Kari Kilpinen

Reflective teacher using the computer-network in teaching; how the psychoepistemological learning styles help to better design learning environments

DEPARTMENT OF COMPUTER SCIENCES
UNIVERSITY OF TAMPERE

A-2004-4

TAMPERE 2004
Kari Kilpinen

Reflective teacher using the computer-network in teaching; how the psycho-epistemological learning styles help to better design learning environments

ACADEMIC DISSERTATION

To be presented, with the permission of the Faculty of Information Sciences of the University of Tampere, for public discussion in Auditorium Pinni B 1096, Kanslerinrinne 1, Tampere, on June 4th, 2004, at 12 o'clock.

DEPARTMENT OF COMPUTER SCIENCES
UNIVERSITY OF TAMPERE

A-2004-4
Abstract

This thesis explores how could the learning environment with computers be arranged in a pedagogically good way. This study was also a learning process for me as a teacher. During the study not only my thoughts were changing, but also the research methods were changing. I studied both how my students learned and what I learned myself. During the process I noticed that it was important to study my own reflections. Before practical solutions I designed, it was important to understand the phenomenon from a theoretical point-of-view. I wasn’t a neutral researcher, because I studied my own job. That is why I changed my method to Reflection-in-Action.

Theoretical educational base of this study is pragmatic constructivism. The learner builds new knowledge in the basis of his/her own experiences. Learners learn with different ways. In this study the psycho-epistemological learning styles proved to be very important in the learning process. Some learners learn through their senses (by observations- the empiricists), some learn with rational ways (by thinking- the rationalists) and some intuitively (by insight- the metaphorists). Their learning process is different. It means a little bit more work for the teacher to allow different ways of learning, but computers help in that process.

Computers have been used for learning as long as computers have existed. The first applications were based on behaviourism and very few people could use them, because the systems were very expensive. In the 1990’s the World Wide Web changed the character of computer-assisted learning. WWW is a worldwide dictionary, but for learning there should be pedagogical actions. Nowadays there is not such a big difference between traditional and distance learning. In traditional learning we use distance-learning methods.

Keywords

computer-network in teaching
reflective teacher
psycho-epistemological learning styles
learning environment
reflection-in-action
Acknowledgements

When I started this study thirteen years ago, my original goal was just to know more about learning and especially how computers help in that process. I studied education and philosophy, but the most important thing was that I joined professor Pertti Järvinen’s IS research seminar. Professor Järvinen and IS research seminar members have given me valuable feedback. Without Pertti Järvinen’s help and encouraging I think I would never have written my thesis. Thank you, Pertti!

My colleagues in Lahden kauppaopilaitos (Lahti Business College) and Päijät-Hämeen koulutuskeskus supported me a lot (especial thanks for Antti Arvela). My employer, Lahden kauppaopilaitos, gave me opportunity to design and study new kinds of methods for learning. Also I am grateful for the three months time I spent 1995 in Århus University, Denmark. During that time my studies changed a lot. I wish to express my gratitude to the reviewers of my thesis, Prof. Emer. Jarkko Leino (University of Tampere) and Prof. Bente Elkjær (The Danish University of Education). Professor Jarkko Leino has given me grateful help in vocational education studies 1994-1995. For the visual appearance of this thesis I would like to thank graphic designers Jürgen Sanides and Julia Sysmäläinen and also I want to thank Keith O’Hiobhaird who as a native language teacher checked the language.

I dedicate this thesis to my parents, mother Eeva and father Eero. My father died before I could finish this thesis.

Lahti, May 2004 Kari Kilpinen
Contents

1 Introduction ........................................................................................................................................... 11

2 Preconception
   2.1 The idea of computer mediated teaching ................................................................. 15
   2.2 Theoretical or empirical study ................................................................................. 16
   2.3 Choice of methodology .......................................................................................... 18
   2.4 Phenomenology ..................................................................................................... 21
   2.5 Phenomenography ................................................................................................. 23
   2.6 Subjectivism and objectivism ............................................................................. 26
   2.7 Empiricism, rationalism and intuitionism ............................................................ 27
   2.8 Learning process ................................................................................................... 33
   2.9 Reflection ................................................................................................................ 37
   2.10 Learning by expanding ......................................................................................... 40
   2.11 Computer-mediated communication ...................................................................... 43
   2.12 Hypertext and multimedia .................................................................................. 46
   2.13 Computer-aided learning ..................................................................................... 49
   2.14 Intelligent tutor systems and artificial intelligence ............................................... 51

3 The pilot project
   3.1 Learning styles ......................................................................................................... 55
   3.2 Psycho-epistemological learning styles .................................................................. 57
   3.3 Kolb’s learning styles .........
4 Small projects
4.1 Creating knowledge in organisation ........................................ 86
4.2 Designing programs ....................................................... 91
4.3 World wide learning environment ........................................ 94
4.4 Teacher or tutor or co-ordinator ......................................... 96
4.5 Students at Polytechnic course .......................................... 101
4.6 Teachers' learning/teaching style ....................................... 105
4.7 Accounting information system ......................................... 107
4.8 Secondary level electronic course ...................................... 109
4.9 New ideas ...................................................................... 115

5 Later projects
5.1 Reflection-in-action .......................................................... 117
5.2 Kilpinen method ............................................................... 120
5.3 The EU-project ................................................................. 124
5.4 Teaching logic for polytechnic students ................................. 125
5.5 More experiments with information
     superhighway course ..................................................... 126
5.6 Summary and comparison of learning styles ......................... 132
5.7 Conclusions .................................................................. 133

6 Epistemological Learning Model
6.1 More learning studies ....................................................... 137
6.2 Networked learning .......................................................... 143
6.3 Vocational education ........................................................ 146
6.4 Designing programs ........................................................ 150
6.5 Pragmatic constructivism .................................................. 153
6.6 Didactical process ............................................................. 159
6.7 Learning environment ....................................................... 163
6.8 Epistemological learning model ......................................... 170
6.9 Learning process model .................................................... 177

7 Discussion
7.1 Experiential learning and epistemology ............................... 179
7.2 New possibilities through computer networks ...................... 181
7.3 Methodology ................................................................... 183

8 Contents
7.4 Recommendations to practitioners and limitations of the study .................................................. 185
7.5 Prospects for future research ........................................................................................................ 186

References ........................................................................................................................................ 188

Appendix

Appendix A Inquiry into the pilot project .......................................................................................... 207
Appendix B Inquiry into the late courses ......................................................................................... 209
Appendix C All students’ learning styles ......................................................................................... 210
Appendix D Polytechnic level students’ learning styles ................................................................. 210
Appendix E Young secondary level students’ learning styles ....................................................... 211
Appendix F Adult secondary level students’ learning styles ......................................................... 211
Appendix G Teachers’ learning styles .............................................................................................. 212
Appendix H Advice in designing www-teaching material .............................................................. 213

Tables

1 Knowledge interests (Habermas) ........................................................................................................ 17
2 Qualitative traditions ........................................................................................................................ 20
3 Levels of reflectivity ........................................................................................................................ 38
4 Learning styles ................................................................................................................................ 55

Figures

1 Researchers’ background commitment ............................................................................................ 18
2 Popper’s theory about three worlds ............................................................................................... 26
3 Engeström’s completed model of learning .................................................................................... 33
4 Kolb’s model for experiential learning ........................................................................................... 34
5 Engeström’s theory about learning by expanding ......................................................................... 40
6 The structure of learning activity .................................................................................................. 41
7 Kolb’s learning styles ...................................................................................................................... 60
8 Four modes of knowledge conversion ............................................................................................ 86
9 Five-phase model of the organisational knowledge-creation process ........................................ 87
10 Distance education components .................................................................................................... 97
11 Trade-offs in research data gathering and analysis ..................................................................... 120
12 Own model of learning material levels ......................................................................................... 153
1 Introduction

Computer-based, and especially network-based learning is a very popular issue in Finnish educational life. The students work with computer-based learning material from elementary schools to universities. An educational institute without computers would be regarded as an old-fashioned one. Sometimes I feel like teachers are promised a trip to “learning paradise” with computers. I refer here, for example, to many lectures at the annual conference “Interaktiivinen Teknologia Koulutuksessa – Interactive Technology in Education” at Hämeenlinna (ITK 1996–2003). The practice is totally different. Many learning applications are just too technically oriented. Too often computer-based learning fails. Perhaps the learning environment is excellent, but the pedagogical arrangements just don’t work.

Computers have been used for learning almost as long as computers have been existing. The first applications were based on behaviourism. The systems were quite expensive and so very few people used them. In the 1980’s especially with PC:s more people had opportunities to learn with computers. The real popularity of computer-based learning came, when the Internet became more common. When the World Wide Web was introduced in 1992, network-based learning became possible for many students. The pedagogical theories used in the applications are based nowadays more on cognitivism and constructivism.

The computer-network is now part of the normal teaching. The Internet is easy to use, but in many cases teachers don’t know how to use them in their normal teaching. The programs designed for teaching are technically excellent, but many times pedagogically not suitable for a single teacher’s teaching. We have to understand that learning environments are social systems. Computers are only tools like books and blackboard. It is not only a matter of designing a learning application, but it is also a matter of the teacher’s learning process. The teaching process goes best in small steps. The reason why the use of the learning applications fails is because the teacher couldn’t adapt the system as a whole to his/her teaching.

The computers give wonderful opportunities for learning. The Internet opens the whole world for learning and communication. The Internet is a world-wide encyclopedia. The multi- and hypermedia features give us more opportunities than the traditional tools alone (books etc.). In writing and calculation the computers help the students. Computers change a lot in learning, but it is not only a technical issue. It is much more a matter of the human learning process. The computer gives a lot of possibilities, for example, in the individualisation of the learning process. It is not only a matter of the computer program, but all the other arrangements. And those arrangements are social items.
With the World Wide Web, both the traditional distance learning and the traditional computer-based learning got a new channel. Nowadays it is nothing at all to discuss about distance learning or computer-based learning or traditional school learning. All these three ways are close to each other. In distance learning, we can adapt the traditional learning methods and in traditional learning, the distance learning methods.

This study has been a learning process for me. When I started the study, I was interested in more technical things than I finally was. What I was studying and what my methods were, changed many times. That is why I chose the first part of my research title as “Reflective teacher using the computer-network in teaching”. When I started this study in the year 1991, I thought that I wanted to study for the new possibilities of computers and computer-networks in a new way. I was dreaming about computers giving more intelligent learning environment for learning than the traditional learning environment. I was even studying the Artificial Intelligence possibilities. The more I studied the more I noticed that the intelligence doesn’t come from the computer but from the learner. I noticed that the most important thing with computers in learning process is that computers allow more possibilities in individualisation. Computers help me in introducing the learning material and tasks. I have more time to take into consideration the single learner’s problems than in traditional teaching environment. So I was thinking that the problem is to think the learning process in a new way. Finally I decided that the issue I was studying was: “How could the learning environment with computers be arranged in a pedagogically good way?”

My ideas were changing all the time, and that you can see also in my research. The chapters are in a chronological order. Of course I later rejected some material, but mostly the material has remained the same as it was at the time I wrote it.

In Chapter 2, I present my preconception of this issue. First, I present the process how I designed the idea of a new computer-based learning environment. Then I present the methodological and philosophical studies. I wanted to use qualitative methods in my study and I studied especially the phenomenographical method (Marton 1981,1988, Uljens 1993). Popper’s theory about 3 Worlds (1972) is the philosophical standpoint in my studies. Then I present some educational studies. I introduce two learning models: 1. Engeström’s (1985) 2. Kolb’s (1984). Finally I write about computers in the learning process. I wrote Chapter 2 mostly in the years 1994–1996, but I started to study these issues in the year 1991.

In Chapter 3, I present my pilot project for an introductory course for philosophy for the polytechnic level students. First I present learning styles. During the evaluation learning styles became more important than I thought beforehand and especially the
psycho-epistemological learning styles presented by Royce and Mos (1980) and Royce and Powell (1983). In Finland the psycho-epistemological learning styles are introduced by Leino and Leino (1990). The learning styles in my research are so important that it is the second part of my research title: “How the psycho-epistemological learning styles help to better design learning environment”. In this project, I also first studied the distance learning theories. So I am also presenting those there. Then I present the pilot project results. I also tried to design three different learning environments for different learning styles. I rejected the idea later, when I noticed with later experiments (Chapter 4) that I made a mistake. I wanted to present the environments, because the thinking process is part of the new integrated environment I designed and also I wanted to show my own learning process (many times making mistakes is a source of learning). I had the pilot project in the year 1995. I wrote the Chapter 3 in years 1995–1996. The pilot project is also written in Finnish (Kilpinen 1997, The supervisor of that research was Jarkko Leino).

In Chapter 4, I present my experiments with some other courses. While I was designing those new kinds of courses for my pilot project, I proceeded with normal courses. These courses changed my opinion in a way, that I totally gave up on proceeding with the pilot courses at all. First in Chapter 4, I present knowledge creating process theories and then information technology theories. Then I present theories about the role of teacher (or tutor or co-ordinator. Then I present the projects, and finally I discuss what is the meaning of these projects. I wrote this Chapter 4 in the years 1997–1998.

In Chapter 5, I present my later projects. Because my working method changed from the pilot project, I introduce some methodological studies. I was studying my own work in this research, so I decided that my research method is Reflection-in-Action (Argyris & Schön 1978, Schön 1983, Schön 1987, Heiskanen 1994a). Then I am introducing some later projects and findings with those projects. I also present the summary of all my empirical studies concerning epistemological learning styles among my students. I wrote the chapter 5 in the years 1998–2000.

In Chapter 6, I combine my empirical and theoretical studies and introduce my own learning environment model and learning process model. I will first introduce some new studies about learning and especially concerning learning styles and network-based learning. Then I present what computers mean to vocational education. Because I have noticed that also the network-based learning environments should be human systems, I present some aspects about designing programs for this purpose. The educational theories also strongly influence practical arrangements in education. Earlier behaviourism dominated the computer applications design process. But now different constructivist
standpoints much mean also in concrete arrangements network-based learning. I present how I see the didactical process from the philosophical point of view. Then I present studies about different learning environments. Finally I am introducing my model about learning and it’s epistemological aspects. I wrote Chapter 6 in the years 2000–2002.

In Chapter 7, I present my conclusions. First I write about experimental learning and epistemological aspects in learning. Then I write about new possibilities through computer networks and designing programs. Then I write methodological aspects about my research quality criteria. Finally I write about recommendations to practitioners and limitations of the study and prospects for future research. I wrote Chapter 7 in the year 2002.
2 Preconception

In this Chapter I present the working practice and the ideas that I had before I designed and evaluated my pilot project (Chapter 3). Some of these earlier ideas and evaluation in the beginning of the 1980’s you could see in my master thesis (Kilpinen 1986). First I present the process of how I designed the idea (Section 2.1). Then I present the methodological and philosophical studies in Sections 2.2–2.7. Then I present some educational studies in Sections 2.8–2.14. I wrote this Chapter 2 mostly in the years 1994–1996.

2.1 The idea of computer mediated teaching

In the year 1981, I started my career as a teacher. Before that I never thought I would be a teacher. In my mind being a teacher meant, at that time, that you are not a very creative person; we have to always give the same lectures and concentrate only on traditional working methods. I had dreamed about new learning methods with computers, when I studied at university, but I thought that that kind of learning was impossible in the school environment. I thought that I would be a teacher only for one or two years. The teaching of IT at the college was a little bit of waste of time; we taught ADP without computers and the content was too technology-oriented (Kilpinen 1986). During the 1980’s I became more experienced teacher, and the content of teaching became more practical (ADP was taught more with microcomputers). But still I had a dream that computers allow much more than we used them. I knew that the main point is the working methods with the teaching and computers. Normal educational evaluation didn’t improve my practice. I thought that perhaps the study of scientific theories would help to understand the problem better.

When I first thought of my research idea, it was 1991 and I started to study at Tampere University. Mostly I studied educational theories. My first idea was: “What is the computer mediated learning environment”. I heard of the idea of Computer Aided Learning (CAL) already in a small project in 1980 (Kurki-Suonio 1980). I was very enthusiastic about that kind of learning. During the 1980’s I prepared many simple CAL-programs at my teaching courses with my secondary level students. I noticed that CAL-programs were good, but only for limited applications. That means teaching, when we are learning quite mechanical things (for example, I made a program for a bookkeeping system). For most systems, flexible tool programs are much better. Then the student has to build him-/herself the idea of a problem, and the student becomes more active. In the year 1992
I thought to more emphasise students own activity and some kind of intelligence in the research idea.

But still I was looking for solutions that came from computer. For example, I studied a little bit about artificial intelligent programs. But I was quite disappointed. In my mind I noticed that artificial intelligent programs (AI) are not much better than the traditional CAL-programs. The reason is simple; nowadays AI-programs are built in the same way as traditional CAL-programs. We have to build a model of the taught issue beforehand, and analyse the learning with already known knowledge. That kind of learning is good for issues, where the structure of learning material is very clear. The programs only check the logic of the answers.

In the year 1994 I thought to change my research question to “Intelligent Learning Environment”, but at the qualitative research methodology seminar I got new ideas. I was introducing my research and I said that I would change my research question. Many researchers said not to give up what the students think is intelligent learning. So I decided to proceed a philosophy teaching course in a way, where I am introducing computer mediated learning, but the most important thing is the students opinions about the idea. I decided to evaluate the material a little bit the way of phenomenography (Section 2.5). I also discussed with Uljens, and he said that it is possible to do the evaluation with a less orthodox phenomenographical study.

2.2 Theoretical or empirical study

This issue can be considered by:

1. Making references from earlier studies
2. Analysing the concepts in a theoretical way
3. Making a laboratory test with test group and pseudo group
4. Working with a group and making observations

My standpoint is a single student’s learning and opinions. That means some kind of case study or action research. That is more demanding study, but it better gives us the real meaning of this kind of issue (not only theoretical academic opinions). Of course it is necessary to know about earlier studies concerning this issue, and also it is good to analyse the basic concepts. Both things are important, but still the main interest in this issue is to study in a real situation, what this question or concept really means.
My opinion is that if we are studying this kind of issue we have to study it by using a qualitative research method. We are not studying quantities, because we don’t know the structure of the idea. It is a question of qualities: what kind of matter is important in a totally new learning environment. That means some kind of ethnographic method, but I am not trying to say I am using just that method. Maybe it means that I have to develop some kind of my own method for this research. It is important to realise that we don’t exactly, in advance, know what are the matters that we are studying. And we are not asking the qualities only for ourselves but also from other people.

In an educational seminar (qualitative research methods for educational studies – December 1994) I was introducing my research to some other researchers and I said that my title “intelligent learning environment” is only a working name, because we can understand the title in a million ways. But other researchers said that just exactly that is what is important. Because a person can understand this kind of issue in a million ways, it is very interesting to hear a person’s own opinion and not the opinion that the researcher thinks. So I decided to use the title also in my empirical studies.

I don’t agree with all that Habermas has said in his theories, but there is one very important feature in his theory about knowledge interests which concern my research. I show first Habermas categories and then I tell the reason.

Table 1 Knowledge interests (Habermas)

<table>
<thead>
<tr>
<th>Interest</th>
<th>Technical</th>
<th>Practical</th>
<th>Emancipatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>To predict</td>
<td>To understand</td>
<td>To criticise (ideology)</td>
</tr>
<tr>
<td>Aim</td>
<td>Nature and society control</td>
<td>Interpretation tradition</td>
<td>Released from wrong knowledge</td>
</tr>
<tr>
<td>Science</td>
<td>Empirical-analytic natural or social science</td>
<td>Humanistic Historic science</td>
<td>Critical social science</td>
</tr>
<tr>
<td>Practical area</td>
<td>Work</td>
<td>Language</td>
<td>Power</td>
</tr>
</tbody>
</table>

The important feature I like in Habermas’ theory is the meaning of my research. I am not going to concentrate on finding some technical solution for the learning environment (that is quite usual in computer science to just find a technical solution for example in computer communication and hypermedia). Nor am I going to only understand students’
opinions. But my aim is to change the world: to find totally new working methods, and
to changes the learning environment into a better qualitative direction. I agree that
Habermas meant more than I here say about my study standpoint. Habermas of course
meant much broader political power. I want to change only some work practices in my
own work. But still I think there are some similarities.

My study is neither a theoretical study, nor is it an orthodox qualitative empirical
study. I want to combine both those elements. I produce an artificial environment and
then ask the students to tell their opinions about it and other things. My study has em-
pirical and theoretical aspects. Both sides influence each other.

2.3 Choice of methodology

I was studying quite a long time the choice of right method. I think my research isn’t
very traditional research even in qualitative research. I am studying a new thing, but it
is still quite an artificial product. Before I present the possible methods in detail, I show
the figure of the researchers’ background presuppositions:

![Figure 1 Researchers’ background commitment](Hirsjärvi et al. 1990, 16)
What I am studying is something new. We could say that I am studying the issue from such standpoint that it is not exactly studied from that standpoint. But I am not saying the target is an everyday life situation in this environment. I have created the idea and I have made many decisions, which direct the content of the course. I could characterise my research as some kind of action research. In Section 2.1 I said, that my motive to do this research is reflective. I want to study my own job and find some alternative solutions for the traditional teaching models. The reflective elements of action research are the essential feature. My research is, in my mind, an action research (later I realised that my research is Reflection-in-Action. See Section 5.1). But I was looking for some concrete methodological models, and couldn’t find very suitable ones for just my research (Syrjälä et al. 1994, Syrjälä et al. 1988). The reason is that, in my mind, action research models are created to study small changes. I am studying totally new environments. It would not only change action but also the thinking models.

Because I don’t know what matters are important in a totally new learning environment, I first thought I could use ethnographic method. When we use ethnographic method the analysis is concerned with an untouchable cultural event or group (Benson et al. 1983, Goetz et al. 1984, Niinistö 1981, Spradley et al. 1979, Syrjälä et al. 1988, Syrjälä et al. 1994, Syrjäläinen 1991). The researcher has to participate in the group’s etc everyday life. We have to have some kind of holistic point of view. Our research strategies are empirical and naturalistic. We have to make every kind of observation. In the ethnographic research, the human being is seen as an active and intuitive person. The interpretation of everyday actions is very important. It is even accepted that ethnographic research can be eclectic (to accept different methods in the basic assumptions and it is possible that they are in conflict between each other). The researcher has to understand the meanings of the whole educational environment. We can study ethnographic studies from phenomenological, phenomenographical, symbolic interactionistic, ethnomethodological or Marcuse and Habermas critical theory standpoints. Some researchers don’t even see any conflict, if we combine different traditions together.

One possible and clear and pragmatic ethnographic methodology is the grounded theory (Strauss et al. 1990). We build the theory and the concepts from our empirical research. And the theory comes wholly from our own empirical observations. It is to some extent allowed to refer to other theories and studies, but the core theory comes from our own observations and categorisations.

In my research there are some ethnographic features, but I am not going to spend my whole time just observing what the students are doing in their studies (that kind of research could be very interesting and I think it should give very useful information...
That kind of research would be possible if the whole environment has been a computer-based learning environment (all teaching) and we will understand the meaning as a holistic standpoint. And the more important thing is that I have myself created that environment (it is also a little bit artificial). So it is better to say that my study can’t be totally ethnographic. I am also not interested in doing my research in the grounded theory way.

Then if my research is not ethnographic what else could it be? Is it some kind of case study? Yin (1983,23) means this concept as empirical research, which in different ways gets information and tries to investigate a present event or acting people in certain environment. Qualitative research method (Syrjälä et al. 1994) is concerned more with the process than the product, the whole environment and not only a part of it. Case study can combine theories and methods from different sciences (Walker 1983). Case study is naturalistic study in the natural environment without any artificial organising.

My research includes some artificial organising. So it is not possible to say that my research is an orthodox case study. But I think it also ha a little bit of those features. One possible method is evaluation research. My research could be such that I try to evaluate my new model comparing it to old teaching models. Järvinen P. (1991, 20–21) says that in action research, the researcher is part of the research, but in a case study the researcher is more an outsider. Evaluations standpoint (Syrjälä et al. 1988) and aims differ from other researchers. The main point is to describe and evaluate the concrete value of some program, not to explain it. In my mind evaluation research is too technical.

Patton presents variety in Qualitative Inquiry and theoretical traditions (I present here only part of those):

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Disciplinary Roots</th>
<th>Central Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ethnography</td>
<td>Anthropology</td>
<td>What is the culture of these people</td>
</tr>
<tr>
<td>2. Phenomenology</td>
<td>Philosophy</td>
<td>What is the structure and essence of experience of a phenomenon for people</td>
</tr>
<tr>
<td>3. Systems theory</td>
<td>Interdisciplinary</td>
<td>How and why does this system function as a whole</td>
</tr>
<tr>
<td>4. Symbolic interactionism</td>
<td>Social psychology</td>
<td>What common set of symbols and understandings have emerged to give meaning to people's interactions</td>
</tr>
<tr>
<td>5. Hermeneutics</td>
<td>Theology, literacy criticism, philosophy</td>
<td>Under which conditions human act took place or a product was produced that makes it possible to interpret its meanings</td>
</tr>
</tbody>
</table>
I think phenomenology’s, symbolic interactionism’s and hermeneutics’ central questions were good for my research. I am interested to know the interpretation people give to my new learning environment.

Symbolic interactionism (Patton 1990, 75–76) is a social psychology approach. It is a perspective that places great emphasis on the importance of meaning and interpretation as essential human processes in reaction against behaviourism. People create shared meanings through their interactions, and those meanings come from reality.

Hermeneutics (Patton 1990, 84–85) is a theoretical approach that can answer qualitative inquiry. The term hermeneutics refers to a Greek technique for interpreting legends, stories, and other texts. To make sense of and interpret a text, it is important to know what the author wanted to communicate, to understand intended meanings, and to place documents in a historical and cultural context. Hermeneutic theory argues that one can only interpret the meaning of something from some perspective, a certain standpoint, praxis, or a situational context.

My research is some kind of action research, and I have some kind of ethnographic and evaluative features, but still I don’t accept either of these concrete models as a research methodological standpoint. Hermeneutics, symbolic interactionism and phenomenology were interesting methods because of their interpretive character, but they are in this way not concrete enough models in this, my research. So I must study a little bit more about those and after that decide my own method.

My study’s standpoint is so different that it needs to be defined maybe much more exactly in a philosophical way. I introduce the phenomenology and some methodological standpoints. I shall use selected features of these methods, but I shall first introduce some methodological approaches, that are interesting from the quantitative research standpoint. Phenomenology is widely used, because that tradition handles an individual’s experience of a phenomenon.

2.4 Phenomenology

The central question of phenomenology is: What is the structure and essence of an experience of a phenomenon for people? So all phenomenological research in a natural way is based on qualitative methods.

