references should be maintained in that year course edition. 'Slides' linked to lecture notes may though from efficiency demands be updated but could beside /latest update/, (previous update), [creation date] have internal date marks for updated content to reflect progression.

It is important that each 'knowledge node' in an educational network has a *responsible* 'publisher'. This may often lead to local storage of referenced material not produced at the publisher site. That is a local copy of the document is stored on the course node, CN, to ensure access even if the referenced original is removed. Copyright issues must here be cleared out.

The new educational shells like LUVIT gives new possibilities to enhance course administration and to introduce new services like documentation of student use of different services, and learning materials. The drawback is that a rather time consuming up-loading to education node (EN in figure 6) must be made each time a change is made in the teachers local course node repository (CN). If only links to local CNs are stored in EN the distributed approach is at hand.

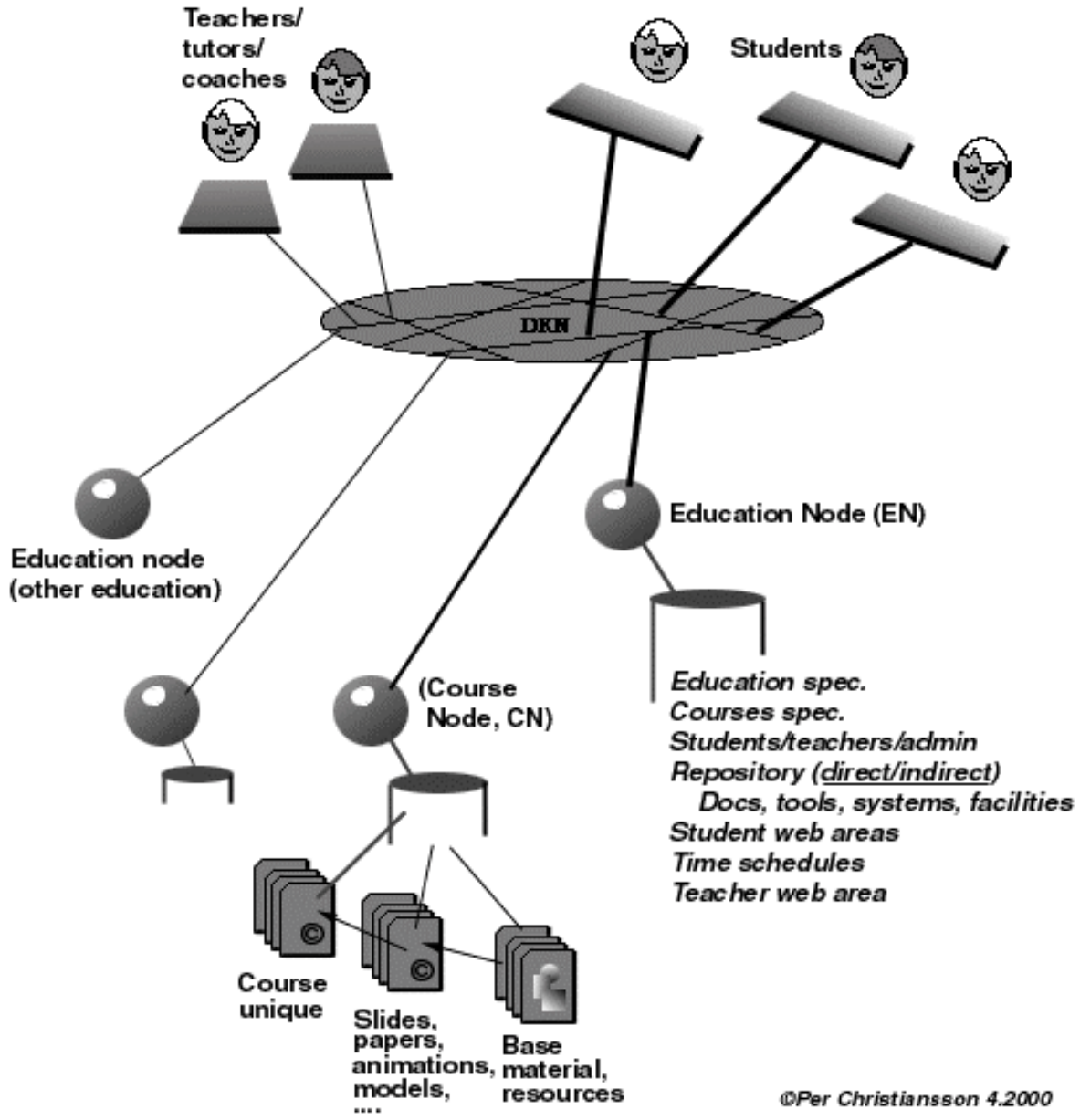

Figure 6. Students main education access is through the Education Node, EN. If all traffic is channelled through EN it is easier to create administrative data as 'who-is-on' and 'when', and 'who has accessed what'.

In case of use in inexperienced teacher's environments a tool like LUVIT has it's obvious advantages to handle course material in a closed form. The QoS of such systems must though be further improved.

Curiously enough we have experienced many young students not to feel comfortable with using WWW based (computer stored) documents as a main source of course material and a source to valuable information and further references. Also many teachers have difficulties to adopt to new additional (i.e. IT-supported) forms of tutoring and project follow up.

5 CONCLUSIONS

We are only in the beginning of development of cross-disciplinary university courses in open environments with highly communicative IT tools in contrast to traditional classroom teaching. IT supported distributed learning provides us with excellent possibilities to advance the learning methodologies suitable for life long learning and to render existing courses more effective. There is a great need to raise the IT competence of the teachers to meet the needs for and carrying through of the changes in education on all levels. We will in the future see a closer natural collaboration between universities in course development, and experience exchange.

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