



# **Uses and Benefits of Information and Communication Technologies in Distributed Learning System**

Post-graduate Thesis  
In Information and Communication  
Technology

by

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## Preface

This project is a part of the master degree education (sivilingeniør -- telematics) at Agder College (Høgskolen i Agder, HiA). The thesis has a duration of 5 months and is valued at ten credits (vektall).

The project is a collaboration between HiA and Telenor Kompetanse. Michael Spector (HiA & UiB) is the teaching supervisor for HiA, and Frithjof Fjeldstad is the project supervisor from Telenor Kompetanse. Kristian Folkman is the technical advisor for Telenor, and Lars Line is the technical advisor at HiA.

Grimstad, 28 May 1999.

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# Abstract

## Purpose and Methods

The paper is a presentation of my post graduate thesis at HiA. The focus of this study is Akademiet, a distributed learning system developed by Telenor Kompetanse in Grimstad, Norway. Akademiet is a web application developed for use by Telenor employees and clients who wish to take courses facilitated by the Internet.

The increasing dissemination of networked computers, especially via the Internet, enables and accelerates changes in our educational system. Many reforms sought in education are exemplified and realized through this new distributed learning situation. We have gained some insights into what new conditions distributed learning systems impose on the participants. Examples are users ability to work asynchronously, to communicate via the web, participate in collaborative efforts via multi media applications, simulate complex problems by use of computers and networks and the increased flexibility in deciding what, where and when to study. Other aspects of our knowledge are limited. One of the key aims of this effort is to develop an understanding of possibilities and constraints of distributed learning systems in the following domains:

- Educational changes with respect to distributed learning situations, especially with regard to technical, organizational and pedagogical issues.
- How these changes mediate and effect social interactions and knowledge construction in a complex manner.

It is difficult to design good learning environments for use in distributed learning systems. Most current design and course development in this area proceeds primarily on technical premises, with other relevant aspects, such as pedagogical approach and social situation, given only secondary consideration. The main goal of my study is to improve the quality and to increase the efficiency of learning in distributed learning systems, with the focus on Akademiet. My basic argument is that a broader view of design, development, and deployment which takes into account organizational and pedagogical issues as well as technical conditions, with attention to context, is more likely to produce improved learning.

In order to make recommendations for improving Akademiet, including how courses should be designed, which applications are appropriate, and how they should be implemented, it is important to have solid background material to support my views. This background consists of both a sound theoretical perspective derived from a review of educational research literature, and empirical data collected specifically with regard to Akademiet.

Primary data was gathered by investigating Akademiet and its surroundings. Secondary data was collected by examining other distributed learning systems, both domestic and foreign, by reviewing other research findings, and by general information gathered through the Internet and literature. Questionnaires were developed and distributed to students at HiA and employees of Telenor; not all of those answering questionnaires had experience with Internet courses. The employees in Telenor who were surveyed did have access to and experience with Akademiet, so results from that research are directly related to Akademiet, whereas other survey data provided a general framework for background considerations. I had several conversations with highly qualified researchers in this area. Various persons in the research staff at Telenor Kompetanse and at Telenor FoU gave me relevant feedback and information for use in this study. I believe that the results from Akademiet, my own research, and these discussions provide a solid background to support my findings and recommendations.

## Summary of Findings and Recommendations

Course development is too often driven by technical constraints and considerations, with pedagogical and organization considerations getting only secondary treatment. The result of inadequate attention to organizational, social and pedagogical issues in the design and development of distributed learning systems is reduced learning effectiveness and marginal benefits to individuals and organizations. Fortunately, this situation can be improved using the available technologies involved in the learning environments.

To understand educational changes associated with distributed learning situations, we need to take into account the entire learning situation, including technical aspects as well as organizational and pedagogical aspects, with particular attention to the way that all of these mediate and effect social interaction and knowledge construction

[21]. Activity theory, distributed cognition, and other related theoretical perspectives suggest fundamentally new ways to design and form distributed learning environments.

The results which are presented in this task are examples of conditions, and not necessarily generally features in educational establishments and organizations. Through the research these conclusions are made:

- Through use of ICT the teaching gets more individualized and fluctuating.
- Use of visualization increases.
- The focus is on student roles. New opportunities to make connections between the students and their interests are possible.
- Motivation can increase among students with a positive attitude, where age, education and living situation influences the motivation by the technology. There is not any indication that the gender influences the motivation.
- Positive sides with classroom education can be described with; good social settings, and the negative sides with; bad individual needs. In distributed learning environments the respective headwords are; personal needs / adjustments, and; isolation.

New technologies introduce new problems with regard to planning and implementing support for learning. As has been historically the case, it is not the new media that dictate how and what can be efficiently learned. Rather, it has been the understanding of the possibilities introduced by new media and then the effective integration of those possibilities into sound pedagogical frameworks, which has proven effective in improving learning. All too often, we have failed to effectively integrate new technologies into learning, and much of this failure is a result of continuing to do what was appropriate for older methods and settings.

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# 1. Background

Most people experience increasing influences of information and communication technology (ICT) in their private lives, at work, and in their studies. Rapidly evolving technologies allow us to do things that were not feasible just a few years earlier. At the same time, new ways of living demand new and more efficient, flexible and practical support in all contexts. The banks realized this situation early and offered 24-hour service through the automated teller machine (ATM). Today we find that more and more banks are making use of the Internet. As a result, customers can get their financial errands done quickly at any time and place. Banks are responding to technology developments and social changes rapidly and purposefully. Not all parts of our society have been that responsive to this evolution. The educational establishments have been noticeably slower in responding to changing social and technological developments.

## 1.1 Education in the Information Age

This entrance into the information age has made our needs for new knowledge more essential. Learning has become a life-long process. The increasing dissemination of networked computers, especially via the Internet, enables and accelerates changes in our educational system. Many reforms sought in education are exemplified and realized through these new technologies. The activities of teachers and experts, along with web-based learning resources, can reach students distributed in time and space. Students outside formal educational institutions can also participate, as the networking infrastructure allows widespread connection to the Internet.

The increasing complexity of the problems and challenges society faces places new demands on education, while technology advances afford new opportunities in education. For example, globalization at the economic level has underscored the interconnectedness of many different sectors and problems. What happens to what might have been thought to be a local environmental resources (e.g., a fresh water lake in Norway) might be related to economic conditions in another country (e.g., German industrialization). Learning to appreciate such complexity and then solve challenging problems related to such complexities is becoming increasingly important. Good uses of technology involve providing rich opportunities for learners to see and appreciate complexity and then solve problems and make decisions in learning situations which involve the richness and complexity likely to be encountered in daily life.

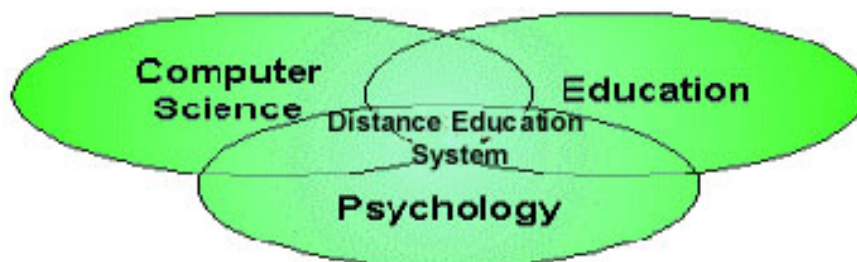


Figure 1.1.1. An integrated perspective.



## Distributed Systems

Technology allows new ways to support learning and instruction. Consider globalization. For economic as well as for technological reasons, working and living contexts have grown in size, in effect making the world smaller. Geographic boundaries are in many situations overcome by the use of ICT tools as Internet or videoconferencing. Persons separated by both distance and time can be brought together into effective learning and working groups using modern ICT. ICT can be used/ applied as a teaching and information tool, as well as a knowledge dissemination tool. ICT offers unique opportunities for educational effects in novel situations involving distributed workers and learners. Using efficient and widely available means such as the Internet can now satisfy the need for alternative educational opportunities as a consequence of globalization.

Individuals, organizations, governments and researchers are all investigating ways and means to design, develop, deploy and take advantage of distributed systems. Because this is a relatively new area of investigation, results are only now being compiled, analyzed, and synthesized, and our knowledge is still somewhat fragmented and incomplete. This has an effect on theory building as well. There is a substantial amount of literature on theories, less agreement on which theoretical platform on which to build distributed learning systems. As has been the case historically, research and development with regard to work environments is ahead of research and development with regard to learning environments. Cases where the two are developing roughly at the same pace and in concert include areas such as flight training and electronic performance support systems (EPSSs). In the case of flight training, the use of interactive simulations is quite advanced. In the case of EPSSs, it is quite common to develop on-line help and tutorials for complex electronic environments as they are being designed, and their successful use in a variety of industrial settings has kept those associated learning developments in pace with the business and industry applications. However, the more common situation is to delay introducing and integrating new technology into learning until long after it has become commonplace in a work setting. One of the more interesting new developments is that this trend is beginning to be less dominant than in the past.

Computer controlled media like hypermedia and interactive multimedia systems are often integrated in distance learning environments. Learners can explore a 3D model of molecules in a science class or watch and hear Hamlet say "To be or not to be, ..." in a literature class. At the same time the teacher might outline the main points of a lecture using a set of bullet charts created with a graphical presentation program.

Macromedia is one of several companies putting efforts into this market, because they expect that the use and demand for distributed learning systems will explode early in the next decade. In 1997, 75% of all training was estimated to be conducted by teachers in classroom settings. By the beginning of the next decade, Macromedia estimates that over 50% of all education will be computer based, and that web-based applications will grow the most, by approximately 400% [16]. Much of this anticipated growth is a result of the Internet.

In this thesis the Internet environment is in focus, and the definitions of the Internet and the web are used as the same term, although there is a difference. The web, or WorldWideWeb, is just a part of the Internet, together with email, ftp, news and more.

## The Internet Learning Environment

The Internet, with its millions of computer connections to homes, businesses, schools, government agencies, and organizations, is redefining how we find and share information. Many community college on-line courses are based on three Internet tools: E-mail, use of newsgroups, and use of the World Wide Web. E-mail is used to electronically send and receive messages and assignments. Newsgroups are ongoing conferences devoted to specific topics. The World Wide Web, a global network of information servers, allows access to documents published by individuals or organizations. The Web browser, one of the most useful Internet tools, is used to retrieve pages from Web servers and display them on a computer screen. In addition to text, these pages may contain graphics, audio, video, animation, and simulation [13].

The last 20 years the telecommunication evolution has found its form in a huge range of application areas and services. This evolution has coexisted with the information revolution and the media merger between telecommunication technology, computer technology and content providers. The personal computer in networks seem to be the winning medium, especially because its performance and rendering capabilities have been doubling every two years for the past twenty years. This is the background for the next generation of communication medium: the networked virtual reality.

New technologies, such as Internet Protocol version 6 (IP v.6) and eXtended Markup Language (XML), will make the Internet an even more powerful tool for distributed learning. Greater use of digital technologies will be facilitated by more reliance on fiber optics rather than copper wire. While data transmission using copper wire has a capacity of about 6 million bits per second, fiber optics can deliver at speeds estimated to be close to 1000 billion bits per second: an information super-highway.

### A Case: The Study of Tomorrow

What will this educational future be like, when new technologies make this information super-highway become an everyday reality? We have no answer to this question, but the following case scenario gives a description of what may be possible in a few years. This case also makes it easier to introduce the scope of the study presented in the next part. The case describes an everyday situation at an arbitrary university, where you are the attending student.

*You have three classes today: Biological Science, English and Mathematics. The first lecture of Biological Science starts at 08:00 A.M. so your personal organizer beeps you fifteen minutes before to remind you of the lecture. You finish your breakfast at your own kitchen and enter the home office. There you log on to your personal university web site via your computer, navigates further to the right course, and the lecture can begin. After a half an hour audio and video conferencing lecture the laboratory exercise is on schedule. The duration of the exercise is estimated to be 40 minutes. You set up the simulated experiment and start the surgical exploration of a frog. You did not prepare well enough, so you search for help in the database of this course. An animation guides you through the first steps, and you get some additional hints how to continue. Your schedule is tight and you must leave for work, so you save your work at your personal file database and inform the teacher that you will finish your exercise in the evening.*

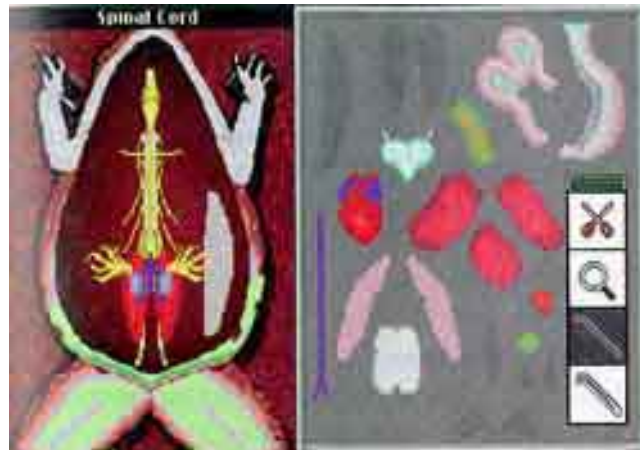


Figure 1.1.2. Simulated experiment of the surgical exploration of a frog.

*After work you get stuck in the traffic on your way to the school, and you missed the beginning of the English lecture at 02:00 P.M. Instead of jumping into a lecture that was already started you go to the university media lab and log on to your personal web site again. There you make a request to the lecture database and instruct the database to display the current lecture from the beginning. Time-shifting the start of the lecture by fifteen minutes allows you to see the lecture from the beginning. The cost is that you can not ask the lecturer any question, because it is not real-time. Fortunately, the lecture is still in progress and should last another thirty minutes, so you invoke the “catch-up” facility. Over the next twenty minutes you watch the first thirty-five minutes of the lecture as the “catch-up” function squeezes out the times of slow movement and silence. Through signal processing, the lecture looks and sounds fast-paced but is otherwise normal. Now caught up with the live lecture, you listen to the rest of the lecture and participate in asking questions together with the other students in the lecture auditorium via the video conferencing system.*

*Once English is over you meet some friends in the canteen for dinner. Afterwards you go off to meet some other students for a group work session in Mathematics. The collaboration group consists of six students, four at the university and two other students located on the other side of the country. The weather is nice so you decide to do the work outside in the park. Therefore you decide which tasks to do and make a new appointment with the two distance students for task evaluation. The four of you go to the park. After an hour you all gather again for a group discussion via the Internet. Then the time is 18:00 P.M. and it is time for some recreational activities, like a computer game, movie or maybe an outing in the woods. Or was it the exercise with the frog you scheduled for tonight? Well, maybe you will find a live frog in the woods!*

## 1.2 Scope of the Study

This paper is a presentation of my post graduate thesis at HiA. The focus of the study is on the collaborative construction of learning contexts in distributed learning settings, with Akademiet as the setting. Akademiet is a distributed learning system developed by Telenor Kompetanse in Grimstad, Norway. It is an application taking ICT into extensive use to facilitate learning.

Because learning has become a lifelong effort both for individuals and organizations, there is much interest in distributed and distance learning. Insights into what new conditions distributed learning systems impose on the participants are limited. One of the key aims of this effort is to develop an understanding of possibilities and constraints of distributed learning systems. To achieve this aim, I have investigated educational changes with respect to distributed learning situations, focusing on technical, organizational and pedagogical issues especially as they mediate and effect social interactions and knowledge construction in a complex manner.

It is difficult to design good learning environments for use in distributed learning systems. Most current design and course development in this area proceeds primarily on technical premises, with other relevant aspects, such as pedagogical approach and social situation, given only secondary consideration. In 1998, when Telenor Kompetanse wanted to develop Akademiet into a new and more modern concept, the development team struggled with this integration issue. On one hand, we had project managers from Telenor Kompetanse. On the other hand, we had the developers, a few students from HiA, including me, working as consultants. The project leaders had marketing, pedagogical approach and social context in mind while working out the specifications of the new Akademiet. The developers focused primarily on the technical aspects. Our primary motivation in developing new features and functionalities for Akademiet was to see if they could be done so as to make Akademiet the most advanced technical system possible. This way of thinking and decision making did not necessarily lead to good pedagogical solutions, but it did lead to some impressive technical solutions.

## Technical Focus

This technical focus, I think, is a reflection of our technological background and education as engineers. In these surroundings, there was a tendency towards a narrow view [21]. In my work on this master degree at HiA and through my work at Telenor Kompetanse, I have acquired a wider view of the complexity in these contexts. To further strengthen my competence outside the technical domain, I have chosen this study as a way to consolidate my understanding of the need for a broad and integrated perspective with regard to technology, users, and impacts.

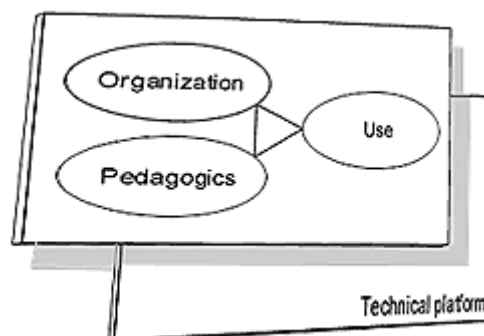


Figure 1.2.1. A holistic presentation of technology based learning.

It is important to get all the elements into consideration to get a holistic view. So the purpose of this study is to improve the quality and increase the efficiency and the collaborative shaping of a learning environment in distributed learning systems. My basic argument is that a

broader view of design, development, and deployment which takes into account organizational and pedagogical issues as well as technical conditions is more likely to produce improved learning.

While technical issues provide both possibilities and constraints relevant to the design of effective learning environments, the focus in this research is on issues pertaining to how people use and interact with a particular environment, Akademiet, on what effects that environment is having on users attitudes towards technology, and, Finally, on how a given learning environment can contribute to the need to provide lifelong learning. Technology is certainly a factor, but pedagogical and organizational issues are equally significant when considering the effectiveness of technology enhanced learning. Before going further on with defining this project. I will give some background information about Telenor Kompetanse and Akademiet.

## Telenor Kompetanse

Telenor Kompetanse is located in Sørlandets Teknologipark in Grimstad. They also have a division in Oslo, and branch offices around Norway represent them. Telenor Kompetanse has a staff of approximately 70 persons.

Telenor Kompetanse offers training at all levels and in several different ways. They have classroom courses, private self-study courses, as well as video-conferencing and web-based education. They train people from the larger Telenor corporation and from other firms and organizations in Norway. Telenor Kompetanse is also a vendor of courses delivered from different domestic and foreign suppliers for use in distributed learning systems. For this purpose Telenor uses Akademiet. Akademiet is Telenor Kompetanse's host environment for web- and electronically based education.

This paper is based on some of the newer areas of concentration for Telenor Kompetanse. As was indicated for Macromedia, Telenor Kompetanse expects that the use and demand for distributed learning systems will explode. The difference between Macromedia and Telenor Kompetanse is that Telenor is not a vendor of courseware development products. Rather, Telenor is an educational organization, which uses distributed learning systems to educate people.

## Akademiet

Akademiet is based on the technology of the Internet. It is a web application developed for the delivery of courses on the Internet. Akademiet provides approximately 600 different course titles based primarily on web-based training (WBT), a relatively new form of computer-based training (CBT). Some courses are delivered in CD-ROM only versions. Topics covered include many in the area of telecommunications (Telecom), information technology (IT), ICT (the combination and integration of Telecom and IT), as well as administrative and mercantile subjects.

The main suppliers of courses to Akademiet are Gartner Group, NKI, NITOL, BI, Ericsson and NetG. Gartner Group is an international enterprise that delivers much of the IT and databased courses in Akademiet. NKI is a Norwegian educational establishment in the

distance teaching area, founded in 1959. It is one of the largest private educational establishments in Norway. NITOL is a collaboration involving the colleges in Stord and Haugesund (HiS), Agder (HiA), Sør-Trøndelag (HiST) and Norges teknisk-naturvitenskapelige universitet (NTNU). NITOL is now being transformed into a larger collaboration called NettSkolen involving also the University of Bergen and other Norwegian educational institutions. BI is Norway's largest business school.

The sites involved in Akademiet have experienced a great change in activity between 1998 and 1999. The reason is mainly because of the Telenor Home-PC project. This project has introduced the widespread availability of powerful home computers to a widely distributed group of workers, making possible many new educational and training opportunities. Therefore, Telenor Kompetanse decided in 1998 to develop Akademiet into a new and more modern system. The Akademiet project managers at Telenor Kompetanse and the developers, including a few students from HiA, developed, with design help from Gartner Group in Ireland, the new interface of Akademiet as it is presented today [L1].



Figure 1.2.2. The main site of Akademiet.

### 1.3 The Setting

The Akademiet project leaders at Telenor Kompetanse wanted further information about the area of distributed learning environments, particularly with regard to how they might be used to improve the skills, knowledge and attitudes of workers. With this desire from Telenor Kompetanse and my wish to get a wider understanding and knowledge of distributed learning environments, the content for this study was set.

In this area of research, there are thousands of different issues and problems. They range from technical alternatives for various technologies to organizational concerns with cost and benefits. Only a few issues can be addressed in this study. I will focus on ways that learning might be improved and optimized in the Akademiet environment, especially with regard to aspects of collaborative learning in distributed learning systems.

## The Task

In the future use and development of Akademiet, Telenor needs new and efficient policy instruments. The main perspective in this task is to analyze existing features, to make an evaluation of new elements and functions for use in Akademiet, and then to make suggestions with regard to possible optimal solutions. The conclusions will give Telenor Kompetanse a guideline to their further development of Akademiet. It is therefore important to use their environmental settings, through all phases of this project to achieve that goal.

The task can be divided into three main issues which will be examined: (1) the features and characteristics which contribute to optimal learning in a distributed learning environment such as Akademiet; (2) the role of collaborative design of specific learning contexts in Akademiet; and, (3) recommendations with regard to tools and design practices which are likely to contribute to improved learning. I include planning and development processes as part of the relevant design practice.

In order to realize the potential of information and communication technology to support, improve or enhance education, we must understand :

- How the social organization of the educational establishment, company or other groups of participants influences the use of the technology.
- How the use of technology effects the functioning of the organization. Learning is a complicated process, which takes time to develop and mature, so the perspective should have a certain time range.
- There is a difference between remembering information and learning, which implies stable and persisting changes in a person's knowledge, attitudes, and abilities. Learning can be characterized as a construction of knowledge, wherein one uses existing knowledge and expertise to transform new information into new knowledge, attitudes, and abilities.

When discussing relevant problems and conditions of a distributed learning environment, which is suited for Akademiet, several questions arises. The following questions which will be addressed and hopefully answered, at least in part, in this study:

1. What capabilities now exist in Akademiet?
2. Do these capabilities contribute to learning and in what ways?
3. How are the Telenor workers computer capabilities and skills?
4. How do users engage in various learning activities in Akademiet?
5. Which courses attract the most users? Who takes courses and why?
6. When are most users engaged in Akademiet activities?
7. How do users become involved with other Akademiet learners?
8. How might they like to see the Akademiet environment improved?
9. What is peoples attitude towards distance learning and training?
10. What have been the effects of the Home-PC project on Akademiet use?
11. How might Akademiet evolve so as to improve collaborative, distributed learning?
12. Which system, applications and software development tools are suited for effective construction of such environments?

## Project Activities

To approach these questions we need information about the technology, the users and the circumstances, and we need relevant theoretical foundations to work on. For the relevant theoretical perspective, there are adopted a combination of several different perspectives, like electronic distance education system by Stubbs and Burnham [5], activity theory by Vygotsky and Nardi [4], distributed cognition by Salomon [6], and “constructionism” by Papert [7]. For the approach to users, I used a survey questionnaire aimed at attitudes, relevant skills and knowledge. Other kinds of relevant theoretical perspectives that are important to mention include: human-factors engineering, instructional design, learning theory, etc.