Husserl (1976) defined the conception life world (it is more than only the concept experienced world). From the phenomenological standpoint, the important concept is in-
tentionality, which denotes that consciousness must be understood in terms of what a subject is aware of in being aware of something.

On the basis of the preceding analyses of the “utensil” and of “world lines” the “spatiality” of Dasein as “Being-in-the-world” and the concept of space are discussed (Heidegger, 44). It is shown that neither the space is in the subject nor the world is in space, but that space is “in” the world and a characteristic of it, insofar as Dasein as “Being-in-the-world” is of its own spatiality and has disclosed space.

These sentences in my mind describe the essential features of phenomenology (Husserl) and existentialistic-phenomenology (Heidegger). I am going to present some methodological aspects based on these traditions.

There are remarkable differences between Husserl’s and Heidegger’s ideas. Husserl didn’t accept psychologism and subjective standpoint in science (in his early writings – in his later writings that standpoint is not so clear). And that is the most important difference. Husserl’s main idea was that in social sciences we have to get the idea of some phenomena as a whole – “zu dem Sachen Selbst”. Husserl created an apodictive science (a strict science), where we have to concentrate on the holistic idea of the phenomena.

When studying the human being Rauhala (1984) says that we have to know what are we studying. The human being is naturally one holistic personality and we can’t divide a person, but we have to know what are we studying:

1. Human conscious (mind, experiences, motions etc.)
2. Human body
3. The situationality of the human being (social situations)

We can’t explain the human mind from his/her body and so on. Varto (1993) emphasises the ethical responsibility of a researcher. We must recognise our research’s significance to the persons we are studying. Varto also stresses that in qualitative research we are studying qualities. We can’t change qualities to quantities without losing something very valuable. He also says that the researcher should always make an ontological analysis for the question we are studying.

Although I don’t accept the phenomenological tradition from methodological standpoint, because of the mainly subjective standpoint (except Husserl’s early writings), there are still some interesting features. I am especially interested in Husserl’s idea of catching a phenomena. My main idea was to understand “the computer mediated learning environments educational and other features”. So I wanted to understand it little bit the way Husserl introduced: “zu den Sachen selbst”. To understand the whole phenomena was the main point for me. I wanted to have a holistic understanding of the phenomena.
Also Varto’s and Rauhala’s ideas are interesting. I agree with Varto’s standpoint that if we try to change qualities into quantities we lose something. But in my mind it is sometimes necessary to do so, if I want to tell a holistic, explicit knowledge of some phenomena. But still I have to admit; I lose something. Varto’s standpoint of making ontological analysis is similar to Hirsjärvi’s standpoint (Section 2.4) and I think it is necessary for a good scientific study. We have to understand what we are studying. I think that is important whether we are doing qualitative or quantitative research.

There are a lot of philosophical features I don’t accept in phenomenology: that especially means the subjectivist standpoint. In Section 2.6 I present the critique against subjectivism. In the next Section I am going to present more practical tradition, which has remarkable similarities with phenomenological research tradition; phenomenography.

2.5 Phenomenography

Researchers (Marton 1981, Gröhn et al. 1989) developed a research method for educational studies; phenomenography. In that method (in early writings) there is a difference between the first grade research standpoint (trying to understand the phenomena) and the second grade research standpoint (people’s opinions about the same phenomena). Marton says that in phenomenology we can’t make that difference, because we can reach the world only with our own observations. But in phenomenography we can do this and Marton says also that:

1. Learning is always concerned with the first grade. We can’t say only from the second grade (books etc.) what the learner has really learned.
2. Learning has to be described in its content.
3. Learning process is always qualitative not quantitative.
4. Learning is always concerned with its context.
5. Human understanding is changing all the time. Everyone can change his/her opinions. So also human mankind’s knowledge develops (there are different opinions about the same phenomenon).

The basic data gathering technique (Marton 1981, Marton 1988, Larsson 1986, Gröhn 1992) is interviewing. We have to get the real meaning of how different people think about the same concept or phenomenon. It must be quite an open interviewing technique, but still the structure of that interviewing must be very strict. For example, we
have to carefully think about the opening questions: how people really understand just that concept or phenomenon we are asking about. These opening questions are all that are the same to everyone. After that we continue with the interviewing persons in their own words. This way we really can have the people’s own opinions of the matter. The results are described as qualitative ways of understanding the matter. Categories are made from the empirical research and not in advance.

Uljens says (Merenheimio et al. 1991, 80–107) that phenomenography can be described as social sciences qualitative research method. It tries to describe, analyse and understand how people act, sense and understand different things. The research interest is how people understand things. The reality is just exactly how a person sees it. A researcher shows the qualitative variations of people’s understandings. A phenomenography researcher is not very interested in understanding the reason why people see the things as they see. He/she only describes the variation of people’s different understandings. Uljens continues that learning is not only a change in learning him-/herself, but also a change in the learner’s and environment’s relationship. From the educational point of view we have to first know the variation of students’ opinions and then the teacher can think of different ways to present the taught subject with a contrast of his/her own opinion.

Uljens (1993) says that basically the philosophical background of phenomenography is quite the same as in phenomenology. Its starting point is also intentionality – to what is the mind directed. It interprets the world in the same way as Husserl has presented it. Uljens also said that the phenomenographical method has changed a lot during the last 15 years.

The steps of a phenomenographic study are following (Syrjälä et al. 1994):

1. **Theoretical studies.** A researcher knows quite well the learning psychology and the essential features of the research subject. Phenomenography is based on the cognitive learning standpoint. A person has schemas or structures in his mind about the issue. So the researcher has to know cognitive psychology.

2. **Research problem setting.** The researcher sets his/her research from his/her theoretical studies. These theoretical studies he/she turns arounds as a problematic question. The problem must be theory-based enough to direct the empirical observations interpretation. From the problem, the researcher designs the interviews and tasks to people who he/she is researching. If we are theory-oriented enough we can design deep interviewing questions.
3. Research material
   a. Open or half-structured interview is the normal way. If we want to know people's own opinions we must continually interpret through our consciousness other people’s thinking structures. And for that, the open or half structured method is good.
   b. Projective tasks. With triangulation it is good to make sure that people really mean what they are saying. Those tasks could be, for example, writing texts, drawings etc.

4. Interpreting analysis
   a. Determining the interpreting unit. In qualitative analysis, the unit refers to holistic thought, not a mechanical unit.
   b. Interpreting manifestations. Qualitative analysis means the interpretation of meanings, and there the researcher should keep in mind at the same time the theoretical background and see people's manifestations in their own context.
   c. Building the categories. Interpreted meaning can be a category in itself. Many times a researcher has to combine different meanings to larger categories so that the reader can better understand the research.

At Gothenburg they had also made some studies about teaching computers (Booth 1992, Booth 1994). They have noticed that students can understand recursion in four different ways. The researcher presented her study at a computer science seminar (October 1994). I was quite surprised with the fact that two of these ways to understand the recursion means big trouble for the student later, but the researcher can’t say it in her study (because phenomenographical research doesn’t ask why people think the way they think but only how they think). For me, that limitation is little bit naive. The reason for this was philosophical.

In phenomenographical tradition I like the earlier writings of Marton, where he made the difference between the two grades (students and the objective one). In my mind, both phenomenology and phenomenography are too naive for me with their subjective standpoint. But I accept Husserl’s early method of apodictive science and the early method of phenomenography. In my mind those standpoints both have interesting scientific methods, which I am going to adapt in my study, but I won’t accept the subjective standpoint of nowadays phenomenology or phenomenography. I am going to, in a limited way, adapt phenomenographical research method to my study; I like the qualitative categorising of phenomena, but I also accept certain quantification in a study. And I also accept certain analysis for categorised opinions.
2.6 Subjectivism and objectivism

I said in Section 2.4, that I don’t accept the subjectivism as a philosophical standpoint. Popper’s theory is a base for my research. Karl Popper (1972, Popper et al. 1977, Niiniluoto 1988) presented a theory of three autonomous worlds:

![Popper’s theory about three worlds](image)

**Figure 2** Popper’s theory about three worlds

First (Popper 1977, 38), there is the physical world – the universe of physical entities … this I will call “World 1”. Second, there is the world of mental states, including states of consciousness and psychological dispositions and unconscious states; this I will call “World 2”. But there is also a third such world of the contents of thought, and, indeed, of the products of the human mind; this I will call “World 3”.

Popper’s World 1 includes physical objects, which are under physical and chemical natural laws. Those are, for example, tables, rocks, oranges, stars, molecules, atoms and electricity.

In Popper’s World 2 he thinks animals also have such a kind of consciousness but at a lower level. This came to us through an emergent evolution from World 1. World 2 states are real, because they are in causal interaction with World 1. The special feature of the evolutionary process is how the consciousness of the human being has been developed; it connects with the human social action, especially developing processes of tools and language.
Popper’s World 3 includes stories, explanatory myths, tools, scientific theories, scientific problems, social institutions and works of arts. These entities may and often do exist in material form. But the material aspect is not essential. World 3 entities can also exist in a non-material form.

Both (Popper et al. 1977, 46) theories and their logical relations are World 3 objects, and in general it makes no difference, neither their character as World 3 objects nor our World 2 grasp of them, whether or not these objects are embodied. Thus a not yet discovered and not yet embodied logical problem situation may prove decisive for our thought processes, and may lead to actions with repercussions in the physical World 1, for example, publication.

Language (Popper et al. 1977, 49) is non-material, and appears in the most varied physical shapes – that is to say, in the form of very different systems of physical sounds. All normal men speak; and speech is of the utmost importance for them; so much that even a deaf, dumb and blind girl like Helen Keller acquired them with enthusiasm … Physically her language was vastly different from spoken English … There can be no doubt that she would have acquired any other language in the place of English.

In my research I come back to Marton’s early thoughts (Section 2.5). There he made that division between grade 1 (in Popper’s theory World 3) and grade 2 (in Popper’s theory World 2). Those worlds are constantly interacting with each other. I am going to use phenomenographic method in the form of Popper’s theory. That means that I accept critique against different opinions (categorised opinions), because I have linked subjective opinions to a wider cultural connection. I also accept certain quantification, because I want to know how many persons from a certain case think in a certain way. But I have to be careful not to generalise too much, because just that case could be unique. But I don’t deny the possibility of generalisation.

2.7 Empiricism, rationalism and intuitionism

During the history of western philosophy it has been discussed whether right or pure knowledge can be acquired empirically, rationally or intuitively. It has been proved that all those ways have difficulties. In philosophy, this issue belongs to epistemology. The basic question can be described as “How can we know what we think to know”. In fact, there are different kinds of knowledge.

Originally it was Plato (1977, Popper 1993) who said that knowledge (episteme) and belief (doxa) are opposite concepts. Knowledge is something more permanent and un-
changeable. It is more than opinions and observations. There must be something permanent other than just our observations and that is knowledge. That knowledge we could get only with rational ways and we then get permanent ideas (it is aprior – before observations). The basic type of science was mathematics, especially geometry. Education means to concentrate on training rational thinking (logic etc). This epistemic way of thinking we call rationalism.

Plato's student Aristotle (1951, Popper 1993) was of the opposite opinion. He criticised Plato's strict rationalism and said that originally we can get knowledge by observing the world around us. By induction we can create the axioms of each science and so the base of knowledge is aposterior (after observations). But also Aristotle thought that science is something unchangeable (with every science's unchangeable axioms). This epistemic way of thinking we call empiricism.

Descartes (lived 1596–1650) doubted his observations and that's why he was sure that because he was alive the only way to get right knowledge is rationalism: "Dubito ergo cogito. Cogito ergo sum." Descartes was sure that all observations may be wrong. And that's why we can get pure or right knowledge only with our rational thinking.

The opposite side of this epistemic standpoint was Locke (lived 1632–1704) who said that a child has no ideas of even him- or herself when he/she is born (tabula rasa). So this means empiricism: we could get knowledge only by observations. There (Locke 1954, 123–125) are three kinds of knowledge which, without an over-careful choice of terms, I may call inscription, tradition and sense-experience... For whatever we know is all either inscribed in our hearts as a gift of nature and a certain privilege of birth, or conveyed to us by hearsay, or drawn by us from the senses.

Kant (1899) (lived 1724–1804) was the philosopher who tried to compromise opposite epistemological standpoints. He said that knowledge can't be directed to things for themselves but to phenomena's the world how we see it in our experience. But there are for human being's knowing many aprior forms of time and space. And these create some possibilities and limitations for our knowledge. Also values and morality are included into Kant's epistemological standpoint: there will be only one rational explanation (the scientific). Values have only one reasonable base. Values are not private but common things.

But in fact there has been also a third epistemic road: intuitivism. It was quite popular among philosophers in the Middle Ages (Royce et al. 1983). It is also now going to be much a more popular epistemological standpoint (Goodman 1984). It operates with metaphors. Metaphors are not only handled in literature but also in arts. We can get the truth of some metaphor only with metaphoric methods. So there must be some kind of
different truth than only rationalistic or empiricist truth and that is metaphoric truth. Nowadays natural scientific tradition has stressed the empiricist way of gathering information. That has been quite useful method for the growing industrial development, but it has meant also that values and opinions are not interesting at all.

Dewey (1982, 119) says that experimentalism is the answer to the conflict between empiricism and rationalism. Past experience is memory; we can do nothing about it. The only thing, which is subject to our control, is the future. There are two ways in which man moves toward the future: by blind trial-and-error, or by consciously planning his future on the basis of his past experience and his projected desires … effective organisation of the past experience is impossible without logic. This is a central feature of experimentalism. The experimentalist hopes to construct methods which mankind can use as instruments with which to control the controllable part of the present, and to make intelligent plans for conscious movement forward, step by step, into a partially foreseeable future.

Notturno (1985) says that there is little clarity, which means a psychologistic theory. One definition is “the intrusion or appeal to mental processes in the analysis of sense”. Referring to Frege and Popper psychologism denies a priori knowledge. So far, doing it is accommodated by a weakening of the criteria for justification. And the epistemological consequence of psychologism means epistemological relativism.

Referring to this claim, I am not going to base theories on psychologism. It means epistemological weaknesses. I more want to find theories that are based on cognitivism and epistemological analysis.

It (Piaget 1972) is impossible to pursue the analysis of the psychological or sociological development of human thought without meeting yet again all the problems of epistemology. For example, in studying the development of thought in the child we are obliged to take experience, the individual’s activities, and so on, into consideration, so that eventually we have to choose between empiristic, aprioristic, dialectic and other theses. Teaching in general is comparable to medicine in the sense that it is based on scientific data, although its applications represent more of an art than a science.

Vygotsky (1978, 90) says about development and learning: learning is not development; however, properly organised learning results in mental development and sets in motion of variety of developmental processes that would be impossible apart from learning. Learning is necessary and universal aspect of the process of developing culturally organised, specifically human, psychological functions. The developmental process lags behind the learning process.
That Vygotsky’s definition was good and clear. I agree that learning itself is not development. But it is a necessary element for development and I think also in a good, flexible learning environment we have to observe other human actions to find out if there is any development.

Karl Popper (Berkson et al. 1984, 6–12) is well known for his ideas on scientific method, but he also recognised that some of his ideas belong to the field of psychology. In particular, his theory of the growth of knowledge belongs to the tradition in psychology, which regards learning not as a passive reception of information, but rather as a result of active attempts to solve problems by trial and error. For Popper, an important kind of problem is the experience of something contrary to our expectations. The upsetting or disappointing of our expectations initiates the process of trial and error. Like Piaget, Popper has been fundamentally concerned with cognitive growth and change. But despite the similarity of concern, the two seem to be describing different worlds. Perhaps the most basic difference between Piaget and Popper lies in Popper’s view of the dominant influence of a search for a coherent and complete horizon of expectations. He believes we have a kind of cognitive hunger, a need for knowledge of what can be expected from the world. Piaget, in contrast, seems mainly concerned with the development of cognitive skills. Piaget is concerned primarily with the growth of intelligence, whereas Popper is concerned mainly with the growth of knowledge in both the individual and mankind.

Popper’s (Berkson et al. 1984, 13–19) view is practically a negation of Hume’s inductive method. Hume depicts the mind as a passive receiver of pure, discrete impressions, which it stores and with repetition automatically generalises. According to Popper, the mind actively seeks and attempts to understand experience, which comes to the individual’s consciousness in an already interpreted form involving many different levels of generality: we seek to improve these generalisations by imaginatively changing and adjusting them to resolve conflicts in our understanding of our experience.

My psychology is based mainly on Popper’s epistemological analysis about the growth of knowledge. I study subjective learning (i.e. what the student really has learned), and in my mind learning is an individualisation process. But the only way to observe the objective development is the study of observing: do we really use better ways to organise a division of labour, do we use better equipment (based on better theories) and what kind of scientific theories we use. That is a growth of knowledge. We must see the both processes: subjective learning process and the objective growth of knowledge on a societal level. But what is the individualisation process. What does it mean?
That (Popper 1965) intangible and vague entity called public opinion sometimes reveals an unsophisticated shrewdness or, more typically, a moral sensitivity superior to that of the government in power. Nevertheless, it is a danger to freedom if it is not moderated by a strong liberal tradition. It is dangerous as an arbiter of taste, and unacceptable as an arbiter of justice. Public opinion should be distinguished from the publicity of free and critical discussion (or should be) the rule of science, and which includes the discussion of justice and other moral issues. Public opinion is influenced by, but neither the result of, nor under the control of, discussions of this kind. Their beneficial influence will be the greater the more honestly, simply, and clearly, these discussions are conducted.

Popper speaks about Open Society, but there is also the phrase with almost the same meaning: Free Society. There are many philosophical writings about this, and I am introducing one of them: Paul Feyerabend (1978, 106–107). He says that a free society is a society in which all traditions have equal rights and equal access to the centres of power. That is why state and science (rationalism) had to separate. Science should not have the monopoly to say what is right. People in a free society must decide about the very base: necessary information, understand the purpose of traditions different from their own etc. Science is only a tradition and it should not have the right to say the final truth in education.

I think Feyerabend is partially right, when he criticises science’s status in modern society. There are many traditions, which have a different point of view than science (art, rock-music, sport etc.). They should also have the right to their say, for example, in education, their own standpoint. But I am defending rationalism in the way, that in final conclusions we should always think educational knowledge in an analytic (rationalistic) way. Other method would mean, in my mind, some kind of irrationalism.

C.S.Peirce (Yu 1994, Peirce 1867/1960) introduced his logical system. In this system, the logic of abduction and deduction contribute to our conceptual understanding of a phenomenon, while the logic of induction increases the quantitative details to the conceptual knowledge. Although Peirce justified the validity of induction as a self-corrective process, Peirce asserted that neither induction nor deduction could help us to unveil the internal structure of meaning, as exploratory data analysis performs the function as a model builder for confirmatory data analysis. At the stage of abduction, the goal is to explore the data, find a pattern, and suggest a plausible hypothesis; deduction is to refine the hypothesis based upon other plausible premises; and induction is the empirical substantion.

In Peirce’s view (Yu 1994, Peirce 1867/1960) knowledge is fallible in nature but continuous inquiry makes knowledge self-corrective. Quantitative understanding builds
qualitative understanding and they can correct each other. On the other hand, qualitative understanding can correct quantitative knowledge by pointing out new directions that have been neglected. Actually, quantitative and qualitative methodologies share more common grounds rather than conflicts in regard to epistemology: They both admit that there is more than one way to approach reality; there is continuity between qualitative and quantitative understanding; there is a tension between the complex world and the reduced model; there is a fallible nature of all inquiries, and thus conclusions are tentative rather than final. More importantly, they both attempt to break down the data and construct them into a pattern. In the process of pattern seeking, they both use symbolic representations. Qualitative research applies language while quantitative research employs numbers. Neither is more descriptive or reducing than the other one.

Popper (1972) said that it is not important whether we get the knowledge to our theories empirically, rationally or intuitively. The only important thing is to testify the truth with falsification. If we can find even one case that shows our theory wrong, the theory proves to be wrong.

In fact, it is very fruitful to accept different ways. The final result what we get is the most important. Many inventories have been made with totally new ways of doing things. And I think it will be useful also for educators to allow different ways. It is also very useful to compare after teaching a course what we have got. It would be good to compare the results. Maybe that will be the intelligent or flexible learning environment and computers allow us many useful things. Maybe creativity is little bit concerned with doing things in different ways. I am going back to this discussion of epistemic truth in Section 3.2, where I present the psycho-epistemological learning style. Why I presented this section here and not in educational theories, is because this subject is important also in methodological standpoint in empirical studies in Chapters 3, 4 and 5.

32 Preconception
2.8 Learning process

In my qualification studies as a teacher I learned a teaching model (Engeström 1985), which means that it is important to orientate the learning issue. It was quite a good model in my classroom teaching, but it is not flexible enough for this kind of learning. Engeström’s model:

![Engeström's completed model of learning](image)

**Figure 3** Engeström's completed model of learning

1. *Motivation* means how we arouse the interest toward the learning issue. The learner should notice the conflict between his/her own knowledge structure and the new knowledge, which he/she should learn. The learner can best notice this conflict, when he/she can’t solve a new problem.

2. *Orientation* means that we build a picture or model, which explains the main idea of the knowledge structure. Thinking and action model, which helps the learner to build and evaluate the learning issue and solve problems with it, is called the orientation base (the concept comes from Galper 1979). There are, of course, different kinds of orientation bases depending on the character of the learning task.
3. **Internalisation** means that we change our knowledge with new knowledge. The learner is interpreting and imprinting on his/her mind new knowledge structures.

4. **Application** means that we adapt the new knowledge in solving concrete problems.

5. **Evaluation** means that the learner is critically thinking about the learning model’s reliability and validity.

6. **Control** means that the learner is critically thinking through his/her own learning process. This differs from evaluation in the way that in evaluation we think the model but in control we are thinking about how we are learning as a critical learner.

Engeström’s model is a good model for traditional learning, when we are learning special skills (Engeström gives some examples; one is how an internal-combustion engine works and how to repair it). But for some advanced learning tasks, there are problems, with that model. It is, for example, possible that we don’t know in advance the issues main idea (orientation base) we are studying. So it is better to find out the idea from theories, which describe learning as a process in a much more flexible way (In Chapter 6, I still refer to this idea as an orientation base). A good base of this purpose is Kolb’s model for experiential learning:

![Figure 4](Kolb's model for experiential learning (Kolb 1984, 42))
Kolb’s model is a process and we can’t understand it only with single learning experiments. Learning is a continuing process and interaction between learning and experience. Learning means constantly solving problems in different conflicts, which comes from the interaction between a person and his environment. In his experimental learning model Kolb (1984, 21–25) has analysed Dewey’s, Lewin’s and Piaget’s theoretical learning process models and their common features.

The experiential learning process we can describe:

1. Personal immediate experienced learning is intuitive, open, creative and emotional learning, where we try to understand the phenomena
2. Reflective observation stresses the phenomena’s different points of view, and reflection of one’s own learning, when we are trying to find the different associative connections
3. In abstract conceptualisation of phenomena we aim at diciplinatory, systematic and regular based thinking, trying to find a theory which fits a solution to the problem
4. Active experimental learning stresses finding practical solutions to our theory and problem solving, and to change things

From these three theoretical models, Kolb presents his own model (Kolb 1984, Ekola 1992, 38, Järvinen A. 1990, 6–8):

1. Learning is possible to describe only as a process, not from the final products of learning
2. Learning is a continuing process, which is based on experiences
3. Learning means solving those conflicts, which come from the contrast of different points of view when adapting to environmental reality
4. Learning is a holistic adaptation process to the world
5. Learning means interaction with environment
6. Knowledge is the product of social and personal interaction, and learning is the process of creating this knowledge

Knowles (1984) says that adult learning differs quite a lot from childrens’ and young people’s learning. He concentrates on describing the andragogic process of learning (andragogic = adult learning):

1. A learner is changing from dependence to a more self-directed state.
   An educator’s duty is to encourage and promote this progress
2. An adult has a growing experience of things, and we can use this in many ways. The older we are the more experienced we are and the more valuable this is for educating.

3. An adult’s willingness to learn something is growing when he/she has to solve real life or working problems.

4. Adults want to adapt the learned things to promote their own living targets and quality.

The andragogic process model is fulfilled in improving the learning atmosphere and in activating the learners to participate.

My standpoint in this research is more a single learner’s standpoint, but it is important to say something about a group’s learning, because of the co-operation between single learners. It has many effects on a single learner. And in a sophisticated learning process we are all the time more working with other learners.

In an experience learning process we are dealing with the real world and not only with the artificial teaching world. If learning in real life is based on experiences and social interaction, we can’t learn these without the same environmental interaction situations. The learning process is not only a single learner’s learning, but also it is a learning process of the whole group.

Glaser (1991, 129–144) says that a group effects the learning process in many ways. First, it offers a much broader knowledge base to represent the problems. Secondly, the group members are promoting change in each others’ represented opinions and self-direction process with their feedback, argumentation, questions and opinions. Thirdly, a group makes it possible to handle also sophisticated problems, because group members can help each other to understand more problematic points in handling the issue.

In a flexible learning environment the social group learning is an essential part of the learning process. It is possible to think that a person is discussing only with a computer (and with artificial intelligent programs), but I think that it is nowadays still far away from what we really think is flexible learning environment. Flexibility is maybe concerned more with social connections with other people than mechanical discussion with a computer. But maybe there is a possibility that I will change my opinion in the future.
2.9 Reflection

Reflection is essential part of Kolb’s experiential learning process. I found it very important in this kind of study, that learners are processing knowledge in a reflective way. In my pilot project (Chapter 3) I want to evaluate the level of learner’s reflection. Reflection is important element also for my own learning process, which also my research title tells; reflective teacher using the computer-network in teaching (that title I choose much later – during Chapter 5).

Leino & Leino (1993, 94) say that the inevitable condition of a person’s continuing developing in his/her work is a reflective attitude to work. Reflection is a very important feature of the intelligent learning environment. Reflection was also a very important part of Kolb’s model, because with reflection we are making better abstract conceptualisations from personal experiences (Kolb 1984)

Dewey (1933, 9–12) sees reflective thinking as a very controlled and rational process. It is active, stable and careful consideration, which happens in the light of the basis, which support these beliefs, and those conclusions, which they lead to. He also says that reflective thinking is connected with a suspicious, surprising and extended decision-making attitude and also looking for new standpoints and inquisitive mind.

Boud et al. (1985, 19–21) much stress the meaning of effective things in reflection. They see reflection as a general conception for intellectual and effective actions. With those actions people can see their experiences in a totally new and deeper meaning.