In order to provide initial answers for the Akademiet project leadership, it was necessary to gain insights into the future users of Akademiet; their current computer capabilities, their general level of skills and knowledge in a variety of areas, and their current attitudes with regard to distant learning and training. And it was necessary to get an overview from other relevant research of this area, related projects and connected issues. Data was gather from these sources as part of a relevant research literature review, and to establish the specific content for this study. The information collection, analyzing and categorization were made form different kinds of sources. Both quantitative and qualitative methods were used in this study. Primary data was gathered through studying Akademiet, and its surroundings, and through research:

- The studying of Akademiet involved charting the contents of Akademiet, logging the activity at the web-server, and analyzing and evaluating these results.
- The employees in Telenor have access and experience with Akademiet, so results from that research area are directly related to Akademiet.

Secondary data was collected through mapping existing distributed learning system, both domestic and foreign, by studying other research, by doing a research among students, and by information gathering through the Internet and literature:

- Qualitative research interviews with students and teachers at HiA who have taken credit courses through Internet.
- Quantitative research based on questionnaires with students at HiA, where just some have experience with courses through Internet.
- Other vendors, suppliers, and educational establishment were surveyed as a source for validation and generalize ability.

I also engaged several highly qualified researchers in extended discussions to contribute to my understanding of this area of knowledge. Various persons in the research staff at Telenor Kompetanse and FoU gave me relevant feedback and information for use in my study.



## 2. Theory and Literature Review

This chapter establishes a theoretical framework for distributed learning. The framework identifies elements of importance to the online teaching and learning processes and explains how they are related. The framework is founded on Nardi's [4] definitions of methods, techniques, and devices in the adult education process, as elaborated by Activity Theory. Stubbs and Burnham's [5] electronic distance education system provides a way to integrate technology into distributed learning. Papert's [7] theories on changes in our approach to learning provide a focus on cognitively rich, experiential environments. Finally, Salomon's [6] interpretation of media in education, which focuses on the interaction of media, cognition, and learning, provides an integrated context for discussing distributed learning systems. I will present some interpretation and argumentation for selecting these theories and methods among other possibilities.

### 2.1 Definition of Distributed Learning Systems

In an article on adult education, Verner discussed three components constituting the process of adult education:

“There are three basic components inherent in the establishment of (a relationship for learning between an educational agent and a learner): organizing people for learning, helping the participants to learn, and selecting from the multitude of devices available to facilitate the operation of the first two. These three components are identified as methods, techniques, and devices.” [26].

Throughout this paper other learning theories are also used to supplement or complement the perspective presented here, such as didactic relation theories. However, these additional learning theories and perspectives are too numerous to treat separately and at length in this context. Either the reader will already have some familiarity with these theories, or these theories can be studied through existing references[1, 2, 17].

We can sense a shift in learning theory; from a teacher / classroom / student based situation to a distributed system. This has led to extensive research in finding new ways of designing courses, of learning / cognitive processes, of communication and collaboration [20]. Building on Verner's components, Stubbs and Burnham [5, p.27] define an electronic distance education system or distributed learning system as: “Any learning situation where methods and techniques enabled by electronic devices combine with instructors and learners who are physically separated and who use methods and techniques enabled by electronic devices to transmit instructional messages over the distance between them is an [electronic distance education] system.”

The next figure is based on the didactic triangle [1]. Organizing, preparations, accomplishment and evaluation of teaching are didactic. Through theory about teaching we can focus on what shall be learned (contents), how it shall be done (method), and why it shall be learned (purpose). The didactic triangle illustrates these relations between the teacher, student and the contents. To give the same illustration through a distance education

environment, the mediation of learning methods and techniques must be presented through a media. And we get an extended figure, as shown under.

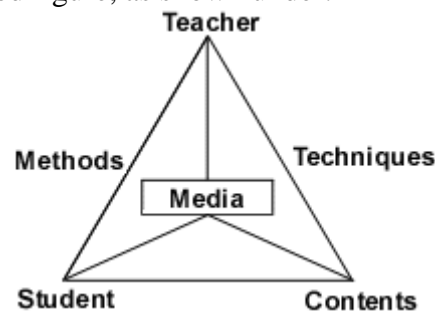


Figure 2.1.1. Mediated interactions between students, teachers, and contents.

NKI has modified the illustration of a distance education system further [L4]. Their model consists of students at the core. At their disposal are course documentation, materials, teaching resources and teachers. Teachers have different tutoring tasks and can facilitate their tutoring by means of different methods, techniques and media. Activity theory [4] takes the approach further and focuses on the role of artifacts in the transmission of knowledge, as well as relations between consciousness and activity. Activity theory provides a framework in which a meaningful unity between knowledge and consciousness on the one hand and activities and artifacts on the other hand can be conceptualized.

Distance teaching has a relatively young history. While distance learning can be traced back to earlier part of this century when the dominant medium was radio, the real breakthrough for distance learning occurred in the 1980's. The crucial factors for this breakthrough were the development of new media in ICT, better knowledge about learning theories, the start of the British Open University, and new research in this particular area of science. This evolution has resulted in several new expressions and terms in the area of distributed system. In this paper, an electronic distance education system is broadly defined to encompass new technologies, tools, and techniques within the area of ICT, including Distributed Learning Systems (DLS), Open and Distance Learning (ODL), Electronic Performance Support System (EPSS), Computer Based Training (CBT), Computer-Mediated Communication System (CMCS), Electronic Campus, Virtual Classroom (VC), Computer Assistant Instruction (CAI), Computer Support for Collaborative Learning (CSCL), Intelligent Tutoring Systems (ITS), and so on. The focus here is on web-based education systems, with Akademiet being one such system.

## 2.2 Approach to Relevant Literature

In this part of the paper, I shall provide a summary of the relevant educational developments that provide a context for the study. The general thread here is that context is crucial to the construction of meaning and acquisition of new knowledge and skills. Context is broadly conceived to include other learners (the collaborative aspect) as well as objects and activities (the experiential aspect) in a social and organizational setting (the organizational aspect). Extending the thread analogy, we might say that technology is the needle in this process. We begin with Papert and the experiential aspect.

Papert [7] argues that we are entering the "age of learning" during which time the "competitive ability is the ability to learn." Papert focus on children's use of computers as means to achieve learning. Still learning is at the core, computers are artifacts by which the

learning potential in the individual can be activated, as illustrated in the case under chapter 1. It is important to understand the role of these artifacts in terms of how they exist in everyday situations and how they are integrated into social practice. To achieve this knowledge we need a set of conceptual tools, which are applicable in various situations, like in studying relationships between a central activity and its neighboring activities. Activity theory [4] covers these needs, and will be presented later on in this chapter. It is the revolution in technology that has simultaneously brought about the need for improvements in learning and learning environments. New technologies will enhance learning through "the creation of personal media capable of supporting a wide range of intellectual styles."

While the computer offers "new opportunities to craft alternatives," a "megachange" is needed to move from the present epistemology and approach in schools to a new paradigm within learning, according to Papert. Perelman [15] argues that schools as we currently know them have outlived their usefulness. In the author's words, "This imminent hyperlearning world, where learning and expertise are diffused everywhere and where people of any age may be engaged in learning anytime, makes the infrastructure of 'schooling' irrelevant and even obstructive."

To go as far as to say that today's school systems have outplayed their role as future educational establishments is an overstatement. New technologies contribute but are not a replacement for the ordinary school system [2]. Changes can and must take place. However, if we really want to realize the educational benefits of technology. Involvement of community, encouragement of educational "diversity," decentralization, fostering of personal teaching styles, and the involvement of parents, teachers and students, are the prime ingredients of change to embark on the revolution necessary to move into "the age of learning" [7].

Sharply contrasting with this perspective are the views of researchers like Postman [8]. He argues that technology brings about and imposes unwanted, unnecessary and threatening changes to our way of life. Technology is portrayed as a dehumanizing and controlling force that must be monitored, curtailed and limited. For Postman, technology is an autonomous intruder which has its own self-serving ends and which must be approached with caution. The destructive view, especially with regards to artificial intelligence, is popularly described in the Hollywood movie *MATRIX*, a science fiction history of a struggle between mankind and self-controlled machines.

My position is one of a proactive, positive view of technological changes, although I do acknowledge that other perspectives are possible. My perspective is close to Papert's [7], who argues for changes in our approach to learning and teaching through improved uses of computers in schools. This proactive attitude informs this study and is adopted in this thesis. As we now have presented the initial point of departure, the next step is to decide upon methods for developing a distributed learning system.

## 2.3 Design: Human Computer Interaction Studies

To understand how people actually use computers in their everyday lives is essential for good design and evaluation of a new distributed learning system, and also for understanding technology mediated learning processes. Therefore, it is necessary to have a development method which not only takes the technical issues into consideration but also covers human computer interactions from both a practical design perspective and a theoretical perspective. How shall the designer introduce a syllabus to stimulate the users in meaningful ways? How shall a distributed learning system be implemented in order to provide an effective learning environment? In the next sections, these questions are discussed, and ideas for the further work are presented.

### Human Factors

Human factor is the study of how people interact with their environment. Human computer interface (HCI) is an area within human factors which focuses on how humans and machines interact. HCI research and development provides technologies and methods for creating designs that work well in human terms. Without knowledge of people and how they use systems, design is a haphazard process. Another way to make the point here is to say that the notion of a system includes one or more human users, and analysis of those users is a critical part of the systems design process.

There are several methods which use human factors in ICT system design. One way to integrate human factors in the development is to use models and theories of use behavior, learning processes, and other psychological aspects of human computer interaction. Theory has the virtue of generality and can therefore give rational guidance even in the absence of specific data and relevant development guidelines. Consequently, I have decided to ground and support my study in the context of selected theories and methods. Specific research methods are covered in the next chapter. In the remainder of this chapter, I shall present an overview of theories relevant to this study. I admit at the outset that the coverage can only be superficial, since this area has a significant body of literature and could easily be the focus of several dissertations on theoretical issues as they arise in the context of Akademiet. Moreover, a selected methodology, such as user-centered design, could easily provide a very focused context for a methodological study in the context of Akademiet. I have already indicated that the concerns addressed in this thesis are more general in nature.

### Activity Theory

In the discussion of the learning processes it is relevant to consider Vygotsky's thoughts and theories. Rooted in Soviet psychology from the 1920s, Vygotsky proposes a view that tools mediate thought, later to developed by Leontoiev and others as Activity Theory [4]. Much like HCI, activity theory concerns itself with practical problems and focuses on practice in context with an emphasis on the work process level of problems. To get more information from this area of knowledge, material from several authors and researchers who have based their work on the activity theory was gathered and studied.

The theory is concerned with understanding the role of artifacts in terms of how these artifacts exist in everyday situations and how these artifacts are integrated into social practice. The purpose of Activity Theory is to understand the coupling of consciousness and activity as the basis for the study of problems in human-computer interaction. Activity theory offers a set of conceptual tools applicable in various situations, especially useful in studying relationships between a central activity and its neighboring activities.

Cognitive science has concentrated on information, its representation and propagation. Activity theory is concerned with practice, that is, doing and activity, which significantly involve "the mastery of external devices and tools of labor activity" [4]. In principle, there is no direct conflict between cognitive science and activity theory, although some activity theorists argue that cognitive models are generally irrelevant or useless.

In *Activity Theory as a Potential Framework for Human-Computer Interaction Research* [4], Kuutti presents the types of problems that are causing a movement away from mainstream information processing psychology. First of all, there is a need to view humans as active agents or actors. There is also a lack of recognition that actual use of systems is a long-term process that cannot be adequately understood by studying just the initial steps of usage. In this thesis, this can be relevant and can effect the results and findings due to the relatively brief time period studied. The final critical problem often mentioned in activity theory is the need for more emphasis on design, like user-centered design.

The key principles of Activity Theory are:

1. Activities are considered to be the basic unit of analysis. The solution offered by this theory is that "a minimal meaningful context for individual actions must be included in the basic unit of analysis.
2. Activities are not static. Thus, the dynamic nature of activities and the consideration of the history of an activity are both pertinent.
3. Artifacts have a mediating role.
4. Activities have a basic structure that can be described by the mediated relationship at the individual level.

According to this structure, activities have the following characteristics:

- A. Activities are a form of doing directed towards an object.
- B. Activities are distinguished from one another according to their object.
- C. The motivation for the transformation from an object to an outcome comes from an activity. The object can be either a material thing or an intangible entity (such as a common idea).
- D. Mediation during an activity is carried out by a tool (which can be anything in the transformation process -- which includes both material tools and tools for thinking).

There are two types of activity processes: (1) A long-term and a short-term process. In a long-term process outcomes are realized from objects through a process that generally consists of several phases. (2) Short-term processes are activities that consist of actions, which in turn consist of operations. An activity can be "realized using different actions, depending on the situation." One particular action can "belong to different activities" [ 4, p. 31].

There are three perspectives which justify why Activity Theory contributes significantly to the field of HCI. The first perspective describes the benefits of the "multi-levelness" of activity theory as an enabler for discussing the different levels involved in an activity within an integrated framework. The second perspective considers the "interaction context." The third perspective considers the issue of "development." This perspective considers change and the dynamic nature of an activity.

## 2.4 Use

How shall the user be introduced to the syllabus to acquire learning? How is the distributed learning system arranged to produce good learning environments? Should the user be involved so he / she can contribute by participatory design or collaborative effort to arrive at a situation that suit the learner? Is use through instructional or constructional approach fore the better? Which application or media in the PC / web environment are useful? In the next part questions about learning media and theories are discussed, and ideas for the further work are presented.

## Media

Studying media in education implicitly assumes that each medium entails some particular, even unique, attributes that support or can be made to matter in learning. Solomon [6] explains that each medium presents data through a specific and special symbol system, for example, language is the symbol system for text-based media and pictures provide a kind of symbol system for film-based media. Therefore, dissimilar media present data and information in different ways, and such information is understood by different cognitive mechanisms. Learning effects are partially dependent on certain aspects and uses of media, since some media will present particular types of information more comprehensively or clearly than other media. In this way each medium has strengths and weaknesses, or appropriate ranges of application for use in supporting learning. One objective of this research is to identify classes of unique attributes which are likely to be correlated with different types of learning goals and situations, and to examine within a theoretical framework the ways in which these attributes can support learning, especially with regard to the use of the PC and web.

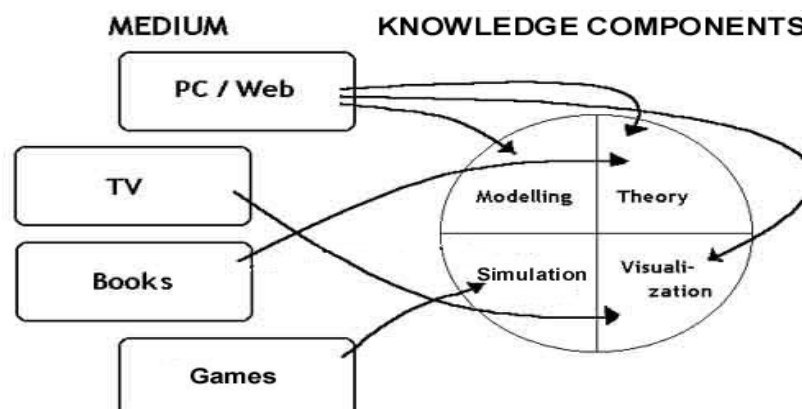


Figure 2.4.1. Knowledge components and media.

In the figure above, relations between different media and the knowledge components through different knowledge construction activities are suggested. In this example there are shown four types of knowledge construction activities and four types of media. The different knowledge construction activities have an obvious process component. Modeling as supporting the interpretation of facts and development of theory. Theories as informing facts. And simulation and visualization as processes which facilitates the comprehensive understanding of sets of related facts. The media contributes to learning via different means. The media differ from each other in some respects but not necessarily in others. For instance, printed books differ from newspapers along timelines, format, and typical content, but not in terms of the technology of print or the symbol system (language) they use. In this thesis, the PC and web are the topical media for further investigation. As illustrated in the figure, the PC and web have their strengths and appropriate uses like all other media. But these media also have their weaknesses, and the PC and the web are a supplement and not a replacement for other methods and media in learning environments. Take, for example, the case represented in chapter one. There was a description of a biological science subject with a practical lesson where the students simulated a surgical procedure on a frog. Such a simulation involves both visualization and modeling, and the PC is obviously appropriate. However, the PC might not be the optimal way to present extensive collections of facts, since reading text on a computer screen is not as easy as reading text on a page, nor is the PC necessarily the best medium to support theory building, although it might be used to support this purpose. With regard to gaining actual experience, the computer simulations are not likely to replace actual job-based training. In general, we still prefer that pilots have some real world experience outside of flight simulators prior to becoming certified and allowed to carry passengers.

We have already discussed and agreed with Papert's general views concerning changes in learning environments, but Papert's theories about the PC as media are somewhat narrow. He predicts that the PC will be the ultimate and primary medium for future learning environments, unlike Salomon and Schofield's belief that the PC will be used primarily to supplement other media and methods. Their view puts different media in a greater context of learning environments. Salomon [6] and Schofield [2] have a theoretical approach to this area of knowledge which I will integrate in this thesis because of the additional knowledge to the field of media-mediated learning in their work. However, Papert's positive attitude toward technological change is still maintained.

In the next figure, the four items on the right, while similar to those presented in the previous figure, represent activities: collaboration, modeling and simulation, visualization, and theory building. The four items on the left represent specific media, two of which are strongly associated with support for a constructivist perspective.

The PC and web media can again be fragmented into several different types of information transmission media. The next figure illustrates this. Some of the different activities which can be used in a PC / web environment are listed in this figure: collaboration, modeling and simulation, visualization, and theory building. The different media are probably, for most people working with ICT, well known. At the left of the figure a circle with the word "Constructionism" is present. Constructionism is a approach to learning [7] and not a PC or web application or media itself.

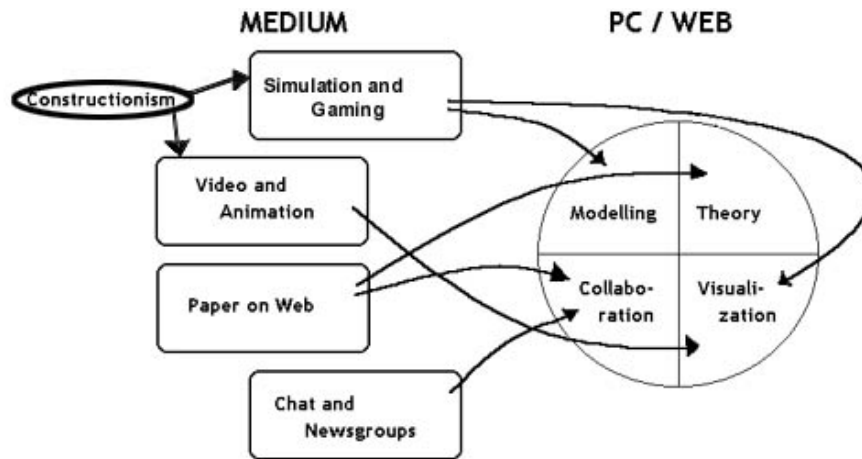


Figure 2.4.2. Information presentation through different means of instruction.

## Constructionism

Papert [7] uses the term "constructionism" to refer to his approach to learning. Constructionism is built on the assumption that the learner will do best by finding for himself or herself the specific knowledge they need. Constructionism is a relatively new approach to learning, which I find very interesting. Therefore, will this approach be studied more thorough in this thesis, but that does not exclude the need for other learning theories (behaviorism, cognitivism, etc.).

In my work as a PADI diver instructor I was obligated to give students the best training possible, particularly because safety issues were involved. Within practical instruction there are several individual aspects which often dominate the learning. Psychological issues, such as anxiety, fear, pleasure, and curiosity, reveal themselves in a more evident and vital form than in traditional classroom settings. Learning effects generally depend on the different methods used. Some students had a theoretical preference whereas some had more practical strengths. Some needed less directive guidance and handled a more open-ended setting better, and vice versa. It was the instructor's job to evaluate the students' capabilities and to foresee their possible weaknesses, so that students could be well prepared to enter the practical diving modules with success. It was essential that the students were self confident and secure, because when a person enters the underwater element, even the most gifted and steady students can loose their self-possession and become panicked and operate inefficiently or even dangerously.

The environment has accordingly a great influence on student learning processes. It is therefore essential to use the actual surroundings as a catalyst to the learning process, and not just pay attention to the transmission of information. To give these students the best training possible we combined theoretical and practical lectures, tests, discussions, games, and simulations through group and individual training sessions both in the classroom and in the field. This combination of motivating learning through activities and also using theory-based studies for adult persons appears to be an effective way to mediate information and stimulate the student learning processes.

All of these psychological aspects are also relevant considerations in studying and designing human computer interactions and interfaces. Some individual elements are less dominant (for



example, whether one is left- or right-handed is rarely significant for the design of an interface for a learning environment), but some have strong effects on learning processes (for example, whether or not a person is a visual learner as opposed to an auditory learner may have a significant impact on the design of an interface).

The constructivist theories takes on a variety of forms just like the behavioristic and cognitivistic. The basic distinction, however, is that while the behaviorists viewed knowledge as nothing more than passive, largely automatic responses to external factors in the environment and the cognitivists viewed knowledge as abstract symbolic representations in the head of individuals, the constructivistic school views knowledge as a constructed entity made by each and every learner through a learning process. Knowledge can thus not be transmitted from one person to the other, it will have to be reconstructed by each person. In a virtual constructionist learning environment, the goal is to foster creativity and to motivate learning through mediated activity. The idea is that learning is more effective when approached as situated in activity rather than received passively. This idea is one of the main reason why Papert's work is used in this thesis.

Active learning is generally preferable to passive learning, but not in all contexts. Constructionism have an appropriate area of application, like other learning theories. In constructionism learners actively attend to construct their own knowledge- individually and collectively. Each learner has a toolkit of conceptions and skills with which he or she must construct knowledge to solve problems presented by the environment. The role of the other participates and teachers are to provide the setting, pose the challenges, and offer the support that will encourage construction of knowledge. Although this does not mean that memorization and rote learning are considered useless. There are matters that can and perhaps must be learned in a purely mechanical way. The solution of a great learning environment lies in a compound of the dissimilar ways of learning, not in rejecting some of the alternatives.

A composition of different media and application in the distributed learning system is for the better. To design a learning environment, which is suited for future demands, we need a combination of several different forms of learning (as theoretically, constructively, instructively, actively, collaboratively, multisensorily and contextually forms). A distributed learning environment like this is hard to design. A lot of different perspectives and demands have to be taken into consideration, and even then it's hard to succeed in all conditions. A description of a state-of-the-art distance education system will be difficult due to the many aspects and perspectives which are involved, but we shall attempt it nevertheless since some description is necessary prior to any design or re-design activity.

Papert's focus is on children and their learning processes. Through these studies and investigation of other relevant source of information (on constructionist models, environments, and strategies [L15]), I believe that Papert's idea also can be profitably carried forward to the adult learning environment, but not as a substitute, but as a contribution to the already existing environment. Adults can perfectly use amounts of theory, through reading and studying. A more practical presentation of some of the syllabus, through animations, gaming and simulations will just enhance the learning effect. An example of this is presented in the case "The Study of Tomorrow" in chapter one of this thesis.

We are seeing the integration of authentic experiences into the more traditional theory-based lectures in many school settings. Today's educational establishment, as Papert sees it, "remains largely committed to the educational philosophy of the late nineteenth and early

twentieth centuries" and attempts to "impose a single way of knowing on everyone." Papert describes the idea of reading as the "essential route to knowledge" as prime characteristics of today's education system. Knowledge is transmitted "through a pipeline from teacher to student" and is "treated like money, to be put away in a bank for the future." However, the other side of the argument is that by proceeding constructively, it took mankind perhaps 3.000 years to discover the Pythagorean theorem. It can be taught effectively in 3 minutes by a good instructor using traditional, theory-based methods. There is perhaps a place for combining both traditional methods with the experiential methods proposed by Papert. Schools practice discrimination and actually impede learning by only emphasizing abstract, formal knowledge and by using an epistemology of precision that insists on students being precisely right all the time. There is certainly a place for precision and formal correctness, but there is surely a place also for exploration and failure.

## 2.5 Literature Summary

To build a good on-line learning environment we need constructing tools and methods to integrate learning theories and technology. We must also pay attention to social and organizational issues, like economics, user-group, etc. Activity Theory is modeling tool to design such environments. Among the different learning approaches, I will pay most intention to constructivist theories. And regarding to the relevant technologies the focus is on PC and web based systems.