Kemmis (1985, 139–163) warns of separating thinking and action. Dialectism is typical for reflection. It looks both inside our thoughts and thinking processes and also outside to those processes, where we live. He sees reflection as a social phenomena and claims that characteristic features to reflection are:

1. Reflection is not a person’s internal, psychological process and not only thinking. It expresses orientation to action and combines thinking and action in a real social situation
2. Reflection is not personal consciousness; it provides social interaction
3. Reflection is not free of values. It expresses and serves human, social, cultural and political aims
4. Reflection renews and actively changes ideological practices in social orders
5. Reflection is not a mechanical process and not only a production of new ideas. It expresses our ability to renew and change social life by those means, through which we participate in communication, decision making and social actions
Suojanen (1992, 27) sees reflection as “meta-thinking”, where we can study our thoughts’ and actions’ interaction. Kiviniemi (1991) sees that reflection can be understood as critical analysis of one’s own work, its base and consequences. So we are going to develop our actions.

Järvinen A. (1990) has studied reflective thinking levels of the students, who are going to be teachers at health-care institutes, on the base of Habermas theories and represents those:

1. At the technical handling level, the central point is the adaptation of adequate educational knowledge. The aims are seen as given from above.
2. At the practical level they are thinking the character of experiences and the basis of choices.
3. At the critical level it is the evaluating of moral and ethic criteria. The central point is to study the aims of education.

Grimmet et al. (1990) has categorised the reflectivity as three levels, which can be interpreted as a hierarchy, reanalysis of reflection experiences, when moving from one level to another:

**Table 3** *Levels of reflectivity (Grimmet et al. 1990)*

<table>
<thead>
<tr>
<th>Reflection perspective</th>
<th>Source of information</th>
<th>The way of knowing</th>
<th>The meaning of reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimenting and adopting</td>
<td>Outside</td>
<td>technical</td>
<td>direct using</td>
</tr>
<tr>
<td></td>
<td>Authority</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice of alternative actions</td>
<td>Outside</td>
<td>thinking</td>
<td>informatic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experiences reconstruction</td>
<td>In context</td>
<td>Dialectic thinking with colleagues</td>
<td>Understandable changeable</td>
</tr>
<tr>
<td></td>
<td>Thinking alone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Leino & Leino (1993) had examined the Grimmet categories and analysed:

1. Reflection can be a process, which leads to an action (for example, testing the results of some research). Reflection’s meaning is instrumental (to adapt a good solution for one’s own job).
2. In another perspectives the thinking concentrates to the selection of alternative solutions in some context. The aim is to choose the best solution just in one’s own case.
3. In the third perspective it is included in those reflections, in which our experiences are reconstructed. It means some kind of understanding of some action, to see us as doing the job in a different way. To question our own job

And what is reflective development? Mezirov (1991) in general sees it as a way of thinking upon the reflection of actions, which include the ability to make rational choices and accept the responsibility for our choices. A developed reflectivity sees the situation from different points of view and seeks the alternative explanations to one action.

In this research, I think the concept of reflective thinking is quite important, because the aim of teaching just that issue I am studying in the pilot project (philosophy) is to see things from different points of view and to find new alternative explanations to different situations. It could also say so, that developing the reflective thinking is even more important than teaching any philosophical concepts. I think that at polytechnics it is not so important to even teach philosophy as a subject, but in the sense that philosophical thinking develops reflective thinking, it is very important.

Dewey saw reflective thinking as only a controlled process. I more accept Suojanen’s definition as a meta-thinking or as instrumental meaning as in Leino & Leino. In my mind, we can’t only say through some simple answers whether someone has thought in a reflective way. It is a much more complex process. We have to observe the whole person’s actions and thoughts. And that’s why Kemmis is right when saying we cannot separate a person’s thinking and action.

There are many categorisations of reflective thinking. Both of those that I chose are, to me, acceptable (and clear enough). I think their basic idea is quite the same. Grimmet’s & others theory has more details, but to me Järvinen’s theory is good from my research point of view. My main interest is not only looking for reflection in my research, but it is an important part of my research. I think the philosophy course is just a course, and its idea is to bring reflective thoughts into someone’s mind. But I said that it is not possible after some simple thought to say, that he/she has thought in a reflective way. I think I can best see it when I am analysing all the student’s actions in a special course. And a remarkable thing is that reflection isn’t an accidental occurrence. It concerns the student’s whole life and studies.

I am not going to make any questions into inquiries or interviews whether the student is thinking reflectively or not. A better way is to critically think about the student’s representations (writings, discussions and so on), whether the student has really thought reflectively? In my mind, we can see and notice it quite easily. If the communication between student and teacher or between students is natural enough, the reflective ideas are easily seen.
2.10 Learning by expanding

First, I decided that my standpoint is only a single learner’s standpoint. Later, I expanded my standpoint more to learners’ co-operative learning. And that is why there is something I want to research in this study, which belongs more to a group or society standpoint. That is, what effects does the new technology have on the educational system’s rules and working routines. It is not only the technical aspect that we just adapt new technology. It means much more. One possible theory for that is activity-theory and it’s educational solution:

Engeström says (1987, 113) that in terms of activity theory, we may say that there is, on the one hand the object-activity (appearing in the form of market demands) requiring high quality, flexibility, variability and short delivery times from the product, which in turn require complex programmable cybernated instruments. However, there is an acute conflict between these factors and the striving for immediate cost-efficiency, manifested above all in the polar and compartmentalised division of labour. In effect, industrial capitalism has split the work activity in two basic layers of action, those of operating or performing and those of design and management.

There is one aspect behind Engeström’s theory, which I don’t accept and that is basically a philosophical and belongs to metaphysics. Engeström bases his theory on the visionary analysis of Marx. Engeström (1987, 106) says, “the sheer volume as well as the technological, economic and organisational complexity of the production process of the

Figure 5 Engeström’s theory (Engeström 1987) about learning by expanding

Engeström says (1987, 113) that in terms of activity theory, we may say that there is, on the one hand the object-activity (appearing in the form of market demands) requiring high quality, flexibility, variability and short delivery times from the product, which in turn require complex programmable cybernated instruments. However, there is an acute conflict between these factors and the striving for immediate cost-efficiency, manifested above all in the polar and compartmentalised division of labour. In effect, industrial capitalism has split the work activity in two basic layers of action, those of operating or performing and those of design and management.

There is one aspect behind Engeström’s theory, which I don’t accept and that is basically a philosophical and belongs to metaphysics. Engeström bases his theory on the visionary analysis of Marx. Engeström (1987, 106) says, “the sheer volume as well as the technological, economic and organisational complexity of the production process of the
plant or firm seem to be absolutely overwhelming for an individual. The whole machinery seems to run by itself, directed by scientific management and planning far beyond the reach of the worker. The immediate appearance gives plenty of nourishment for theories of dequalification.”

I am against that kind of determinism and I believe more in Popper’s theories about evolutionary development of society (history is not a machine – we can change it if we want to do that). But there are also good aspects in activity theory. In my opinion, there is a strong connection between human actions, rules and division of labour. Though I think the future is indeterministic, we can say something about the connection between human actions, social division of labour and the instruments (both equipment and immaterial theories etc.) that we are using.

Engeström (1987, 124–125) says about learning activities:

1. Human learning begins in the form of learning operations and learning actions embedded in other activities, phylogenetically above all in work
2. Learning activity has an object and a systemic structure of its own. Its prerequisites are currently developing within earlier activity types: school going, work, and science/art. In the network of human activities, learning activity will mediate between science/art on the one hand, and work or some other central productive practice on the other hand.

Figure 6 The structure of learning activity (Engeström 1987, 127)
3. The essence of learning activity is production of objectively, societally new activity structures (including new objects, instruments, etc.) out of actions manifesting the inner contradictions of the preceding form of the activity in question. Learning activity is mastery of expansion from actions to a new activity. While traditional school-going is essentially a subject-producing activity and traditional science is essentially an instrument-producing activity, learning activity is an activity-producing activity.

Engeström (1987, 125) also says that the object of learning activity is the societal productive practice, or the social life-world, in its full diversity and complexity. The productive practice, or the central activity, exists in its presently dominant form as well as in it’s historically more advanced and earlier, already surpassed forms. Learning activity makes the interaction of these forms, i.e., the historical development of activity systems, its object.

I am not going to theoretise on this issue more. The reason I wanted to present this theory is that:

1. The use of new technology is not an accidental event. When we are teaching students, we want them to be better workers than earlier. New technology is mostly a consequence of this demand. We are promoting the student’s vocational skills, because we want that he/she gets a good job. And when students get jobs we can demand the Finnish government give us better resources. Competition between educational institutes is a growing fact.

2. When using new technology it will also change our rules of teaching. My teaching and rules of practical teaching methods have been changed a lot in the past 20 years I have been a teacher (not so much formal norms of behaving, evaluation has changed from quite stupid old fashioned tests to larger evaluated exercises etc). But it is going to be changed even more if I think I am using, for example, electronic mail in my teaching. The control could be no more how long we are spending our time in some place but what we have done (exercises, discussions etc). There will be many difficulties in changing evaluation overall.

3. Division of labour (in education) will be changed dramatically. Because it is more collective working in a global network (education will become continuously more international), so how are we organising all this. I know it means big problems and work.
2.11 Computer-mediated communication

Steinfield (1986, 167–202) defines: Computer-Mediated Communication (CMC) systems can be divided into several broad classes, including electronic mail, voice mail, computer conferencing, and computerised bulletin boards.

Electronic mail is only a part of that concept and computer-mediated communication includes much more possibilities than only e-mail (nowadays almost continually there are new inventions in this area). But the importance of that definition is that different computer-mediated communication means have different characteristics (I mean this especially from a user’s standpoint).

There are different definitions of what electronic mail means:
1. Potter (1988, 5–9) says that electronic mail is the transmission of textual material from one place to another using electronic means for capture, transmission and delivery of information.
2. Held (1989, 83) says that e-mail is a storage and forward service for text messages from one computer terminal or system to another. The text is stored for the recipient until that person logs into the system to retrieve messages.

These two definitions are, in my mind, the essential on electronic mail. Electronic mail gives many benefits also in education, comparing it to physical mail and telephone discussions:
1. You are independent of place you are staying. As long as there is a computer, which has a connection to your network, you can check and send your electronic mail. At Lahti Polytechnics, the departments are not in the same place. One department is almost 40 kilometres from Lahti and also some other departments are not situated at Lahti Centre (few kilometres from the Centre). But for pedagogical reasons it is good to have cooperation between different departments. E-mail brings a good opportunity for this
2. You are independent of time. Because you can make contact whenever you want. Compare to telephone, it is not necessary to wait for someone’s contact. This feature is also very important at Lahti Polytechnic, because it has caused terrible difficulties to fit together different departments’ schedules. This is not only a weekly problem but also a long-term problem: some departments have certain exercises to do in exact periods. Also for this problem, e-mail is a solution. In a three-months course, executed in the way I presented, it brings enough flexibility to the general schedule.
3. You are not in direct contact. This can be a good feature for shy people. It could be a good thing in that kind of teaching in general, where you have to think of your ideas in a reflective way. I think it is not good at all to make a comment right away. You must think a little and then give your comment. That means, probably, much more reflective answers. This issue is next more discussed from the social psychological standpoint. In my mind that aspect is still not studied enough in computer-mediated communication.

Computer-mediated communication (Kiesler et al. 1988, 657–682) differs in many ways, both technically and culturally, from more traditional communication technologies. In traditional forms of communication, head nods, smiles, eye contact, distance, tone of voice, and other non-verbal behaviour give speakers and listeners information they can use to regulate, modify, and control exchanges. People are compensating to some extent that dramaturgical weakness of electronic media of sending computerised screams, hugs, and kisses. Software for electronic communication is blind with respect to the vertical hierarchy in social relationships and organisations. Thus charismatic and high status people may have less influence, and group members may participate more equally in computer communication. Messages are depersonalised, inviting stronger or more inhibited text and more assertiveness in return. “Sometimes users lose sight of the fact that they are really addressing other people, not the computer. From a social psychological perspective there are two interesting characteristics in computer-mediated communication: a) a paucity of social context information and b) few widely shared norms governing its use. These have effect in three areas: 1) the lack of social feedback and unpredictable style of messages might make it difficult to co-ordinate and comprehend the messages. 2) Social influence among communicators might become more equal because so much hierarchical dominance and power information is hidden. 3) Social standards will be more impersonal and freer. Indeed, computer-mediated communication seems to be comprised of the same conditions that are important for de-individuation – anonymity, reduced self-regulation, and reduced self-awareness”.

These aspects affect me quite much in designing philosophical courses. I think the good affects are, that I believe students can more easily communicate through computers than in face-to-face contact. It is especially important in a difficult subject like philosophy. But I think the new communication method makes some difficulties. To some extent it is very important to understand also the non-verbal communication in this difficult subject. Many students will think this feature is important (at least metaphoric learning style people). In my mind in general there should also be human face-to-face
contacts in most computer-mediated education. Those learning meetings should not concentrate on teaching facts etc., but discussing the aims of that education and giving more understanding about difficult issues. Through computers we can learn facts and some kind of clear cognitive structures, but deep understanding of a difficult subject’s meaning is in my mind possible best in face-to-face discussion. If it is possible the best computer-based education courses are combinations of computer-mediated and human face-to-face communication.

According (Galegher et al. 1992, 155–162) to contingency theory, tasks involving high levels of uncertainty and equivocality require a communication medium that permits interactive, expressive communication. The theory of adaptive structuration (Orlikowski, Robey, Poole and DeSanctis) takes a more dynamic view of the relationship between communication technology and communication behaviour, recognising the malleability of human behaviour as well as the adaptability of technology. According to the structural perspective, individuals can adapt their behaviour to achieve their goals despite obstacles in the technological environment. Gallagher and Kraut examined the media choices and responses to communication constraints in a collaborative writing task. The results of this experiment indicate that contingency theory has some general validity in that the task/technology matches it defines occur spontaneously and contribute to ease and efficiency in task performance.

This thing supports my design about combining computer-mediated and face-to-face methods in my teaching model. The most difficult issues should be first decided before you start the working with computer communication and data gathering. The uncertain things in a course should be minimised first. Though the contingency theory is based on an unjustified assumption of technological determinism, which I am not accepting, there is still some evidence in the basic claim of that theory.

Orlikowski (1992, 362–369) introduces a case-study about office organisation and a GroupWare product, but in my mind the results of that study are adaptable to an educational organisation. Because people act towards technology on the basis of their understanding of it, people’s technological frame-works often need to be changed to accommodate a new technology. Where people do not appreciate the premises and purposes of a technology they may use it in less effective ways. A major premise underlying GroupWare is the co-ordination of activities and people across time and space. For many users, such a premise may represent a radically different understanding of technology than they have experienced before. The users should have appropriate understanding of the technology, and in this case the users’ technological frame-works should reflect a perception of the technology as a collective rather than a personal tool.
In Section 2.10 I said that using electronic communication in education is not an accidental event. The use of electronic communication is going to be everyday life in society. So we are not terrible intelligent at Lahti Polytechnic if we don’t train these kinds of skills. This is a natural way to do that. In most cases electronic mail is used in very artificial situations. Some students may not understand the real meaning of electronic communication in that way.

2.12 Hypertext and multimedia

Vannevar Bush (1988/1945) first published the idea of hypertext in the year 1945. Bush criticises the way data of any sort are placed in storage. They are filed alphabetically and numerically, and information is found by tracing it down from subclass to subclass. It can only be in one place, unless duplicates are used. The human mind does not operate that way. It operates by association. He suggests that selection by association, rather than by indexing, may yet be mechanised. He suggested a system called a MEMEX. It was based on the technology of that time, but computers allowed it to be carried out.

Ted Nelson (Conklin 1987, 17–41), one of the pioneers of hypertext, once defined it as “a combination of natural language text with the computer’s capacity for interactive branching, or dynamic display ... of a non-linear text ... which cannot be printed conveniently on a conventional page”

Hypermedia (Yankelovich et al. 1988, 81–96) is simply an extension of hypertext that incorporates other media in addition to text. With a hypermedia system, authors can create a linked body of material that includes text, static graphics, animated graphics, video, and sound.

Nielsen (1990, 1–14) defines the concept hypertext: All traditional text is sequential, meaning that there is a single linear sequence defining the order in which the text is to be read. Hypertext is nonsequential; there is no single order that determines the sequence in which the text is to be read. Hypertext presents several different options to the reader, and the individual reader determines which of them to follow at the time of reading the text. Each unit of information is called a node. Each of them may have pointers to other units, and these pointers are called links. The traditional hypertext implies that it is a system dealing with plain text. If system is working with graphics and various other media, you can use the term hypermedia, to stress the multimedia aspects of systems (and multimedia means just opportunity to use graphics and various other media in your system).
Nielsen (1995, 66–78) predicts that in the short term of three to five years, there will not be significant changes in the way hypertext is carried out, but some major changes will come:

1. Consolidation of the mass market for hypertext. For example encyclopaedias are selling better in hypermedia form than in paper form. Truly, new Entertainment will have to wait for the next century (2004 we know this was wrong belief).
2. Commercial hypertext on the Internet. In order to get good quality information, people will have to pay something for the necessary authoring and editing efforts
3. Hypertext with other computer facilities. We are currently seeing a trend towards hypertext systems to be integrated with other advanced types of computer facilities. For example, there are several systems that integrate hypertext with artificial intelligence. Students can learn through a computer system different roles of meetings. It is possible to simulate the other participants on a computer by the use of artificial intelligence.

In the Long-term future (ten to twenty years) Ted Nelson expects to see the global hypertext as what has been called the docuverse (universe of documents). Nielsen doesn’t expect this will completely happen, but we will very likely see the emergence of very large hypertexts and shared information space at universities and certain large companies. Two opposite trends of the hypermedia publishing might be possible: either publishing will be concentrated in a few, near-monopolistic companies, or the ability to publish information will be distributed over many more companies than are now involved.

The hypertext and multimedia usage in education has some good effects. Beichner (1994, 55–70) noticed in research multimedia editing to promote science learning that by establishing an environment where creative thinking about the content material is combined with real-world assignments, students will learn content, enjoy the learning process, and recognise that they have created something worthwhile. Swan (1994, 120–139); in her research, noticed that hypermedia applications could be designed in ways that support students’ historical thinking. It especially increases propensity to discover links between people, places, events, and issues of historical importance. Becker et al. (1994, 155–172) claims that a variety of benefits may arise from increasing a learner’s control through hypermedia implementation. For example, increased control may result in deeper learning because it allows learners to discover their own links within the information. This allows learners to better assimilate new information into their existing knowledge of a topic or to form associations between old and new information easily. Hsi et al.
(1994, 351–376) basing their research claimed that interactive multimedia cannot replace actual engineering experience, but aspects of the engineering process and practice can be captured and conveyed with multimedia. Building on the Kolb model of experiential learning, multimedia examples combined with opportunities for active experimentation and reflection can be used to improve engineering education and accommodate different learning styles and life experiences. Chun et al. (1995, 95–116) studied second language learning with multimedia. They found that students not only reported the photograph- and movie-links (helping to understand the words) as most helpful for learning vocabulary, but in fact also chose these links to a much greater degree than text links.

Horney et al. (1994, 71–91) found in their research with Middle School Students six different reading patterns when using the hypertext:

1. Skimming: Moving through the text at a pace too fast for reading or studying
2. Checking: Moving through the text and/or resources systematically, checking things out but apparently not reading or responding
3. Reading: Moving through the text systematically, visiting pages long enough to read the text but with little or no use of supporting resources
4. Responding: Accessing one or more of the interactive resources (self-monitoring questions, PopUps) and writing responses
5. Studying: Moving through the text systematically, visiting pages long enough to read the text and using resources in an integrated manner
6. Reviewing: Moving systematically through text which has previously been read, re-reading pages and/or revisiting resources

McKendree et al. (1995, 74–82) presented that any analogies between hypertext and the mind and especially the brain are dropped. The structure of the brain is too poorly understood to give us any insight into how we should design educational programmes; the same applies to the structure of memory. More importantly, they are not particularly relevant guides for our efforts as instructional designers are. Many processes mediate learning; materials cannot engage directly with the brain. Rather we would advise an approach based on activities that learners can perform which reflect the important features of domain and which engage the students in significant problem solving or reflection.

McKendree et al. (1995, 74–82) say that hypertext holds much promise, but it often fails to support some of the key principles for effective understanding and memorisation. Hypertext is quite a good medium for searching, browsing, and retrieving infor-
mation. However, many of the statements about hypertext involve claims that it is good for teaching. Studies have shown that hypertext is not particularly good for initially attempting to learn about a topic. The hypertext itself just doesn't easily create our conceptual structures, if we don't think actively (and also begin active work with learning tasks). If we intend to use on-line resources to teach skills, practice procedures or get across highly interconnected arguments, a dictionary or keyword searching tool is not the best choice. We need to organise information in ways, which will support these different learning tasks effectively. Building in a combination of relevant work and supportive environment is more effective for learners than giving them a whizzy, fact-filled “multimedia experience”.

2.13 Computer aided learning

Computer Aided Instruction (CAI) means that a teacher uses the computer as tutoring the student. Computer Aided Learning means that the student is using computer and programs in learning. These both concepts belong to Computer Aided Education. Instead of the word Aided the word Assisted is also used. But I think it is not even very reasonable to study the differences between these definitions.

Since 1980 I have been inspired in computer opportunities in teaching. In spring 1980 there was a small project at Tampere University, where we studied Computer Aided Learning (CAL) in a PLATO-system (Kurkisuonio 1980). Plato-system is one of the pioneer-programs in CAL. It was first time used in the end of the 1950's. In our project we could use on-line courses in our peripherals. The mainframe computer was in Amsterdam. I think the use was not very cheap. But we tried to study whether it is useful at all to teach some subject in computer science. I studied all possible courses from elementary English and mathematics to medicine and computer science. I admired this new learning environment, and I really thought that this solution might be a good solution to many kinds of learning. Plato was so important in that time at the university, that there was even an open discussion for the issue arranged by the student’s organisation. Students from educational department were almost shocked by this kind of stupidity. They thought that such a kind of human interaction, as teaching, is never possible through a computer lecture.

One year after that project I was a teacher at Lahti College of Business Studies. I taught computers and bookkeeping. In both subjects I made some very simple CAL-programs. They were all on elementary knowledge in those subjects. I also had experiences
in using public programs for those same subjects. I first thought that I should change my teachings into computer aided education as much as it is possible. But very soon I found limitations to this. Computer aided learning is suitable for only those kind of lessons, where there is a clear theory or rules on how everything should be done. In much more sophisticated learning tasks it is better to use other procedures.

In inductive learning it is better to use word processing, spreadsheet etc. programs. They are flexible and the student him-/herself must analyse the problem, seek information and write it into rational form. This helps to better learn than any mechanical answer from computers.

In traditional computer-aided education it has been found that it does not replace the teacher but enriches the situation (Tawney 1979) and is very good in some special situations, for example, to teach blind and handicapped students (Lewis 1981, 433–467).

Microcomputers brought cheap computer-aided learning programs into the market and it was quite easy to use those in different kinds of learning issues. But this indicated also the problems of traditional CAL-programs in the middle of the 80’s. Especially (Jones 1988) children got only a static idea of knowledge and theories. Much more reasonable than a computer is telling the student what to do, is the way that the student is using the computer in gathering information.

In the end of the 1980’s the hypertext-based multimedia solution came into CAL (Maurer 1989). Many good features were found, for example, in Computer Assisted Language Learning it was found that visualisation increases the efficiency of learning, which is quite obvious.

In the 90’s it was proved (Frasson, 1992), that traditional computer aided learning has many problems. Computers should be much more used in modelling things and using the computer in problem solving.

I am coming back to the relation between computers and learning styles. Allinson (Tomek 1992, 61–73) says that students’ styles of learning, using CAL systems, differ and that they manipulate the material to be learnt in different ways. Learning Support Environments need to support the learner not only for a variety of tasks, but also by providing flexibility so they can determine their own navigation or learning strategy with which to accomplish these tasks. In Entwistle’s Approach to Study inventory research was selected to test subjects, various dimensions of a student’s approach to study, deep/surface processing, the serial/holistic dimension, and various strategic and motivation elements. There were two groups. The holistic group showed greater use of the self-determined hypertext linkages as a navigational strategy, and appears to be more actively searching the material.
I was interested to know whether the good applications in CAL mostly are from mathematics, computer-issues and elementary language teaching, as I saw in the 1980’s. I counted the case studies in the 2nd, 3rd and 4th International Conferences of Computer Assisted Learning (Maurer 1989, Norrie et al. 1990, Tomek 1992). I counted just those cases, which are traditional CAL-programs; the computer-program’s logic determines the learning process (I didn’t take word processing, spreadsheet etc. cases or theoretical articles – only practical case-designed programs or the use of a certain program). The result was just what I expected (from 34 cases):

1. Mathematics, logic or rule-based natural science 11 cases (32%)
2. Computers, other machines or engineering 9 cases (26%)
3. Elementary languages (rule-based) 7 cases (21%)
4. Medical (all exact mathematical models ) 3 (9%)
5. Others (deductive concept learning 2, flight simulator, music analyser-mathematics model ) 4 (12%)

Traditional computer-aided learning systems have their best areas in elementary level teaching. There they should be used in issues, where there is a clear theory and a user had to adopt it. The learning is based on deductive theory, but mostly the use of those programs means more inductive learning (students are learning through their senses – in those programs there is visualisation, the computer generates many similar tasks, which the students have to solve. The best epistemological learning style for this is empiricistic style, (Section 3.2). But in some areas this kind of learning is good (for example, in mathematics). Now, computer-aided education designing is directed much more into Artificial Intelligence and Intelligent Tutor Systems and of course most of the programs are hypermedia-based.

2.14 Intelligent tutor systems and artificial intelligence

The aim of the Intelligent Tutoring System (ITS) is to individualise human-computer interaction, and that means it has to keep track of what and how the student has learned. It is necessary to maintain a Student Model (SM) dealing with complex knowledge representation, such as incomplete and inconsistent knowledge and belief revision. These kinds of systems interest me quite much, because the idea is a little bit the same as I have in my research; to individualise human-computer learning interaction.
Carbonaro et al (1995, 233–251) describe the student model in a system that teaches Euclidean geometry. Their system has an expert model for solving problems in Euclidean geometry and a model for the individual student. The student model consists of three components:

1. The problem solver
2. The analogical reasoner/learner
3. The database of the exercises known to the student

The program can be used both by teachers, wishing to define tutorial strategies, and by students, wishing to exercise or to undergo self-learning on the specific teaching domain. Euclidean geometry is presented as a case study, but the ideas underlying this system can be, in principle, generalised to any deductive discipline.

Corbett et al (1995, 253–278) describe work based on executable cognitive models represented as productions rules. This continues their long-term mastery learning of programming. The student model uses knowledge tracing, modelling the development of the student’s knowledge through the period of teaching. This enables the system to predict student performance and thereby to individualise the exercises offered. As the student works, the tutor also maintains an estimate of the probability that the student has learned each of the rules in the ideal model, in a process called knowledge tracing. The tutor presents an individualised sequence of exercises to the student based on the probability estimates until the student has mastered each rule. They used this model in the cognitive model of Lisp programming skill. The resulting model predicts student performance quite well and enables most students to reach a high level of task performance.