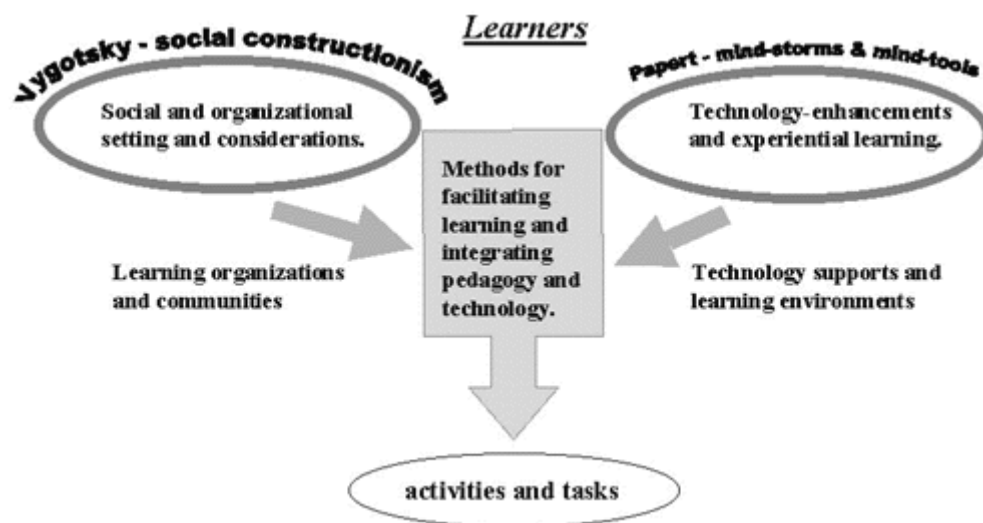


Figure 2.5.2. An integrated perspective.

In activity theory the unit of analysis is an activity that is being composed of subject, object, actions, and operation. A subject is a person or a group engaged in an activity. An object is help by the subject and motivates activity. Behind the object there always stands a need or a desire, to which (the activity) always answer.

A contextual shift from a classroom to an online teaching setting effects the process of learning and how one might then design good on-line learning environments. This set of methodological implications of Activity Theory, for HCI studies, is a tool to model such environments:

1. Use a research time frame long enough to understand user's objects, goals, and activities.
2. Pay attention to broad patterns of activity.
3. Use varied sets of data collection techniques rather than rely on a single indicator of learning or usage.
4. Be committed to understanding things from the users' point of view.

If we use a model under the frame of Activity theory then we will have a model that is simple, the actions described are high level abstractions so that the system can be described in terms of a small number of elements. The system model will be dynamic, a designer can play through high-level action sequences and observe its behavior. And it will be non-deterministic, typically a model will permit a large number of possible action sequences and it is up to the modeller to explore this space of operator choice when evaluating a design.

The behaviorists tried to explain learning without referring to mental processes. The focus was on observable behavior and how an organism adapts to the environment. Constructionism is based on the premise that we all construct our own perspective of the world, based on individual experiences and schema. Focuses on preparing the learner to problem solve in ambiguous situations. The socially oriented constructivist theories stress the collaborative efforts of groups of learners as sources of learning.

As we continue to design and develop new technologies, we can focus more on issues related to human-machine interaction. Interdisciplinary, collaborative work and research by social scientists, engineers and designers can consider approaches to machine design that focus more on human factors. For those individuals who, like Papert, have an interest in promoting greater use of computers and technology in schools, it is essential that they are able to dispel or alleviate concerns and fears related to computers and machines. Effectiveness in bringing about change in schools through use of technology may be far more a function of people's personal reactions and feelings than it is a function of the technology itself.

### 3. The Research Method

To approach the problem of improving Akademiet we need more information about the technology, the users and the circumstances. Therefore, several different investigations were accomplished. The state of Akademiet is examined, a survey on the Telenor Home-PC project and a study on the student situation at HiA are conducted. Also, a vendors and product survey in the distributed learning system market is done. With data from these researches we have a good foundation for an analysis.

It was necessary to break the evaluation processes into different types of activities, consistent with the spirit of activity theory. In this way, the scope and purpose of my research became clearer. The research was divided into activities within these three steps [9]:

1. Planning and designing (and re-designing);
2. Data collection and reporting; and
3. Data analysis and usage.

All three steps will be more thoroughly described later, but a brief introduction of the different activities are presented in the next part.

#### Activity One: Planning and Designing

This first phase involves collecting relevant background information and defining intentions and goals of the research. This requirement for information can be solved through several different information gathering methods. We here distinguish between two kinds of information sources: primary and secondary data sources. Secondary data sources provide general information concerning the issues, which are elaborated through other, more specific, research studies. These kind of data come from a variety of sources, including the following: advisors, articles, Internet reports, data from Telenor Kompetanse and other educational establishments, contact with research workers, and so on. Secondary data sources provide good background information and focus on primary data collection and sources, which brings us to step two.

#### Activity Two: Data Collection and Reporting

The next activity concentrates more on primary data: information that comes from Akademiet and its environment. These data were acquired through surveys, interviews, logging of user activities, and direct observations of users. The gathered information included numerical, textual and descriptive sorts of data. Distributed learning environments researches, has in its short history, favored a tradition of naturalistic observations where collaborative situations are described with detailed realistic and factual descriptions [2]. Because the focus is on understanding what is happening in collaboration between people and artifacts, a combination of quantitative and qualitative methods is required. So again the methods used were both qualitative (observations and interviews) and quantitative (survey data and logged times and actions).

## Activity Three: Data Analysis and Usage

The data resulting from the activities just indicated are processed and finalized in this part of the study. This third analysis activity will be discussed in more detail in the next chapter.

### 3.1 The Studying of Akademiet

The studying of Akademiet involved charting the contents of Akademiet and logging activities at the web-server. The data collected in log files was primarily quantitative, so we can search for and look at changes over time in attitudes, uses, skills and knowledge. Therefore, I began to collect logging files from the server as early as November 1998. From these results we can hypothesize causal explanations for observed changes based on aspects of the system, the organizational environment, the learning opportunities and the learning approach. Analyzes and evaluation of these results are presented in the next chapter entitled "Data Analysis And Findings."

#### Activity One: Overview of Akademiet

It was important to get an overview of the contents and applications in Akademiet in order to establish a foundation for my study. This initial part of the study is a purely descriptive task. The exploratory data was appropriately gathered by qualitative methods, including open-ended interviews and direct observations of the Akademiet environment.

#### Activity Two: Logging the Activity

Logfiles from November 1998 to May 1999 were collected and examined. The start of the Telenor Home-PC project was in January 1999. Since the general hypothesis was that the introduction of so many home PCs would have an enormous impact on Akademiet use, it was important to examine log files before the Home-PC project as well as after most Home-PCs were delivered and in use. Activity theory's methodological implication for HCI studies supports this view. The theory points out that you must use a research time frame long enough to understand user's objects, goals, and activities. Further the theory indicates that use of a varied sets of data collection techniques, rather than rely on a single indicator of learning or usage, is important. This is followed through in this thesis with activity one and two in this part and the Telenor Home-PC project research in chapter 3.2. With the collection of both user, system, and activity information we also get nearer to understand things from the users' point of view, which is important in the Activity theory.

To get relevant information about the user activity the Akademiet server were logged. Activities which were logged are user id, IP-address, use of time, requests, visits, data transfers, and more. Also the arrival and exit sites were logged. To make these user activity logfiles Internet Information Server 4.0 (IIS 4.0) was used. Then the logfile results were graphically presented [Chapter 4.1]. To analyze the logfiles and make the graphically figures MarketWave Hit List Professional 4.0 was used. Hit List Professional 4.0 provides flexible and completely automated server log analysis solution for Internet sites.

## 3.2 The Telenor Home-PC Research

Telenor has realized that the ICT business sector has become one of the most exposed industries to domestic and international competition. The competence and the expertise in an organization become more and more critical to both survival and success. Telenor has recognized this and decided to develop and implement a strategy to significantly improve the knowledge base of Telenor employees so as to insure that Telenor remain competitive well into the future. One of the initiatives to realize their goals is to support employees with a home-PC.

Telenor decided to support workers with their own home-PC as a part of their strategy to be one of the leading organizations using ICT as an integral part of staff development and training. A great part of the future in corporate and external training will be based on ICT-facilitated and enhanced training, so this project aims to provide additional incentives to Telenor employees to be prepared for this future.

The Home-PC project will also introduce other areas of use and benefits. ICT will be an important instrument for internal communications in the organization. Telenor's own Intranet, INFOTORG, is developed as an internal system for information and communication exchange among workers, managers, and corporate leadership. INFOTORG will also be available from the home office in 1999.

The offer from Telenor to employees gives the workers a chance to develop their own skills. But it also gives the workers more responsibility for their own personal and professional development. This can be a problem, resulting in long working day, the need for additional resources, conflicts with family interests, stress on the job, demands on limited time, and so on. As suggested earlier, user perceptions about the desirability and benefits associated with a system are critical to its success. In this case, while it may at first appear that a nearly free PC is a benefit, many workers may not perceive that as a benefit in and of itself. This is exactly one of the questions that were addressed in this study.

### Activity One: The Background

The intention of this part of the research was to collect information and data from the Telenor Home-PC project. From these information and data results we can make an evaluation of the introduction and use of the project. The purpose of this formative evaluation study is to improve the types of functionality and learning environments supported in association with the effort.

In the time after the delivery of the computers, a requirement for research pertaining to effects, perceptions, and usage was raised. This need for data and information about the project are vital to evaluate the success of and the gains associated with this project. This study is part of that overall research objective. Part of the research plan involves observations of the organization and its members.

Because the delivery was made as late as January 1999, it is likely that the participants have not entered a higher level of use (INFOTORG, FTP, and Newsgroups) at this moment of the research. But we assume that they are somewhat familiar with use of WorldWideWeb and

email. There will be a follow-up research in the autumn of 1999 by other research workers in Telenor to examine continuing effects and trends with users who have entered higher levels of sophistication and who may then have changed expectations and usage patterns. This study will provide a point of reference for planned future research.

### Activity Two: The Research

The intention of the research is to gather information and data, which represents the overall attitudes and situation of the employees in the Telenor Concern.

In cooperation with persons from Telenor Kompetanse and Telenor FoU, a questionnaire was developed and distributed to randomly selected persons in the organization [Appendix 2]. Telenor will conduct qualitative examinations with focus groups of some representative people in the autumn of 1999 as part of the follow-on study.

About 11,156 of the total 20,000 employees responded positively to the offer of a home PC, and they received a personal computer. This percentage is not surprisingly low because the employees had to contribute 10,000 kroner of the total cost of 34,000 kroner. Some employees already had invested in a computer, and others did not take the offer because 10,000 kroner are too much for something they would not use anyway.

For the purposes of the research reported here, the population sample includes all 20,000 employees where the population is divided into these three subgroups, as illustrated in table 3.2.1. The selection of participates are presented in table 3.2.2.

Group 1	New home-PC users who have accepted the offer. Approximately 11,000 people.
Group 2	Users with previous existing home-offices, who do not need new equipment. Approximately 4-5,000 people, according to Telenor FoU.
Group 3	Employees who refused the offer for different reasons, as people whom already have made an investment in a PC or do not want to invest in such equipment at all. Approximately 4,000 persons.

Table 3.2.1. Subgroups of Telenor employees.

1	From Group 1 and 2 we drew a selection of 2,500 persons. With a response rate of 60-70% (1,500-1,700 persons), we believe this is a representative sample.
2	From Group 3, we drew a selection of 500 persons. With a response rate of 60-70% we will have 300-350 responses. It is possible that the response in this group will be more moderate than in the two other groups.
SUM	We then have a total selection of 3,000 of a total of 20,000 workers in the organization. A response rate of 60-70% gives 1,800-2,100 answers. We believe this is a representative sample of the population.

Table 3.2.2. The selection of participates.

## Selection Methods

We wanted to include some demographic variables in our research, including gender, age and geographical location, since these factors might be correlated with attitudes, expectations, and pre-existing knowledge and skills. Based on the assumption that critical factors are evenly distributed (as supported by the demographic data), we then made a random selection. The intent was, of course, to have a representative, sample. To guarantee this the actual selection of participants and distribution was consistent by professionals in DNB Distribusjon. They used mailing lists over the 11,000 employees, and made a random selection of 2,500 persons. With a response rate of approximately 50% and the professional random selection process, we believe the sample to be representative.

## Plan of Accomplishment

Telenor Kompetanse has accepted the overall responsibility to carry out the actual research, as they believe it is in their interest for this project to be successful. This means that there is a real opportunity to conduct a meaningful and serious formative evaluation, which will have a major impact on a critical project at a major corporation in Norway. Telenor also covered all material expenses associated with this research. The project plan and major scheduled activities are shown in the next figure.

The University of Bergen (UiB) has an observation role in the project. The university is interested in the results since there is active interest in the areas of distance teaching, ICT-based education, life-long learning, and the evaluation and study of learning effectiveness. Michael Spector, my supervisor at HiA, is a professor of information science at UiB, in addition to his 20 % Professor II position at HiA.

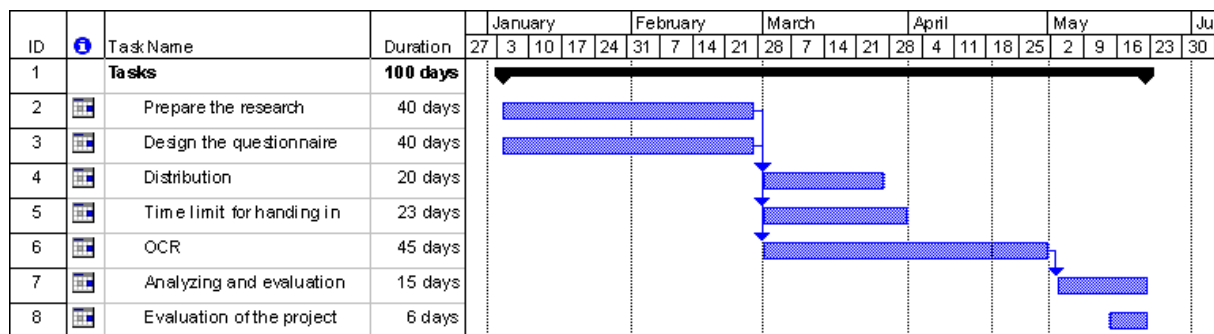


Table 3.2.3. Telenor Home-PC project schedule.

The registration of the answered questionnaires was, for reasons concerning privacy rights, handled by Telenor Direkte, which used an OCR (optical character registration) to summary and categorize the answers for us. Telenor Direkte is an established and reliable organization and their only role was to summarize and categorize answers while preserving anonymity of those who responded to the questionnaires.



### 3.3 The Student Situation Research

Part of this study is descriptive or phenomenographic, in the sense that there is interest in observing how people are using the computers, what interactions are now occurring, and so on. Much of this type of exploratory data is appropriately gathered by qualitative methods, including structured and open-ended interviews, direct observations, focus groups, and so on. These case descriptions and elaborations provide a general sense of what kinds of things are occurring and what kinds of changes may be significant. Part of the study is inferential and prescriptive in the sense that it is part of a formative evaluation and is intended to offer explanations for observed effects which might lead to organizational or system improvements. Some of this type of data can be inferred from survey questionnaires and data gathered on-line while users are involved with the system.

#### Activity One: The Reason

Do ICT contribute to learning and in what ways? How do users engage in various learning activities? Which courses attract the most users? Who takes courses and why? How might students like to see distance education environments improved? How should a web course evolve to improve collaborative, distributed learning? Answers to all, or some, of these questions will help us in the work with Akademiet. Results from this research can give us an indication of how students, with different technical background, react on the technical evolution in educational establishments.

Changes in the educational establishments are a fact. We can sense a shift in learning theory from a teacher / classroom / student based situation to a distributed system. This has led to extensive research in finding new ways of designing courses, of learning / cognitive processes, of communication and collaboration [20]. The approach to this investigation was to get students opinions and attitude about distributed learning systems.

The research consisted of qualitative interviews with students and teachers at HiA who have taken credit courses through the Internet. Group discussions with five random students at HiA were conducted so as to provide a backbone for further research work. Both flip chart summaries, tape recording, and individual questionnaires were used to document findings, so that group reactions and cognitive dissonance could be checked against an analysis of individual response. Source of errors in this research, like, was tried to be minimized. However, the validity of this research is restricted to be relevant for HiA, and is only an indication for other equivalent surroundings. The tools and results used in this research are documented in Appendix 3.

Relevant factors for the students' attitude towards changes in the student situation was drawn and illustrated in the next figure. From the results and findings in this work a questionnaire was designed.

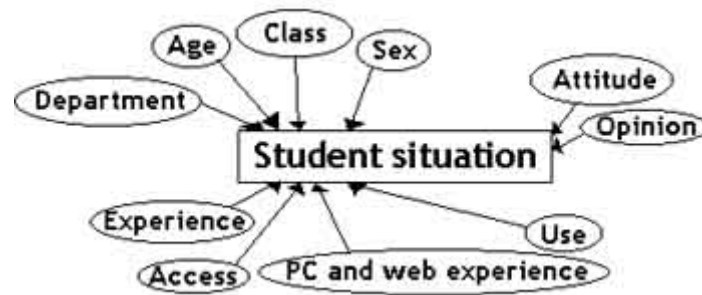


Figure 3.3.1. Relevant factors for the student's attitude towards changes in the student situation.

## Activity Two: The Quantitative Research

Based on the results and findings in activity one a questionnaire was made. The idea of this questionnaire was to gather information from students at HiA. Quantitative results from this research can give us an indication of how the student attitude and opinion towards the development in educational establishments are.

The questionnaire was distributed to all students at HiA via Email. The advantage of this group is that both technical and non-technical students and both experienced and inexperienced students (with regard to having taken Internet courses) are represented. The disadvantage is that the surveys were conducted through email, and therefore it does introduce a bias for those using email and who are therefore likely to be more technologically sophisticated. The fact that the reasonably high response rate (30%) and that many were still somewhat hesitant about new learning opportunities indicates that this might not be a hugely significant bias, but we should at least acknowledge its existence.

The design of the questionnaire was difficult. It was important to make it as clear and as neutral as possible. At the same time it must be easy for both technical and non-technical students to read and understand. The multi-answer questions were designed with only three answering alternatives (positive, neutral and negative). This was done so as to elicit a definite attitude.

## 3.4 Market Survey

Macromedia research findings, in 1997 [L12], show that real-time collaboration tools are enjoying significant interest and market growth. A tendency in this business sector is for more and more developers to use real-time, collaborative applications in their products. One of the main reasons for this trend is that customers demand collaborative functionality in their working tools. Many employers also expect distributed workers to be able to effectively collaborate. As collaborative tools spread into the workplace, there is a growing demand for collaborative support in learning environments.

## Activity One: The Market

Macromedia is one of several companies putting effort into this market, because they expect that the use and demand for distributed learning systems will explode early in the next decade. In 1997, 75% of all training was estimated to be conducted by teachers in classroom settings. By the beginning of the next decade, Macromedia estimates that over 50% of all education will be computer based, and that web-based applications will grow the most, by approximately 400% [16]. The next figure compares the differences expected in a short, three-year period.

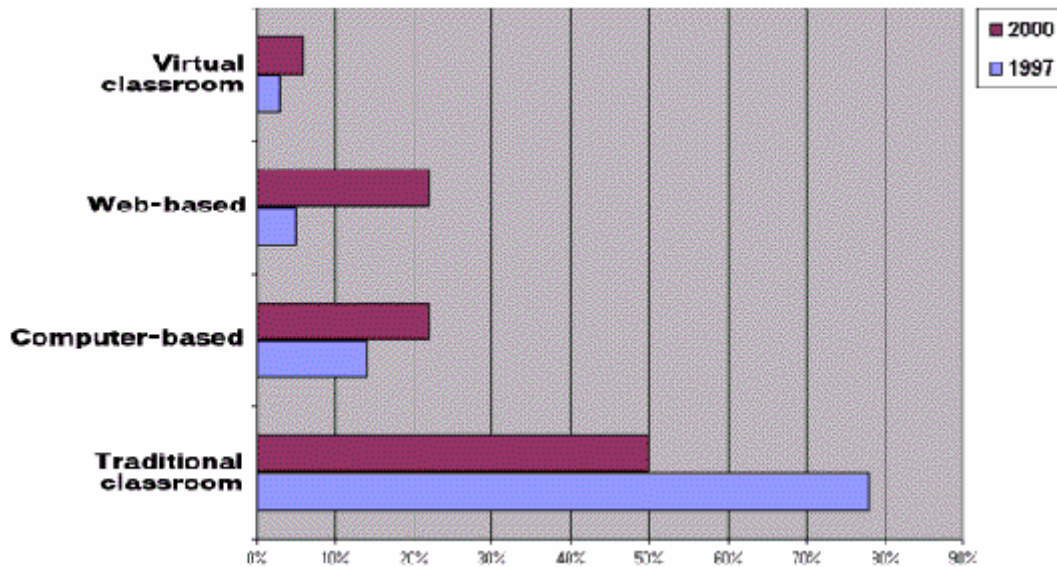


Figure 3.4.1. Estimated growth in web-based training applications [16].

The following figure indicates the exposition in the trade of ICT related products. The Y-axis represents growth in terms of sales (millions of dollars). The X-axis indicates time, from 1970 through 2000. Again, the estimated growth in terms of technology-based training products appears to be exponential, and we are just now entering the period of greatest growth.

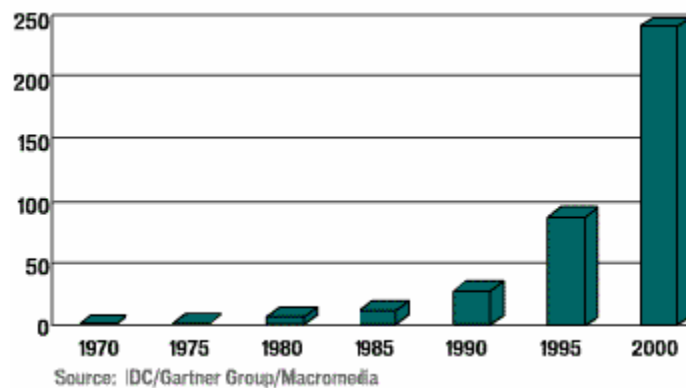


Figure 3.4.2. Growth rates in ICT based training products [16].

## Activity Two: The Market Survey

Which features and characteristics contribute to optimal learning in a distributed learning environment? Which system, applications and software development tools are suited for effective construction of such environments? What are the trends in the ICT market? To map and get answers to some of these approaches was important for the work with Akademiet. Results from this research can give us an indication of how the vendors and suppliers are presuming the future and which technologies they give their reliance to. As illustrated in the last part: Vendors and suppliers make several different attempts on making a state-of-the-art solution appears, some succeed and some not. It is therefore important to make a survey over the entire market, including competitors, suppliers, vendors, and other relevant factors. The vendors and suppliers were surveyed as a source for validation and generalizability. Other educational establishments in the market were also examined as a kind of baseline comparison or reference group. Examples of this are UCLA, LUVIT, and NITOL.

Technological changes provide new opportunities for the design and deployment of educational environments, especially with regard to the use of collaboration and coordination technologies. It was necessary to get an overview from these relevant developing projects and connected issues in this area of knowledge. Data was gathered from these sources as part of a research literature review and to establish the specific context for this study. The next figure shows an outline of relevant factors involved in this survey.

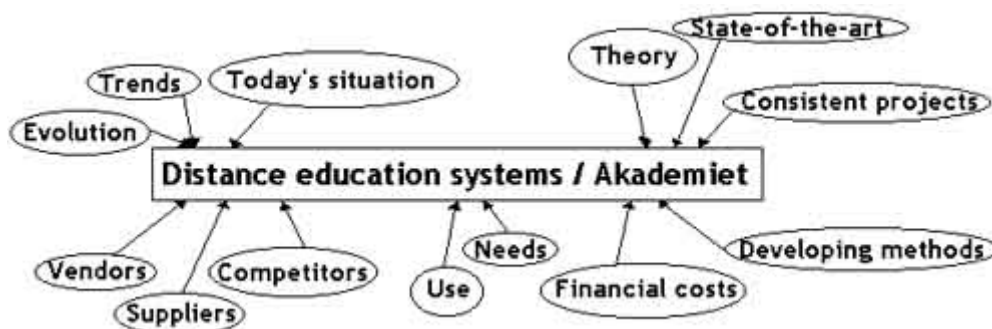


Figure 3.4.3. Relevant factors in distance education systems.