Kashihara et al. (1995) describe the system that individualises explanations to create the optimal cognitive load for the student. Users who can cope with a higher cognitive load are given more substantial and demanding forms of information. The aim is that they learn more efficiently and remain motivated. This system also operates in an interesting and novel way: after giving an explanation to the student to explain how this new information fits into their existing knowledge structure. This supports the system’s diagnosis tasks and encourages reflection. The most important point of load application is to control a cognitive load by means of instruction. This requires student’s explicit load representation. The load presentation depends on how to model a student’s learning process (learning model). Instructions enable the tutor to apply a load. The tutor has to control the amount or content of instructional information with the load estimate (instruction control). A student may bear the different amount of load from what the tutor estimates. It is therefore necessary to set up an educational situation so that the student
may face the estimated load (situation setting). A student will often reach an impasse due to an applied load. Therefore supporting instructional information is necessary for the student to find a way out of the impasse (supporting instruction).

Through this article I understood that it is possible to use this tutor application for different kinds of subjects. But the example they gave was from computer science knowledge explanations and that explanation was totally based on deductive models. They also said that the tutor enables reflection. I think it is quite low level technical reflection. The way this application was introduced was very exciting, but I was a little bit disappointed by the use of this tooling with complex knowledge.

Shute (1994, 1–44) describes a new student-modelling paradigm called SMART (Student Modelling Approach for Responsive Tutoring). That article describes that intelligent instructional systems more efficiently teach by individualising instruction. A central component within these systems is on modelling a learner to support this individualisation (i.e. developing a valid student model). SMART relates to the dynamic interplay between cognitive diagnosis and remediation and it not only models evolving knowledge and skills (domain specific) for purposes of microadaptation, but it also assesses incoming abilities (general and specific cognitive aptitudes) as predictors of subsequent learning, and indicators of suitable instructional environments for macroadaptation. For instance, knowing that an individual has low working-memory capacity suggests smaller units of instruction, and an explanatory learning style suggests a less pedantic, more open type of learning environment. SMART models a range of outcome types (most others approach only one), including: symbolic knowledge, procedural skill and conceptual skill. SMART uses artificial intelligence in analysing a student. And it is used in Stat Lady, which is a series of computerised experiential learning environments teaching topics in introductory statistics (probability, descriptive statistics etc).

The SMART gave good results. I think that it will be suitable for those kinds of mastery learning programs, which are natural scientific and where the knowledge, is very rational. But is that kind of tutorial program also suitable for social issues? I very much doubt it. The learning process is totally different and the knowledge is different. But in this kind of statistical mastery learning it is very exciting. The computer can really analyse a student this way and then give individual advice that is good. But I still claim that it is suitable only for these kinds of subjects.

Bull et al. (1995, 45–65) says that the student model necessarily contains more flexible information than is normally found in other types of user model, as the aim of any learning environment is that a student should learn, and the student model should be continually changing to reflect successive changes in understanding. The system they
presented was Mr. Collins (COLLaboratively constructed, INSpectable student model) and they used it for foreign language teaching. The important issues of this model are:

1. Domain knowledge and misconceptions
2. Acquisition order of the target knowledge.
   - Learning history → Current student model → Anticipated future performance → Expert model
3. Analogy
4. Learning strategies. Metacognitive, cognitive and social strategies
5. Awareness and reflection

This article was presenting only a theoretical model. It would be very interesting if it should be used, because the subject where it was planned was foreign language, especially Portuguese language. But it is also surely much more difficult than the former natural science’s issues.

In these Intelligent Tutor Systems it is very clear to notice that they are suitable for deductive thinking (in natural sciences) and in elementary teaching issues. They have the same limitations as computer assisted learning has. The subject is so determinant in learning. In a clearly rational subject, where you can use deductive thinking with theories, the computers are good. That is because of the fact that our present computer technology means deductive programming. It is possible to also produce learning environments with inductive logic. But if you want them to be really good ones, I think it means expensive systems.

Hollnagel (1991, 153–202) says that Artificial Intelligence (AI) was defined as having the goal of making computers more useful by applying the basic characteristics of AI systems: 1. That they can use general knowledge and principles to infer heuristic rules from data and 2. That they can apply these rules to solve the problems they are given. One of the reasons why the actual influence of AI on Human-Computer Interaction (HCI) has been quite small, and certainly less than one would have expected, is that the goals of AI and HCI do not really coincide. The ultimate goal of AI is to recreate human intelligence in an artefact. Despite the fact that the pragmatic goal was defined as making computers easier to use, it is the ultimate goal, which has driven the main developments in AI. The goals of HCI are, on the other hand, to facilitate the way in which computers are used as a tool in carrying out tasks. While this may seem similar to the pragmatic goal of AI, it is quite different from its ultimate goals. The potentially useful contributions from AI are therefore the tools and techniques that have been developed over the years – for knowledge representation, rule interpretation, reasoning (logic), learning, system building and prototyping, modelling and simulation, etc.
3. The pilot project

First I present learning styles in Sections 3.1–3.3, those things I studied in order to compare the learning process both in theoretical and practical levels. During the evaluation process, the learning styles became more important than I thought beforehand. So I want to present these theories in a more detailed form. In connection with this project I also initially studied the distance learning theories (Sections 3.4–3.5). And finally I present the empirical distance learning project and my ideas for the future distance learning courses (Sections 3.6–3.14).

3.1 Learning styles

What are learning styles? As we can see the epistemological concept of the truth from different point of views, so we can also see the concept of learning styles from different points of view. There are many controversial theories to define that concept. In this Section, I repeat the categorisation of what Leino & Leino (1990) had presented.

The relationship between the concepts of learning styles and -strategies to information gathering as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Target</th>
<th>Theoretic background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistemic styles</td>
<td>Directed to information and its gathering</td>
<td>Psycho-epistemology, epistemology, personality theories</td>
</tr>
<tr>
<td>Learning styles</td>
<td>The ways of learning (in general)</td>
<td>Learning theories, learning practices</td>
</tr>
<tr>
<td>Cognitive styles</td>
<td>The ways of processing the information</td>
<td>Observation psychology, cognitive psychology</td>
</tr>
<tr>
<td>Learning strategies</td>
<td>The ways of processing information functionally</td>
<td>Cognitive psychology, cognition science</td>
</tr>
</tbody>
</table>

Epistemic styles are concerned about a person’s general ways to build the picture from the environment into knowledge and opinions. The epistemic styles describe the human ways to handle the information, gather it for using it and what is reliable information.
Learning styles are usually described to include learning practices, and theoretical descriptions of learning.

Cognitive styles are concerned with human beings’ typical ways to use the information; ways of making observations, ways of handling it in short time memory, converting it to save it in memory and to associate it for further information, seeking it from the memory, working it up and using it.

The learning strategies describe the human ways to approach and process information in a functional task. Sometimes it is also concerned about different other sciences, for example: linguistics, anthropology, brain explorations, artificial intelligence, philosophy etc. There are many learning styles, which could be very interesting, but I present two of them deeper: Royce/Powell psycho-epistemological learning styles (Section 3.2) and Kolb’s learning styles (Section 3.3).

Leino & Leino (1990) also describe some other learning styles, which I mention (some of them) here briefly:

1. K. and R. Dunn: the school practices learning styles
2. Canfield: academic adult learning practices
3. Briggs and Myers: Jung’s type theoretical personality learning styles
4. Letteri: based on information processing
5. Schmeck &: inventory of learning processes
6. Owens and Straton: social points of learning
7. Torrance: the left and right side of brains
8. Pask and Scott: serialistic and holistic learning

In the Internet I could find one article, which is similar to the third theory of Briggs and Myers; Keirsey’s Jung’s type theoretical personality learning styles (Internetix 1997). In that theory there are 4 types of personalities:

1. Sensitive Perceiving (SP): Wants to act (actors, adventurers, etc). Spontaneous life here and now is important for this type.
2. Sensitive Judging (SJ): Devotion in family, group, school, etc is important. Responsibility, duty and serving are important.
3. iNtuition Thinking (NT): Needs to assess. Wants to know everything. Building, designing and commanding are important things.
4. Intuition Feeling (IF): Self-confidence is important. Empathy, drama, idealism, etc are important.
Keirsey has also adapted teaching styles (same as above): Sensitive perceivers are good teachers, because they are interested in freedom and spontaneity (but only 2% of teachers are SP:s). About 60% of teachers are sensitive judges. They are quite conservative. Intuition thinkers are interested in developing intelligence. Intuition feeling teachers are interested in students' social and intellectual welfare.

3.2 Psycho-epistemological learning styles

In Section 2.7, I wrote that there has been a long debate during the whole of western history about how we can get the right knowledge. That debate (Leino & Leino 1990) means that there are three main standpoints on how the philosophers have thought that this knowledge is available:

1. Through our senses (by observations)
2. With rational ways (by thinking)
3. Intuitively (by insight)

Royce and Powell (1983, 133–145) found epistemological styles in their theory through empirical analysis in the top of the personal constructed style hierarchies. In one persona’s actions learning styles are as stable and remarkable as values controlling our lower level cognition and affections. Their theory has two levels. The upper level consists of just the three styles: rationalistic, empiricistic and metaphoristic and I concentrate on that upper level.

Royce and Mos (1980, 3) presented the following definitions of the learning styles:

1. Metaphorism. The person whose view of reality is largely determined by his commitment to metaphoric experience would test the validity of his view in terms of the universality of his insight or awareness. The cognitive process underlying this commitment is of a symbolising nature, including both conscious and unconscious aspects.
2. Rationalism. The person whose view of reality is largely determined by his commitment to rationality would test the validity of his view of reality by its logical consistency. The major underlying cognitive processes involve clear thinking, and the rational analysis and synthesis of ideas.
3. Empiricism. The person whose view of the reality is largely determined by his commitment to external experience would test his view of reality in terms of...
the reliability and validity of observations. The major underlying cognitive processes involve active perception and the seeking out of sensory experience.

Royce and Mos continues (1980,13) that the rationalistic person prefers deductive thinking and thinking is conceptual (verbal or/and reasoning). The empiricistic person prefers inductive thinking and thinking is perceptual thinking (spatio-visual and/or memorisation). The metaphoric person prefers analogical thinking and thinking lies on symbols (fluency and/or imaginativeness).

Those who think that information could best be gotten through rational thinking, with mental processes and ideas; they have a rationalistic learning style. They check the truth of their information comparing it to their prior concepts and structures. They do apriori selections of the information, which they are going to process. They use deduction. That means that they have upper concepts and from those they logically want to make conclusions. In their mental affective life they are usually quite calm.

Those who think that information could best be gotten through senses, concrete actions and with experiences, they have an empirical learning style. They are gathering facts and with them they can check the truth. With them you can say what is practical truth. They are active observers and they make conclusions by inductive method. In effect, this learning style means more control of impulsivity. They are concentrating on facts rather than being very social.

Those who think that information could best be gained through intuition and subjective experiences, or through direct almost unexplained feelings (“I am sure, it is so”), they have a metaphoristic learning style. Their own ideas about the reality they test in their universe of experiences. Their thinking is based on analogies and the changeability of those analogies. They are also using some kind of abductive way of gathering information (abducere – disconnect). They will study the environment with analogies of their own experiences. Usually creative and original ideas come from these people. The conclusion process is analogues, intuitive and holistic. They are usually social, emotional, non-traditional, imaginary and talkative persons.

It is proved (Leino & Leino 1990) that certain vocational studies will change a person’s learning style to some direction. And that is caused by the fact that in certain vocations it is suitable to have a certain learning style. It is not necessary, but it helps your vocational adaptation (for example in many business vocations it is quite easy to have an empirical learning style). So learning styles can be changed, but the changing process might take a long time.
I don’t think that one person always uses only one learning style, which is dominating his/her thinking. In strange situations he/she will change his/her way of doing things. And it is only a good thing, if you have balance between different styles (ideal to use all of them). And I think it should also be a real intelligent learning environment’s aim to ensure that a student has some kind of balance between different learning styles (to be so flexible that in some situations it is good to use one learning style and in other situation another). An empirical student’s rationalistic and metaphoric skills should be improved and so on.

How did Royce get these categories? Measuring these epistemic styles he designed 90 different statements (PEP, Psycho-Epistemic-Profile). It was validated to a test, which was derived from personality theories. For example, rationality is correlating with theoretical values, metaphoric features with aesthetic-social-religious values and empiricistic features with theoretic-economic-political values.

Rancourt (1986) has designed a better test with 20 questions to validate the learning style (K.A.M.I – Knowledge Accessing Modes Inventory). The epistemical knowledge-based issues had become more important in the psycho-epistemic learning style than personality theories through his research.

Rancourt (1986) and Leino J. (1987) have shown in their studies in Canada and Finland that teachers bring their learning issues’ epistemology (knowledge structure) with them. They showed that a student wants to adopt his/her favourite teacher’s way of thinking (and thus learning style). Naturally, teachers’ profiles at different issues are different. Most teachers of mother tongue and arts have a metaphoric teaching style. In physics, chemistry and biology most teachers have an empiricistic teaching style. There were differences between Canada and Finland, but still similarities between teacher groups and learning styles at both countries are remarkable.

In all the projects, I used a test with 3 questions. They are based on Rancourt’s research, but I took those questions from Leino & Leino book (1990, see also Appendix B). Those questions can give quite good results for one student’s epistemological learning style. I tested the learning style questions with 6 persons (before the pilot project with other students) and the result was the same with three questions as with 10 questions. I don’t want to concentrate on asking many different questions from a student for only learning style, because in my mind it is more important to ask open questions and observe the student real actions than only asking exact formulated questions. I am going to minimise those kinds of questions. Almost the only questions for that are those three questions, because they just gave such good results.
The Royce/Powell epistemological theory suits my research quite well, because it has a philosophical dimension. I prefer these kinds of learning styles to pure psychological theories, though I don’t deny that the theory also has a psychological dimension. I want to avoid theories based on psychologism, because of the standpoint I have in accepting Popper’s theories. Also, I like the clear structure of the psycho-epistemological learning styles theory.

3.3 Kolb’s learning styles

Kolb’s model of experiential learning is also based on his theory about learning styles (Kolb 1984, Leino 1987, Leino et al. 1990). It has a combination of Dewey’s, Piaget’s and Jung’s theories.

Over time (Kolb 1984, 76–77), individuals develop unique possibility-processing structures such that the dialectic tension between the prehension and transformation dimensions are consistantly resolved in a characteristic fashion. As a result of our hereditary equipment, our particular past life experience, and the demands of our present environment, most people develop learning styles that emphasise some learning abilities over others. Through socialisation experiences in family, school, and work, we come to resolve the conflicts between being active and reflective and between being immediate and analytical in characteristic ways, thus lending reliance to one of the basic forms of knowing.
Some people develop minds that excel at assimilating disparate facts into coherent theories, yet these same people are incapable of or uninterested in deducing hypotheses from the theory. Others are geniuses in logic but find it impossible to involve and surrender them to an experience. And so on. A mathematician may come to place great emphasis on abstract concepts, whereas a poet may value concrete experience more highly. A manager may be primarily concerned with the active applications of ideas, whereas a naturalist may develop his observational skills highly. Each of us in a unique way develops a learning style that has some weak and some strong points.

The Kolb’s model’s 4 learning styles are (Kolb 1984, 77–78):

1. The convergent learning style (achieved through extensive transformation by comprehension) relies primarily on the dominant learning abilities of abstract conceptualisation and active experimentation. The greatest strength of this approach lies in problem solving, decision making, and the practical application of ideas. She/he is best in such situations, where there is a single correct answer or solution to a question or problem. In this learning style, knowledge is organised in such a way that through hypothetical reasoning, it can be focused on specific problems. They prefer dealing with technical tasks and problems to social and interpersonal issues. (In an other ways she/he is a pragmatic person)

2. In assimilation (achieved by comprehension transformed by intention), the dominant learning abilities are abstract conceptualisation and reflective observation. The greatest strength of this orientation lies in inductive reasoning and the ability to create theoretical models, in assimilating disparate observations into an integrated explanation. As in convergence, this orientation is less focused on people and more concerned with ideas and abstract concepts. Ideas, however, are judged less in this orientation by their practical value. Here, it is more important that the theory be logically sound and precise. (He is a theoretic person)

3. The divergent learning style (achieved by reliance on apprehension transformed by intention) has the opposite learning strength from convergence, emphasising concrete experience and reflective observation. The greatest strength of this orientation lies in an imaginative ability and awareness of meaning and values. The primary adaptive ability of divergence is to view concrete situations from many perspectives and to organise many relationships into a meaningful “gestalt”. The emphasis in this orientation is on adaptation by observation rather than action. These persons perform better in situations that call for generation of alter-
native ideas and implications, such as “brainstorming” idea session. Those oriented toward divergence are interested in people and tend to be imaginative and feeling-oriented. (He is a thinker.)

4. The accommodative learning style (achieved through extensive transformation by apprehension) has the opposite strength from assimilation, emphasising concrete experience and active experimentation. The greatest strength of this orientation lies in doing things, in carrying out plans and tasks and getting involved in new experiences. The adaptive emphasis of this orientation is on opportunity seeking, risk taking, and action. He is best in those situations where one must adapt oneself to changing immediate circumstances. In situations where theory or plans do not fit the facts, they will most likely discard the plan or theory. They tend to solve problems in an intuitive trial-and-error manner, relying heavily on other people than on their own analytic ability. They are at ease with people but are sometimes seen as impatient and “pushy”. (He is active in doing things)

Esichaikul et al. (1994, 101–110) found out that the Kolb’s learning styles theory had an impact on problem solving quality when using the hypermedia system. The preferred learning style in a hypermedia-based problem solving is the converger. In terms of learning orientation, abstract conceptualisation performed a higher quality of hypertext-based problem solving than those who prefer concrete experience. Convergers are relatively unemotional and prefer to deal with data and machines rather than people. These strengths suggest the convergers’ ability to use non-linear hypermedia because they have a facility for dealing with mental models and a willingness to experiment with various navigation paths in arriving at a decision or problem solution. Divergers, because of their orientation to learning through experience and their weakness in developing abstract mental models would benefit from extra training in using a hypermedia system. Divergers may also have special problems in using hypermedia because they are reflectors rather than experimenters. Assimilators should do well with hypermedia because of their ability to construct models. However they have reluctance to experiment, take risks and make decisions. Therefore, they may benefit from structured training exercises prior to intensive use of a hypermedia-based problem-solving tool. Accomodators might welcome the experimental exercises but probably would need extra assistance in developing their mental maps, which facilitate navigation through hyperspace. The accommodator, in taking rapid action, would probably not consider sufficient mapping alternatives while using the hypermedia model.
Kolb’s model and Royce/Powell model have many similarities. The styles are quite the same: assimilator is almost the same as rational learning style, coverger is almost the same as empiricistic learning style and diverger is almost the same as metaphoric learning style. Only accomodator is problematic, because Royce/Powell categorisation doesn’t have such. It would be interesting to know are those accomodators empiricists or metaphorist persons? (I think they are more empiricist persons). In Kolb’s model we do not only think how we get knowledge but also how we are going to use that information. That changes much this comparison I made.

The difficult thing in Kolb’s learning style testing is that the meanings are too much depending on one word. In the pilot project I made a four questions test for learning style. The result comparing to other answers at inquiry was little bit confusing. I had to admit that I used wrong words for the questions (later I heard about a standard test for the Kolb’s learning styles).

3.4 Traditional distance education

The projects I designed were more or less distance education courses. That is why it is important to define the concept of distance education. In this section I introduce some traditional distance learning definitions and in the next section the computer-based distance education.

Teaching and learning by correspondence is the origin of what is today called distance education (Holmberg 1995, 1–3; Keegan 1990, 7–9; Keegan 1993, 2–4; Moore 1990). Correspondence education has been known for several generations, mainly as part of adult education. References to what was probably correspondence education occur as early as 1720’s and to what was indisputably correspondence education in the 1830’s. One important thing behind correspondence education was the concept of Open University and those has been in action for over 100 years. In America the International Council for Correspondence Education (ICCE) was organised in year 1938. That Council in 1972 first time used the term of “distance education”, and the concept of distance as a dimension of teaching and learning, was introduced. Moore says that what really changed the concept of distance education was Charles Wedemeyer’s experiments between 1963 and 1966 at the University of Wisconsin, when he attempted to articulate, or join together, instruction by new, electronic communications media and traditional correspondence teaching. When exactly did computers come first time with in distance education? I couldn’t find
the exact date. There are some experiments in 1960’s (were they in Wedemeyer’s experiments I don’t know), but largely they were used in 1970’s.

What then is distance education? Holmberg (1989, 2–3) says that distance learning is a sub-category of open learning. And he defines distance education (revisited version Holmberg 1995, 175): “Distance education is based on deep learning as an individual activity. Learning is guided and supported by non-contiguous means, which activate students, i.e. by mediated communication, usually based on pre-produced courses. This constitutes the teaching component of distance education for which a supporting organisation is responsible”.

In 1979 UNESCO (Keegan 1990, 44–45) defined distance education: “Education conducted through the postal service, radio, television, telephone or newspaper, without face-to-face contact between teacher and learner. Teaching is done by specially prepared material transmitted to individuals or learning groups. Learners’ progress is monitored through written or taped exercises, sent to the teacher, who corrects them and returns them to the learner with criticism and advice”.

Keegan (1990, 44) defines distance education:

1. The quasi-permanent separation of teacher and learner throughout the length of the learning process (this distinguishes it from conventional face-to-face education)
2. The influence of an educational organisation both in the planning and preparation of learning materials and the provision of student support services (this distinguishes it from private study and teach-yourself programmes)
3. The use of technical media – print, audio, video or computer – to connect teacher and learner and carry the content of course
4. The provision of two-way communication so that the student may benefit from the even initiate dialogue (this distinguishes it from other uses of technology in education)
5. The quasi-permanent absence of the learning group throughout the length of the learning process so that people are usually taught as individuals and not in groups, with the possibility of occasional meetings for both didactical and socialisation purposes.

Distance (Holmberg 1995, 175) education requires a degree of maturity, self-discipline, and independence in its students, as they usually carry out the study activity autonomously. Central to the learning and teaching in distance education are personal relations,
study pleasure, and empathy between students and those representing the supporting organisation. The students are being engaged in decision making by lucid, problem-oriented, conversation-like, presentation of learning matter that may be anchored in existing knowledge.

Holmberg (1989, 168) says that, through distance education, a course of study can be offered to very large number of students. This implies possibilities for division of labour in the supporting organisation between counsellors, course writers, instructional designers, editors, developers of audio-visual materials, tutors, administrators, etc. This leads to a varying extent of mass-communication and industrialisation and to economies of scale.

Keegan (1990, 109) says “an essential feature of distance education is that the teaching acts are separated in time and place from the learning acts. The learning material may be offered to students, one, five or ten years after they were developed and to students spread throughout a nation or overseas. In distance education a teacher prepares learning materials from which he or she may never teach ... The pedagogical structuring of the learning materials, instructional design, and execution may be assigned to persons other than the teacher and to persons not skilled in the content to be taught. Teaching becomes institutionalised”.

Otto Peters (Keegan 1993, 39–58) claims that:

1. Distance education is a typical product of industrial society. This not only applies to its inherent industrial principles and trends, but also to the fact that distance education has been capable of meeting educational needs typical of an industrialised economy and that it could attract and keep highly motivated students who wish to improve their vocational or professional status as well as their income, sacrificing their leisure time for gratification often delayed for many years

2. In a post-industrial society the traditional industrial model of distance teaching will no longer satisfy the new need of new types of students with their particular expectations and values which, seemingly, not only differ from those of the students in the industrial society but are in many cases even the exact opposites of them

3. This situation calls for the design of new models of distance education. They will probably learn by combinations of intensified and sustained group work – highly sophisticated ways of acquiring the necessary information for self-study and increased telecommunication between the participants. They will have dif-
different sets of goals and objectives. And they will have to rely on self-directing and self-controlling – that is, on students becoming autonomous.

Qvortrup (1992, 21–32) says interestingly that; “I learn very little by reading books, but much more writing books”. Distance learning should concentrate more on doing things than only reading. Through organised teaching it is good to have something unexpected things and there should also be flexibility in distance learning. And also learning isn’t only an individual matter. It is as well a process within people. Through feed-across learners increase the level of complexity and self-confidence by asking and answering questions, telling stories etc. Especially it is important with computers not only linking learners to teachers vertically, but also linking learners to each other in a horizontal level.

Of those definitions of distance education all are suitable to my studies (especially Keegan’s), but for me, more important was the writings of the character of distance learning and its change. It is quite clear that distance learning is a product of industrial society. Distance learning and its electronic form very well allow the automatisation of educational process. And that can also mean many undesirable things. What Holmberg, Keegan and Peters said is very possible. But I claim that it is not inevitable, because I believe in indeterministic theory (I refer here to Popper 1993). The most interesting thing was Peters hope about post-industrial societies, distance learning; the situation calls for the design of new models of distance learning. And that is just the main thing. A new computer element in distance learning really means to think about distance learning and its nature in a new way. Of course some kind of new division of labour is necessary in the computer model (that is quite the same as in learning by expanding in Chapter 2.10 I said). The computer program designer can be a different person than the person, who co-ordinates the students’ learning. These persons and maybe others too (administrative etc) must work as a collective. In my special course it is obligatory, that the learning material and co-ordination fit together. The concrete form of an education is not inevitable; the form depends on decision-makers and designer values. If we want to have more individualised courses, it is possible. Like Peters and Qvortrup said, there is need for new values (flexibility, co-operation, self-directing and self-controlling).
3.5 Computer-based distance education

In the previous section I introduced theories, which try to define distance learning in a new way. The new element (the computer) gives us lot of new possibilities. And referring to Engeström (Section 2.10), new tools will change working methods and many other things.

Peters (Keegan 1994, 238) demands that the role of learners will have to become a more prominent one. Their being presented with standardised and prefabricated course material of some length with computerised control will simply not work any longer. We will have to find ways in which the learner takes the initiative in most phases of the teaching-learning process, and this must include more say in curricular decisions and methods of control and evaluation. The planners of distance education will also have to concentrate on the task of dealing with the students indirectly – that is, by developing learning environments which are conducive to open learning situations in which the students are encouraged to become active in organising and managing their learning processes themselves. And finally, the planners of distance education will have to deal with the problem of how to transform the learning experience in a such a way that it is no longer just a preparation for some specific future goal but also a preparation of life itself, with a result improvement in the quality of living.

There are a lot of examples of computer-based distance learning. In my mind in many educational programs, there is too much concentration on technology and the educational aspect is forgotten. But there are also good examples. One of these is (Tella 1991) a case-study in Finnish Senior Secondary Schools: Introducing International Communications Networks and Electronic mail into Foreign Language Classrooms. The scientific problem was to build on communicativeness as a general objective in foreign language (FL) teaching and communications networks contributing to simulating communicativeness in FL classrooms (with foreign participants in USA, Britain and 6 other countries). The study was a multisite ethnographic case study. No significant attitudinal or preference barriers prevented the Finnish teachers from learning to use networks or e-mail. The teachers realised these would soon be an integrated part of FL teaching (for extra work). The lesson was learner-centred but somewhat teacher-monitored. Learners’ autonomous, dyadic and small group work increased, while teachers partly became co-learners with regard to students.

Atman (Moore 1990, 136–150) says that as increasingly sophisticated technology becomes available to the average student, the potential grows for creatively designed distance education programs that are responsive to individual student needs. It is possible
to develop interactive, individualised orientation programs, based on psychological type differences that focus on personal skills such as: Information management, Energy mobilisation and Time-use control. If we are to meet the challenge of education in the 1990’s, distance educators must find ways to empower students so that they, as individuals, can succeed utilising the telecommunication-based programs we offer. Grance says (Moore 1990, 163–171) that distance education has recognised the need to cross-distances to foster learning. By continuing to bridge individual gaps of culture and understanding, as well as space and time, it promises to enrich the entire span of education.

Sparks (Keegan 1993, 135–151) also says that in designing the courses we should remember the fact that students differ in their preferred learning styles (see Sections 3.1–3.3 and Chapter 6 – my conclusions). That is, ‘holistic’ students need first a structure or explanation, whilst ‘serialists’ students prefer a logical step-by-step progression through a subject. Most real-world problems are normally complex, and therefore need a mixture of knowledge, skills, know-how, values and understanding for their satisfactory solution. Well-designed courses, for which understanding is a specified aim, therefore require a balance between the more formal educational methods aimed at conceptual development and the less formal project-based activities. This is true whether the subject is religion, science, philosophy, education, technology or any other conceptually rich subject.

Hawkridge (1995, 1–12) argues that if you join with any group of distance educators today and discuss the changes you will hear talk of exponential expansion of distance education when the information superhighways come into being, within a decade. This might be called the Big Bang theory of distance education. You will hear enthusiastic talk about two-way communication (at last) between teacher and student, replacing the old one-way systems. Students will be able to explore massive knowledge stores. You may also hear gloomy comments about limited access, costs and the dangers of technological determinism. It seems clear that the Big Bang in distance education is likely to happen first in those countries that are the first to have electronic superhighways (Finland among the first – my own comment). Canada’s Open Learning Agency has brought its students on thirty-two courses on to computer-mediated communication and Internet. In the USA there has been many experimental computer-mediated courses. In 1994 the first ‘virtual summer school’ was held, replacing a week-long period of residential study and laboratory work for a dozen students taking a psychology course. Linked to the tutor and each other via e-mail, videoconferencing and a collaborative work system, these students worked for two weeks on psychology experiments, statistical analysis of the results and writing simple artificial intelligence programs. Via Internet, they attend-
ed a lecture by a world expert on human-computer interaction from the Apple headquarters in California.

In Qvartrup’s book (1992) there are many examples from Australia, Finland, Norway, Sweden and so on, about Open Learning Centre Networks. The concept differs in other countries (in this form it is from Australia – in Finland telecottages). But the idea is quite the same: to serve, especially in rural areas, opportunities in communicating through computers in distance learning projects. This kind of opportunity is very good. It allows also those, who don’t own a computer and e-mail address to participate in computer-mediated learning. In our polytechnics there is on a small scale, the same problem. Some students are not living in Lahti and they are working most days. They participate in computer-mediated courses, but they have technical problems. This kind of solution (and Finnish libraries are becoming more involved in this kind of action) allows the courses.

Utsumi et al. (Moore 1990, 96–109) also present the idea of the Global Electronic University: a world wide educational network, a partnership of universities and business, of governmental, nongovernmental and community organisations. The idea is presented in 1972 and then started a small project, which is now already a world-wide project. It wants to promote perception among people of wisdom and experiences of the world’s cultures.

The Open Universiteit of the Netherlands (Valcke et al. 1995, 185–196) consists of students with very heterogeneous profiles: differences in aptitudes, study intentions, prior knowledge levels, motivation and so on. That is why the need for flexibility in the learning material is important. They have a system called ILCE (Interactive Learning and Course-development Environment – in 1994 it was still a prototype for limited experiences). The material is mainly (hyper-)text-base. The system consists of:

1. Building environment for creating learning material
2. Selection environment, where student decides his/her personal study needs and requirements and the system makes a student profile
3. Delivery environment, where the student will study

Romiszowski (1995, 164–172) presents an interesting case-study on discussion environment at Syracuse University. There is a long history and fairly developed technology of the design, development and delivery of self-study materials in different media. There is much less known about the running of effective group-discussion sessions at a distance. There are traditional teaching methods for seminars and case-studies (exchange ideas). Can such participatory discussions be effectively orchestrated at a computer-based dis-
tance? At Syracuse University case materials and the software are at the campus server and are accessible from any of the computers linked to the campus network, the materials are accessible to a much wider audience. The system is so configured as to automatically form separate small discussion groups of about six to ten participants, so as to maintain the characteristics of in-depth small-group work. Future developments involve the incorporation of multimedia in the presentation of the basic case information and the extension of access to the system via Internet. The system is seen as a prototype for future public-access case-discussion environments.

This case-study was very interesting, because I am also going to use discussion as a main way of learning. The Syracuse case was largely computer-directed (computer automatically forms the groups). I am much more interested in human directed systems, where the co-ordinator or the learners form group themselves. It would be interesting to know the educational experiences of that study, but there was not much. I think the model of traditional seminars etc. doesn’t suit computer-based discussion without big changes. The context is totally different, when you are not physically in the same place. How are you arranging all the discussion issues, for example? In my mind, the Syracuse University cases were a mechanical solution, but a very interesting one. I am going to design a combination of computer-based material (as in Syracuse), but a more human-organised computer-based discussion environment.

It has not been so unusual for some years to study at home. Kirkwood (1995, 129–150) argues that home-based-learning includes these unwarranted assumptions:

a. That home-based learners already have access to, or are willing to acquire, a wide range of high specification information and communication technologies
b. That the information and communication technologies to which home-based learners do have access can be used (singly or in combination) at times and in circumstances that are convenient for learners and optimal for effective studying
c. That learners studying by themselves have sufficient familiarity with or experience in using media (singly or in combination) for effective learning to take place.

Kirkwood continues that course designers and policy-makers need to shed some light on those processes by finding out more about how students actually learn with and from information and communication technologies in the home.

As the researchers said in the previous section, that there is a need for totally new learning models in computer-based distance learning, so the cases presented here con-
firm the conclusion. The nature of computer-based learning so much differs from traditional, that you also need a new learning model. The communication is different, the supporting learning material is different, the control of learning (or should there at all be such) is different etc.

3.6 Lahti Polytechnic

I say a few words about the Lahti Polytechnic and whole new educational system built through projects in Finland in the 1990’s. In 1992 when our experiment project started, similar efforts were begun at the same time in 16 localities. Lahti Polytechnic consists of 8 different departments, which were all separate institutes all. In Finland there has been such a situation, that in many institutes there has been both secondary level teaching and teaching, where the prerequisite has been a secondary level examination. That situation was also in our institute, and it means some kind of separation; we had to separate the secondary level and the polytechnic level. In 1995 the Finnish government made a decision on 10 permanent polytechnics, among them Lahti.

I personally was teaching at both sides; the polytechnic level and the secondary level in the years 1992–1999. In this research, I report on empirical studies from both sides. From the autumn 1999 I have been a teacher only in the secondary level (one important reason for this is the bigger freedom to organise teaching in the network).

22.5.1990 the government gave an educational report on the polytechnic reform aims to the parliament, (the main points of which were):

1. Raise the educational level and stress culture
2. Modernise the concepts of knowledge
3. Foresee new kinds of vocational skills
4. Design flexible individualised learning programs
5. Diversify learning opportunities

Finnish Parliament accepted (The Law 22.2.1991) the law of experimental polytechnics, and the aims of educational report were seen also in legislation. These aims are in a general form, and Ekola (1992, 12–16) wants to express these aims in a more concrete form:

1. To build a flexible expertise. This means ability and will to change in flexible situations
2. To be able to conceptualise and use information in a scientific way. Scientific
doesn’t mean here that the teaching should be very theoretical, but the ability to use theoretical information.

3. Internationalisation.

4. A human being is to be seen as a self-directed learner.

Koro (1992, 43–56) sees self-direction as a part of Finnish society’s administrative rebuilding. A human being is seen as able to decide his/her own personal matters as free as is possible. And that demand is coming also to schooling. That means: independent knowledge seeking, learning material is problem-oriented and working as projects, education concerns modern vocational and scientific development and that the student is able to use independently the information after he/she had examined the education.

Guglielmino (1977, 55–56) defines characteristic features for the self-directed learner: aim-oriented, initiative ability, independent, self-confident, seeking information, determined, sees problems as commons (not as obstacles), is able to make schedules, is able to finish his/her works, uses learning skills efficiently, is able to evaluate own learning and enjoys learning. Outside-directed (Pasanen et al., 1989) is the opposite of self-directed. Then the teacher is responsible for what is to be taught and how. Varila (1990) also sees problems, if there is not enough time for adaptation to self-directed process learning, then it might create many troubles.

The Ministry of Education in Finland (1989) defined that essential part of the self-directed learning as a many-sided learning method (monimuoto-opetus). That means (Koro et al. 1990, Larna 1990, Paakkola 1991, Takatalo 1992, Vento 1991) teaching, in which the main action can’t be a lecture. Part of it can be home studying, open learning, distance learning, radio and TV-teaching, learning groups, projects, etc. different learning methods. This kind of teaching is a possibility in motivating learners, using resources and enriching learning. The definition is quite close to modern distance learning (Section 3.5), but not exactly. This is a combination of traditional and distance learning.

3.7 Designing the project

In spring 1995 I designed a distance-learning project at Lahti Polytechnic. I was teaching elementary philosophy studies. In polytechnics, that doesn’t mean very theoretical teaching but a course, where you have to think critically about your own opinions The course is obligatory for all polytechnic students and it is a 2 credit course for the students. The aims for that course are:
1. To understand the significance of philosophy
2. To understand epistemological meanings and logic
3. To be able to consider ethical problems

One year before the evaluation of this pilot project I was programming an artificial intelligence program for logical thinking and I planned to have that as a part of my course, but I never managed to have it ready. Also there was a small hypertext database, but that, I never used in my course. Maybe those things were only good for my research purposes, because the students were not too concentrated on technology but they were answering my inquiries from their own standpoints and not too much from my standpoint. When I started to study this pilot project, I thought that I shall present the students as many possibilities as I could. I thought that intelligence in this issue refers to all the people equally. I show the students different possibilities and they tell me what they think.

I carried out the course mostly by using electronic mail. I planned that the students both were sending the electronic mail to me and to each other. But in an educational seminar some experts in pedagogy told me that it would make the teaching too complicated. And so I decided that the students were mainly sending mails to me and I was sending those to other students. What a pity, because later I found out that that's just the thing students would have wanted to (communicate with each other).

The students got an e-mail address and they also got the introductory lesson for the course (they could get it electronically). I also designed two inquiries (in the beginning and in the end) and two open interviews (from technical and learning aspects). The main idea was to ask the students to tell what they think about “intelligent learning environment” (3 times) and whether this course had anything to do with this idea. I was also interested in knowing their social and educational background and technical skills with computers. The questions mainly were in open form so the students could answer quite freely what they wanted.

3.8 The elementary philosophy course

I had only 18 students (normally in a group there are at least 30 students, but in this project there was less). There was 5 more students, who registered for that course at the polytechnic central office, but who never shared up the course (the reason is not known, that is quite usual and I think it has not so remarkable influence on the results). One
student was at the introductory lesson, but didn’t manage with the course (she gave up for the reason of difficulties in communicating through the network – she was working in Helsinki and didn’t have a direct Internet connection, and so she unfortunately gave up). First we had an introductory lesson in January, where I introduced to the students the aims of this philosophy course, students answered to my first inquiry, I had an introductory lesson for the philosophical basic concepts etc. And I also introduced the students into the concrete communication equipment. The inquiry of this pilot project you can see in Appendix A. This inquiry proved to be the most important information from students.

I gave students teaching material (about 35–50 pages and different material for each student) and they should write a reference from that material (one month time to do this) and then send those to me (about 2 pages). The students could communicate through our polytechnic network, which is a part of the Finnish University NETwork (FUNET). Then I sent the students papers to other students (they had different subjects: metaphysics, epistemology, science, values and 2 different ethics) and I sent 6 questions for each of those subjects, which they had to answer (for example, to a technical department student: Is it right that machines can pollute nature?). The students got the questions from their own area (students were from technical, commercial, social, health care or design departments). Mostly the students did not send their answers in time, because they said that many of them had a really busy time with their other studies. In our polytechnic the distances between departments are a real problem, because only 4 departments are located at the same campus area (within 1 kilometre distance). One department lies 30–40-kilometre distance from the others. For this purpose, distance learning therefore offers great opportunities in our polytechnic.

There were many technical difficulties in communicating. The network was not in very good condition (sometimes the Finnish alphabet was not all right and so on). Also the students didn’t know the network very well, because it had been in the polytechnic only a few months and there was not enough training for the communication. Also, I had difficulties in using the network, because the networks in different departments differed quite much from each other (in one place you could start the e-mail only with your own diskette, in an other place there were only few peripherals connected, in another Dos/Unix interface, in another Windows interface etc.). These differences caused many problems. When I started this project, I knew that there were difficulties with differences between departments, but I was surprised at how much difficulty there was. And for the students it was not possible or easy enough to send messages wherever they wanted. Many problems were found. But the students still liked the communicating.
During the course I made those 2 inquiries. Some inquiries I made through the network, but most inquiries I made face-to-face. I had the starting questions, but I let the students comment on whatever they wanted and in most cases they really wanted to tell all kinds of things (most things related to the polytechnic education in general). That information was very valuable. In the end of the course we had the final lecture. There we discussed the philosophical issues, students gave me information about learning organisations and I made the final inquiry. I made a video from the final lecture, but I couldn’t get any more information from that video comparing to the first experience during the lecture.

The main idea when designing the interviews and inquiries was, that students tell their opinion about computer-mediated learning environment and the idea of “intelligent learning environment”. I told then that any time when they had new ideas they should tell how next time this kind of course should be organised. My idea was to categorise the students’ opinions, and thus in that way analyse the idea.

There were many technical difficulties and in my mind the course could be a little better than it was. I wasn’t teaching enough philosophy and I didn’t demand as much work from the students as normally in those kind of courses is necessary. I wanted to concentrate on observing and analysing the new working methods and students’ opinions about the idea. What was really the most interesting thing was not what the students were doing but what they answered to my research questions for the idea of what they think about intelligent learning environment should be. One very important thing is that I asked the questions in Finnish, and the meaning of the Finnish word “älykäs” is not exactly the same as the English word “intelligent”.

3.9 The results

Students many times answered the question: what they thought about the conception of “intelligent learning environment”. I said earlier, that it was a good thing that students could answer this question in open form (the first inquiry is in Appendix B). They presented their own answers, not in that form what I maybe thought about. The main idea in the students’ answers was: intelligent environment is not what comes from the computer, but what comes from student him-/herself. It was the same result I found many years ago with CAL-programs: in most situations it is more important that student masters the computer and not vice versa. I could group the students’ answers in three different categories:
1. Those who stressed the learning process (9 students)
2. Those who stressed the content of discussion (6 students)
3. Those who gave exact definition (2 students)

Those who stressed the learning process were saying (two examples): “you can decide for yourself … reading, doing, experiencing, talking” and “the relationship between a teacher and a student should be such that both are influencing the action and designing of a learning environment … foreshadow future situations, help if it is necessary”. Those who stressed the content of discussion were saying (2 examples): “new ideas, joy of learning and maybe I can give something to others” and “people really mean what they say, and say what they mean”. The categories were quite clear to me (answers in different categories were so different compared to other categories)

The answers every student gave during the course were quite similar. In open interview this feature was quite clear. For example, almost everyone who stressed the content of discussion stressed the significance of discussion (the others stressed more process or other things). The triangulation technique confirms much of this difference: in all ways the students’ answers were different comparing to another category (different students’ answers in the same categories were quite similar). Also motivation to participate in just this course was different in different categories (process-oriented stressed the freedom of time and place, no lectures etc. and content-oriented stressed the new experience).

I also asked many background factors for the students. I was interested in many educational and social facts. I noticed that there was no remarkable difference between the background factors; whether you are a man or woman or you are a younger or older student (ages 19–38) or you have a long working experience or not (0– more than 15 years) or the educational background (only secondary level or many vocational schools – and also the quality of that education). When I designed that inquiry I thought that those background factors should have an influence on the answers you give. I thought that reflective thinking changes your opinions about the educational environment, but I couldn’t find anything.

I notice that one thing was really interesting for the relation between what students think is intelligent learning environment and their background. That was their learning styles. I asked them with 7 questions to categorise what kind of learners they were (4 questions were connected with the learning circle introduced by Kolb and 3 questions with the learning style introduced by Rancourt). I have been quite interested in using Kolb’s model, but I notice that there was no connection between the student’s answers
about intelligent learning environment and answers about Kolb’s learning styles. I must admit that I made some mistakes in translating. The meaning of some words were not telling the right meaning in Kolb’s model (Kolb’s model asks the meaning of some words related to other words see Appendix B). But there was a very clear connection between what students think about intelligent learning environment and the learning style introduced by Rancourt (preferring the ways you get information – how you learn).

I found out that those students, whose learning style was empirical or metaphoric, differed totally from each other. They stressed in their answers just those things in the intelligent learning environment, which are important in their learning style. There was only one person, who had a rationalistic learning style, but he also differed from the other students (some similarities with one metaphoric student).

There were 10 students who were empirical in their learning style, 6 who were metaphoric in their learning style and 1 rationalistic in his learning style. The categories were quite the same as categories derived from their answers about intelligent learning environment. All students who stressed the process had the empiricist learning style. All students except one who stressed the content of discussion had the metaphoric learning style. And one rationalistic and one metaphoric person gave the exact definitions.

If your learning style is empirical you will stress practical things in your learning: practical exercises, easy to find answers, and easy to communicate whenever you want or wherever you want. Computers can give you many opportunities to help you in this kind of learning. If your learning style is metaphoric you will stress more human communication. And nowadays communication networks allow you many opportunities. Metaphoric persons think this is the most important thing. For a rationalistic learning style I am not quite sure what is the most important thing, but I think a rationalistic person very easily finds the solution with computers. A rationalistic person stresses the theory and there are many ways to do that with computers (artificial intelligence programs and so on – but a rationalistic person also wants to be quite independent- he/she almost knows things in advance or believes so). Intelligence means to the students how computers adapt to their own learning style and not so much how intelligent the programs inside the computers are. And if you really want to make a successful learning environment through computers you have to know how students want to learn. That maybe means different pathways. Someone wants to learn empirically, someone rationally and someone intuitively (metaphorically).

The metaphoric persons thought they were better in communicating and human relationships. Almost every metaphoric person said that he/she was very good in communicating (4 of all 6) and from the others only 2 said they were very good in commu-
nunication and 4 said they were quite bad in communicating. In human relations, this distinction was not so clear as in communication but remarkable.

I think that the students, who participated in this course were a little bit more experienced in using computers. There were some students, who had only little experience with computers. This fact maybe influences the result, but I don’t think it has a big influence on this main finding of the relation between learning style and what they think was intelligent learning environment. Because in all categories there were experienced users. In both empirical and metaphoric categories there were not so many experienced users.

I didn’t have enough time to ask the final enquiry from all students. But the answers I got were quite the same as in the former inquiry and interviews. Those who stressed the process were stressing process in the final interview too etc. I was not very satisfied with this course, because there were difficulties both in technology and also in learning organisations. So I was little bit surprised that students were not so disappointed (I asked this in my inquiry). The students were little bit disappointed only for some special learning arrangements.

One thing was a disappointment to me: the students didn’t work as much as I wanted. This course should mean two weeks work to the students, but they said that they have worked only an average of about 3–4 days. The course was a self-directed course, so that was possible. The answers were not in general as good as I expected. Some of the answers were very good. One student I should have rejected (I didn’t – now I don’t know why).

And finally, I am analysing whether this course promoted reflective thinking. I must say, not enough. If I compare their working and answers to Järvinen’s theory about reflective thinking levels (Section 2.9), most students were only at level 1 or 2 (technical or practical level). Only 3–4 students in my mind were thinking reflectively at a critical level (of course that is my subjective opinion, because I can’t say exactly what a level of reflective thinking is).

3.10 Different learning environments

I claim that what is interesting in intelligent learning environment is what takes place inside of a student’s head and not what takes place inside of a computer. Nowadays the computer allows many things. Global worldwide network has been thought of as a solution for almost everything, but I think it is not itself neither a good nor bad solution
The pilot project 79

for learning. To build a good learning environment is not only a technical problem. You have to find also the educational solutions.

The computer easily allows quite different pathways to organise learning. I am not afraid that with computer-assisted learning we need no teachers. We still need a person, who organises and directs learning. Should we call her/him a tutor or learning coordinator? But anyway there must be someone who knows also the educational aspects. Learner herself/himself decides what are most important things, but someone should in most cases (in traditional learning environments) organise the educational aspects. That is because a novice (or non-expert) doesn’t know the structure of learning a topic, which is necessary for total independent learning.

It is a little bit difficult to think that we not only need one way but at least three pathways. From a technical point of view, it is not so difficult. In all the three alternatives we need the same kind of programs. It is good to have hypertext databases and it is good to have electronic mail. The biggest difficulty is organising the learning environment and there we need educational tutoring. If it is possible to use different persons to tutor different pathways, it is good, but it isn’t necessary. You have to just know different pathways. In computer-assisted learning it is possible to use many pathways. It doesn’t mean a very big job for the tutor. Is it necessary first to test the students’ learning styles and tell them you have to learn in this way and you in that way? No! Students will soon find their own way they want to learn. The only thing is to offer different ways to them. And also some students, I am sure, sometimes want to do things in a different way. That is very good.

When I was talking about the intelligent learning environment, I should talk in the base of my pilot project for 18 different learning environments (my own and 17 students’). Before the pilot project, I thought that intelligent learning environment is some kind of universal concept. Now I had to understand that the concept is connected with everyone’s epistemological ways of doing things. Though I wanted to study this issue from an educational point of view, I was working too much just with technical matters. I think it was a lucky thing that I didn’t manage the artificial intelligence system programming. I had to concentrate on educational points of view and ask the students’ opinions. This point was the essential thing in my research. The students wanted a different course. Now I know a little bit about that. But in the next sections I should design the practical features of those different learning styles.

In Section 3.3 I presented the Esichaikul et al. (1994, 101–110) studies about Kolb’s experimental learning model’s learning styles impacts on problem-solving quality when using the hypermedia system. In fact, also on the basis of that study, I could claim those
different learning styles should either have different interfaces or at least should have
different tasks or advice when using the hypermedia system. Because the psycho-epis-
temological and Kolb’s model have some parallels with learning styles, I claim that it is
quite obvious that learning styles should be taken into consideration when designing
computer programs in general.

What I am going to do next is to design a computer-assisted course with different
pathways (for empiricistic, intuitivistic and rationalistic learning styles). That course is a
practical philosophy for polytechnic students. I think it does not mean a bigger job than
a normal course (computer-assisted) but only thinking things from different aspects. The
empiricistic (Section 3.11) and metaphoric (Section 3.12) courses I can design on the ba-
sis of what the students said in my pilot project, but the design of a rationalistic (Section
3.13) pathway is quite totally a theoretical one.

When I am designing three different environments, I don’t want to say, that empir-
ical students should learn only in an empirical way etc. It is good that people can learn
in their own ways. But it is also important to improve empirical students’ rationalistic
and metaphoric skills etc. A good balance between different learning styles is the ide-
al solution. It is very good if you can use different learning styles in different situations.
I have noticed this fact also in my own learning and action. I manage quite well in ra-
tional and intuitive tasks, but I am too often very bad in practical things. I should im-
prove my empirical skills. A person’s learning style is quite a stabile thing, but it can be
improved in the long term. And that is why I want to also include some features in all
those learning styles, which improve a student’s uncharacteristic ways of learning. But
the importance here is, that you should go first inside the learning material with the
learning style, which is characteristic to you.

3.11 Empirical learning environment

Students with empirical learning style want to learn through their senses, with concrete
actions and having experiences. They want to know what is true through practical rea-
soning. I noticed, that the students were mostly criticising the practical organising: there
wasn’t enough good material for studying, there should be more basic knowledge for the
background of philosophy and exercises should be organised in a much better way. To
say it another way they could say: we need a clear educational schedule even for this
kind of issue. Philosophical studies should also have some kind of clear organised time-
table. A person with empirical learning style is neither as good in conversations nor good
in human relationships as a metaphoric person. Also an empirical person hopes for more discussions, but those discussions should be more in an organised form than a metaphoric person wants. The empirical person stresses more than the metaphoric person does the meaning of a schedule and the independence of time and place with electronic mail.

In the pilot project the schedule was made for three months. The students liked this and I think that should also be the duration of the new course. In this time the exercises could have been done just in time. In my mind, it is a good thing that you have time to think about difficult items. Most of time students are quite busy in doing their normal exercises and it is not the best arrangement if they have to do philosophical studies in a big hurry. It is good to have a loose timetable that could mean some kind of reflective thoughts about the educational issues they are normally studying.

First, there should be an introductory lecture, where the aims, schedule and concrete actions should be decided. The lesson learned is that I’m going to organise it as group learning. Though I said that my standpoint is a learner’s standpoint, I think a better learning environment is learning within groups than alone: the students wanted more discussions and the learning in groups gives a different result than learning alone. I think the optimal size of a group in these kinds of subjects is about 4–7 students.

And how should these groups to be combined. In my mind it would be very interesting to have, in one-group, students from different departments. It is good for a student to see different points of view (maybe that allows reflective thinking). I am sure that discussing real situations, as an empirical learning environment should be, means that students don’t see the same situation in the same way. For example if we are discussing machines and pollution, a student from the technical department sees more technical aspects, a student from health-care department more health-related aspects etc. I think this will mean more reflection in discussion.

And what tasks should the students perform? The group task should be such that you must refer to some material and shed light upon some philosophical concepts. Because empirical students like concrete and graphic things, so the tasks should be quite clear. For example, if the issue to be studied is values, the concrete task should be such of that the student clears up which kind of values are important in advertising (laws, official orders, advertising manners etc.). The tasks should always be such that you first have to find what some concept means (information retrieval, books etc.) and then you have to concretise the question and then you have to clear up the final answer. That is, in my mind, very important for the reason of Kolb’s experienced learning circle: The student should think things in an abstract way and also think those through experiences. This also means active experimenting of theories and later it hopefully means reflec-
tive thinking. Philosophically it is important that we should test objective concepts and structures in reality.