## 4. Data Analysis and Findings

A number of relevant factors and variables are hypothesized to be relevant to the use and effects of Akademiet. Among the groups of related factors thought to be relevant to a meaningful analysis are the following:

- Variables pertaining to space (separation from other users, office, etc.);
- Variables pertaining to time (when the system was used, how long it was used, etc.);
- Variables pertaining to presentation (syllabus presentation through different media, as visualization, audio, video, etc.);
- Variables pertaining to expectations with regard to effectiveness (both individual and corporate expectations); and,
- Variables pertaining to ICT skills and knowledge of the Participants.

These clusters of variables are associated with how we think about the notion of distance in distance learning environments. There is clearly distance with regard to time and place involved in most modern tele-learning or on-line learning environments. Learners are separated in time and place from teachers, tutors, and other learners. There may also be some distance between the expectations of individual users and those of their managers. There is also distance between the relevant existing knowledge, skills, and attitudes of various users. We are not focusing on distances related to language and culture although those are also relevant with regard to many distance learning environments which cross ethnic and national boundaries.

Presentation of the syllabus is an important factor in a distributed learning system. Today's courses delivered via the web, both domestic and foreign, are often only representations of a textbook in digital papers. The results from the different surveys and observations in the market, which are presented later in this chapter, acknowledge this. Just "paper on web" is not necessarily a bad thing since many courses use these supplementary digital materials to foster collaboration over and across the network. Nonetheless, the contents of these digital learning materials are basically similar in scope and functionality to that possible with paper-based materials. In other words, we are basically at the beginning of the first phase of several phases or levels of virtuality. Tomorrow's learning environment will deliver increasing levels of virtual reality. The different vendors clearly illustrate this through their distinction between theoretical approaches to a distributed learning system and their actual infrastructure of today. Virtual universities will transform the very nature of schooling, integrating many more virtual and web-based experiences than is now common, as Tor G Syvertsen from Studio Apertura at NTNU [L13] predicts it.



Figure 4.1. Levels of virtuality.

## Other Researches

It is important to gather and investigate relevant information from other researches, when you shall conduct your own research. Findings and conclusions from several different researches are used throughout my work in this thesis, but some of the headlines from other researches are presented here.

Several important validation concerns in this project are compared with findings from Statoil [L16], with regard to their introduction of Home-PCs. One of the primary reasons why their work is used, is that preliminary indications indicate that findings and conclusions from both the Statoil and the Telenor research should have similar outcomes. Also the questionnaire they developed was used as a support and creativity in my work. Reports from NKI [17, 18, L4] are also used.

Kulik examined approximately 100 evaluation studies on the use of ICT in learning. His conclusion was that ICT has a vague positive effect on student learning outcomes. This effect is estimated to be about 0.3 from the standard deviation [24]. Kulik's analysis indicates that motivation for studying also increased. Research on "The Apple classrooms of tomorrow" (ACOT) [25] also indicates that ICT has a positive influence on the pupils schooling performance, but this also involved specific demands on the teachers and on the educational establishment as an organization. Problems with these research results are the low degree of argumentation or independent corroboration. They have indicated that there are some positive effects, but they can not refer to the actual conditions of this outcome, beside the use of ICT itself.

Schofield [2] has put through a different kind of research study, where she has taken the conditions into consideration. She has used an ethnographic research on changes in social patterns through the use of ICT in classroom training. Schofield concluded that the effect of ICT is partly described by common sense assumptions of how ICT affects teachers' roles and students' learning effect [2, s. 190-228]. The social interaction pattern changes from a teacher-based pattern to more individually based patterns of work using ICT, with the teacher acting primarily as a facilitator. In this way the students control their own progress and the content of their learning tasks. Also, Schofield found that students had higher motivation and desire to learn through studying with computers than in ordinary and traditional school settings.

The interactions between the students and teachers also changed as a result of ICT use. In contrast to common sense assumptions where computers make the participators more isolated, the introduction of ICT actually lead to an increased interactivity between the students and teachers. The collaborations involved both technical and theoretical problem solutions and increases were found among students as well as between teachers and students. Note that this findings was made in a classroom / PC-lab situation, where the participates was located at the same place at the same time. In other words; it was ICT based training, but not distance education based.

As a form of non-traditional education, distance education serves mainly adults. Those adult students possess unique needs, motivations, goals and self-concepts. In a qualitative study with 1,000 adults Aslanian & Brickell [13] developed a profile of an adult distance education learner. They found that, in general, the students are married (61%), female (58%), part-time students (80%), employed full time (71%), and paying for their own schooling (60%).

Seventy-five percent of the adults surveyed were between the ages of twenty-five and forty-four years of age. Apt and Enert [13] compiled student characteristics at six open learning programs and found similar results.

The adult student generally enters the learning environment, whether traditional or distant, with a high degree of motivation. Adult learning is generally motivated by a desire to move from their current level of proficiency to a new, higher level. Verduin & Clark [13] put the point in this way: "Discrepancies between adults' current level and desired proficiency level directly affect motivation and achievement in both learning activities and life roles."

Although adults possess a high degree of motivation, the technology associated with distance education, coupled with the distance separating the student and instructor, leads to high degrees of anxiety.

Many distance education researchers have questioned the need for so much student / instructor interaction. They see a large amount of interaction as inhibiting the independence of the learner. Sewart [13] suggests that distance education students, perhaps, have greater freedom but with that freedom comes responsibilities. Freedom demands that the student make a number of important decisions which would normally be made for him. "It is an interesting and perhaps sometimes infuriating paradox that this provision of flexibility to cater for individuals needs inevitably results in increasing complexity of administrative and organizational procedures which may present the student with problems." [13].

## 4.1 Activity Three: Results From the Studying of Akademiet

It was important to get an overview of the contents and applications in Akademiet in order to establish a foundation for my study. This initial part of the study is a purely descriptive task. The technical features and the logfile results of Akademiet are presented in under.

### Overview of Akademiet

The content of Akademiet today consists of several different functionalities and applications. Personal login, general information, FAQ (Frequently Asked Questions) sites, a web-shop database listing over 600 courses, newsgroups/discussion-groups, course activities, private class/enterprise pages, and more are all provided in Akademiet. The site contains many types of media, including text, pictures, audio files, animations and video [L1].

Akademiet is located on a web server at Telenor Kompetanse in Grimstad. The Server system is described below:

- Compaq ProLiant 800, with a 400MHz Pentium II processor and 327MB (320 x 1024KB) SDRAM.
- Windows NT 4.0.
- NT option pack 4.0.
- SQL Server 6.5.
- IIS4.0. (Used to make logfiles of the activity at Akademiet.)
- 1 Mbit data transmission network link to Telenor Nextel in Arendal.

Akademiet was developed using a variety of different authoring tools: HTML editors, Macromedia Flash 3, Perl, Active Server Pages, JavaScript and Java. Akademiet runs on a Windows NT Server using its latest Web services, NT Service Pack 4.0, and Internet Information Server v.4.0. Akademiet queries information from multiple Microsoft SQL Server™ databases.

### Logging Results

In this part the logging results from the Akademiet server are introduced. Akademiet have experienced a great increase of activity after the start of the Telenor Home-PC Project. This shows that the project has given Telenor new possibilities as an organization. It is also a verification that the employees are using the technology, as the Telenor Home-PC research indicates.

Average Requests Per Day	1,280.36
Average Visits Per Day	115.5

Table 4.1.1. Average activity data.



The next figures show the increase in visits and requests per day, over the period from November to Mars. In the period from Mars to May, a slight decrease was noticed at first, and then a stabilization around 150 – 180 visits per day, which is much more than before the PC project. Most of these visitors are Telenor employees, which is indicated through the login profile, IP-addresses, and answers at question 10 in the Telenor Home-PC research. Another source which demonstrates that there already are activity in Akademiet, is the action in the course “Innføring i IKT.” Through a part time job at Telenor I developed this introduction course in ICT, in advance of the opening of Akademiet [1]. I therefore had the responsibility for this course in the first opening stages, and monitored the feedback the participators gave in the Guestbook and via email. This activity at Akademiet, in the courses which Akademiet delivers, and the booking of external courses is very interesting. It may announce that it is a possibility that training through this media already is accepted in some social groups at Telenor.

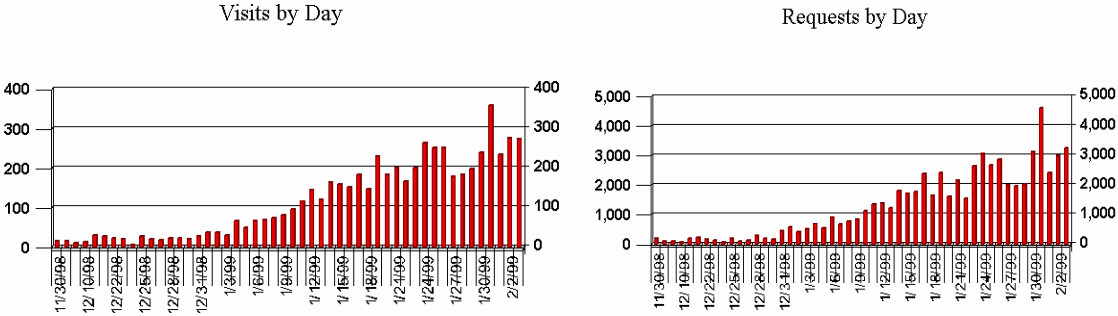


Figure 4.1.1. Visits and requests by day, in the period form November 1998 to Mars 1999.

If we look at the number of new visitors per day there was an increase in the period from November to Mars as figure 4.1.2 demonstrates. From Mars to May, a decrease was noticed at first, and then it has alternated up and down because of eastern and some other unknown factors. Today the number of new visitor is at the most 50 (in the weekends). This demonstrates that although the number of requests is decreasing and stabilizing, the number of visitors are still increasing and that Akademiet in this way gets a bigger usergroup for each passing day.

Even so, it is not only positive data which comes out of the logfiles. The measured activity also indicates that several visitors are not captured in the sites of Akademiet. They get lost to other sites. The average time used per visit is approximately 8 minutes, as presented in table 4.1.2.

Average Requests Per Visit	11.09
Average Time Per Visit (Seconds)	481.64
Average Time Per Page (Seconds)	43.45

Table 4.1.2. Average activity data.

Most common exit pages are very important to investigate, these are the last pages that visitors saw before they left the site. The site [www.akademiet.no/kurs/logginn.asp](http://www.akademiet.no/kurs/logginn.asp) was the highest ranked with 2,137 leaving visitors. Then [www.akademiet.no/index.html](http://www.akademiet.no/index.html) with 917 and [www.akademiet.no/cgi-bin/kurs.pl](http://www.akademiet.no/cgi-bin/kurs.pl) with 829 followed. This indicates that most people leave the sites when a login and password request appears or at the main site. Since most visitors

are Telenor employees the login and password request should not be a problem, because all the Telenor staff have an entry password. The reason can be that the password is forgotten, or that persons with less ICT competence have problems with entering these sites, or is afraid it will cost an additional fee, since several of the other courses in the database does.

Another negative trend is the number of single page visits. The main site of Akademiet has had 1,263 single page visit. A single page visit occurs when a visitor enters the site and then leaves again without seeing any other pages. A large number of single page visits may indicate the need for a more compelling home page. But in this case I do not believe that this is the reason, I rather think the reason is that several users have Akademiet as their default home page in the browsers.

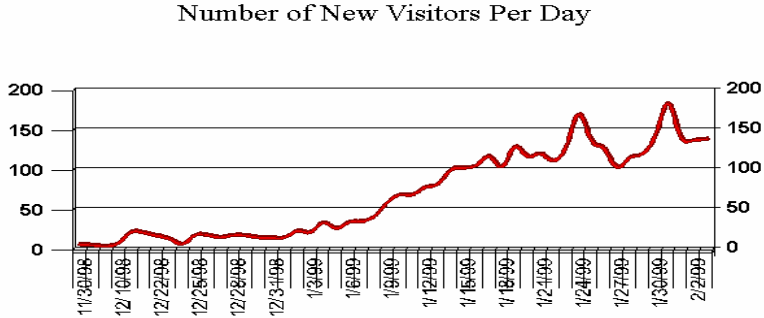


Figure 4.1.2. Number of new visitors per day, in the period from November 1998 to March 1999.

At what time of the day and which days in the week people visits Akademiet at the most and less is also an interesting issue. Is it in the working hour? Spare hours? At evening? Weekends?

The next figures give us a clear answer to these questions. The activity is highest at evenings from 18.00 to 24.00 and less during the night hours. On weekly basis the activity is best at weekends, but also Tuesdays have a high activity.

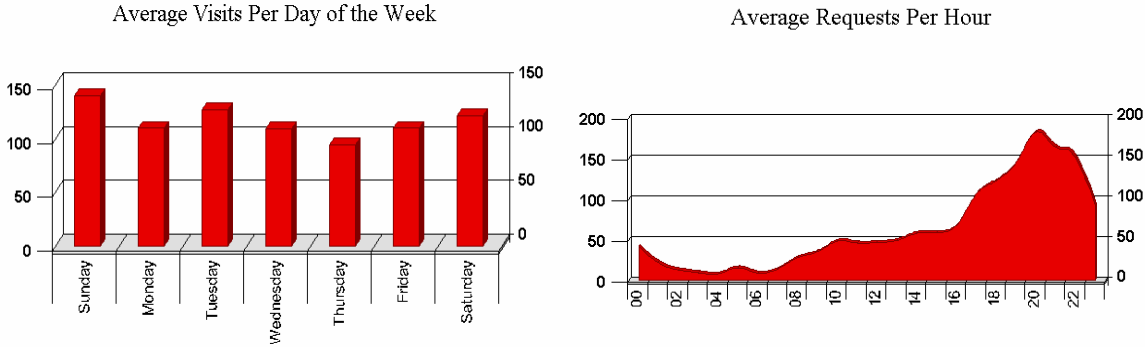


Figure 4.1.3. Average visits per day of the week and average requests per hour.

## 4.2 Activity Three: Results From the Telenor Home-PC Research

The research at Telenor gave several interesting results. Together with the data from the studying of Akademiet, various findings and conclusion can be made, regarding to the initial questions from Chapter 1.3.

The first figure shows the age dispersion of the participators. The average in this research is some higher than in the student research in Chapter 4.3.

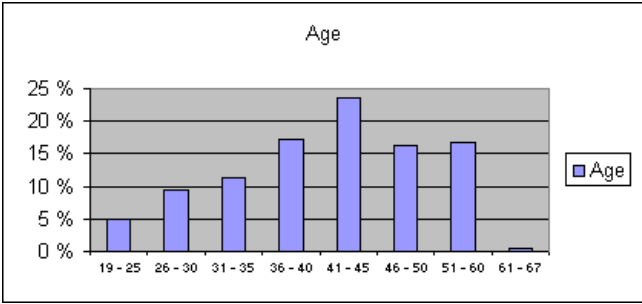


Figure 4.2.1. Age dispersion.

The next figure illustrates a highly interesting issue; the use of computer. 81% of the participates uses computers, mainly PC or Mac, and 17 % did not use any kind of computers. It would here be very exciting to focus on context between demographic issues, like age, gender, education, location, and working situation. Therefore it is a pity that the only results which is given by Telenor Direkte are the data in Appendix 2. These results do not give the opportunity to use analyst tools like Pivot-tables to find answers to the mentioned issues. In that case we needed more data, like we have from the student research.

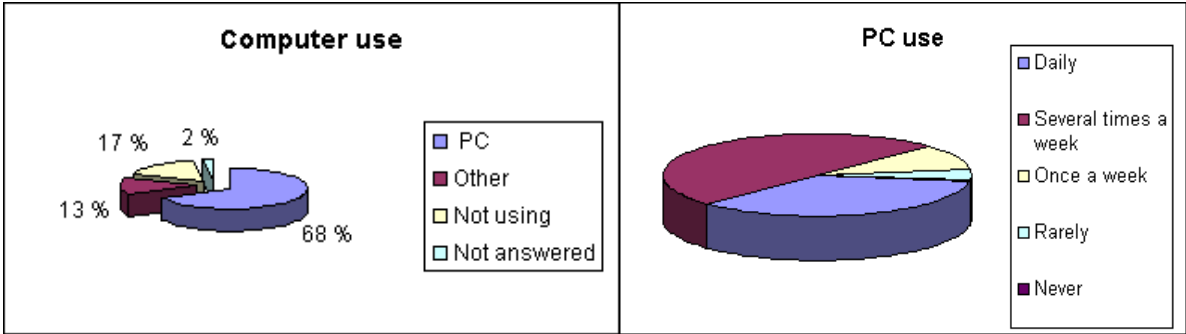


Figure 4.2.2. Use of computer and quantity of PC use.

Most of the workers at Telenor uses a PC several times a week or daily. And if we look at which programs they use at work and at home (Table 4.2.1.) we notice that approximately 63% uses educational programs at home, but only 2% uses it at work. This is a fascinating and important observation for this thesis. This indicates that most participators at distance education systems are using their spear time for education, or that they choose to use their home-office for educational tasks. The results from the logging of Akademiet indicates the same condition, see Chapter 4.1.

Use of:	At work	Home-PC
Word 97	61,5%	76,3%
Power Point	26,5%	30,4%
Excel	50,1%	52,5%
E-post/ON-Mail	59,5%	<b>67,1%</b>
Internet	43,5%	<b>85,4%</b>
Educational programs	2,1%	<b>62,5%</b>

Table 4.2.1. Use of applications.

Also the next table display the worker attitude. About 68% answers that education via CD-ROM or web has a beneficial effect on their educational situation. And in figure 4.2.3 we see that around 20% of the users already uses web or / and CD-ROM for educational purposes. The table below also reflects the attitude in other issues, and common for all is a majority of a positive view.

	No benefit	Small benefit	Have benefit	Great benefit
Better ICT knowledge	5,2%	14%	62,7%	18%
More confident in ICT use.	7,3%	13,4%	59,4%	19,8%
Direct efficiency in work and privacy	4,4%	14,5%	55,6%	25,6%
More confident use of the Internet	5,1%	10,2%	57,1%	27,7%
Education through CD ROM or web	8,4%	23,4%	51,7%	16,4%
Access to relevant information	7,4%	25,1%	50,9%	16,5%
Entertainment / games	17,7%	37,4%	37,4%	7,3%
Communication with others	10,5%	16,8%	49,7%	23%

Table 4.2.2. User benefits from the Home-PC project.

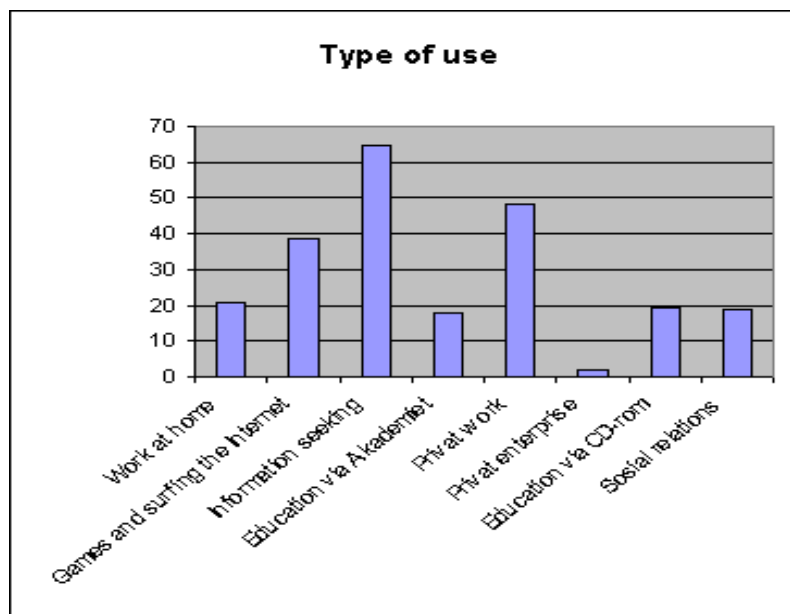


Figure 4.2.3. Type of use.

Very few participants thought that help and guidance through the Internet was satisfactory -- only 19 %. The other alternatives were much more accepted as satisfactory, as illustrated in

the figure under. A common problem was the ISDN installation and connection to the Internet, and that explains some of the moderate use of help through the Internet. However, it was only 10% of the participants who had experienced these problems. This means that the confidence in Internet support is low and / or that people feel insecure in his or her own skills. It is easier to call a telephone number or get a support person for direct guidance than to describe the problem and seek the solution yourself via the web. For some people test and failure is a part of their line of action, while others are less experimentally inclined and need more clear and specific instructions. This insecurity in their own ICT capabilities is a common problem. Many people are afraid that they will act stupid if they confront their ICT problems. Many feel ICT-illiterate. In this matter relevant factors can play an important role, including differences in age, gender, previous knowledge and experience, other specific differences to individual persons, and so on.

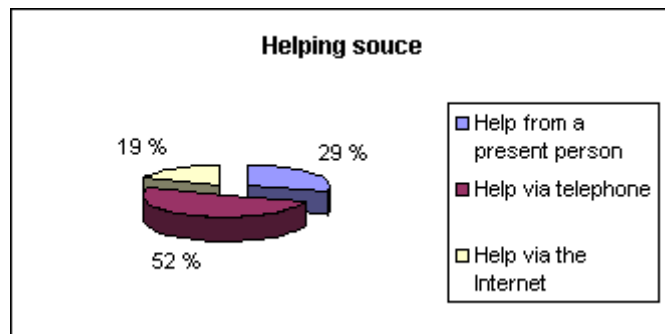


Figure 4.2.4. Alternative sources of help and their reliance.

This is a problem Telenor must take seriously and try to transform into something more positive and useful, such as an online environment where people can help each other, or a source of helping co-workers. In such surroundings Telenor might experience that a synergy effect was generated, and that the workers not only exchange ICT knowledge and experience but, in time, all kinds of knowledge and experience. This idea is built up on the foundation which is described in chapter 2.5, or under part 4.4 where LUVIT and their IT Campus is described. Through such an environment more people could collect help through the Internet. And whit use of applications like FAQ and newsgroups for support, other resources could be released, like telephone and field support personnel. And most important of all; the workers would be more self-confident and secure in their everyday work situation.

### 4.3 Activity Three: Results From the Student Situation Research

The study of learning and characteristics of learners engages a large number of researchers [1, 2, 17, 18] and includes studies of learning styles, attitudes, personality, locus of control, motivation and attrition. Reports in the literature suggest that some combination of cognitive style, personality characteristics, and self-expectations can be predictors of success in distance education programs.

It appears that those students who are most successful in distance learning situations tend to be independent, autonomous learners who prefer to control their own learning situations. However, distance learning environments can also be a good contribution those students who manage classroom environments badly, such as asocial persons or people who are especially dependent on tranquillity in the learning process.

#### Results and Findings

The results from this research are presented in Appendix 3. In this chapter only some issues are discussed and the represented findings are analyzed with Pivot-tables from the answers in Appendix 3.

In the first figure we can view the types of use whit regard to the different age groups.