First, the bigger task for the group should last about one month. During that time the group should seek information from books, given papers and especially from a hypertext-based multimedia database for the meanings of a given task. From that information they should write it in small text. They should communicate with each other through network and also send the result to a co-ordinator. Of course they can ask the co-ordinator to help them in very difficult philosophical things. But the main working way is self-learning. In empirical learning groups, the tasks should be large enough but still also concrete enough.

After the group has made the introductory task (to clear up the concepts etc.), the second task begins: the personal standpoints manifestation. This is important both for educational and philosophical reasons. The learning should never be a learning of concepts without connecting them to personal concrete concept structures. And philosophically one may not have understood the real meanings of the difficult concepts. So it is better to make them more in a concrete form. The tasks, which the co-ordinator gives, should always be connected to a person’s own learning branch (for example business and there especially international marketing). There should be 2 or 3 tasks and the student should write for them answers of 2 pages. To ensure reflective thought, the students should send them to each other and everyone should comment on each other’s writings. This must happen 3 or 4 weeks before the end of the course. After that the students have enough time to improve their writings. Then they send then to the co-ordinator.

In the final lecture the co-ordinator gives his comments on the groups’ work and he/she also sets some questions (3–5). These questions must be based on the writing of the students. All students should give their own comments on these questions. Of course there should also be feedback to the co-ordinator for educational and practical arrangements.

3.12 Metaphoric learning environment

A student with metaphoric learning style wants to adopt information mainly intuitively, through his/her former subjective experiences and through direct almost unexplained feelings. This kind of student is probably much better at discussing and better in human relations than an empirical student. He/she likes to have philosophical debates. Many times that philosophy should be understood in a broad way; the debate should handle
some issue in its basic or deep meanings. That nearly always means a holistic debate. Ordinary debates and debates through a computer are very well suited to these kinds of students.

I refer to my pilot research and say that debates through a computer are a good way to learn philosophy for a metaphoric student. In Internet, that means, for example, the use of news groups. What should the debate include? The debate should include some kind of subjective elements. It is very important for a metaphoric student to just touch the issues in his/her own life. So it should not only be general concepts of philosophy, but what does philosophy mean to a specific issue. Of course students should after this kind of course know the general concepts of philosophy, but those concepts should be connected to his/her own subjective life. And because the debate should be as close as possible to a student, then there should be many different debate issues (many news groups).

I think a suitable timetable for this kind of course is the same 3 months as in empirical course. I refer here to those answers in my pilot project. It is also possible to have a continuing opportunity to take a course in this way, but it makes very big problems from an educational point of view and also from an administrative point of view. But in the end of this chapter I’ll write some notes, on what this course should be like.

First, the students can get the information about a future news group from the philosophy course home page. From that page you go to the future news group page and see the groups. Of course there should be 20 different courses per year, if we want to serve the students issues from their own interests. But for administrative and practical reasons, I think there will only be 6–8 issues and I think most of them are only once a year. If some issue is not popular (no participants) then it should be changed to another issue. In the empirical course there should be about 30 persons per course, but I think in metaphoric course there should be less participants, if we don’t want the debate to be chaos. And I also think that there will be less willing students for some specific issue (the issue should be specific enough but not too specific).

The actual course should also begin with an introductory lecture. In the lecture, a decision should be made about the specific issue of the debate (that issue presented in the Internet database should only be a draft – it should be checked). It is important to show the issue beforehand, so that we get the right students for this specific issue. The first debate of this issue happens right in the introductory lesson. It is important to make sure that the students understand the issue.

After the introductory lecture the students read some articles in the philosophy course Internet pages. There should be one article written by the co-ordinator (with
hypertext connections). This article should give the students some kind of philosophical background to the issue and also introduce them to central philosophical concepts. Then there should also be 2–3 articles, which consider the issue. Maybe the co-ordinator should also give some exercises that the students should first perform (to get information about concepts from hypertext database).

Two weeks after the introductory lecture there should begin the debate in the news group. Students should write their comments to the news group. There should be 3–4 comments at least from each student. But of course the number is not the main point. The co-ordinator can also take part in the debate, but he/she must also read the students’ texts, whether some student’s writings should be accepted or not. The group should give some common manifestation of its work. I think this is very important for educational reasons. I am sure that there are enough debates for the subjective experiences, but are there also enough reflective thoughts and abstract conceptualisation? For that reason, it is common manifest. The common manifest should be such that, for example, the co-ordinator gives someone a task to draw up a proposition of it two weeks before the final lecture and there will be a debate also on that.

At the end, the group will have the final debate. That means a concrete meeting. The co-ordinator gives his/her comments and then they should debate the issue, decide the concrete final manifestation and also discuss the course (give a student evaluation). I think the next group with this same issue should have this manifestation as one article.

3.13 Rationalistic learning environment

In my pilot research I could find only one student, who had a rationalistic learning style. I think, in general, at polytechnics there are not many rationalistic students (in learning style). That is because I think the idea of polytechnic means much more empirical studies. Students in advance know that at polytechnics teaching is not so theoretical. If you are directed more theoretically, you go to a university. I think that is also a good thing: to offer students different ways of learning.

Designing a course only for a few people is may not be so reasonable. But I think it is possible to extend the idea a little bit and also some other people will be interested in the idea of a rationalistic learning environment. A rationalistic learning style stresses deductive thinking. And they check the validity of their information comparing it to their aprior concepts and structures. I think a rationalistic person thinks that he/she
knows the things well enough in advance. He/she only checks if they are valuable information (I am myself also rationalistic in learning style – but also a little bit orientated to metaphoric learning style). A rationalistic student relies on his own rational thinking. He/she can learn well enough without any bigger guidance. An “examination” – alternative should be good for him/her. But in my mind a test alone is not good enough for real learning. There should also be something else. We must ensure that a student understands the basic philosophical concepts and is able to read philosophical literature.

3.14 New direction

What I was designing in these Sections 3.11–3.13, was, in my mind, some kind of failure. I realise that after one-year study and experience with some other courses. But I left the sections in, because I will in later chapters, in more detailed form, show why I made these mistakes. Also the theoretical study of those three learning environments was important, because I did use the principles in didactic design of the normal courses (see projects at Chapter 4). I didn’t have three different courses, but only one, where I tried to enable the flexibility for different learning styles.

The main mistake of this design was; it is much better to organise learning in a way, where students with different learning styles communicate with each other. Perhaps it gives much better results than the way, where students only with the same kind of learning style communicate with each other.

Also there are difficulties in organising learning and informing the students the way how one course proceeds. It is possible, but still too complicated.

The way I designed the three courses indicates a normal traditional attitude of educational design: I saw the learners as individuals learning one course. I didn’t think about the importance towards co-operation between different students. Perhaps behavioristic teaching tradition still influences in my design process. We think the only important relationship is that between learner and learning material.

And finally my research question changed: I am no more studying the concept “intelligence”, but flexibility or adjustability.
4 Small projects

While I was designing those new kinds of philosophy courses (Sections 3.10–3.13), I proceeded with normal courses. These courses did change my opinion in a way, that I totally gave up on proceeding with those philosophy courses at all. First I present knowledge creating process theories (Section 4.1) and then information technology theories (Sections 4.2–4.3). Then I present theories about the role of teacher (or tutor or co-ordinator – Section 4.4). Then I present the projects (4.5–4.8) and finally I discuss what are the findings of these projects (4.9). I wrote this Chapter 4 in the years 1997–1998.

4.1 Creating knowledge in organisations

In this section I will introduce theories, which tell how companies create the dynamics of innovations. I especially introduce Japanese researchers Nonaka’s and Takeuchi’s theory. And that theory concerns induction, deduction and abduction in knowledge creating. This section connects the theories of the previous chapter to the practical school environment.

Nonaka (1994, 14–37) describes his dynamic theory of organisational knowledge creation as systems processing and solving problems. Nonaka introduces his model in a basis of two dimensions: 1. The epistemological dimension of tacit knowledge (a personal quality, which makes that knowledge difficult to formalise and communicate) and explicit knowledge (a knowledge, which is to be transmitted in a formal systematic language) 2. The ontological dimension of social interactions between individuals. An individual should commit to the organisation, and there are three factors in that commitment: 1. Intention (individuals intent towards their working environment and try to understand it), 2. Autonomy (individuals have freedom to create new ideas) and 3. Requisite variety (working environment is so versatile that it necessarily breaks the normal routines). And on this basis Nonaka and Takeuchi describe the modes of knowledge creation:

<table>
<thead>
<tr>
<th>from: Tacit knowledge</th>
<th>to: Tacit knowledge</th>
<th>Explicit knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Socialisation</td>
<td>Externalisation</td>
</tr>
<tr>
<td>Explicit knowledge</td>
<td>Internalisation</td>
<td>Combination</td>
</tr>
</tbody>
</table>

Figure 8 Four modes of knowledge conversion. (Nonaka and Takeuchi, 1995, 62)
Socialisation (Nonaka 1994, 14–37) means that tacit knowledge is moved from master to journeyman as on-the-job-training. Nonaka encourages making a group, where it is possible to share members’ experiences and perspectives. Externalisation means the conversion process from tacit knowledge to explicit knowledge. Nonaka encourages using metaphors in order to grasp tacit knowledge. A combination means explicit knowledge transmission in a conversation with each other. The recipient can assert, increase or categorise his/her own knowledge. Nonaka encourages co-ordinating group’s discussions and documentate the knowing knowledge. Internalisation means the process of how explicit knowledge is changed to tacit knowledge. Nonaka encourages using learning-by-doing-method or trial and error-method in internalisation. Nonaka’s spiral model means

**Figure 9** Five-phase model of the organizational knowledge-creation process.  
(Nonaka and Takeuchi, 1995, 84)
variation of socialisation, combination, externalisation and internalisation in order to get new organisational memory in social interactions among the group, organisation and also with the organisation’s external persons. Nonaka (1994, 14–37) thinks, that the individual’s role in creating organisation’s memory is central, and especially in forming the tacit knowledge. That’s why he first stresses the variety of the individual’s experiences and second the quality. Routine work decreases creative thinking.

**Intention.** The knowledge spiral is driven by organizational intention, which is defined as an organization’s aspiration to its goals. … Organizational intention provides the most important criterion for judging the truthfulness of a given piece of knowledge. … At the organizational level, intention is often expressed by organizational standards or visions that can be used to evaluate and justify the created knowledge. It is necessarily value-laden. (Nonaka and Takeuchi, 1995, 74–75)

**Autonomy.** At the individual level, all members of an organization should be allowed to autonomously act as far as circumstances permit. (Nonaka and Takeuchi, 1995, 75)

**Fluctuation and Creative Chaos.** Fluctuation is different from complete disorder and characterized by “order without recursiveness.” It is an order whose pattern is hard to predict at the beginning (Gleick, 1987). If organization adopt an open attitude toward environmental signals, they can exploit those signals’ ambiguity, redundancy, or noise in order to improve their own knowledge system (Nonaka and Takeuchi, 1995, 78).

This approach is in sharp contrast to the information-processing paradigm, in which a problem is simply given and a solution found through a process of combining relevant information based upon a preset algorithm. Such a process ignores the importance of defining the problem to be solved (Nonaka and Takeuchi, 1995, 79).

It should be noted that the benefits of “creative chaos” could only be realized when organizational members have the ability to reflect upon their actions. (Nonaka and Takeuchi, 1995, 79) Schön (1983, 68) captures this key point as follows: “When someone reflects while in action, he becomes a researcher in the practice context. He is not dependent on the categories of established theory and technique, but constructs a new theory of the unique case” (Nonaka and Takeuchi, 1995, 79).

**Redundancy.** What we mean here by redundancy is the existence of information that goes beyond the immediate operational requirements of organizational members. In business organizations, redundancy refers to intentional overlapping of information about business activities, management responsibilities, and the company as a whole (Nonaka and Takeuchi, 1995, 80). Redundant information enables individuals to invade each other’s functional boundaries and offer advice or provide new information from different perspectives. In short, redundancy of information brings about “learning by
intrusion” into each individual’s sphere of perception (Nonaka and Takeuchi, 1995, 81). Redundancy of information increases the amount of information to be processed and can lead to the problem of information overload. It also increases the cost of knowledge creation, at least in the short run (e.g., decreased operational efficiency) (Nonaka and Takeuchi, 1995, 82).

**Requisite Variety.** According to Ashby (1956), an organization’s internal diversity must match the variety and complexity of the environment in order to deal with challenges posed by the environment. (Nonaka and Takeuchi, 1995, 82)

Developing a flat and flexible organizational structure in which the different units are interlinked with an information network is one way to deal with the complexity of the environment. Another way to quickly react to unexpected fluctuations in the environment and maintain internal diversity is to frequently change organizational structure (Nonaka and Takeuchi, 1995, 83).

Creating organisational memory begins with establishing a self-directed group. A group creates mutual trust within its members. At the same time implicit knowledge and perspective are transformed and shared. This is a central part of the socialisation. When there is a mutual trust between the group members it is possible to name things that belong to the tacit knowledge. And it is even possible to have dialect conversations, which are:

1. Discussion is not one-sided and deterministic, but many-sided and momentary, which makes correction of misunderstandings possible
2. Participants can freely and sincerely express their thoughts
3. Negation is not a value in itself, but with constructive critique a consensus is to be gained
4. Conversation process is going on all the time. Shared tacit knowledge is conceptualised new perspectives with abduction

I refer here to Section 2.7. Nonaka also thinks that abduction is very important: old concepts you can get with induction and deduction, but if you want to create real new concepts, you have to use abduction. I want to also refer to the Section 2.8, because Kolb’s learning process also stresses all these features and also the psycho-epistemological learning style theories (Royce/Rancourt) stress exactly these same features.

And Nonaka (1994, 14–37) continues that the new knowledge should be tested in practise (some kind of crystallisation when, for example, testing a new product or system). It is a question about internalisation and there should be large commitment, which has came through social process. Then is much redundancy about the thing. And finally evaluation and integration process shows the justification of the knowledge. The justifi-
cation is the measure for quality. And new knowledge is to be increased to the organisation’s knowledge network.

Nonaka (1994, 14–37) adds new concepts to three commitment factors; Creative chaos. This is both an interesting and confusing concept. Nonaka claims that in order to get a really creative atmosphere, uncertainty but increased not decreased. Chaos means that you have to recognise new problems, not only to solve already known problems. But individuals should learn to reflect (reflection-in-action), otherwise chaos will destroy the organisation. There should also be more information than is necessary (redundancy), so that actors know what their neighbours are doing in the organisation. Nonaka also claims that there should be balance between information processing and creation, otherwise there will be problems with the information channels. That is why there should be requisite variety, which means that the organisation should not create variety more than the environment requires.

Conclin (1992) adds a very interesting point of view to the organisational memory. Knowledge management is an essential capability in the emerging knowledge economy. Organisations have a valuable asset in the informal knowledge; that is the daily currency of their knowledge workers, but this asset usually lives only in the collective human memory, and this is poorly preserved and managed. There are significant technical and cultural barriers to capturing informal knowledge and making it explicit. Conclin claims that we are not at all saving information about the process; “how we are doing something”. We are just saving some central artefacts (documents and so on), but not how we process them.

Both theories, Nonaka and Takeuchi and Conclin, are very interesting. They also have an interesting connection to the philosophical theories of Popper and Peirce. Popper presented the idea of three worlds. Tacit knowledge means something similar to Popper’s world two (subjective conscious) and explicit knowledge to world three (objective knowledge). And the way Popper said that objective knowledge would be converted is very similar to the Nonaka and Takeuchi theory; it is evolutionary process. Popper meant more scientific evolution (not only), but Nonaka and Takeuchi described the process in business life. The way Nonaka and Takeuchi described the process was more detailed and concrete (in a process of new discoveries) than was Popper’s theory. Conclin described the result of new discoveries much the same way as Popper did it: though explicit knowledge is created by individuals, it is not depending any more on the tacit knowledge (workers can leave the organisation, but the explicit knowledge remains). I agree with that conclusion. And the similarity between Nonaka’s and Takeuchi’s and Peirce’s theories is also clear: both theories tell how inductive, deductive and abductive processes affect creation of new knowledge.
4.2 Designing programs

One important standpoint to the system, which I am designing, is the fact that this system is also a computer system. So there is reason to also study the system from the computer system design standpoint. But in my mind educational computer programs differ from many other programs in one characteristic feature: you don’t know the end-users of the system, because most of them don’t even know this thing themselves. Using an educational program is, in most cases, a temporary event. So how can you ask the end-users their opinion about the system? In my mind that is possible, but it differs from most system design methods. The temporary character of using these systems also means that users are not very willing to participate in the system’s design for a long time. The only time is probably the time when they are using the system, and if they are using some system there must be at least a prototype of the system.

To design some computer system is also a learning process and to design an educational system means to learn the learning process (this whole study concentrates on this fact). Van der Veer (1991, 59–93) claims that designers of the user interface and application interface should be aware of the fact that the future users of their systems will have to learn and understand the system. He also claims the same thing that I noticed: The success of education is related to adaptation to individual differences. Whether optimal learning results can be expected may to a certain extend depend on the matching of the learning situation (including teaching style, level of difficulty, speed of presentation) to the characteristics of the student. Matching means tuning “tutor” and student to each other.

Because of the difficult characteristics of designing educational systems the design, in my mind, has in many cases only happened in some system designers head. The experience I have from educational programs is they usually don’t fit the real situations, which maybe the designer hasn’t noticed or probably even designer don’t know the real situation so well. Designing is in my mind more based on an imagined laboratory situation than real learning. Of course we can say that there are two kinds of users: the learners (end-users) and the practical learning designers (teachers). In my mind, the both levels are important: the programs should fit the learning situations (designers i.e. teachers standpoint), and we should know how the systems are really used (learners standpoint). In my mind here are the levels, which are in Marton’s early Phenomenographical theories (what the learner should learn, and what the learner really learned).

As Bannon says (1991, 25–44) that early studies on human factors tended to focus on evaluation of existing systems, and analysis of features that had been found in the
use situation to be good or bad from the point of view of the user. We don’t just want to know about systems after they have been built, we want to know how we should build them in the first place, and even what we should build.

In my mind the question of, what we should build is probably very seldom asked from the end-user (learner) in educational systems. The reason for this is because the learner doesn’t know the learning item beforehand, so we also think it is not useful to ask how he/she wants to learn. But the learners (adult ones) are not so stupid. We must make a difference between the learning material and the learning method. The method is quite stable and every adult knows a lot about it. So why don’t we ask the learner himself/herself how he/she wants to learn. I am sure that it will make the results more efficient.

Bødker et al. (1991, 139–154) state that the design philosophy emphasises the following points:

1. Co-operative Design. Users, as well as professional designers, have knowledge and skills that are central to the design of useful computer applications; therefore, design needs to be organised as a co-operative activity between the users and the designers.

2. Family Resemblance. To allow both groups to contribute effectively and creatively, the design could be based on situations having a family resemblance to the prior work experience of both the users and the designers.

3. Practice. Designing a computer application and introducing it in a work setting will change the work practice. Yet designing must take its starting point in the current practice of the users – an invaluable source for the design of systems that will fit newly emerging work practices.

4. Experiencing the Future. An effective way of allowing users to employ their knowledge and skills is to simulate future work situations, creating the illusion of actually working with the projected system. In this way the ability of the future computer application to mediate work can be tried out, and changes in the use practice can, to some extend, be predicted.

5. Learning and Transcendence. Learning is an important ingredient in design processes. The different groups involved learn about the work and background of the others, and confrontation with “outsiders” contributes to the understanding of one’s own work practices. In situations where real or simulated work breaks down, where people’s involved actions suddenly stops and they start to reflect on their own work, this brings to design an innovative character: The opening of possibilities for new ways of doing things.
Those also were good designing principles for educational systems, but you have to adapt them because of the different character of education. Co-operative design means, in educational systems, that you have to design co-operatively with systems designers, teaching co-ordinators, and practical teachers (here I refer much to the Section 4.5, where I also present this issue more). In modern computer-based learning environment the division of labour between designing and teaching the learning environment will be dramatically changed, and therefore the designing structures should also be changed to more co-operative form. But as I have many times said; real learning always happens in the learner’s own head. So we should take the learner with our designing process, but not in the same way as in many office systems (because we don’t know the exact end users). The designing should be part of the real learning. We should design with the students, how they want to learn the subject just handled. And if that succeeds, I am sure the learning will resemble more a family than traditional authoritarian ordering in teaching. And if the designing (and learning) process will be changed in this direction, so the practice in learning will also be changed very much (it has changed a lot when new goals has been set in teaching). And it is important that we are simulating the future also in education (and especially in education, because it is directed towards the future). My research is itself a reflection of my own job, and I think if someone wants to design or seriously participate in a new system design in education, this will mean surely reflective thoughts to own job.

By referring to Lyytinen, some others, Kensing and Madsen (1991, 155–168) show that the designing process has not helped the users and designers to generate alternative ideas about how they would like their work-situations to be in the future. They suggest using metaphoric design and generating visions about how the work should be done in the future.

That is also my idea in educational systems, but we can’t use very large future workshops, because of the different character of education. Instead we must ask learners to make visions; how they want to learn in the future. Open questions give creativity and reflection to the answers.

In this Section I developed some visions of what the future computer-mediated teaching should be. The totally different learning environment changes the teaching designing and practical teaching situation. Those components should all the time interact. Designing education should always happen there where the teaching is going on. There will come some kind of division of labour: someone teaches or co-ordinates the learning, someone is more preparing the learning material and someone is more building computer systems. The ideal situation is that the same person is able to do all these (but also
in these cases it should be a good working method to work in collectives just getting a broader vision of the learning environment). And designing future teaching should always be a part of present teaching or learning environment. The real learners know best how they want to learn, and if we trust that a learner is autonomous and able to make decisions, why don’t we ask her/him.

4.3 World wide learning environment

In Section 2.12 it said said that the Web project has changed the way people view and create information – it has created the first true global hypermedia network. First it changed the ways in viewing information in science and education and now the communication is revolutionising many other elements of society, including commerce, politics, and literature.

To some extend that is true, but the standpoint saying the above is quite technical. Of course the traditional communication and Internet communication differ very much, and when an advanced Internet user is using the network, the user can pretty surely say that his/her way of getting information has changed. But to many users the ways of getting information is still quite the same as earlier. You have to first learn the environment to use it efficiently. Human interactions are not changing as quickly as maybe some computer designers think.

If you think a global network is a solution to all education right now without thinking of its educational aspect, I am sure you will be disappointed. There are lots of Internet courses especially in the USA, some of them are quite good, but also some of them are not so good. In my mind, the technical solution doesn’t make one course good and another not. It also needs other organisations; a human educational organisation. Maybe some very rationalistic learning style persons manage without any special arrangements, but most learners need guidance, help and also communication with other people to learn something. In Section 2.11 Galecher proved that it is difficult to communicate uncertain issues through a computer. Also Kiesler proved that computer-mediated communication changes the character of communication. This gives many difficulties to learning environment through a computer. It is quite easy to just learn some technical issues from a computer, but to learn complex social things, that is more difficult.

Also in Section 2.12 McKendree et al. proved that analogies between hypertext and how people think are not valid. Hypertext is not a very good learning environment, for example, for a novice to learn the basic idea of some issue. You need much easier ways to just teach (or learn) the basic idea of some issue.
I have noticed many things in the World Wide Web that shows that the environment is not so good for learning something. This is quite a subjective standpoint, but I have discussed with many other people, who agree with my claims. Some very common claims for the Internet and WWW are:

1. The World Wide Web is often seen as just a means to navigate through hypertexts across the Internet. More sophisticated uses are however possible. The statistics on the use of the Internet backbone show that the use of WWW is growing exponentially and is becoming one of the most important media for global information sharing. There are many searching programs (for ex. Lycos) and you can search out interesting articles, if you know your problem: you can formulate the question of what you are looking for. But if you can’t formulate the question or, even worse you are not sure what exactly is the thing you want to know, then you get problems. You have so much information that for a novice learner it is impossible to get the essential information.

2. The same problem comes when you are just “surfing” round the world in the WWW, and think you may be learning something. I was surfing in WWW about 40 hours just searching for something (this was a totally subjective research to notice do I really learn something in this way). At certain times I took printings to remember where I have surfed and what have I learned. I must say I learned many details about Albanian geography and Hollywood filmstars, but in this way, learning is more entertainment than a serious way of learning something important and something about structural conceptions.

3. In most newsgroups and IRC (real time) discussions, there is not much educationally interesting. Many newsgroups have only 1 story. In many newsgroups the discussion resembles a very bad “discussion”; everyone is telling his/her own story, but I think no one is listening to others. And the worst discussion is in IRC. For example, I have noticed that many students in my secondary level teaching groups want to use it as an easy communication channel, but they are conversing there not for learning purpose but just as communicating with trifling thoughts. For some secondary level students this channel is a channel for toilet graffiti. And it is a much broader channel than writing the nonsense on toilet walls.

4. And many times I really thought that now I found really good information, I found out that either my server has no rights to see the information or I need a password to get the information. Also many times I notice that information is not there anymore or the server doesn’t respond to my request. I understand
the purpose that some information is produced for some special group (for example, for a conference) and in order to get the information you have to be a participant or pay for the information (all information costs – the question is who pays?). As Nielsen said in Section 2.12, people have to pay something for the necessary authoring and editing efforts.

In my mind, the Internet is a very good forum for education, discussing, information seeking etc., but it isn’t in that itself. I claim that electronic cyber space needs more rules (flexible ones) and especially electronic education needs models to be efficient. Computers are still only machines even if they are world-wide information spaces. Novice learners especially need guidance to get the right information. Freedom is a good thing in the Internet, but it doesn’t help you, if you don’t exactly know what you are going to learn. The flexibility in using Internet gives many possibilities to education, but it also brings many problems in using it efficiently.

4.4 Teacher or tutor or co-ordinator

In distance education, it is better not to call someone teacher, because the nature of learning is so different from traditional teaching. And in my mind the character of computer-based distance learning changes even that role. What are the tasks of that person in supporting students and what shall we call him/her.

Amundsen asks (Keegan 1993, 75–76) what is meant by the concept of teacher in distance education? Moore does not use the word ‘teacher’ and generally speaks about ‘programs’. His concept of the teacher is someone who an autonomous learner will seek out to help formulate programs, gather information and so on. Holmberg also does not specially speak of a teacher; he concentrates on the teaching process. Keegan speaks of the teaching and learning acts and describes the interpersonal components of face-to-face teaching which are missing in distance education. Garrison is one of the few who literally speaks of a teacher and a student; he describes the teaching role as collaborative and the teaching activity as one of the negotiation and dialogue. Verduin and Clarke make no direct reference to teaching, but they address the need for dialogue and support.