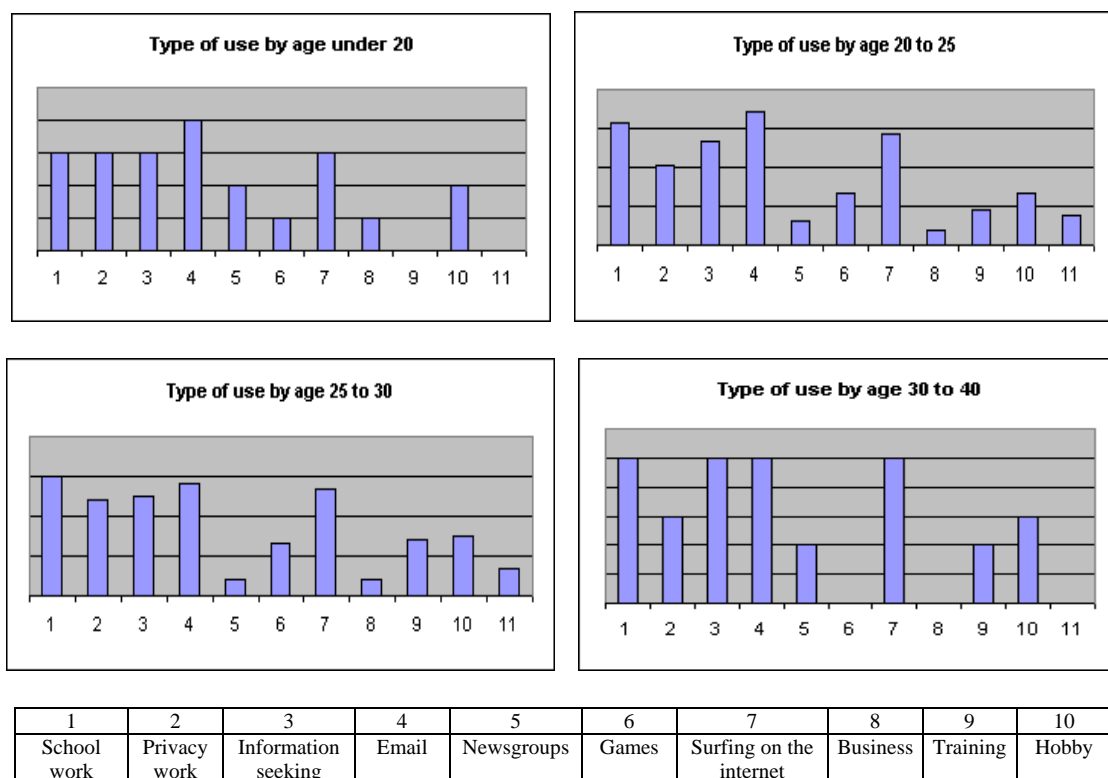


Figure 4.3.1. Different types of use whit regard to the age groups.

The patterns of use are not as dissimilar as expected, in fact, they are quite equal. The younger users utilize games in a higher degree than the elder does, as anticipated. But they also use ICT equipment for private enterprises in a higher degree, and that was not expected.

The proportionality between gender and their weekly use of PC are plain dispersed over the different amounts of use, with exception for the user group of less than a hour a week and the group of use between 15 and 20 hours a week. This means that there are only small differences between gender and their amount of use, and that it is other elements (type of class or work) which determines the quantity of use at HiA. The difference noticed in the figure, is probably related to the class of economics. In this class there are a higher number of women, and this class also have a lower use rate as illustrated later on in this section. This to factors most likely makes the deflection.

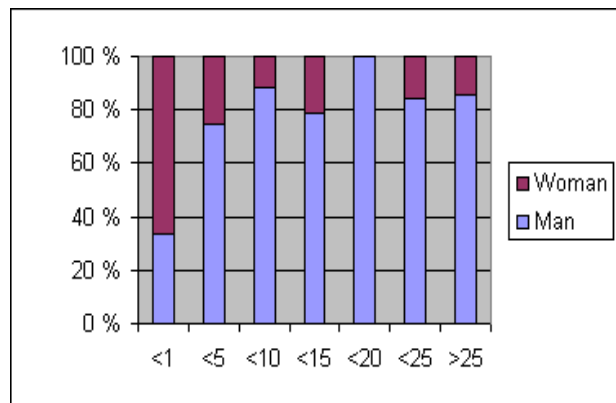


Figure 4.3.2. The proportionality between gender and their weekly use of PC.

The findings in the last part are even more strengthened through this next figure. The graphs for both genders are very alike, only a small deviation can be noticed, which believably is caused by the same elements that was discussed above.

Another issue with this figure can be the reliability of the figure. This figure illustrates use of PC and web in their studies at HiA. Since this questionnaire was consistent through email and web, is it most likely that the result has a fault indication in the result. However, the miscalculation has no significance on the previous discussion.

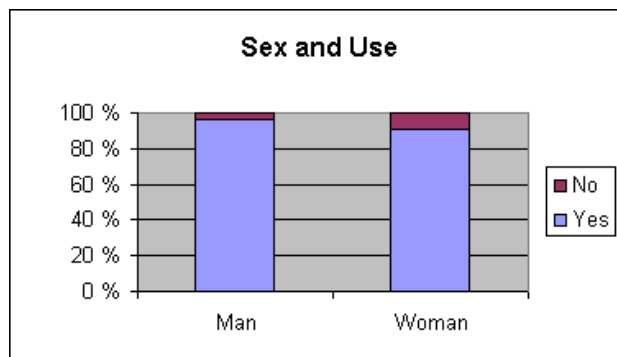


Figure 4.3.3. Overview of the dispersion between gender, users and non-users of PC and web in schooling.

The weekly use of computer at different departments displays a situation that was expected. Students at technical departments use ICT equipment more than non-technical students. And Computer science students use computers more than Telematic students.

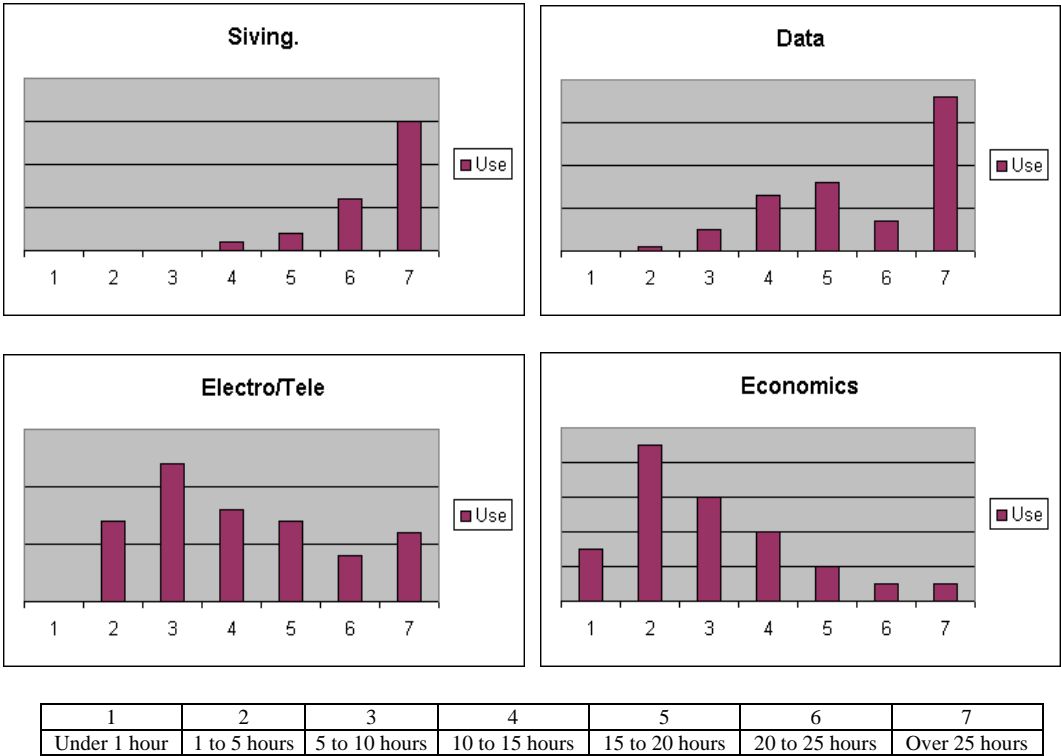


Figure 4.3.4. Weekly use of computer at different departments.

Under this research I made an overview of the participators attitude on positive and negative sides of classroom and distance education environments. This overview is attached in Appendix 3. From the different statements which the students have given me I have made some headwords to describe the attitude. Positive sides with classroom education can be described with; good social settings, and the negative sides with; bad individual needs. In distributed learning environments the respective headwords are; personal needs / adjustments, and; isolation.



## 4.4 Activity Three: Results From the Market Survey

At the end of the 1960's the first form of distance education organizations was presented. In 1969 the Open University in England was established, and the German FernUniversitat was founded five years later. These two distinctive organizations represent the beginning of higher education through distributed learning environments. They have been a great significance for further exposition in the last decades. Today the Open University and FernUniversitat are joined by such prominent organizations as the University of California at Los Angeles (UCLA) and Lund University in Sweden.

To get an insight into today's situation of the research and development in the distance education market, a survey was developed. Several large organizations with significant involvement with ICT were explored, both from the industrial and educational establishments. Some of the investigated organizations are MIT, Open University, Macromedia, Adobe, Microsoft, UCLA, Hewlett-Packard Company, IBM, New Jersey Institute of Technology, Apple Research Laboratories and Gartner Group. Also some Scandinavian participators, like Lund University, NKI College of Computer Science and NITOL were studied in association with this research.

The information obtained from the survey is used throughout all of this project. Locations at the Internet such as IBM's and Apple Research Laboratories' sites have given me a great help to get an overview and to decide how to proceed. This survey has therefore been in process through the whole project.

I will comment on some of the findings in the following section. I have had a chance to get first hand information about UCLA and NITOL through students in these two educational establishments. This opportunity is one of the main issues why the more thorough comments are concentrated on UCLA, instead of other organizations such as MIT. At UCLA the university's research situation and their operational infrastructure are studied.

### UCLA

UCLA is one of the leading technological research organizations in the world. I mapped some of the activities and growth areas on which UCLA focused in its research and development. I have focused on how ICT has influenced and changed the student situation at UCLA, especially with regard to students at the Mechanical and Aerospace Engineering Department and the Computer Science Department, since these students were most likely to have interests and expertise to students at Agder College. This research is built on information gained through the Internet and from extended interviews with two students at the school. The interviews were conducted through online chat meetings, email and telephone calls. I also got access to their personal web sites. While a sample size of two is insufficient for quantitative research, these in-depth interviews do provide valuable qualitative data and insights concerning the student situation at UCLA.

## The student situation at UCLA

At UCLA, classrooms and laboratory training are used to support the learning process. We must therefore evaluate the use of ICT as a supplementary service system. It is not a main object for the educational situation at UCLA, but they are giving it more and more attention as an important tool in educational environments.

At UCLA all general information about the organization and student situation is presented on the web. This is very much the same as HiA's web presentation of the "Studiehaandboka" [L11]. The students control their own schedule and must pay attention to the state of their course in "Schedule of classes" [L10]. The only dynamic sites the pupils see are their own balance sheet sites at UCLA-online [L10]. Here the students find information about their degrees, fulfilled subjects and financial situation.

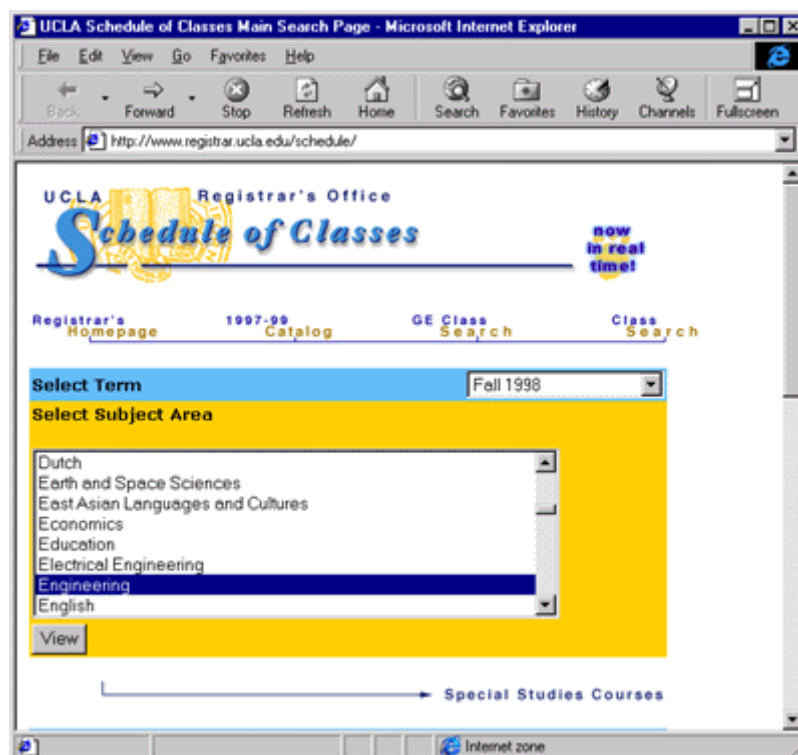


Figure 4.4.1. Schedule of classes.

Today the main pages and the personal dynamic pages have links to the different departments. There are no links to the actual courses which the students are attending. If you want to go to the homepage of a specific course, you need the exact address. Examples of this are the courses in Mechanics and Aerospace, Mae131A and Mae192A [L10]. There are some departments which have outlines and links to the different courses which are available, but this is the exception. The content in the different courses on the web is simple and static. It is pure representation of paper on web. Some courses have newsgroups or chat functionality. But most often it is just a syllabus overview and a database for literature and exercise download. The chemistry class is an example of how most of the courses are represented on the web [L10].

Another observation about the infrastructure is that when the students enter a course they must go to an examination office and hand in a form, or they can use a telephone service. There is no offer for this on the web as there is at HiA. The personal web was also only accessible in the opening hours of the school office since the registration process was not completely virtual.

Through interviews with two students at the university I got information about the great changes which to take place at the beginning of the next semester. UCLA is now informing the students about the new student situation at UCLA with “MyUCLA”.

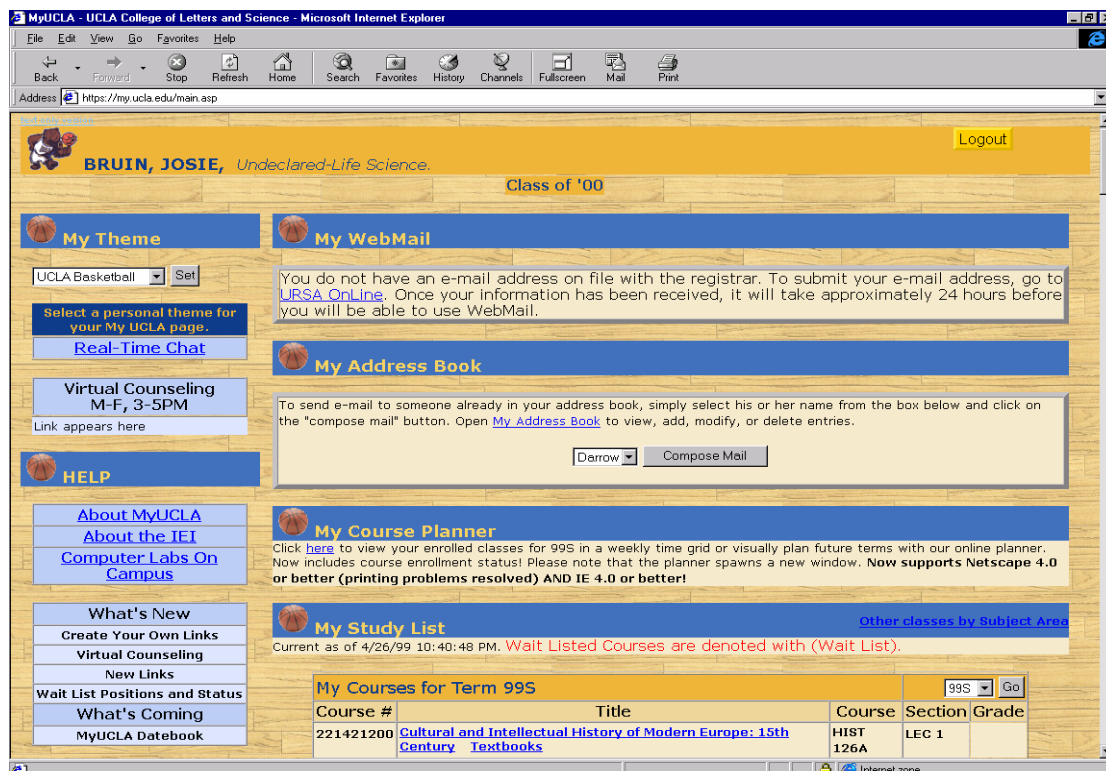


Figure 4.4.2. Bruin Online’s MyUCLA.

Through infoweb students are told that; ”Students entering the sprawling University of California, Los Angeles (UCLA) campus this fall will be greeted by more than hordes of strangers and unfamiliar surroundings. They’ll find a friend in MyUCLA, an innovative, personalized Web page that greets them by name, reminds them of class times and counselor meetings, lets them chat with other undergraduates, and dynamically changes to meet their changing needs.”

The situation at UCLA shows that even the biggest contributors in this research area have problems in getting state-of-the-art models and theories implemented in actuality. One of the main problems is to get the whole organization up to date with new technology. Most of their newer research achievements are not implemented in their infrastructure, but are only used in scientific contexts. This reflects the nearly universal finding that ICT work almost always takes precedence over ICT use in education; in the UCLA case, the relevant ICT work happens to be research. There is also a financial issue. Expenditure on research is covered by the Government, and industry and commerce organizations. The Computer Science Department has developed several pilot projects and innovations in ICT use [L10]. In

cooperation with UCLA's technical division Bruin [L10] they have developed MyUCLA. MyUCLA seems to be one of their new features which actually will be realized in UCLA's infrastructure.

MyUCLA is an example of a consistent and practical state of the art products. An area where they really are competent is in the administration and handling of over 20,000 students. Few of the other surveyed organizations in this paper can refer to that.

MyUCLA was developed using several different tools. Active Server Pages, Visual C++ v.5.0, Visual Basic version 5.0, Visual InterDev™ v.1.0, and Microsoft Transaction Server. MyUCLA runs on a Windows NT® Server using its latest Web services, Internet Information Server v.4.0. It queries information from multiple Microsoft SQL Server™ databases and IBM DB2 on the campus administrative mainframe [L10].

## Lund

Lund University has a saying that you should start when you have time, read at your own place and cooperate with those taking it at the same time. Their answer to this is the ITCampus. ITCampus is a virtual meeting place for students and teachers who want to increase the education quality with use of ICT. At the campus resources for students and teachers are located in an easy accessible way, and it is also available for guests. LUVIT actually invites outsiders to contribute to the sites. That everybody is welcome to use the resources and contribute to the sites, can result in a synergy effect of information content and system developing. The system is open for modifications and new application development, much like the idea of Netscape, who holds their source codes open for common people and developers. This encourage to cooperation and synergism for development of IT resources is a result of their strategy; that by cooperation it should be possible to achieve more than one man can. This is one of the main differences between LUVIT and the other organizations which have been examined, like UCLA and NITOL.

The fundamental idea of ITCampus is that it should not belong to anyone, but it should be a platform around which everybody could cooperate and where they could give and collect good course materials, links etc. Above all, ITCampus is a platform for students and teachers at universities but also open for everybody. You are welcome to build on this or give us tips for improvements.

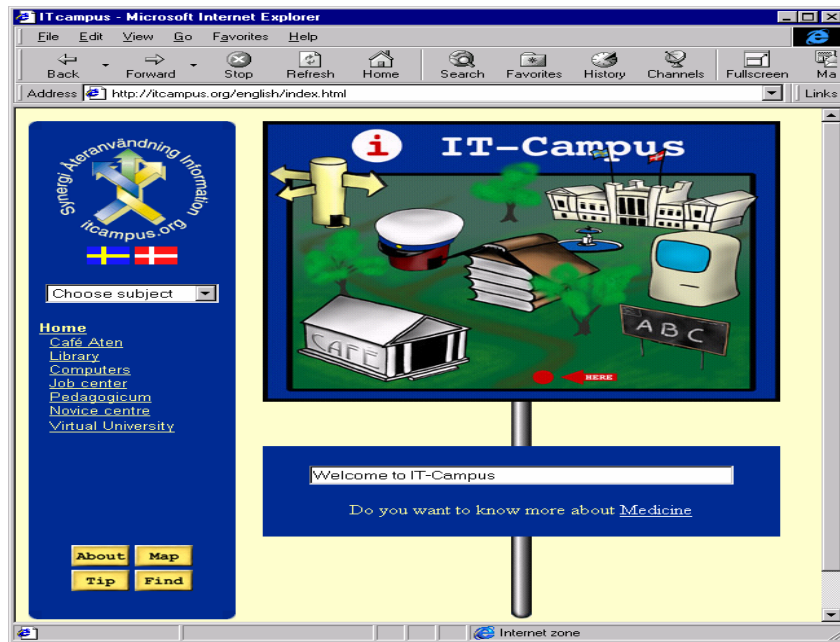


Figure 4.4.3. LUVIT IT Campus.

The development team behind LUVIT is now introducing the Microsoft Netshow concept for streaming multimedia across the Internet. Microsoft Netshow 3.0 is a server-based product that allows multimedia content to be streamed over the Internet. This feature is very interesting, like the other new Microsoft products for audio and video. Another example is Microsoft's cooperation with Sony. They have developed a rival to the mp3 audio format.

Windows NT Server NetShow Services enable users to stream audio and video over the Internet or corporate Intranets, delivering the highest-quality end-user experience over the widest range of bandwidths. Because NetShow Services integrate with Microsoft Office, BackOffice, and many third-party applications, content providers are able to take advantage of services such as ad insertion, commerce, and robust security, allowing them to generate revenue with streaming media. Corporations can utilize streaming media to provide online training applications and enhanced corporate communications. For developers, NetShow Services' comprehensive tools and APIs, combined with the Web and applications services in Windows NT Server, make it easy to author audio and video content and build value added applications [L9].

NetShow Services include a comprehensive suite of authoring tools and streaming services to provide everything you need to deliver audio, video, illustrated audio, animations, and other multimedia over your network or the Internet. Users play Windows Media content with the new Windows Media Player, a universal player that plays most local and streamed media file types. Together, NetShow Services and the Windows Media Player provide the foundation for building rich, interactive multimedia applications to sell goods and services, provide news and entertainment, conduct training, and deliver corporate communications.

## Hewlett Packard

Hewlett Packard's (HP) worldwide test and measurement (T&M) education center has used Acrobat PDF and Java technologies to create some complementary materials available online and for customers desktop that bring T&M application notes alive. This part is included in the report, because it is a good example of what we can offer to the participators of a course. Through my education I have worked on spectrum analysis of amplitude and frequency modulation, and I must confess that I never achieved a satisfactory understanding. When I tried the simulations from HP, these topics were visualized and it was much easier to see the behavior and context between the carrier frequency, modulation frequency and the degree of the modulation [L14].

Acrobat PDF interactive application notes contain the full text of popular classics enhanced with zoomable graphs, animated charts, and new illustrated text putting the complex technologies in context. These PDF files, containing mostly digital information, have been optimized for downloading, on-screen viewing, and convenience printing on color or black-and-white printers. Hyperlinks in the text allow direct access to continuously updated T&M information on the HP World Wide Web site, such as product datasheets, catalogs, training courses, and newsletters.

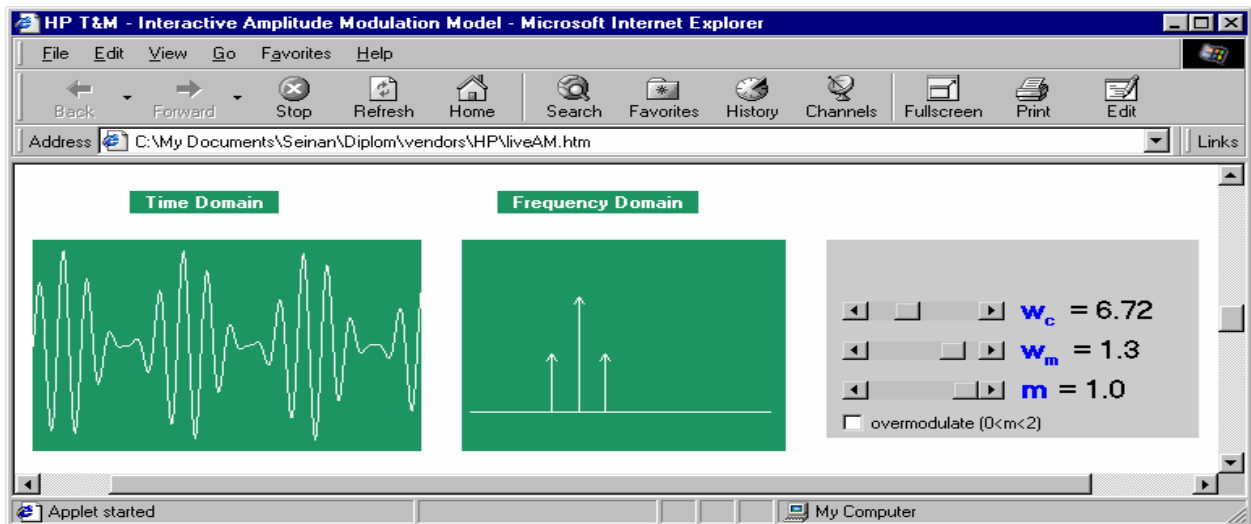


Figure 4.4.4. HP simulator.