Sammons (Moore 1990, 151–162) wants to look to an epistemological justification for the role of teaching in distance education. Knowledge and knowing, is not a state of being. It is a continuous activity of adaptation involving checking, refining and sometimes radically changing our conceptual frames of reference. He refers to Petrie’s theory
and says that educators cannot simply assume that what they have to teach is appropriate (see similarities to Phenomenography Chapter 2.5). And that means that in general, the learner should understand as an autonomous or self-directing person (he/she decides what to learn). In distance learning the situation does not so much differ from traditional teaching. Also in distance learning the teaching needs some kind of guidance. New telecommunication technology can be used in a very sophisticated way to make it possible for learners and teachers to interact and to promote learner understanding through mediation.

Henry and Kaye (1993, 30–31) defines the components of the educational relationship in distance education:

![Distance education components](image)

Figure 10 Distance education components

The distance education institution: administrative communications, admission requirements, evaluation procedures, assessments, etc.

The student support staff: all distance-learning systems attach vital importance to human student support systems. These intermediaries have numerous relationships with students and carry out the following functions: counselling, tutoring, evaluating, correcting, and helping the learning processes.
I accept this model, but there should be some improvements. The developer in this model is not in the action circle. In my computer-supported model, the developer should be in active co-operation with student support staff. The learner should be changed to learners, because it is necessary to learn more co-operatively in groups than learning alone. And also the student support staff tasks are, in my mind, more actively related to learners (in my model support staff in some cases also participate in the learning action – maybe learn also themselves). Keegan (1993) and Qvortrup (1992) also say this in their books.

Miller (Moore 1990, 211–219) claims that distance learning brings new possibilities to curriculum reform:

1. Its increasingly sophisticated use of media can bring together interdisciplinary teams to create materials that allow even a solitary instructor to achieve a degree of interdisciplinary.
2. Media can reinvigorate the role of experience in the learning process.
3. Our technology allows us to create new kinds of learning communities.
4. It can stimulate new levels of interaction between the individual student and the material to be learned. And finally referring to Dewey that lifelong learning has become not just a good idea, but an absolute necessity if this particular democracy is to maintain itself.

I think the Sammons epistemological standpoint was very important. Why have we only looked for some concrete features about when and where learning happens? And is it so important to make a division between traditional and distance learning? If we accept that a learner is an autonomous person and decides him-/herself what to learn, why do we make that division? Sammons standpoint was almost the same as Marton said from the phenomenographical standpoint: learning is always a subjective action. I want to study this issue from Popper’s theory. In my mind we should always accept, or even stimulate or encourage, the learner to make his/her own conceptual structure. The knowledge structure, which is in books, computer programs etc., “the objective knowledge”, is only a base for learner’s knowledge. In my mind, the learning process we could see as a individualisation process, where it is very important for a learner even to criticise the objective theories. That is the way evolutionary progress goes on.

So maybe we should define the learning process more in that way that you adapt your knowledge. And in my mind, Kolb’s model is pretty good in this: you must make theories, you must test them in using them in practice and you must continously make
observations from the outside world. In this standpoint it is not so important to make a big difference where and when learning happens. Traditional learning is more adapting the same methods as distance learning. In our polytechnics, we have a lot distance-learning parts (with every course it is determined how much face-to-face teaching there is and how much distance learning). And the same thing is a characteristic (not so clear) referred to in our institute’s secondary level teachings. And like most researchers in this section had said, distance-learning also needs more pedagogical structures. That means that distance-learning is more the same as what traditional learning is becoming.

I said that Henry’s and Kaye’s model about distance learning needs to be improved. That model is based too much on an industrialised model of distance education. I am not going to do that here, but I am sketching some essential features about the model.

Atman, Grance, Sparks and Miller said that a new distance learning model should be made, which takes into consideration the personal differences in learning. That is possible, with not so very high costs, with a new kind of computer-based communication technology. It is not wise to just change some details and forms of knowledge, when changing from traditional distance learning to computer-based learning. As Engeström said (Section 2.10): the rules and division of labour should also be changed. The computer allows much more sophisticated ways of doing learning.

There is quite a good concept for the teacher or learning co-ordinator; it is tutor. Lehtinen (1992, 163–182) sees the tutor’s main tasks as:

1. Direct advising and informing
2. Guidance for learning techniques
3. Guidance for learning contents
4. Understanding and helping.

There can be many roles for the tutor: from academic (supervisor – who is concentrating mostly on learning contents) to close personal guidance (helping student also possibly in personal problems). Between these two extreme possibilities there is a social tutoring-area, which means quite informal interaction between tutor and learner.

In educational systems, there is a big need for collaboration. Teaching is no more only a series of lessons, but it means contacts to different places, seeking information from different places etc. So there is need for co-operation between the whole school staff (in all developed countries – USA, Finland...). Schwab et al. (1992, 241–248) studied two schools, where they utilised different strategies for supporting collaborative work. The one used more traditional ways and the other e-mail as a communication channel.

Small projects 99
Though the two schools implemented very different innovations for collaboration, the ways teachers used depended the availability of personnel, locations, and time and communication channels to perform their work. The traditions of schooling, teacher’s beliefs and understandings about what constitutes “teaching” determines the teacher job still although changes in working methods are demanded. New innovations could increase their effectiveness only to a certain extend. New innovations didn’t remarkably change the learning job, but more, it did change the social job concerning teaching. Particular social, temporal and social organisations seem to be very strong in the teacher’s job, and they don’t change very easily.

I have noticed the same things in my own teaching environment that researchers in USA found out. The school bell (time) and classroom (space) for example are such remarkable concepts that it is very difficult to even think about changing them (although you are allowed to do that). And not only for teachers but also for students. Changes mean students have to adapt to a new system. That means hard work, and many times you just want to do it in the old ways. But collaboration between teachers means in the long term the possibility for division of work, easier preparation of teaching material and so on. Collaboration between teachers will increase, but the main barrier is the tradition of learning. Maybe the whole teaching should be defined in a new way: reject the traditional time and space conceptions and make an epistemological analysis of what teaching is (learning definition from Kolb is in my mind a good one).

In the beginning of this section I said that it is not good to use the term “teacher”. Nor do I think it is good to talk about a tutor. In my mind that is only one part of the job. I am talking about a learning environment co-ordinator. And the co-ordinator’s tasks in my mind are:

1. Being responsible for the learning material. Books, computer-programs, videos etc.
2. Defining the preliminary learning aims of the course. Of course the group itself makes the final decisions about it (administrative or institutional demands are also important).
3. Organising the concrete schedule of the course. Of course here the group decides the concrete schedule (including institutional demands).
4. Organising the learning communication
5. Being a part of the learning process (discussing etc.)
6. Counselling, tutoring, correcting and helping the students
7. Evaluating the learning process and communicating at an institutional level.
Instead of talking about co-ordinator I could just use the talk about tutor, supervisor or pedagogue. The tutor would be a good name, but I don’t want to use that name, because it has a tradition, which is too different from those tasks I want to include it. Supervisor is too academic. And it also has a tradition, which would make too many difficulties. The pedagogue is very old fashion name to this, but it is so old fashion that it is almost possible to use. Webster’s New Encyclopaedic Dictionary (1993) defines the concept pedagogue: teacher, schoolmaster; a dull, formal, and pedantic teacher (from Greek paidagōgos – paid leader, a slave who escorted children to school). The term is now not much used and many don’t even know the terms old fashion background. The term is quite good one to describe the tasks in leading the students to find the information in certain issue. But in this research I am using the name co-ordinator.

4.5 Students at Polytechnic course

I was very enthusiastic in my studies about learning styles. I tried to adapt these studies in all of my teaching courses. I tried to correct my methods in many courses. I understood the meaning of flexibility in the teaching method. And I think it also gave me some good results.

In the spring 1996 I had a 1-study week course for the polytechnic first year students (excluding the computer branch students) at business faculty. The name of the course was: “Information Superhighways” – course. That meant applied electronic communication: 1. The basic concepts of the electronic communication (modems, cables and so on) 2. Internet (especially e-mail and World Wide Web) and 3. Information retrieval and available retrieval systems at our library. The marking consisted of three parts: 1. Test of the basic concepts, 2. A www-exercise, where every student should surf in Internet and seek information from the web pages (5–10 pages) and 3. Seek information from retrieval systems (library or commercial or law systems) and the third part was possible carry out in 2–3 member groups. I had lessons for about 10 hours and practice with computers for about 12 hours. There should have been 92 students at this course, but only 89 performed it successfully.

My aim was not that this course was the “intelligent learning course”, but I only adapted some flexible organising during the course. I don’t want to explain more about how I organised my teaching, because that wasn’t the most important thing. The most important thing was that observations with this course confirmed my studies with the
philosophy course concerning especially learning styles. The results where even more clear than in former studies.

When I proceeded with this course, I didn’t want to include the results in this study. The reason to evaluate the teaching in this way was didactical: I wanted to develop a good “Information Superhighway” – course. The research method of this project was more quantitative than the method with the pilot project: I wanted to know were my findings with the pilot project right. I wanted to experiment those in a new situation and with larger group. Of course I also used qualitative methods, especially when analysing the students’ exercises. I think it was good for my research to have these both directions (see Sections 2.3–2.7).

At the first concept test there were 86 students. And at that test I had also a questionnaire concerning students’ learning styles, their opinions about Intelligent Learning, and their opinions about the good and bad course feedback and how I should make better my teaching in the next course. It wasn’t obligatory to return the questionnaire, but 77 did return it (90% of the students at the test). I didn’t use that questionnaire at repeat tests, because I forget to do so (only one student has returned it later. She belongs to the “Open to Europe” group, and I was interested to know her learning style also. I report that later at Chapter 5). It was voluntary to tell also student’s e-mail address. I told how I am going to use that information and as a fee I informed the student his/her learning style and what it meant. 47 students did tell the e-mail address (60% of those who gave the questionnaire feedback – Inquiry see Appendix B).

The learning style theory, which I used in this questionnaire, was also based on the Royce/Powell theory (Section 3.2). According to Leino and Leino (1990) the most common learning style among Finns is the empirical learning style. It was the most common learning style in the study with philosophy course and it was the most common learning style also in this study. One student didn’t want to answer the learning style questions. 48 students were gathering information with empirical learning style (62% of all students), and 32 students had strong stress on empirical style (42%). 12 students were gathering information with rationalistic learning style (16%). 8 students were gathering information with metaphoric learning style (10%), and 9 students didn’t emphasise any learning style more than other style (12%).

The connection between learning style and other feedback was very clear. The same result I had in the philosophy course (Chapter 5). I don’t want to analyse every single question in the questionnaire separately, because the feedback seems to me to be important only as a whole. Many students didn’t even answer all of those questions.
The empirical learning style students emphasised practical things. 39 of the all 48 told some of those things. Only 9 of the other 29 learning style students gave the same kind of feedback. For an empirical student clear schedules are a very important thing (27 of all 48 empirical students, and only 4 other students), classroom and computers were important thing (22 empirical students, and 9 of other students told so), and number of students in a group and such things as noise etc. (18 empirical students, and 3 of all other students did tell so). Some comments for the empirical learning style students:

- “I needed more controlled teaching”
- “lectures were not clear enough ... students didn’t have the same background of ADP knowledge”
- “I don’t want any noise ... it was interesting to surf in Internet ... I shouldn’t have done it alone”
- “you should adapt more practice to teaching ... I learned Internet ... more use of computers”
- “sometimes it was confusing ... subject was interesting”
- “the aim was not clear ... I got practical information ... more practice, less speech”

Metaphoric learning style students emphasised co-operation in the teaching situation, subjective feelings, communication and human relations in general. Some comments:

- “Intelligent learning environment means personal contacts in learning”
- “at Intelligent learning environment I FEEL I could learn something”
- “… not among my friends”

The rationalistic learning style students didn’t answer hardly anything to other questions as the learning style questions. That is quite natural, because rationalists want to handle the issues in their own way. They are not so interested in organised learning environment as the other students. 5 of all 12 rationalistic students didn’t answer anything (except learning style) and only three students answered all feedback questions. It was also little bit surprising that only four students wanted to know their learning style. Here are some comments:

- “possibility to perform own ideas ... if only could get some Internet addresses, where you could start to surf”
- “concentrating to the essential, let the student to get insight of the things”
- “stimulating to think about ... stimulating people’s own ideas”
The learning style had very clear effects on how students worked during the course. Naturally I could study this thing only among those 46 students, who told me their e-mail addresses (I informed this to students. I am not doing this secretly). The empiricistic students told more often than the other students their e-mail address: 34 empiricistic students told it. In this study I made the other group all the others 12, who told the address (4 rationalistic students, 3 metaphoristic students, and 5 students with no dominating learning style). In the www-exercise the students gathered information from www-pages. Empiricistic students’ exercises were longer (measuring the number of pages) than the other students’ exercises. Most empiricistic students had almost 10 pages (on average 9 pages), while the other students’ exercises were on average 6 pages. But the other students’ exercises structure was much more clear and concentrated on the most essential idea more than the empiricistic students’ exercises. The empiricistic students only gathered information from different addresses in a way: address after address, and not to think too much how texts link together. The test answers had the same structure.

I also studied the negative attitude of the students. I noticed that totally negative attitude against this course had about 10% of the students. They were almost all empiricistic learning style students. Most students gave both negative and positive feedback. When I compared the empiricistic learning style students’ attitude to the other students’ attitude, I noticed that empiricistic students were more negative. The reason is, in my mind, clear: empiricistic students find this learning environment quite strange. On the other hand, the other students like different experiments more. To me it’s obvious that I should organise my courses much better (clear schedules, exact exercises and clear material), if I want to be successful among empiricistic students. I am quite sure that most students in our faculty have been, they are now and they shall be in the future empiricistic learning style students. Students know that business education is oriented in empiricistic way. But it is also important to remember the other learning styles. There is also a need to have different views.

The importance of this study wasn’t that the course was something very different or the students did something very remarkable. In my mind the most important thing was that it confirmed my studies with the philosophy course in a larger student group. Learning style is an important point no matter what subject you are learning. This study also gave me information on what is the distribution in learning styles within our faculty (though I also expected this kind of result).

104 Small projects
4.6 Teachers’ learning/teaching style

I wanted to also ask the teachers’ learning styles. Before I asked it my hypothesis was that also most of the teachers were empiricistic learning style people. The reason to suppose that is because business oriented people is quite general practical people and that is to say empiricistic learning style people. Of course it is possible, that your learning style is different than your teaching style. For example, in most cases I try to teach in another way than I personally learn myself. I think many teachers have noticed using flexible teaching methods in order to teach efficiently. The research method in this small project was a totally quantitative method, because I wanted to prove my theory about relationship between learning and teaching styles in our faculty. An orthodox quality method researcher would say that I was reducing too much. In my mind I got interesting information in a quite easy way. I admit that I perhaps made a mistake in interpretation (but I don’t think so).

In our faculty we had two different levels: the secondary level and the polytechnic level (later our institute separated into two different organisations). It was possible that you are teaching only at one level. Most teachers taught at both levels. Earlier our teachers meeting was together, later we had separated meetings for both levels. At that meeting, where I asked questionnaire about learning styles, not all the teachers were there. Those, who were not there were mostly part-time teachers. At the meeting were 39 teachers and 35 of them gave me back the questionnaire (almost same as Appendix B the learning style questions changed to teaching styles). Also in this questionnaire I did ask the e-mail address. Only four teachers didn’t give that information. I told why I asked that information and also here as a fee, the information on learning style to those teachers, who told that information.

The result was quite expected, but not exactly: there was more empiricistic learning/teaching style (I asked the questions in a form how you teach not how you learn) teachers than other styles, but that was not the majority. 15 teachers were empiricists (43% of all). The surprising thing was that there was 9 rationalistic learning/teaching style teachers (26% of all). 4 teachers were metaphoristic learning/teaching style teachers (11% of all) and 7 teachers with no dominating learning/teaching style (Appendix G).

I also asked the teachers to tell the subject they were teaching. I categorise the subject on four categories: languages, business studies, mathematical-natural sciences and other subjects. The thing that explained the number of rationalists in this study was that half of the mathematical-natural science teachers were rationalists and half of them were empiricists. Almost all metaphoric teachers were language teachers (except one). In this
case those results were quite expected (Leino 1987, Rancourt 1986). Most teachers were business subject teachers, and there was clear majority of empiricistic learning-/teaching style teachers. That was what I expected. So what explains the learning/teaching style is much the subject your are teaching, or most teachers have chosen such a subject as main studies at university, which sounds good for their learning style.

I asked the teachers if they taught the polytechnic first year students (Section 4.5 students)? The number of rationalistic teachers stressed more (32% of all those teachers). It seems that polytechnic teachers are more rationalistic style teachers than those, who are teaching only the secondary level students. That seems quite natural to me.

I would analyse these things a bit concerning my own teaching style. When I, years ago, performed some pedagogical experiments, I wondered why so many students were against my experiments. I thought only that they are just afraid of all changes (to some extent that is also true). Sometimes I got a brilliant idea to change courses and my own teaching in a totally new way. Unfortunately my learning-/teaching style is rationalistic with small metaphoric emphasises. When I have been very enthusiastic, I have forgotten successful pedagogical advice and I have designed courses based on my rationalistic learning style. I have designed (still I think very seldom) courses with teaching method, which is quite strange to most of the students. And that is the reason why most of the students are against these experiments. Normal courses I have designed (except 1–2 first years) with quite empiricistic way.

But what is the benefit to compare teachers’ teaching style and students’ learning style. I think I have noticed big difficulties for some students to adapt new knowledge with strange method. If the method is very strange, the teaching will fail, although the knowledge taught has been excellent. I know good examples of this also here in our faculty. For example, I know one teacher, who knows things very well, but the feedback for the courses is very bad. In my mind the reason is the conflict between teaching style and students’ learning style. There are especially big conflicts if the teacher is an absolute rationalist and most of the students are absolute empiricists.

Pedagogically a good teacher could always adapt his/her teaching for the students learning style (Leino and Leino 1990). A good teacher is able to differentiate his/her teaching for different learning styles. I said just, that although I am a rationalist, I normally design my courses with quite empiricistic way, because most of my students are empiricists (and when I have not done so the students have complained the confusion). Flexibility in designing the courses is the key word.

Computers give many possibilities in flexibility. But in my mind it is not enough to just give a computer and a program. Most students also need other features of learning
environment. So you have to design both computer environment and the other features and link those together. And if you want to take different learning styles into consideration you have to know how the content of the course can successfully be learned with different learning styles.

To a certain extend it is not bad thing that teaching styles and learning styles are not the same. If the student can understand the aims of teaching he/she can get good stimulants for new kinds of views to see things. Concerning to Kolb’s learning model good learning requires observations, reflections, abstract conceptualisation and active experiments. So if a teacher could give a new kind of point of view, that is good. The worst thing is still that student couldn’t understand anything with strange method.

4.7 Accounting information system

Since 1993 (the first students at our polytechnic) I have taught the accounting oriented business students a course, the name of which is “accounting information systems”. The aim of that course is to teach the elementary knowledge of information systems and what kind of applications there are at accounting. The implementation of that course has been quite traditional, although I have used large tasks (that means learning by doing). In 1996 I wasn’t anymore satisfied with the implementation. I wanted to renew the whole content, implementation and working methods of that course. I thought that I should find some new ideas how that course should be implemented next years. Unfortunately I heard during that course that the structure of accounting studies will be changed and it was last time that course was carried out.

The course was 2-study weeks course. During the course I gave 15 lecturing hours and guided exercises about 20 hours. The course consisted of three different parts (all parts equal compensation):

1. Concept test
2. Concepts analysis and access database implementation of simple consumer-dept information system (working at 3 students groups)
3. The same group seeking information from www and making report “net money and accounting”

There were 20 students at this course. The distribution of students’ learning styles was quite exactly the same as the distribution of the same thing in Section 4.5 (differences
less than 5%). The results of learning style and other opinions and working during the course were the same kind as the results in Chapter 3 and Section 4.5. So I am not going to present them. One important thing was that the students had quite much working experience.

The most important thing to me was, that the difference between learning styles in a student group influenced on the results, how one group made its analysis and reports. The more rationalistic learning style there was among the group, the better designation and implementation the group made with access database. When I gave the task “net money and accounting”, I didn’t want to inform the students in clear way. I wanted that students should use their creativity and find themselves how net money affects on the accounting systems. I only gave some central www-addresses and we were little bit discussing the issue. If there were students with different learning styles in a group, they prepared much better reports than those groups with almost the same learning style (unfortunately all those groups consisted of empirical learning style students). Groups with different learning styles were much more creative than the other groups (that was of course only my “feeling”, because I can’t say what exactly shows the creativity in certain issue).

When I designed this course, I didn’t mean to include it to this report. But when I analyse the results, I found that there was that very interesting result of co-operation of students with different learning styles. In my mind I could not still say after this study that result is very clear. The reason is because my evaluation process was only normal teaching evaluation (I didn’t beforehand know to make exact observations). It is also possible that the groups with only empirical learning style students were not good at this kind of tasks. It would be very interesting to know if a group should with only rationalists or metaphorists reach as good results as groups with different learning styles. The groups with only empiricists just sought information from www-addresses and put information on the report not much analysing it. The groups with different learning styles carried out much better analysis and they found interesting links between different links and developed creative inventions. I asked the groups how they worked. That was no surprise: empiricists did more practical things (writing and so on) and the rationalists and metaphorists developed new ideas.

To me the most important feedback was that it is much more interesting to put students with different learning styles to work together than design learning environments for every learning style and let them work with same kind of students.
4.8 Secondary level electronic course

At Lahti Business College (that means secondary level, not polytechnic level) I have had a course called also “Information Super Highways” since the year 1993. That course does not mean at all technical telecommunication course, but more a course, where you have to realise the possibilities how you use the network to find information for your own studies. From the very beginning of that course the aim has been not the technical issues, but the knowledge how we get information for ourselves. If someone wants to learn technical issues more he/she has to go to special computer courses. And from the very beginning of this course I have had three basic elements: 1. How to find information from www-pages, 2. Information retrieval from databanks 3. The basic concepts of telecommunication. From year 1995 till November 1997 I added and supplemented something; the elements I have evaluated have been: 1. www-exercise; that means the student has to collect information of certain issue from www-addresses. And the student decides the issue, 2. Information retrieval from databank, and the students also decide the issue here (first it was a modem connection, nowadays from CD-ROM databanks – essential is the seeking strategy, books or articles they don’t have to read) 3. An essay from given issues (electronic marketing,..., telecommunication at a company, telecommunication solutions) 4. A small test of basic concepts of telecommunication.

Students normally told that this course was an Internet-course. Internet has been the central idea already from the year 1993, but I have tried to lay stress on the meaning of telecommunication. The students like to study more concrete things, and Internet is nowadays a popular issue. Because the Internet has become the central idea, I thought that it is reasonable to have the learning material at www-pages (earlier the material has been mostly printed articles and some www-addresses). At the years 1997–1998 I had many courses, because earlier the course was during the second year, but it is during the first year (so I had totally 9 groups at the years 1997–1998). With 7 groups I taught with normal method, but the last 2 groups I taught from 1.12. 1997 till 6.2 1998 with changed method and learning material; the learning material was 95% at www-pages. Normal lecturing was 6 hours and guided training for 6 hours. It was obligatory to participating these hours, as it is normal at secondary level. After these hours the distance learning period started. That meant the normal larger exercises (see above the elements 1–3) and smaller exercises (5) returned at given timetable. In the distance-learning period both groups had the possibility to work in the computer room for 4 hours and I reserved some extra hours from computer rooms for both groups. I tried to be there in order to help with students’ problems. Approximately every fourth student had the Internet-connec-
tion from home (and they mostly worked and sent their messages there). There were 61 students on the course. Two students haven’t done anything and two students probably are not going to pass this course. In the first test there were 54 students (later 2 students more).

When I designed the course I tried to adapt as flexible methods as it is possible. I especially thought the learning style theories (Sections 3.1–3.3) and different epistemological categories. One educational theory I used was the Engeström’s theory about orientation to learning (Section 2.8) I thought that I should concentrate only on the basic idea and let the student to find the detail information from the network. Kolb’s experimental learning theory was naturally an important standpoint also here (I wanted to ensure all the elements of the learning process). There wasn’t much learning material at my own www-pages, but many links to outside www-pages. My aim was that there is enough material for both beginners and more advanced users. I already beforehand knew that differences between students’ skills were enormous. And one thing I also knew was that for some students it is too difficult, if all learning material (tutor-material) is only at www-pages. That is why I made a paper for the tutor-material. Referring to the former projects I knew that some students (the empiricist ones) need practical advice and clear schedules. On the other hand the rationalists want freedom to carry out their own ideas and the metaforists need communication and interaction (contacts with each other and with tutor/teacher).

The distribution of students epistemological learning styles at these groups was quite the same as the distribution with polytechnic students groups’ (Sections 3.9–3.10 and Sections 4.5 and 4.7). There were some small differences (Inquiry was the same as earlier see Appendix B). The most common learning style was the empiricists (the amount was 25–46% of all). I expected that there would be even more empiricists than among the polytechnic students groups, because the learning is known to be very practical oriented in secondary level teaching. And comparing to the learning style study with teachers (Section 4.6) I want to say, that the secondary level teachers were more often empiricists than the polytechnic teachers. So I thought that the students were also more often empiricists than the polytechnic students were, but that wasn’t the truth. The teachers, who taught mostly secondary level, were more often empiricists than students were (55% of teachers were empiricists). Among the students there was 8 rationalists (15% of all). This number was little bit surprising, because I supposed, that most rationalists choose other colleges than our college (in case rationalist learning style doesn’t mean you are good in formal logic, but that you are interested in ideas and you make
your own analogies). There were 10 metaphorists (19% of all) and there were 11 students with no dominating learning style (20% of all).

I compared the students’ learning style with other feedback and students’ learning activities (exercises and tasks), and the result was quite the same as the result with the former polytechnic projects. I knew in this inquiry all students’ names (none did have anything against that fact). There were some small differences comparing to the results with polytechnic student groups: Polytechnic students’ actions were almost 100% the same, but with secondary level students’ actions were only 80% similar. In all learning styles there were students, whose feedback told totally different than their learning style test. Still most students feedback and answers were similar concerning the learning style test. Most students did like the freedom to do whenever or wherever the tasks (62% did mention something like that in inquiry and 8 students – 15% of all – didn’t tell anything, the feedback space was empty). Most students preferred their own information seeking, when they compared it to the normal lecturing. There was some, which preferred the normal lectures, because now they had to work more intensively. The feedback seemed to me more positive than I thought. I should have done things better; e.g. the electronic feedback didn’t work immediately, but by January. So I thought the students are little bit disappointed, but I was surprised that they were quite satisfied.