## Domestic suppliers in Norway

Norwegian in-service training suppliers in this market are also investigated. Like the connections inside UCLA made a more intimate research at UCLA, also similar connections inside NITOL made it possible to observe some of the courses they offered. NITOL's course "Internet og Sikkerhet" was thorough investigated and observed. The course had, like most of the domestic courses which were investigated, only "paper on web" functionality, (the definition of "paper on web" is described in the beginning of chapter 4). There were no audios, simulations, videos or animations in the sites, just a few pictures. Only email could be used as a communication and collaboration tool. The only visualization in the course "Internet og Sikkerhet" is pictured in the next figure.

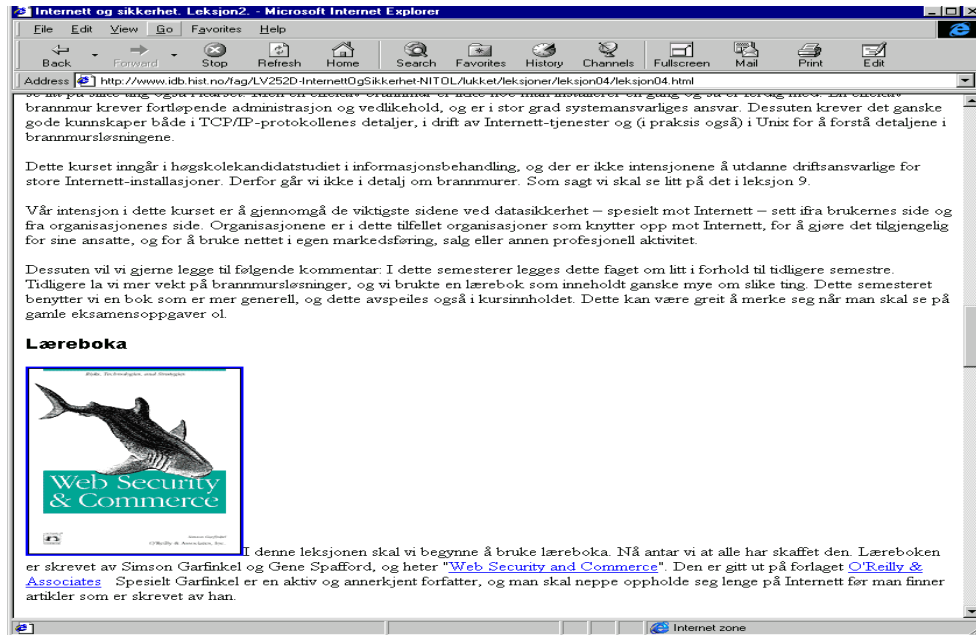


Figure 4.4.5. Picture of the NITOL course “Internet og Sikkerhet.”

The results of these observations indicated that the Norwegian educational establishments in the ICT market, had no unique or state-of-the-art conditions which would be an advantage or reasonable priority area for Telenor and Akademiet. Although there are, of course, some exceptions, like Telenor Research and Development’s DOVRE. DOVRE is presented in the following part.

The different suppliers (as NITOL, NKI, and Azlan), also made predictions and visions for the future, which was more interesting. Few of the theoretical attainments were obtained in their infrastructure, which is the same problem as at the foreign suppliers. In Appendix 4 a collection of the biggest domestic vendors of courses in the ICT market are presented. It is important to emphasize that only some of their courses are purely web-based, most courses are a combination of seminars and post-qualifying education via the Internet.

## DOVRE from Telenor

A domestic achievement in the distributed environments is the Telenor Research and Development’s 3D-visualisations program, DOVRE. DOVRE is a software platform for developing networked real-time 3D applications. The primary goal of DOVRE is to provide a platform for work, education, entertainment and co-operation in distributed digital 3D worlds. The DOVRE framework is ideal for creating distributed virtual environments. In such environments new ways of interaction between humans, and new ways for humans to interact with computers, is possible. DOVRE provides a platform for making intuitive interfaces and integrating multimedia sources into a natural 3D environment.

The market for 3D-visualisations is rapidly growing and the use of 3D virtual environments for interaction is maturing. This is the background for the next generation of communication medium; the networked virtual reality. The advantages seem quite obvious, as it can overcome the obstacles of traditional remote telephone conference meetings,



videoconferences, multimedia conferences and computer conferences. These barriers are related to limitations in the various media and first of all the ability to make the participants fully engaged in the conferences. To “feel and sense” objects, be able to determine its own viewpoint, appearance and utilize a variety of functionality seems to be what we can expect of a future educational collaboration system. The alienating nature of many traditional media can be overcome in virtual reality conferencing. The participants can experience a new kind of presence with each other and with the three-dimensional objects and documents they collaborate on, as they are present in the same virtual room.



## 4.5 Future development

We also need to take the technical specifications into consideration when we are trying to organize the future of Akademiet. Students entering Akademiet in the future should be able to find more than hordes of courses and unfamiliar surroundings. They should meet an innovative, personalized Web page that greets them by name, reminds them of class schedules, time limits and interactive group meetings, lets them chat with other undergraduates, and dynamically changes to meet their changing needs. With this new "web" of Web pages, Akademiet could give students a more convenient, personalized experience through their studying and helping the facilitators communicate more effectively with students.

When students log in, Akademiet could connect the PC users with a mainframe, by using an ActiveX component to authenticate their passwords. Then the program can use Active Server Pages to pull student and course information on the fly and dynamically build the student's Web page. In the course IT 4200 at HiA we began to build a system environment like this [L11]. In the pages the students would see their progress toward completing honors requirements, stay in tune with their evolving academic goals, the status of any petitions they have submitted, letters of recommendation on file, conveniently request and receive services, and much more. Each class listing is hypertext-linked to the Web page for that course, where students can find assignments and reading lists, syllabus material, send e-mail to professors, post homework, check for schedule changes, review grades for past quarters and so forth.

Akademiet would also make it easy to stay in touch with students and post course information, for all participates. For administrators, it is a great way to communicate with specific students or specific student populations, notifying them about available courses, financial state, the status of student requests or informing all history majors that a certain course won't be offered next quarter.

In selecting an operating environment for the future, the speed, reliability, ease of development, and cost are all important. Telenor needs a server that meets the requirements for fast response time and robust reliability. Telenor is already moving down a path paved with Microsoft products; for example, all records of the 600 courses at Akademiet are stored on a Microsoft SQL Server database. Since the server of Akademiet has to pull data from this and other Microsoft product-based environments, I think Telenor will get the best results by sticking with their Microsoft foundation. Another advantage of Microsoft products such as SQL Server and Active Server Pages is the easy and good interface and system logic. Microsoft is the only vendor offering the full breadth of fully compatible pieces. To go any other route, you must do all the integration yourself, and that makes development a lot harder and longer.

### Development tools

There are several different types of development tools in the market. I will not be given a synopsis of the different suppliers and products. There will only be a discussion over the most suitable and relevant development tools for constructing on Akademiet.

There are several different developing tools for creating Web pages. The most popular products today are Front Page 98 and DreamWeaver. As we see in the next figure these products can only create static pages with live data functionality like streaming videos or CGI scripts. My questionnaire at HiA is a concrete example of such a product [L11]. We still operate in the “paper on web” world, with some additional data transaction availability. To create more dynamic and personalized pages we must use other tools, such as Active Server Pages and SQL Server databases.

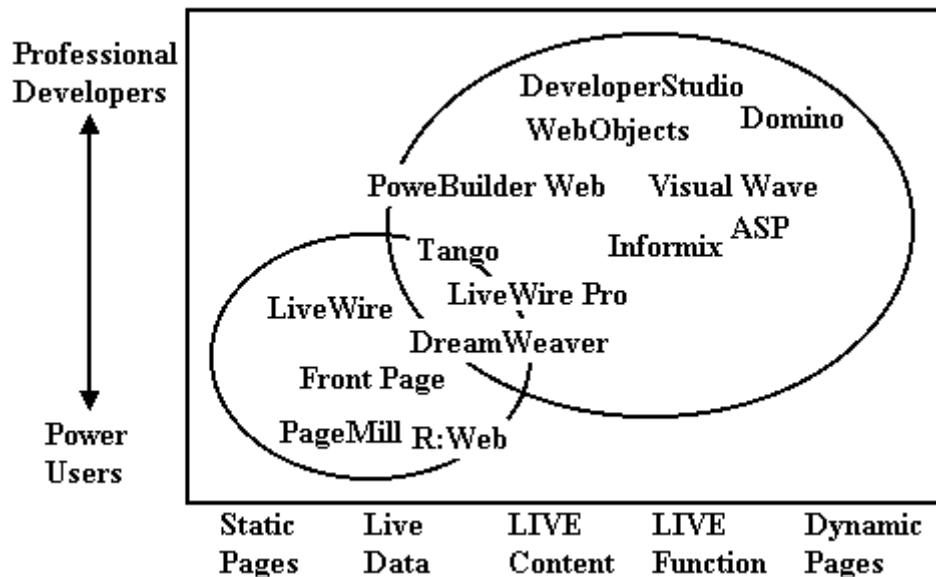


Figure 4.5.1. Development tools.

## Macromedia Flash

The developers of Akademiet have already used Macromedia Flash 3 in their production of animations in Akademiet. Flash is one of the best animation editors and authoring tools on today’s market. Flash is optimized for downloading and on-screen viewing, and is Macromedias “web tool version” of Macromedia Director.

Flash is a vector graphic editor and an animation and authoring tool ideal for creating animation and interactivity for web pages. It is perfect for interactive menus and animations. We can use the Flash authoring environment to create vector-based interactive animations and incorporate sounds. The advantage of the vector-based format in Flash 3 is by the same principles as well known FreeHand and Adobe Illustrator. Flash can import a bitmap image (scanned photographs, BMP, JPG, TGA, TIFF or GIF files). These source files of raster format uses the picture element pixels to describe the visual image. Flash import this data as a single object that behaves just like a group of shapes and converts it into a vector graphic with editable discreet areas of color. This vector graphics have a redoubtable reduce in the size of the animation files. A file transformed from a GIF to a Flash animation can be reduced with into 70 - 90% of the size, and at the same time be delivered with better contingency and functionality.

When using a Shockwave Flash movie on a web server, it is important that the server has been configured with the proper MIME type so that the browser can recognize Flash movies. This problem is experienced at Akademiet. With Internet Explorer 4.0 or higher this is a default setting. . But in other browsers this configuring may need to be set.

## The Knowledge Machine; Computers and Construction

In the next part some of Papert [7] ideas from his constructive approach to learning will be adopted. Some of his ideas are relevant for adult teaching, as discussed in part 2.4. Constructionism attaches special importance to the role of constructions in the world. As examples of constructionist learning activities, Papert refers, amongst others, to measuring quantities while making a cake, building with Lego or working with the computer programming language *LOGO* developed specifically by Papert and colleagues for educational use . *LEGO* is developed for children's learning environments, but some of the ideas are relevant for adult teaching, too. *LEGO* is based on the work of the Piaget as extended into experientially rich environments by Papert.

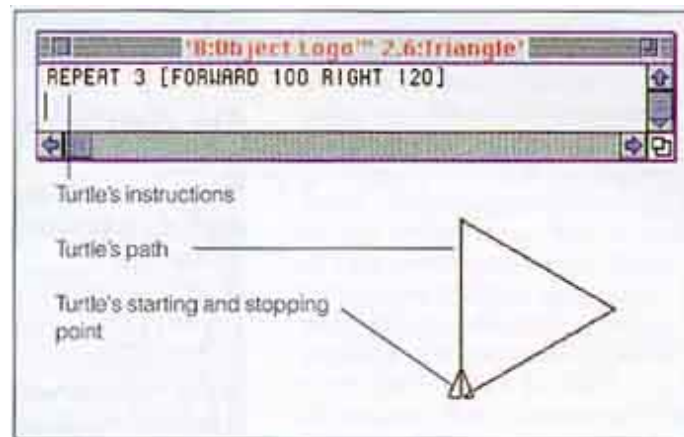


Figure 4.5.2. LOGO program.

Use of the surroundings in the learning process is important for some areas of knowledge construction. Resources are given through a facilitator, and the learners carry out the learning process themselves. In LOGO, learning to control the Turtle is like learning to speak a language it mobilizes the child's expertise and pleasure in speaking. Since it is like being in command, it mobilizes the child's expertise and pleasure in commanding. To make the Turtle trace a square you walk in a square yourself and describe what you are doing in TURTLE TALK. The method tries to establish a firm connection between personal activity and the creation of formal knowledge [7, p.58].

Papert's philosophy of learning and his constructionist approach rely on the computer for realization. He posits that the computer, and particularly, its future development, will change "children's relationship with knowledge" producing a revolution comparable to that of the "advent of printing and writing". He imagines a machine he refers to as "The Knowledge Machine" which would allow children a rich exploration of the world. Primitive examples of this Knowledge Machine would include "interactive video", "electronic books" and "virtual reality."

Several examples with practical applications suited for the Knowledge Machine are presented in this paper. Earlier we discussed Hewlett Packard's worldwide T&M education center and some other relevant distributors in the simulation and gaming market. Papert's work and theories highly supports these constructive environments, as illustrated in figure 2.4.2. The next part shows that also Telenor Kompetanse have considered such environments for their distributed learning systems.

## Measurement and Simulation of ISDN

The different results from the vendors and suppliers, and the LOGO example from Papert [7] illustrate new achievements of current interest. The need to deliver audio, video, illustrated audio, animations, or other multimedia over a network or the Internet are vital in the future.

Telenor Kompetanse has realized this and Erik Korslund and Ragnar Johnsen, from HiA and NITOL, developed this plain beta model for measurement and simulation of ISDN. You can measure the gain [dB] between HK, F3 and F3-8, and the system gain is calculated with the equation  $D = P_{F3-8dBm} - P_{hkdBm}$  [dB]. This demonstration is made with LabVIEW 4.0. LabVIEW is a programming tool for graphical instrumentation.

This is only a beta version, but further development will improve the system, with regard to both context and graphics. This project indicates that Telenor, together with NITOL, are taking the right steps towards making a distance education environment for the future.

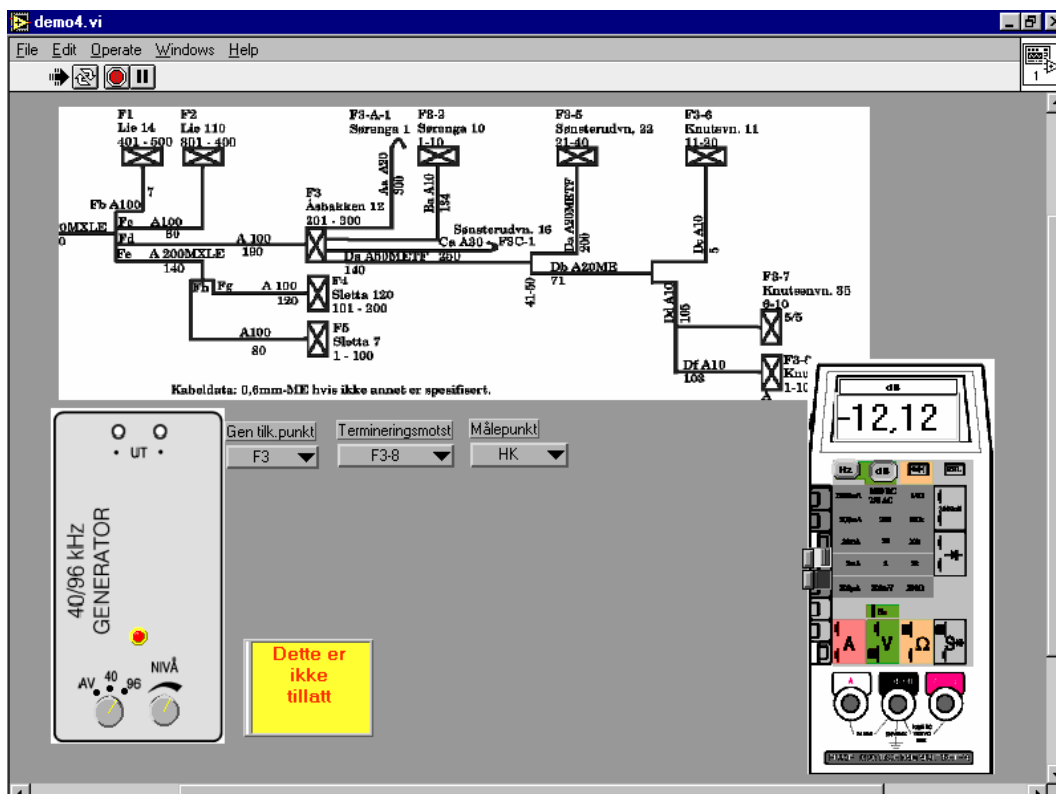


Figure X. Demo from Telenor Kompetanse.

## Hardware Requirements

We have been presented several different types of software and methods to develop the alternative tools for learning environments. There is also a hardware perspective which is concerning this issue. Both server, client, and transmission link must gratify a given specification to be functional in the given distributed learning system.

The Institute of Educational Technology at Open University in England has found that their learners must have access to a suitable computer and peripheral equipment. It is their responsibility to make sure that their hardware and software meet at least these specifications:

- Fast connections (at least 28.8bps) to the Internet and the World Wide Web.
- A standard word-processing package, such as Word 5 or 6, for preparing notes and assignments.
- A CD-ROM drive that meets the ISO 9660 specification, with Microsoft MS-Dos CD-ROM Extensions software.
- A Pentium PC running Windows 95, 16 MB of memory (ram), a hard disk with at least 15 MB free space after the Windows software has been loaded, and a high-density floppy-disk drive.
- A Microsoft-compatible mouse and a Windows-compatible printer.
- A monitor with at least VGA graphics (a color screen that can display thousands of colors is desirable).

Other establishments, as NITOL, NKI and LUVIT have about the same demands for equipment as the Open University. Telenor employees fulfill these demands easily, because Telenor has defined a much higher standard. Telenor employees are therefore provided with equipment with high capacity. All employees in the Home-PC project are supplied with:

- ISDN connections to the Internet and the World Wide Web.
- Netscape Navigator 4.0 or Internet Explorer 4.0.
- The word-processing package in Office 98.
- A DVD-ROM whit 5 x speed and 24 x CD-ROM speed.
- A Pentium II PC running Windows 98 and with a 17'' monitor.
- Audio and video out channels.

The high equipment standard makes the development of Akademiet more promising. Newer technology can be used within the limits of the transmission network, ISDN, which is the critical part. Telenor Kompetanse's Akademiet also have a server with high standard, which is described in chapter 4.1.

## 4.6 Research Findings

Throughout this paper different issues, approaches and results are presented and discussed. The initial questions and approaches that were presented in chapter 1.3 are tried answered through chapter 4. In this part a summation of the different results is given.

### Changes

Studying via the Internet opens new possibilities but also introduces some limits. Web-based education means many different things, ranging from placing simple course materials on a web page to integrating web-based activities into course activities. An ordinary campus-based course can utilize an educational establishment as a good complement, giving access to complementary materials and enhancing the communication among students and between students and teachers. Web-based education represents a major change, whether as the sole channel or as a complement, and is changing the roles for students as well as for the teachers.

The teacher's role is changing from an information source and distributor to a supervisor, organizer, and facilitator, as illustrated in figure 2.4.1. Teachers have to be better planned and prepared, ready to articulate goals and means. The new teacher role has been described as being more of a "learning coach" than a teacher is today, by way of facilitating learning and not teaching. The new role is thus implying that teachers shall create as good learning environment as possible.

Students have to take more responsibility and be self-disciplined to a much higher degree. The technology in itself should be as transparent as possible, which means that both teachers and students ought to be very familiar with the interface and associated techniques of using the technology for learning. Learning the technical stuff will otherwise take time from the real subject. To study at a distance means also that the study environment for ordinary courses has to be displaced with something else: family, workplace mates, friends, etc. [2]. It is often important for the individual learning process to discuss the theme with someone, to reflect thoughts and ideas. If it is a campus-based electronic course, the need for fellow discussants and co-learners might be easily arranged. UCLA [L10] and LUVIT [L9] are examples of this. They provides ways of communicating which never can fully replace the personal meeting, but they still can be efficient and fill some of the needs.

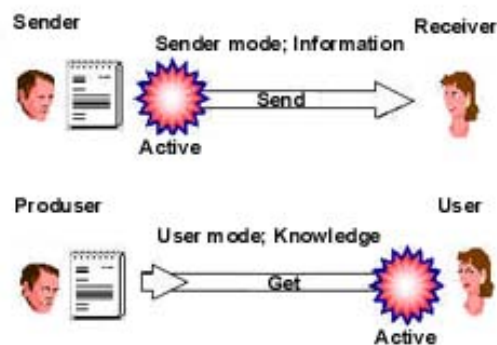


Figure 2.6.1. User mode; Push vs. Pull.

## Akademiet

New technologies introduce new problems with regard to planning and implementing support for learning. As has been historically the case, it is not the new media that dictate how and what can be efficiently learned. Rather, it has been the understanding of the possibilities introduced by new media and then the effective integration of those possibilities into sound pedagogical frameworks, which has proven effective in improving learning. All too often, we have failed to effectively integrate new technologies into learning, and much of this failure is a result of continuing to do what was appropriate for older methods and settings.

In order to realize the potential of information and communication technology to support, improve or enhance education, we must understand how the social organization of the educational establishment, company or other groups of participants influences the use of the technology, and how the use of technology affects and changes the functioning of the organization. One topic is often paid less attention to: context [20]. Therefore, we need good constructing tools and methods, to integrate learning theories and technology, when designing such environments. The methods must also pay attention to social, pedagogical and organizational relations. Activity Theory is a modeling tool to design such on-line learning environment.

How might Akademiet evolve so as to improve collaborative, distributed learning? Several examples with practical applications suited for the distributed learning environments are presented in this paper. Earlier we discussed Hewlett Packard's worldwide T&M education center and some other relevant distributors in the simulation and gaming market. Papert's work and theories highly supports these constructive environments, as illustrated in figure 2.4.2. The next part shows that also Telenor Kompetanse have considered such environments for their distributed learning systems.

The greatest motivation for a student is accomplishment. Learning something new is the most powerful motivator we have. But we must be able to see that we are learning. It must be evident to the learner that he/she can do something following the instruction that they could not do prior to the instruction. Answering just multiple-choice questions does not count. Most students do not see this as accomplishment [19].

In many instructional settings, differences and desires among a varied learner population play a crucial role. Some relevant differences include differences in age, gender, previous knowledge and experience, and so on. Other differences are specific to individual persons. Some learners are highly visual while others are more textually oriented, for example. Some learners prefer to have a highly structured environment while others prefer much less structure. Some are highly independent and self-sufficient, while others are dependent on context and frequent collaboration. Some are social and prefer peer-peer interactions, while others are private and prefer fewer interactions. For some people test and failure is a part of their line of action, while other are more level-headed and needs clear instruction. A continuing challenge for the instructional design community is to take all of these differences into account when planning instruction. When the instruction involves technology, these differences are quite critical and make the planning process more challenging. The concept has to be dynamic. It is therefore important to design a learning environment with a broad supply of applications (as actively, constructively, collaboratively, multisensorily, contextually based functionalities).

What is peoples attitude towards distance learning and training? The Telenor employee's attitude towards ICT was mainly positive, even though many workers feel insecure about own ICT capabilities. This insecurity is a common problem for many users, many people are afraid that they will act stupid if they confront their ICT problems. They feel ICT-illiterate. In this matter relevant factors can play an important role, including differences in age, gender, previous knowledge and experience, other specific differences to individual persons, and so on. I have tried to describe the attitude towards classroom and distance education at HiA with headwords. Positive sides with classroom education can be described with; good social settings, and the negative sides with; bad individual needs. In distributed learning environments the respective headwords are; personal needs / adjustments, and; isolation.

When are most users engaged in Akademiet activities? Results from my researches indicate that most participators at distance education systems are using their spare time for education, or that they choose to use their home-office for educational tasks. And we see that around 20% of the users already uses web or / and CD-ROM for educational purposes.

Which courses attract the most users? Most students at HiA would hesitate to participate on heavy technical, highly theoretical or practical courses. Also courses with deeper social aspects, as nursery education, is a negative attitude to accomplish via distance education.

How is Akademiet suited for future development? Telenor Kompetanse have a great foundation, accordingly to the results presented above, to succeed in future development of distributed learning systems. With regard to technical issues, Telenor Kompetanse has a perfect position (both at server, transmission-link, and client side). The software platform Telenor uses is basically of Microsoft products. In future development they should stick to their existing Microsoft foundation. This will, probably, give the best results, because of the advantage of Microsoft products (such as SQL Server and Active Server Pages is the easy and good interface and system logic). Microsoft is the only vendor offering the full breadth of fully compatible pieces. To go any other route, you must do all the integration yourself, and that makes development a lot harder and longer.

It is no doubt that the students at UCLA and LUND have a very independent existence. And that the administrative data processing have come far at the university. Aiming at the standard these educational establishments are representing will give Akademiet an educational system for the future.



## 5. Conclusion

The focus of this study is Akademiet, a distributed learning system developed by Telenor Kompetanse in Grimstad, Norway. Akademiet is a web application developed for use by Telenor employees and clients who wish to take courses facilitated by the Internet.

The framework of the thesis is founded on Nardi's [4] definitions of methods, techniques, and devices in the adult education process, as elaborated by Activity Theory. Stubbs and Burnham's [5] electronic distance education system provides a way to integrate technology into distributed learning. Papert's [7] theories on changes in our approach to learning provide a focus on cognitively rich, experiential environments. And Salomon's [6] interpretation of media in education, which focuses on the interaction of media, cognition, and learning, provides an integrated context for discussing distributed learning systems.

The results which are presented in this task are examples of conditions, and not necessarily generally features in educational establishments and organizations. Through the research these conclusions are made:

- Through use of ICT the teaching gets more individualized and fluctuating.
- Use of visualization increases.
- The focus is on student roles. New opportunities to make connections between the students and their interests are possible.
- Motivation can increase among students with a positive attitude, where age, education and living situation influences the motivation by the technology. There is not any indication that the gender influences the motivation.
- Positive sides with classroom education can be described with; good social settings, and the negative sides with; bad individual needs. In distributed learning environments the respective headwords are; personal needs / adjustments, and; isolation.

These results indicate that use of ICT creates a more varying and rich learning environment for the participants. Negative effects that use of ICT in educational establishments are also expected. ICT can increase the difference between intellectual strong and weak students. While the talented students uses ICT to improve better learning, the weak students can not manage to use ICT to control their learning process. Also the speed and automatic in educational software programs can make disadvantages. If the technology solves the tasks for the student, just through a simple instruction process, the student mind is not activated and stimulated and the learning process is impaired. Therefore it is very important that the types of tasks used in ICT environments, to stimulate the learning process, are modeled in a way (actively, constructively, collaboratively, multisensorily, contextually, etc.) so the student can not resolve the task inactively, but needs to combine different information sources. In this way the student learns to reason and the intellectual mind is stimulated.

The environment has accordingly a great influence on student learning processes. It is therefore essential to use the actual surroundings as a catalyst to the learning process, and not just pay attention to the transmission of information. The more relevant the theme and context are to the learners' situation, attitude and motivation, will give more realistic and effective learning. A learning environment which compound theoretical and practical lectures, tests, discussions, games, and simulations through group and individual training, is therefore more likely to succeed. To design such environments we need constructing tools and methods to

integrate learning theories and technology. We must also pay attention to social and organizational issues, like economics, user-group, etc. Activity Theory is modeling tool to design such on-line learning environment.

The socially oriented constructivist theories stress the collaboratory efforts of groups of learners as sources of learning. In a virtual constructionist learning environment, the goal is to foster creativity and to motivate learning through mediated activity. I have focused on this learning approach in my work. An ancient Chinese proverb illustrates the key principal of the constructionism; I hear and I forget, I see and I remember, I do and I understand. If this approach to learning should totally predominate the distributed learning system, without other elements, several problems would occur. The problem, then for designers, is to think a little about what to say, more about what to show, and a lot about what people are and will be doing. Psychological research, however, indicates that hearing may well contribute a great deal to remembering and understanding. We should not discount the value of what is written and spoken, and we should be careful to conduct complete, so other learning theories (behaviorism, cognitivism, etc.) are not excluded in this approach. A combination of active, self experienced, integrated, cumulative and motivating learning, where also use of theory-based studies takes part, appears to be an effective way to mediate information and stimulate the student learning processes.

Past and present trends indicate that machines and computers are not something we simply can rid ourselves of. On the contrary, it would appear that use of computers and intelligent machines will become more widespread. Therefore, as a society, we do have a vested interest in learning to live with it and to come to terms with some of the more negative emotions that technology appears to generate for many. Along with this evolution, which we must attend deliberately, follows many new terms, words, shortenings, and logos, which can result in ICT-illiteracy among the people. This is a serious problem we must oppose.

New technologies introduce new problems with regard to planning and implementing support for learning. As has been historically the case, it is not the new media that dictate how and what can be efficiently learned. Rather, it has been the understanding of the possibilities introduced by new media and then the effective integration of those possibilities into sound pedagogical frameworks, which has proven effective in improving learning. All too often, we have failed to effectively integrate new technologies into learning, and much of this failure is a result of continuing to do what was appropriate for older methods and settings.

A crucial factor in the success of any learning environment is its acceptance and appeal to its audience. This is especially true with regard to technology-based learning, since many will be skeptical or ill-prepared for learning in non-traditional settings. As a consequence, it is reasonable to consider the appeal of the existing courses in Akademiet, and then to consider which factors contribute to an appealing and successful design, and finally how those factors can be made most effective in new settings. Key questions include the following: Is an interface that looks like the work setting always desirable and effective? What sorts of icons are meaningful to intended and anticipated users? What kinds of interface features promote desirable learning behaviors? What kinds of interactivity are possible and desirable? What kinds of media uses are relevant and when are they helpful? What role does visualization play in technology based learning?

Creating more empowering machines and focusing more on human-computer interaction in the design process of educational environments may lead to more acceptance both of technology and of the changes that often accompany it in educational establishments.

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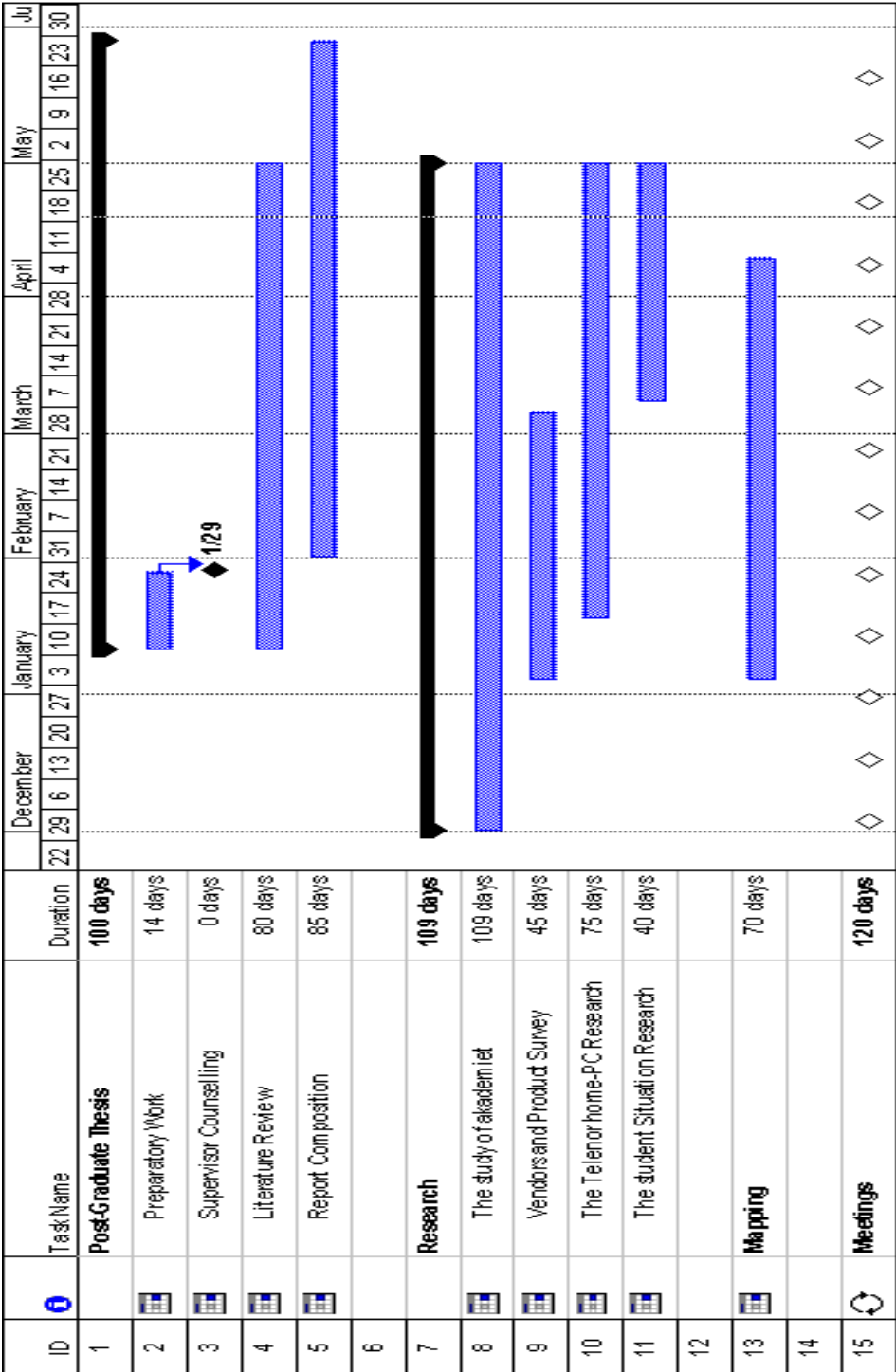
## Internet Links

- L1 <http://www.akademiet.no>
- L2 <http://tk-web.agder-ikt.hia.no/Diplom>
- L3 <http://www.tmo.hp.com/tmo/Notes/interactive/>
- L4 <http://www.nki.no>
- L5 <http://www.nettskolen.com>  
<http://www.nettskolen.com/alle/forskning/index.html>  
<http://www.nettskolen.com/alle/forskning/19/cmcped.html>
- L6 <http://www.id2.usu.edu>
- L7 <http://www.open.ac.uk>
- L8 <http://iet.open.ac.uk>
- L9 <http://www.luvit.org/demo/>
- L10 <http://www.ucla.com>  
<http://my.ucla.edu/>  
<http://www.ucla.edu/bruinonline/>  
<http://www.registrar.ucla.edu/schedule/>  
<https://rex.ais.ucla.edu/sid.htm>  
<http://voh.chem.ucla.edu/20L/>  
<http://www.seas.ucla.edu/ma131a/> Mae192A:  
<http://www.seas.ucla.edu/ma192a/>
- L11 <http://siving.hia.no/fag>
- L12 <http://www.macromedia.com>
- L13 <http://www.pakt.ntnu.no/>
- L14 <http://www.tmo.hp.com/>
- L15 <http://www.cudenver.edu/~mryder/itc/constructivism.html>
- L16 <http://www.statoil.com>

# Appendices

## Appendix 1: Schedule of Project

The project schedule is a plain outline of the main activities in this project.



## Appendix 2: The Telenor Home-PC Research

Enclosed in this appendix is a summary of the questionnaire results from the Telenor Home-PC research. The results are based on a selection of 2500 employees. 1231 responded their questionnaire, this is 49,2%. The results are presented in Norwegian, but headlines and important findings are presented in English under chapter 4.2.

### 1. Brukersituasjon.

- a. 96,3% av respondentene har hjemme PC fra Telenor
- b. 0,3% har hjemmekontor løsning fra Telenor
- c. 2,7% har både a og b
- d. 0,4% har ikke a eller b, men eget PC utstyr hjemme
- e. 0,2% har verken a,b,c,d

Kommentar : utvalget baserte seg på adresselister fra leveransesenteret i Telenor Bedrift. At prosenten på kategori a. Ikke er 100% kan skyldes at det er feil i adresselistene, at for eksempel ektemake har besvart eller at man har misforstått spørsmålet eller følt at kategoriene ikke er dekkende for egen situasjon.

På jobb bruker :       67,9% PC  
                              13% annen datamaskin  
                              16,7% bruker ikke data  
                              2,4% har ikke svart

### 2. Demografiske data om utvalget.

Alder :	19 – 25 = 5%	41 – 45 = 23,7%
	26 – 30 = 9,4%	46 – 50 = 16,2%
	31 – 35 = 11,3%	51 – 60 = 16,7%
	36 – 40 = 17,3%	61 – 67 = 0,4%

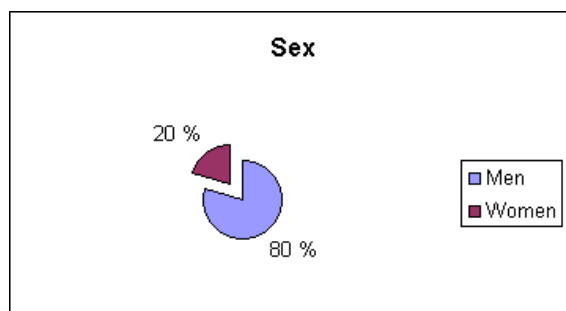


Figure A2.1. Outline over gender composition.

### 3. Utdanning: Antall år utdanning utover ungdomsskole el. Tilsvarende:

0 = 3,6%	6 = 8,9%
1 = 12,1%	7 = 4,9%
2 = 16,3%	8 = 4,1%
3 = 20,8%	9 = 2,2%
4 = 15,5%	10 = 0,9%

5 = 9,9%

Mer enn 10 år = 0,9%

Av delundersøkelsen blant ansatte uten hjemmePC eller hjemmekontor fremgikk det at det ikke helt var samsvar mellom tittel og antall års utdanning i svarene. Utdannelsesnivå mht. antall år må derfor leses med dette i mente.

19,7% er ingeniør	3,1% sivil ingeniør	0,1% er dr. ingeniør
5% er økonom	1,2% sivil økonom	0% er dr. økonom
1,4% er cand. Mag.	1,3% har hovedfag	0,1% har annen doktorgrad
55,6% har intern opplæring i Telenor utover ungdomsskolen/ folkeskolen		

Table A2.1. Outline over education composition.

0,5% er leder på overordnet nivå

12% er mellomleder

85,5% har ikke lederansvar

#### 5. Hva brukerne har høyest forventninger til ang. hjemme-PC'en fra Telenor:

Hastighet, effektivitet på selve maskinen = 23,7%	Brukervennlig programvare = 9,7%
Enkel installasjon = 1,4%	Gode opplæringsprodukter = 16,7%
At jeg skal bli tryggere i bruk av IKT = 31,6%	Bli i stand til å kommunisere med andre = 5,7%
Høy hastighet på Internett via ISDN = 4,7%	Bruke telefon og Internett samtidig med ISDN = 6,6%

Table A2.2. Outline over expectations.

#### 6. Brukers nivå når det gjelder bruk av hjemme-PC:

PC mottatt/ installert = 2,6%	Begge dele installert, men lite i bruk = 17,2%
PC installert, ikke ISDN = 1,6%	Aktivt i bruk av meg og familien = 41,5%
Begge dele installert, i aktivt bruk = 41,1%	Aktivt i bruk av familien/ andre = 3,3%

Table A2.3. Outline over user level.

#### 7. Anslag, brukshyppighet, hjemmePC:

Daglig	25,2%	Flere ganger i uken	35,3%	1 gang i uken	6,8%
Mindre enn 1 time	11%	Mindre enn 1 time	8,3%	Mindre enn 1 time	17,5%
1	37%	1	13%	1	28,9%
2	34%	2	19,3%	2	41,2%
3	11%	3	17%	3	9,3%
4	2,4%	4	12,1%	4	0%
5	1,9%	5	14,1%	5	3,1%
6	0,5%	6	5,4%	6	0%
7	0,2%	7	2,5%	7	0%
8	0,5%	8	3,1%	8	0%
9	0%	9	0,4%	9	0%
10	0,2%	10	1,8%	10	0%
		Mer enn 10 timer i uken	2,9%		



Sjeldent = 3,1%	Aldri = 0,2%	
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Table A2.4. Outline over user activity.

8. Hva de ansatte bruker hjemme-PC'en til:

Ta med arbeide hjem = 20,7%	Privat arbeide ( frivillig arbeide, skrive brev etc ) = 48,3%
Spill, surfing på Internett = 38,7%	Egen næring = 1,7%
Bruk av Internett, informasjonssøk = 64,6%	Opplæring på CD rom = 19,4%
Opplæring via "Akademiet" på Internett = 18,1%	Hobby/ samvær m. familie og venner = 18,6%

Hyppighet på den/de funksjonene bruker benytter deg av:

	Daglig	Ukentlig
Informasjonssøk/ surfing	23%	57,5%
Spill/ underholdning	7,3%	18%
Handel/ banktjenester etc.	2,1%	20,6%
Lage egne hjemmesider	1,1%	5,4%
Nedlasting av programmer	1,6%	17,6%
E-post, Mail	27%	42,3%
Nyhetsgrupper	5,2%	15,8%
Chat	1,9%	6,7%
Filoverføring ( ftp )	1,6%	10,5%

Table A2.5. Outline over use.

9. Gjør hjemme-PC'en de ansatte mer effektiv:

Enig	Uenig	
29,8%	36,4%	Mange sender privat e-post eller bruker Internett til private formål på jobben. 33,7 % har ikke svart.
53,7%	13,7%	Hjemme-PC gjør det naturlig for mange å ta med seg private oppgaver hjem. 32,6% har ikke svart.
63%	10,4%	På hjemme-PC'en lærer jeg nye programmer, blir mer effektiv på PC i jobb. 26,6% har ikke svart.
55,8%	10,1%	Jeg skriver brev, e-post, surfer hjemme, kommuniserer mer effektivt på jobb. 34,1% har ikke svart.
69,9%	6,3%	Jeg bruker ISDN og hjemme-PC'en aktivt, min kunnskap om IKT øker. 23,7% har ikke svart.

Table A2.6. Outline over effect.

10. Hvilke programmer brukes på hjemme-PC'en/ på jobb:

Jeg bruker	På jobb	Hjemme PC
Word 97	61,5%	76,3%
Power Point	26,5%	30,4%
Excel – regneark	50,1%	52,5%

E-post/ON-Mail	59,5%	67,1%
Internett	43,5%	85,4%
Opplæringsprogrammer	2,1%	62,5%

Table A2.7. Outline over application use.

11. Har brukerne hatt nytte av hjemme-PC:

	Har ingen nytte	Lite nytte	Har nytte	Stor nytteverdi
Økt kunnskap om IKT	5,2%	14%	62,7%	18%
Bli tryggere på bruk av IKT	7,3%	13,4%	59,4%	19,8%
Direkte nytteverdi i jobben/ privat	4,4%	14,5%	55,6%	25,6%
Bli trygg på bruk av Internett	5,1%	10,2%	57,1%	27,7%
Lære fra CD rom/web	8,4%	23,4%	51,7%	16,4%
Tilgang til nyttig info på web/ handel	7,4%	25,1%	50,9%	16,5%
Underholdning/ spill	17,7%	37,4%	37,4%	7,3%
Kommunisere med andre	10,5%	16,8%	49,7%	23%

Table A2.8. Outline over user benefits.

12. Hvor fornøyd var brukerne med selve leveransen : ( Innhold, opplæring, selve leveranseprosessen ):

	Svært bra	Bra	Middels	Lite bra	Svært dårlig
Bestilling/ mottak av hjemme-PC'en	64,2	29,2	4,4	1,1	1,1
Opplæringstilbudet i pakken	20	54,6	20,6	3,8	1,0
Brukerhjelp og informasjon	22,7	51,6	19,9	4,5	1,3
Finansiering	45,8	41,8	10,4	1,2	0,7
Totalt	35,8	55,9	7,8	0,4	0,1

Table A2.9. User satisfaction.

13a. Har det oppstått problemer i leveransen :

81,3% svarer nei, 18,7% svarer ja.

Blant de som svarer ja, er det følgende problemer som meldes :

Tekniske problem med maskinvaren = 0,2%      Installasjon av maskin/ programmer = 2,8 %  
 Bruk av programmer, opplæring = 2,3%      ISDN/ internettoppkopling = 10%

Har du fått hjelp ?                      Ja = 63,4%                      Nei = 36,6%  
 Er du fornøyd med hjelpen ? Ja = 70,8%                      Nei = 29,2%

13b. Hva slags oppfølging er viktigst for deg som hjemme-PC bruker ( bare ett valg ):

Teknisk veiledning/ installasjon = 24,3%                      Bruk av andre programmer = 23,5%  
 Bruk av opplæringsprogrammer = 42,2%                      Oppfølging på arbeidsplassen = 10%

14. Hva slags hjelp fungerer tilfredsstillende for brukerne:

Hjelp fra en person på stedet = 26,6%  
 Hjelp via telefon = 49,2%  
 Hjelp via Internett = 17,5%

## Appendix 3: Research at HiA

Under the interviews a questionnaire, and two fill in forms was handed out to the participators. The fill in forms had the themes “Learning environments” and “Applications.” The questionnaire and the forms are, together with the debate schedule, presented on the next pages in this report.

### The qualitative research

This research was done with 5 students from HiA. The debate schedule is described under in Norwegian language.

#### INNLEDNING

Vi leverer ut arkene Demografi og Læring. Deltagerne jobber aktivt med disse skjemaene i 15 minutter.

#### TEMA I Bruker erfaringer/ Gruppe erfaringer

1. Oppfatning av web basert kurs?
2. Oppfatning av web, sterke / svake sider?
3. Evaluering av konkrete brukererfaringer / verktøyer i kurs?
4. Praktiske hindringer for bruk av web (kostnad, sosialt, lesevansker)?
5. Hvilke samarbeidsformer har du brukt i forbindelse med web opplæring?

#### TEMA II Krav for å lykkes

Fyll inn støtteelementer til web basert læring på utlevert skjema.

Vi ønsker å få drøftet disse spørsmålene / temaene:

6. Hva stimulerer /kan stimulere til bruk av web?

#### TEMA III Individuelle / sosiale rammer

Vi ønsker å få drøftet disse spørsmålene / temaene:

7. Gi en beskrivelse av PC som læringsmiddel?
8. I hvilke fag / situasjoner passer web best?
9. Kurs / Læring / Trening / Sosial læring – Ulike oppgavetyper.

#### TEMA IV Forventninger

Vi ønsker å få drøftet disse spørsmålene / temaene:

10. Hva er forventningene til web og web baserte kurs i fremtiden?
11. Hvilke typer kurs passer best for web?

## Demografi

### OM DEG:

Alder:

- Under 15
- 15 til 20
- 20 til 30
- 30 til 40
- Over 40

Kjønn:

- Kvinne
- Mann

Sosial status:

- Gift
- Samboer
- Enslig

### BRUK OG ERFARING:

Har du erfaring ved PC/Web kurs?

- Ja
- Nei

Bruker du PC og web aktivt i dine studier?

- JA
- Nei

Hvor ofte bruker du PC'en ?

- Daglig
- Noen ganger i uken
- 1 gang i uken
- Sjeldent  Aldri

Hvor mye bruker du PC'en p.r. uke?

- Under 1 time
- 1 til 5 timer
- 5 til 10 timer
- 10 til 15 timer
- 15 til 20 timer
- 20 til 25 timer
- Over 25 timer

Hva bruker du PC'en og Internett til ?

- Skole arbeide
- Privat arbeide
- Informasjonssøk
- Email
- Newsgroups
- Spill
- Surfing på Internett
- Egen næring
- Opplæring
- Hobby
- Annet:

Har du tilgang på Internett?

- Hjemme
- På skolen
- Andre steder:

Har du arbeidet ut ifra grupper / kollokvier i tilknytning til web kurs?

- Ja
- Nei

## Learning Environments

<b>Classroom</b>	<b>Web</b>
<p style="text-align: center;"><b>Positive</b></p> <ul style="list-style-type: none"> <li>▪ Conversations with teacher.</li> <li>▪ Questions answered simultaneous.</li> <li>▪ Studying on regular basis.</li> <li>▪ Presentation of syllabus.</li> <li>▪ Help to strain the important data.</li> <li>▪ Well organized and survivable, syllabus can be adjusted</li> <li>▪ Examination advice.</li> <li>▪ Get an examination before self studying.</li> <li>▪ Group work.</li> <li>▪ Be a member of a social group.</li> <li>▪ The ambience settings. (Humor, serious, relevant theory.)</li> </ul> <p style="text-align: center;">Head word: <b>SOCIAL SETTINGS</b></p>	<p style="text-align: center;"><b>Positive</b></p> <ul style="list-style-type: none"> <li>▪ Private study.</li> <li>▪ Self-discipline.</li> <li>▪ Your individually choices.</li> <li>▪ Own rate of progress.</li> <li>▪ Time / place.</li> <li>▪ Own archive, paperless.</li> <li>▪ Gathers (niche) competence from the whole world. Covers almost all special fields of interest.</li> <li>▪ Do revision.</li> <li>▪ Virtual Reality.</li> <li>▪ Visualization.</li> <li>▪ A good alternative especially for well-established.</li> <li>▪ Post-qualifying education.</li> <li>▪ Optional subjects.</li> <li>▪ Good supplementary to traditional courses.</li> </ul> <p style="text-align: center;">Head word: <b>PERSONAL NEEDS/ADJUSTMENTS</b></p>
<p style="text-align: center;"><b>Negative</b></p> <ul style="list-style-type: none"> <li>▪ The main focus and goal is the examination itself.</li> <li>▪ To many students, auditorium.</li> <li>▪ Auditorium is impersonal.</li> <li>▪ Monotonous, lack of concentration.</li> <li>▪ The way of accomplishment in classroom courses are to limited.</li> <li>▪ Pure repetition of textbook.</li> <li>▪ Success is depended on teacher capabilities.</li> <li>▪ Disturbing elements as noise from other students.</li> <li>▪ You can not decide the tempo of the lecture.</li> </ul> <p style="text-align: center;">Head word: <b>INDIVIDUAL NEEDS</b></p>	<p style="text-align: center;"><b>Negative</b></p> <ul style="list-style-type: none"> <li>▪ If lack of self-discipline.</li> <li>▪ Limited target group. Regarding to technical skills and availability.</li> <li>▪ Harder to communicate with other participates.</li> <li>▪ Less / no contact with other students.</li> <li>▪ Low social activity.</li> <li>▪ Alone, psychiatric and physical depressive effect.</li> <li>▪ Poor layout.</li> <li>▪ Information overload.</li> <li>▪ Bad functionality and applications in today's courses.</li> <li>▪ Paper on web.</li> <li>▪ Bad updating and quality insurance.</li> <li>▪ Low functionality.</li> <li>▪ Bad equipment, health problems.</li> <li>▪ Technology must be better than it is today.</li> <li>▪ High threshold / technical insight.</li> <li>▪ High economical threshold.</li> </ul> <p style="text-align: center;">Head word: <b>ISOLATED</b></p>

## Applications

- Which type of functionalities / applications can help you in PC / Web based education?
- How can they help you?

### 1. Remedy:

Tests

#### Function:

To check own insight.  
Help to better understanding.  
Highlight important issues.

### 3. Remedy:

Group work, interactive.

#### Function:

Applications for collaboration.

### 5. Remedy:

Tutorials

#### Function:

How to use the applications.  
Take advantage of course.

### 7. Remedy:

Virtual Reality

#### Function:

Practical and visual accomplishment.

### 2. Remedy:

Selecting own applications

#### Function:

To select the tools you need from a variety of tools. Build your own personal learning environment.

### 4. Remedy:

FAQ

#### Function:

To get help on common problems.

### 6. Remedy:

Netmeetings as;  
Video conferencing.  
Chat.

#### Function:

Meetings for discussions with students and teachers.

### 8. Remedy:

Video  
Animations

#### Function:

Visualization.  
Demonstrations.  
Theoretical support.

PC / Web  
Based Teaching

## The quantitative research

Results from the web questionnaire are introduced in the following section. Findings and conclusions are presented in chapters 4.3 and 5. The response on the questionnaire ended on a total of 280 replies. Approximately 950 emails was distributed to different students at HiA. This makes a response rate at 30%.

Question one was a demographic question about age. Most answers was from the age group 20 to 25 (80%) and from age group 25 to 30 (14%).

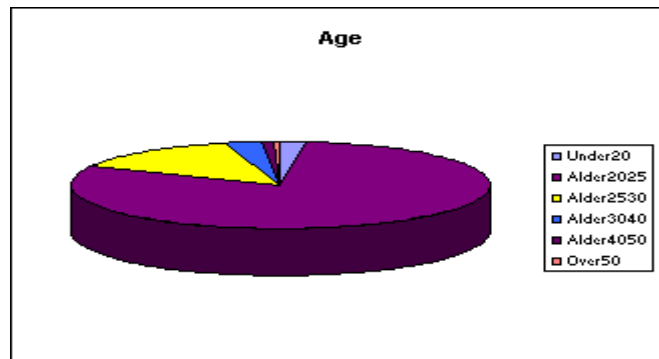


Figure A3.1. Outline of age composition.

In question two the participators background at HiA was charted.

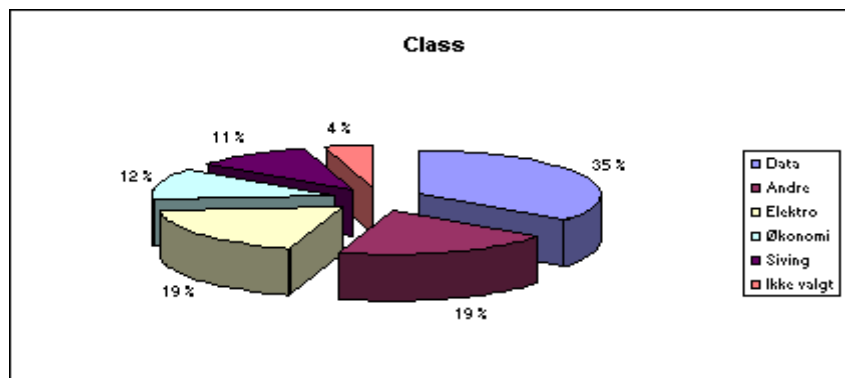


Figure A3.2. Outline of background at HiA.

Question three displays the dispersion between gender.

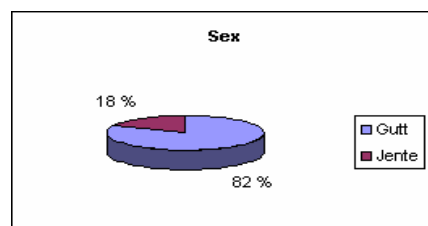


Figure A3.3. Outline of gender composition.

In question four they was asked if they used PC and web actively in their studies. Since this questionnaire was consistent through email and web, is it most likely that the result has a fault indication in the result. This source of error lays in the students which do not use email and web at all, by different reasons. These students are not reached in this questionnaire. However, the miscalculation can not be of great significance, because most students are using PC and web because many teachers demands electronically collaboration, scheduling, and handing in exercises. The use of email and Internet are also so popular that several students have an access to it for personal use (see results from question six).

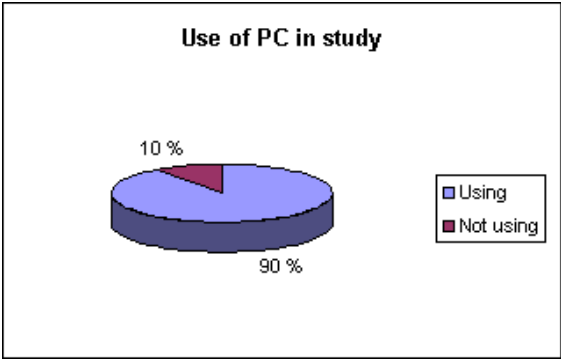


Figure A3.4. Outline of use of PC and web in study.

In question five we have results of the weekly use of computers. The highest assembling we find in section over 25 hours use (29%) and in the section 1 to 5 and 5 to 10 hours use (total of 35 %). Remark that this answer is on use in all contexts, not just in relation with school work.

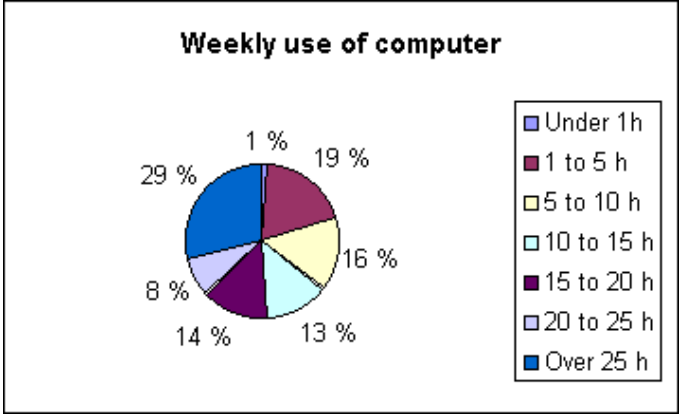


Figure A3.5. Outline of weekly use of computer.

In question six we have results from the different types of use. The reason why some students use email, but do not use PC and web for school purposes, can be a result of this media's popularity. It has become a status to use email as communication between friends, in the same way the cellular phones and their text messages have. Many teachers demands electronically collaboration, scheduling, and handing in exercises for practical reasons. This also forces some students to use email.



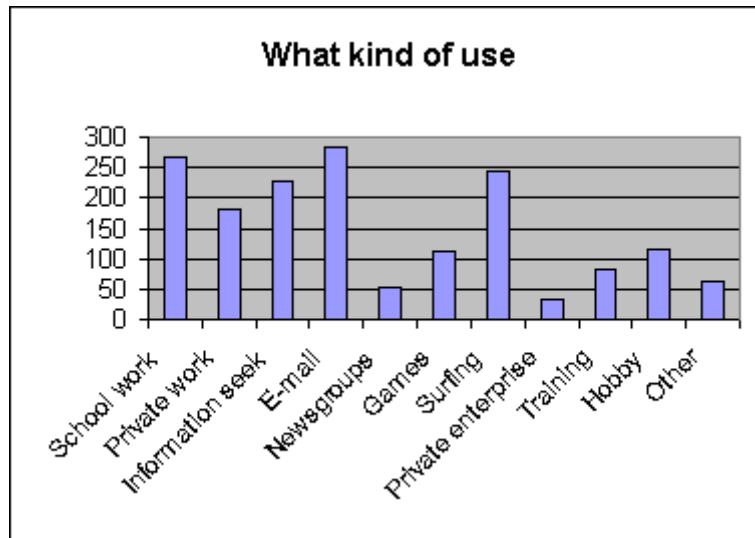


Figure A3.6. Outline of what kind of use on computer.

In question seven we have results from where the students have access to the Internet. In the group of other places, the answers was mostly at work. Note that most of the students with access at home and / or at work also have access at school.

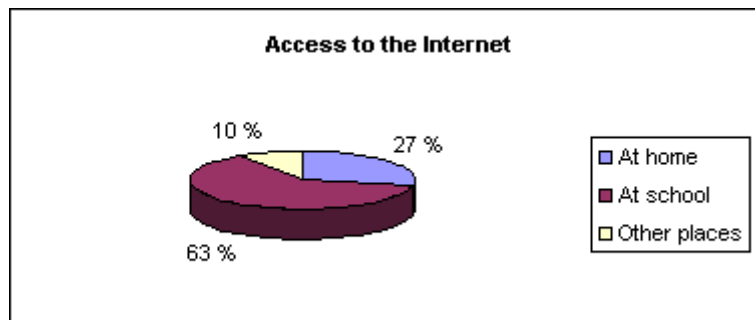


Figure A3.7. Outline of access to the Internet.

In question eight we have results from the students' attitude towards web based training. There is a remarkable large amount of students which have answered neutral in these questions. This neutral opinion can be a result of three different reasons. It can be a reflection of their true attitude, they do not know. Calculation I have done through Excel and Pivot-tables indicates that a great amount of the neutral students comes from the departure of economics at HiA. The non technician students shows in that way that they do not have a clear point of view in these matters. The second issue can be the understanding and misinterpretations of the questionnaire, the questions asked can be indistinct. And the third reason can be the indolence of some students, because there are some students which have left all in the default position (neutral), and continued.

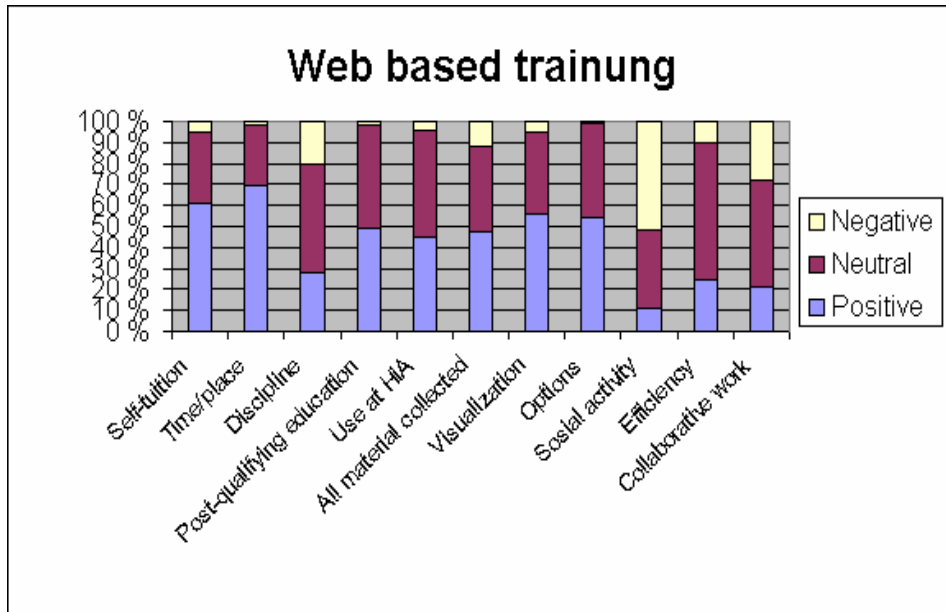


Figure A3.8. Outline of attitude to web based training.

In question ten we have results from the students' attitude towards classroom based training. There is also a remarkable large amount of students which have answered neutral in these questions. Here this neutral opinion can be a result of to different reasons. It is doubtful that the students do not have a point of view in this matter, since it concerns everybody. The first reason can be the understanding and miss-interpretations of the questionnaire, the questions asked can be indistinct. And the second can be the indolence of some students, because there are some students which have left all in the default position (neutral), and continued, like in question eight.

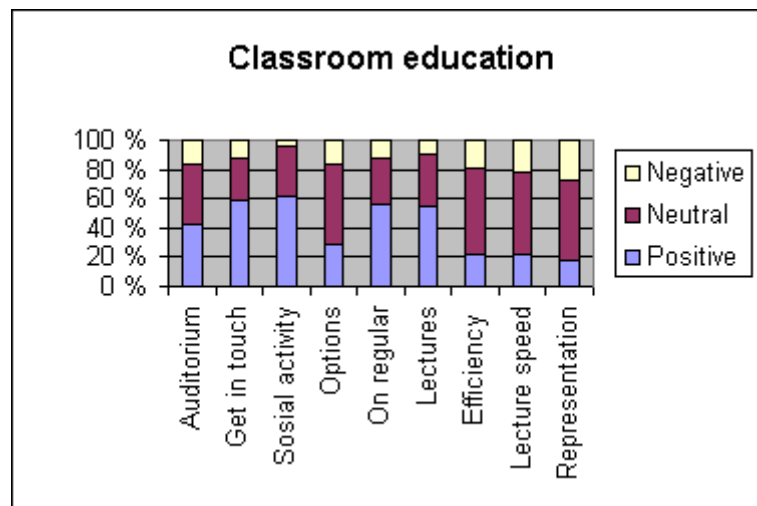


Figure A3.9. Outline of attitude to classroom based training.

In question fourteen their collaborative experience over the Internet is measured. Only 26% of the students have studied in group work over the Internet.

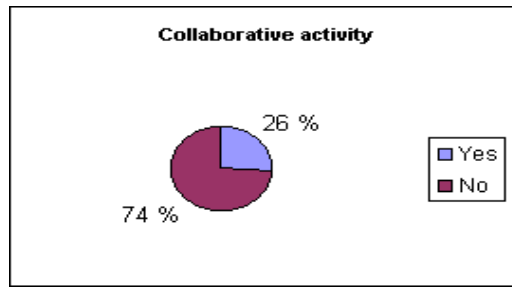


Figure A3.10. Outline of attitude to web based training.

In question eighteen their attitudes to the technical evolution are gauged. 73% had a positive attitude to the evolution, 22% were neutral, and only 5% was negative.

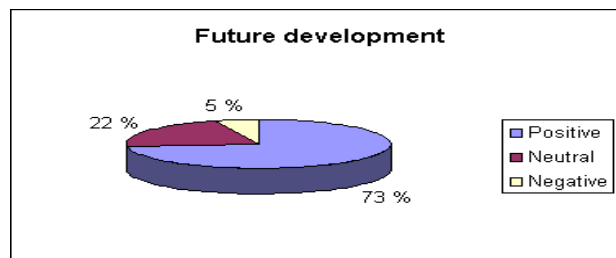


Figure A3.11. Outline of attitude to web based training.

In question nineteen the results are from the students' attitude towards different applications. There is a remarkable large amount of students which have answered neutral in several of these questions. This neutral opinion can be a result of three different reasons. It can be a reflection of their true attitude, they do not know or they did not feel that they had insight enough to make an opinion. The students shows in that way that they do not have a clear point of view in these matters, or that they are uncertain of their own knowledge and judgement in these matters. The second issue can be the understanding and miss-interpretations of the questionnaire, the questions asked can be indistinct. And the third reason can be the indolence of some students, because there are some students which have left almost all in the default position (neutral), and continued.

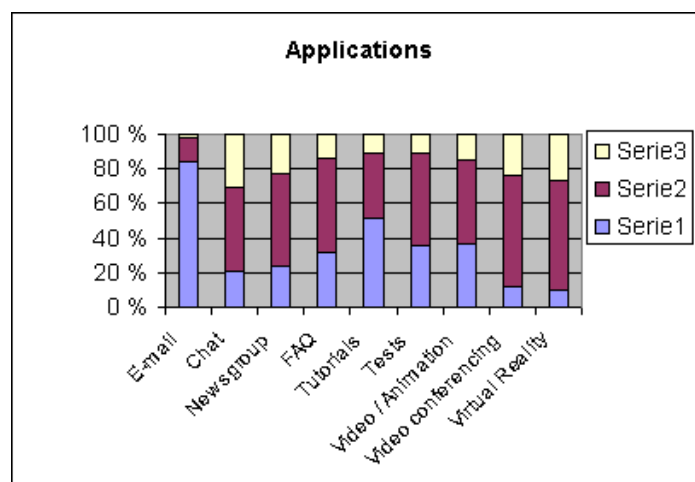


Figure A3.12. Outline of attitude to different application for use in web based training.

## Appendix 4: The Domestic Vendors of ICT Courses

Vendors of ICT courses on the Norwegian market. Note that several of the organizations offers only courses in English language, because they are international vendors which are represented on the Norwegian market. Therefore are some of the Internet links to foreign sites. This is vendors with smaller or higher degree of knowledge to the distance education system environment, and only some have longer experiences with the Internet as a media for learning, like Azlan. But all have their ideas and visions of how their future distributed learning system shall work. A lot of relevant data and information can be found through these sites.

<a href="http://www.adra.no">www.adra.no</a>	<a href="http://www.ktb.no">www.ktb.no</a>
<a href="http://www.akademiet.no">www.akademiet.no</a>	<a href="http://www.learningtree.com/se">www.learningtree.com/se</a>
<a href="http://www.aktiv.no">www.aktiv.no</a>	<a href="http://www.mandator.no/kurs">www.mandator.no/kurs</a>
<a href="http://www.aladdin.no">www.aladdin.no</a>	<a href="http://www.merkantildata.no/kunnskap">www.merkantildata.no/kunnskap</a>
<a href="http://www.azlan.no">www.azlan.no</a>	<a href="http://www.netman.no">www.netman.no</a>
<a href="http://www.bitforbit.no">www.bitforbit.no</a>	<a href="http://www.quality.no">www.quality.no</a>
<a href="http://www.boxer.no">www.boxer.no</a>	<a href="http://www.ndi.no">www.ndi.no</a>
<a href="http://www.circle.no">www.circle.no</a>	<a href="http://www.nka.no">www.nka.no</a>
<a href="http://www.civit.no">www.civit.no</a>	<a href="http://www.nki.no">www.nki.no</a>
<a href="http://www.compaq.no">www.compaq.no</a>	<a href="http://www.ntnu.no/sevu">www.ntnu.no/sevu</a>
<a href="http://www.cornerstone.no">www.cornerstone.no</a>	<a href="http://www.nærings-akademiet.no">www.nærings-akademiet.no</a>
<a href="http://www.datametrix.no">www.datametrix.no</a>	<a href="http://www.na.of.no">www.na.of.no</a>
<a href="http://www.datapower.no">www.datapower.no</a>	<a href="http://www.olsten.no">www.olsten.no</a>
<a href="http://www.designskolen.no">www.designskolen.no</a>	<a href="http://www.opus.nl.no">www.opus.nl.no</a>
<a href="http://www.edbasa.no/pckurs">www.edbasa.no/pckurs</a>	<a href="http://www.pcsyscom.no">www.pcsyscom.no</a>
<a href="http://www.funorge.no/bergen">www.funorge.no/bergen</a>	<a href="http://www.pc-help.no">www.pc-help.no</a>
<a href="http://www.gateway94.no">www.gateway94.no</a>	<a href="http://www.pluss.no">www.pluss.no</a>
<a href="http://www.halden-datasevice.no">www.halden-datasevice.no</a>	<a href="http://www.prokom.nl.no">www.prokom.nl.no</a>
<a href="http://www.hp.no/kurs">www.hp.no/kurs</a>	<a href="http://www.sni.no/kurs">www.sni.no/kurs</a>
<a href="http://www.ibm.no/utdanning">www.ibm.no/utdanning</a>	<a href="http://www.softinn.no">www.softinn.no</a>
<a href="http://www.infopartner.no">www.infopartner.no</a>	<a href="http://www.supportinst.com">www.supportinst.com</a>
<a href="http://www.a-team.no">www.a-team.no</a>	<a href="http://www.minar.no">www.minar.no</a>
<a href="http://www.intrasys.no">www.intrasys.no</a>	<a href="http://www.visual-world.com">www.visual-world.com</a>
<a href="http://www.ipos.no">www.ipos.no</a>	<a href="http://norway.wg.com">http://norway.wg.com</a>
<a href="http://www.isi.no">www.isi.no</a>	<a href="http://www.cimtec.no">www.cimtec.no</a>
<a href="http://www.it-akademiet.no">www.it-akademiet.no</a>	<a href="http://www.keysoft.no">www.keysoft.no</a>