I want to present some empiricist student’s comments:

– “... more Internet tasks and distance tasks in general”
– “I didn’t understand everything in the introducing lectures ... the amazing server we should see with our own eyes”
– “Too many tasks. You didn’t tell enough about the CD-ROM. The www-task was a good thing”
– “The connections with the Internet didn’t work. The distance tasks we could do with our own working tempo ... less small tasks. More bigger tasks. More time, more opportunities to do tasks at school”
– “First it was difficult to manage at the www-pages ... they were a little bit chaotic ... we learned to work more independently ... There should be clear pages for orientating to do tasks”

Some comments of the rationalist students:

– “Bad, so many tasks. Good interesting issues. Useful ones.”
– “Bad: –. Good: distance working. Perfecto”
Some comments of the metaphorist students:

– “... good was that I could do alone or with my friend the tasks when it was suitable for me ... more tasks with a group or with a friend”
– “... we did learn about that thing, which is important now + in the future ... I got a lot of self-confidence and I got new visions in the Internet ...”

Most students said that they learned a lot during this course (9% answered very much and 61% of all students answered quite much). 30% of all students thought they learned not much, and no one did answer that they learned nothing during the course. Interesting detail was, that those who answered they learned little during the course, did know better the answers at the final test than the others. This meant in my mind, that those who learned quite little during the course already knew better this issue before the course (confirming facts to this opinion is the feedback answers; the other comments of less learned students). When I compare the learning results of these two groups with the earlier groups (especially the results of final test, which was equal demanding), the learning results were remarkably better with these groups than with earlier groups. Now I got the feeling that students, when gathering information themselves, did understand better the issue (these two groups got 60% better points for their answers than the earlier groups). When I asked my colleagues, I heard that these two groups were not better groups in general than the other groups.

The students did criticise only one thing; and that was the fact that I shouted too much during the few introductory lessons (6 did mention it). “You shout too much”, “the volume of the voice was little bit exaggerated”, “otherwise the course was perfect, but teacher shouted too much”. Most comments were positive comments.

Most students (70% of all) thought that the course wasn’t very demanding (only medium demanding comparing to all other courses). 9 students thought that the course was very demanding. 5 students thought that the course was very easy. Of course it was clear that those students with lot of experience about Internet thought that the course was very easy. Those who thought this course very demanding got quite naturally also lower point for the final test than the other students (and those who thought this course very easy got better points than the others on average). Students did criticise much about busy timetable. This was true, because technical difficulties did cause lot of troubles at the end of the course (I had to change timetable – there was too much tasks at the end the course). I have to combine and change some tasks, but the course was suitably demanding (perhaps little bit more demanding).
In my mind the course feedback tells, that the direction when developing the course was right: 1. The learning results were much better than earlier. 2. The students did like this kind of course (in my mind mostly because of the fact, that the students could learn with their own learning style) and 3. Both students’ and teacher’s freedom is increasing. Teacher’s work is essentially increasing, but if this experiment comes to normal routines in the next courses, I am sure I don’t have to work much more than during “normal” teaching courses (now I had to work twice comparing to normal courses because of new learning material etc.).

Perhaps I should analyse this course more. Then an important standing point will be Kolb’s experimental learning model (Section 2.8). I noticed, that referring to students’ feedback the experimental learning is increasing in these kinds of courses (in my mind this conclusion was very clear). I tried to increase tasks, which combine the theoretical concepts better with students’ experimental reality. And that means that students test concepts with their experimental reality (for example what device, programs and treatments you need if you want to have Internet connection at your home. Seek information from network and make a report). I want to increase reflection in learning (I am not absolutely sure if this succeeds, for example, in writing an essay, where the student has to comment electric commerce or network threats or how new communication media is changing student’s own opinions and values). Concerning abstract conceptualisation, I am not exactly sure if that thing succeeds when you can’t find exact answers from the network and so you have to analyse the information material in your own words (but if there is no clear answers for the questions, the empiricists have criticised this). In my mind the model of experimental learning helps to analyse the learning better. You have to take part of the student’s critique seriously and make the corrections. But there is also critique, which is quite natural (and you don’t have to worry too much; for example it is important to think about certain concepts and for those questions there isn’t always completed answers).

How should the next course to be organised? In accordance students’ critique and my own observations I designed some improvements. I still think that it is important to teach the main idea; the core of electronic networks use (I want to refer Engeström’s theory about orientation base). But this should be presented in a longer time period (for example one hour in a week is a theory lesson and the other hours practical hours). The theory should be supported more with web-material than now. In the beginning of the course there should be lot of guided practice with Internet services. Among secondary level students, www-exercises have proved to be very important and also students have thought that with very positive comments. There should be fewer exercises, but content
should be improved and should be based even more on the student’s real experience. The information seeking exercise is for the purpose of what is the best information seeking strategy; how you combine the words in search process. Now the meaning of this exercise is not at all clear for the students. I should make better material at the web pages and I should improve my teaching with more practical exercises. The meaning of the short essay is to start the student’s reflective thinking. I stress that the evaluation criteria are the personal comments and not the material at any www-pages.

The technology has been quite simple: www-pages, e-mail, electronic feedback and information seeking programs. And also I have taught the students to connect servers with telnet-connection, take part at IRC (and that is a thing which most of the students already know and the students teach this thing to themselves and use file transfer protocol programs. It is adequate enough to use these simple programs. The most essential thing is not the programs intelligence or efficiency, but how the students could understand the electronic environment as a whole. I said earlier (Section 4.3), that the www-material itself is not so important in learning. It is more important to integrate the material, learning tasks, lectures, guidance, students social contacts and other arrangements in a way, that you could learn in a versatile way (for example, when thinking of Kolb’s experimental learning model). I even think now that the simple technology helps me to develop the learning environment in a more interesting way than when using for example Artificial Intelligent programs. Students’ connections from home are becoming now quite familiar. In this course 23% of the e-mails came from outside our campus-network and 16% of e-mails came from our campus library. 53% of all e-mails were sent just from computers I have reserved for this course.

Still I have to think about whether I should leave something inside our own network (Intranet) or to the common network (Internet www-pages). This and some other things influence learning environment arrangements (systems designing). I give an example: in developing www-pages, one should remember, that students want to study material from home (at Intranet it is not possible). Then we should know what kind of connection students have (modem/ISDN etc) and what kind of browsers they have. I have had feedback during the course how the pages have functioned (my own pages were to be seen, though they were not so sophisticated than some other pages, but many outside link-pages were not so good because of for example background images and the text is not readable). Although it is very easy to build www-pages, these kinds of things should always be taken into consideration. Some kind of systems design method is needed also at educational www-systems.
4.9 New ideas

It is very important to understand the meaning of co-operation between different students. Referring to Nonaka and Takeuchi (Section 4.1) I want to study both empirical and ontological dimensions of learning. Section 4.8 showed that it is interesting to study the co-operation between students with different learning styles. I hope that co-operation will create new kind of learning.

I refer here also to Engeström’s theory about learning by expanding (Section 2.10). He did stress the meaning of the expanding at the learning process from individual learning to collective learning means better learning and it changes the character of learning activity. I accept this, and I think my empirical study concerning these small projects did support that theory (although I have to say, that I study the thing especially from that point of view). Referring to Engeström’s theory: rules of teaching methods and division of educational labour will also be changed due to the expanding work process. I also agree with these claims, and the study of these small projects does support that theory. I also refer to another theory of Engeström (Section 2.8): how good learning is organised. Engeström stressed the orientation base of learning. At the electronic course (Section 4.8) I found it very important to teach first the core idea of course. Then I think it is necessary to build a model for the most important things. Then students can add the details from hypertext learning material (www-pages).

If we think that it is important that students learn how to learn, so why are we not at all saving the process-oriented information (“Hasn’t this problem been solved before?”). So is it necessary that all students should make the same mistakes? Of course an important learning method is trial and error, but is it necessary to do everything in this way? In my mind, information society (knowledge work) means also to learn the importance of organisational memory. And students should learn that before, they were working in different organisations. The biggest problem is that we should change the working methods in educational organisations. I give an example of this change: our polytechnic product innovation project. In that project students work in groups (in every group there are members from different departments: business, technical, design and social healthcare departments). They make an innovation (some of them are even manufactured by some company). The group creates a sophisticated report, but gives almost no information about the process (“how did we do that, what ideas and problems did we have”). I think every year the groups meet the same problems. In vocational education there are many similar projects (new computer systems, market analyses, international projects and so on). The teacher has of course information about the process, but it is not
so unusual that he/she forgets something or has no time to explain the process or leaves the organisation. The change is not so easy: I claim that most teachers are quite conservative in changing their working methods. Educational organisation is knowledge work, but our organisational memory consists only of some central artefacts (not much information about the process).

At the pilot project I said I did use for my study more qualitative methods than quantitative methods. At these small projects (Sections 4.5, 4.7 and 4.8) I did use more quantitative methods than qualitative methods. The reason is that in most of these projects, I didn’t think to include them in my thesis (only the project presented at 4.5 I wanted to include only as ensuring my findings with the pilot project). Mostly the reason to evaluate these projects was for normal educational interest. I was very interested in leaning styles, and I wanted to know the meaning of it in normal teaching. I wanted to have evidence about my theories with learning styles. I was testing my theories; so that was quantitative research method. I did use both inductive and deductive methods, but in my mind the most important thing to notice is, that I did use the abductive method guiding my future research (see Section 2.7). I just noticed the new things that are perhaps more interesting than the design I made in Sections 3.10–3.13. The intuitive thoughts I got when first I was evaluating the learning in those projects and then I was reading some theoretical issues (perhaps the most important was the Nonaka and Takeuchi theory presented at Section 4.1).

I said in Section 2.1, that my motive to study is to study my own job. The motive to study is both scientific and vocational. I could say, that I am also trying to design better teaching courses, and better teaching practice. I see also some similarities with the process Nonaka and Takeuchi presented (Section 4.2). They presented their theory for companies, but my environment is my colleagues (teachers and research group colleagues) and students. I am responsible for the design process, but I haven’t designed better courses alone. I could see all those processes in my design process with Nonaka and Takeuchi presented; socialisation (to learn to build internet material – colleagues from different institutes did inform etc), combination (mostly in this report), internalisation (lot of learning-by-doing and trial and mistake experience) and externalisation (feedback from students both written and discussion and the dialogue with colleagues). I also recognise the commitment factors in my design process: intention, autonomy, requisite variety, redundancy and especially creative chaos. Of course I wouldn’t say that I have used the process just the way Nonaka and Takeuchi presented, but in my mind also (distance) learning courses are some kind of “products”, where it is possible to make inventories, and educational organisations are institutions, where organisational memory is.

116 Small projects
5 Later projects

Here I will introduce first some methodological studies (5.1–5.2). Then I am introducing the EU-Socrates project (5.3), teaching logic (5.4), more experiments with information superhighway course (5.5), summary for learning styles among my students (5.6) and Conclusions (5.7). I wrote this chapter 5 in 1998–2000.

5.1 Reflection-in-action

Reflection-in-action method is for studying professional practices. The normal concept of rationality isn’t good for solving problems in our work practise. I refer to the process of knowledge creating process (Section 4.2) and the critique against orthodox use of empiricism or rationalism (Section 2.7). We need reflection during the study of our work practice. I noticed after the first projects in my research that the methods, which I used, were not good at all. Actually at the pilot project I tried to use the phenomenographical method, but to be honest the methodology wasn’t phenomenography at the end of the pilot project. The essential feature of my research is the reflective action in my study. I had ideas how to make better learning environment, but after the study there came new problems or ideas to make even better environment. The result of the old study didn’t seem good enough to me. I saw the problems from a new point of view. The methodological solution for my study is the reflection-in-action method.

Orlikowski and Baroudi (Orlikowski et al. 1991; Heiskanen 1994a, pp 202–203) note that there are three main philosophical research stances (Section 2.2 Habermas):

1. The positivist research philosophy maintains that the physical world is objective and exists independently of human beings. Positivist research is value-free and the researcher is a neutral observer.

2. The interpretative research philosophy emphasises the importance of subjective meaning, political and symbolic action, through which people construct and reconstruct their reality. The world is not given, but the people produce it by their actions and interactions. The researchers’ role can be perceived in two ways. In the weak form the researcher tries to understand the existing systems of meanings of the researched. The researcher interprets acts and other events. In the strong form the researcher not only describes but also enacts the social reality she or he is investigating. Retelling the stories by the informants is not
possible, because the interpretative schemas of the investigator intervene; she or he coproduces the reality.

3. The critical research philosophy differs from the two previous ones because it challenges the status quo, which is only explained or predicted by the other approaches. It aims to change the world. The task of a critical researcher is to bring the conditions of the status quo into the open. By this means she or he is aiming to start a social change to remove alienation and domination. The researcher has two options, either only to start the reflective process of the participants or to actively participate in effectuating the social change.

In the Section 2.2, I said that my aim is to change the learning environment. Still I wanted to adapt, at the pilot project, some kind of interpretative research method. During the project I noticed the contradiction between the orthodox method and my study actions. I wanted to make changes. In the next Section, I am going to present this critique in a larger scale.

Reflection-in-action is defined by Schön (Schön 1983, Schön 1987, Argyris et al. 1978, Argyris et al. 1987, Heiskanen 1994a, Heiskanen 1994b), and the method is rather closely related to the critical tradition. Schön criticised “technical rationality” according to which professional practice consists of the application of standardised scientific knowledge instrumentally in problem solving. Preferably Schön sees that practitioners are involved in personal relationships, situations demanding action, and value conflicts. The practitioners develop knowledge that is often tacit and spontaneous, and sometimes becomes routine. In order to break these routines; the practitioners need reflection-in-action. They will develop a practice-oriented theory or rationale according to which they explain the situation and choose their actions. The practitioners do not consider that they have formed a satisfactory account of phenomena in any practice situation until they have framed it in terms of their overall theory.

Referring to Argyris et al. (1987, 81–82) there are two kinds of theories of action:

1. Espoused theories are those that an individual claims to follow, and
2. Theories-in-action are those that can be inferred from action. Espoused theory and theory-in-action may be consistent or inconsistent, and the actor may or may not be aware of any inconsistency. Theories-in-use are tacit cognitive maps by which actions are designed. They can be made explicit by reflecting in action.
Reflection-in-action has four distinctive features (Schön 1983, Chapter 5):

1. It presupposes evaluating experiments in problem setting, which means that the practitioner is trying to understand and in some way to change the situation. Practitioner also tries to frame the problem in such a way that he/she will not find him/herself in a dead end situation.

2. The practitioner is trying to bring past experience to bear on a unique situation by using examples, images, understanding, and action schemata from the mental repertoire he/she has built during his/her career.

3. The third feature is rigour in on-the-spot experiment (exploratory, move-testing and hypothesis testing experiments). The reflective practitioner experiments rigorously when he/she strives to make the situation conform to his/her view of it. At the same time he remains open to the evidence of his/her failure to do so. He must learn by reflection on the situation’s resistance whether his/her framing of the problem is inadequate, and in what way. Moreover, his/her target is moving because he/she is changing the phenomena as he/she experiments.

4. The fourth feature is design in virtual worlds. An architect does not dig on a building site, he/she uses a sketchpad. An essential ingredient in situation framing and action design is the notion of a generative metaphor. A generative metaphor is a vehicle for seeing the phenomenon under study as something.

The way Schön sees the reflection-in-action is little bit similar to the way Nonaka and Takeuchi (Section 4.1) think knowledge is created in organisations, although the aim is different. Both theories try to define the process how tacit knowledge is converted to explicit knowledge. And an important detail of those two theories is to underline the use of metaphors. I have to admit that these features presented above describe quite much my own research. I criticised the positivistic research, but my research is also not interpretative. Finally at the end of my study I found a good methodological base for my research.

At the end of this chapter I want to present the research data question (Heiskanen 1994a, 57–63): “Which kind of data does the reflective practitioner need for his reflections from the research point of view”? It seems that a reflective practitioner reporting to academic audience is in a trade-off situation when faced with the problem how he/she should divide his/her resources between three competing activities: theoretical sensitivity, number of phenomena observed, and amount of scrutiny in data recording and processing. Theoretical sensitivity (Strauss 1987) means the scope of theoretical concepts the practitioner is aware of and is able to use when trying to understand his/her daily encounters with organisational life. Number of phenomena observed means the breadth
of observations the practitioner is able to grasp in the light of his/her theoretical knowledge. Amount of scrutiny in data recording and processing means the adoption of the typical data gathering methods employed by ethnographers: e.g. making field notes, taping interviews that are later transcribed, gathering organisational documents, arranging writing competitions for the people that are studied. And Heiskanen presents the trade-offs in research data gathering:

![Diagram](image)

**Figure 11** The trade-offs in research data gathering and analysis

### 5.2 Kilpinen method

When I started the study of this research I was not at all sure, what is the exact method. I criticised the positivistic research method, because it was dealing too much with technical problems and quantities. I thought that my study is handling more social values and interpretation of the issue. So I thought that my study is more qualitative. In computer science we can study with natural science methods only when we are studying pure events inside the computer. Always when we study human beings, we should study this with social science methods.

I noticed criticism against orthodox qualitative methods quite soon. I criticise the subjectivism in most qualitative methods. But I’m not at all against qualitative methods, but I’m against some philosophical aspects in phenomenography.

120 Later projects
I said in Section 2.5, that I accept the main idea of phenomenographical research method. In my pilot project (Chapter 3) I did gather information from people with half-structured interviews. I tried to analysis the results with phenomenographical method, but my analysing method wasn’t exact phenomenographical (I did not only make categories, but I analysed much more). And then I began to design new environments.

I accept to some degree, quantitative methods. To me it is a practical question. It is sometimes impossible to get information from big study, for example a large evaluative program, without quantifying our research methods (I refer here Patton 1990, 165–166). But we must remember that we lose much qualitative information in the same time. That is obvious when we think of all those reduced well-structured inquiries.

It is good to have different points of view. Many studies are concerned both with qualities and quantities. Maybe in those studies we should have two parallel studies: a smaller for qualitative information and a larger for quantitative information. And I think first the smaller (we get guiding information for larger) and then larger (we can say what is the meaning of the research in a broader scale). From a philosophical point of view I agree Peirce’s methodological standpoint: induction, deduction and abduction are tools for different ways of analysing a phenomena. The orthodox methodology gives only one point of view. If we want to have a good analysis for phenomena, we have to use all these methods.

First, in research, we have to analyse the research question (to do ontological analyse of the phenomena researched). In that analysis abduction was a very important method in my study. I knew there were other ways to fulfil the teaching. I had been a long time teacher, and I knew that some educational working methods will improve learning environment. “I had a feeling, I knew that these changes would probably effect positively”. I couldn’t prove these theories in a deductive or inductive method. And I used the abductive method many times in my study. Abduction is a necessary method for deciding the direction of future studies. Of course all research needs to be analysed in a deductive way. Peirce told the importance of the use of all these methods in research.

Orthodox scientific methods stress inductivism and deductivism in certain ways. I think those methods always lose something. In my mind it is important to understand the meaning of a phenomenon. A good way to use the hermeneutic method is to understand both the details and phenomena as a whole (Chapter 2.4). In my mind if we are studying some phenomena, we have to start the analysis with its meaning as a whole “zu den Sachen selbst”. That analysis tells what methods we should use in a certain part of the study.
Then what is my standpoint to the relation between empiric and theoretic study in social sciences? I refer here to the Popper’s theory about three worlds. Social sciences are dealing with interaction between subjective consciousness (World 2) and objective theories (World 3). What we observe from nature (World 1) is so trivial that it belongs to natural sciences (social sciences deals with the cultural relationship). If I specify what empirical observation is in social sciences: that means how subjective consciousness sees its relation to other people and other people’s thoughts and on cultural concepts. We can’t say that we are not depending at cultural theories (World 3). Objective material influences our subjective consciousness and of course vice versa. If I think about my teaching history, my subjective consciousness did have a lot of opinions about teaching at the beginning of the 80’s, when I started my teaching career. After that I got a lot of information about good ways of teaching. And that influenced me to change (I hope it did improve) my theoretical knowledge about teaching. Practice and theory influence each other.

It is quite useless to think of whether it is theoretical or empirical knowledge first. In social sciences qualitative research means that we are studying the meanings of subjective opinions, and many times trying to relate them to objective knowledge concepts. Quantitative research means that we are studying our theory’s evidence by categorising people’s subjective opinions. The difference is that the direction is opposite. It is naive to say that we need only qualitative or quantitative research in social sciences. Both methods are good for certain situations.

In my research process I have used both qualitative and quantitative methods. The first period of my study lasted many years: through my empirical and theoretical experience I tried to analyse the most important things. This analysis was mostly qualitative, because I tried to analyse my own subjective consciousness with the help of my colleagues and students (and their subjective consciousness). The pilot project did have both qualitative and quantitative elements. I studied some theories, because I wanted to understand, what things could be worthwhile in observing, interviewing and making inquiries.

My aim is to change the working methods in certain learning situations. So my research method is not case-study, because in that method the researcher is more an outsider and neutral concerning the environment. My research method is action research, because I want to design a better environment for certain learning. I am not neutral for the changes. I am designing myself the environment and then asking other people to comment on the situations that I am presenting.

First I analysed the most important things concerning studied phenomena. After the analysis I moved to a pilot project for the purpose of directing the idea of my re-
search. I got information, on what things would be worthwhile in my research. In that empirical research I wanted to use phenomenographical method in order to reach the idea of the research question.

After the pilot project, I studied more methodological issues. I didn’t want to adapt the phenomenography, but I think that the methodological standpoint was good in my pilot project; I knew much better what things were interesting and what were not. I should say that at first I did use inductive methods in my study. Then I noticed the important features, and that process is abductive. And at the end of that analysis I made a deductive analysis that there was no logical contradiction between my theories and my empirical study. I must admit that I changed many things; I threw some theories away, because they were not at all suitable, and I changed my aims.

At the beginning of the study I thought I would have two projects: the pilot project and the larger project. I had some normal teaching courses, but during those courses I noticed some very important things that influenced my way of thinking about my research. That process was mostly abductive. In the evaluation process of those courses I noticed remarkable things. At the same time I noticed similarities with empirical information and some scientific theories. The direction of my research did change.

So I have to agree with Peirce’s theory; there is no conflict between qualitative and quantitative methods (they are just different sides of the same issue). A good research process consists of the both elements using all the time different methods (abductive, deductive and inductive). I was not making any well-structured program for those projects I studied, but it was possible to change program, if I felt that way. I tried to improve the learning environment with the students and not make any controlled tests. And that I was telling right away when the courses were starting.

For practical reasons, I had to use both interviews and inquiries. I think I was also was able to accept proposals to improve the course at any time students wanted (because it is so easy through a computer). The problem is that I get so much information that I must do categorisations all the time and at once when actions take place.

And finally, studying methodological things, I realised that the best methodology to follow is the reflect-in-action theory. In the beginning of my research I tried to find a well-structured (orthodox) methodology to follow. I wanted to study my student’s opinions and find something interesting, although the research problem was always the interaction between my own learning organising and the students’ actions. I continually created new (artificial) environments. So it was very stupid to think that I was neutral researcher. The main point was, all the time, that I tried to be reflective in studying my own courses.
5.3 The EU-project

The Open to Europe project was a European Socrates ODL (Open and Distance Learning) partnership project (which means supported by European Union): a network of 19 conventional European universities from 10 countries, with different profiles and levels of ODL and information technology expertise coming together to improve the European dimension of their educational courses (Socrates ODL 1). The need of this project arises from the imperative to make the European economy more competitive by better preparation of university (and polytechnic) graduates. The project aims were to establish an effective network for interactive distance learning. Students in different subject areas from each of 18 full partner universities will carry out collaborative projects in 8 subject areas, using email, www-pages and other new communication technologies. This project was carried out in the years 1996–1998.

One subproject was the business management and economics project. Six students from our polytechnic were working collaboratively with student groups from six universities around Europe. The aim of this project was to give some insights on how and why European firms use the Internet in their various business functions such as marketing, finance and accounting and human resource management and advantages and disadvantages of using the Internet in these functions as opposed to more traditional methods. General objectives for the subproject were:

1. For the students to develop cross cultural and technological communication skills in creation of a joint product
2. For the students to enjoy collaborative research as a way of learning

During the project we had meetings at Salford England (totally three meetings and I was there twice – pictures from the last meeting you can see at http://ameba.lpt.fi/~kilpuri/photos/). We communicated through email (I got 583 messages from project co-ordinators, colleagues, students and so on), the project produced web pages (http://www.salford.ac.uk/iti/ote/) and the students used all kinds of programs (word processing, spreadsheet Excel to analyse inquiries, IRC for communication with other groups). For the purpose of learning, the project was quite good. Our students evaluated the inquiry from 50 Finnish companies. The results of the Internet business inquiry weren’t a big success. The reason for this in my mind was that

1. The students did not have enough knowledge about electronic business beforehand (the students couldn’t get new factors about why electronic business is becoming so popular)
2. The culture in different countries (concerning business and especially electronic business is so different)

I studied our student group working during more than 2 years and the group gave me their learning diaries (what they did together and separately and what they learned). I also discussed with the students many times (I planned to do a final interview with the students, but all students from the group finished their studies at our polytechnic before I tried to contact them).

In my mind, the reason the project was good for the purpose of learning: the students thought that the project was Their Project. Although academic professors set some goals the students really decided what they were studying and how they wanted to evaluate their studies. All learning was based on own observations. The students did like this kind of learning in the final project report. The business culture is different in different countries, but it really gave insight into the phenomena. Mutual communication did help learning (if you want to communicate with different cultures you have to put your knowledge in explicit form and especially when it is not your own language). That was, in my mind, also important in our own student group: the students have to put their own thoughts in an explicit form, and they learned in that way.

I had studied during this research a lot on the learning styles. I knew all of my students’ learning styles (they did participate in my course – see Section 4. – and all of them answered by name, so I knew their learning styles). 3 of the 6 students were clear empiricists, one was a metaphorist and 2 of them were empiricists with metaphorist features. I noticed that different learning styles supported each other: in the division of labour those with more metaphoristic style wanted to communicate with other groups (and did more characteristically metaphoristic learning) and the clear empiricists did more empiristic work (observations and so on). In my mind, if the group has a mutual understanding for the goal and the group is able to work autonomously, also the ways of working within the group will be more efficient, because different learning styles support each other.

5.4 Teaching logic for polytechnic students

In spring 1999 I taught (computer-) logic for the computer students. Logic as a science is very rationalistically directed (or it is to say: if you understand the theory of logic it is easy to lead the results of logical sentences). But I also knew (Section 4) that our students
are mostly empiricists and so they like to learn more in an empiricist way. The rationalist way to teach is to tell theories and ask the students to use these theories to evaluate exercises. But there are also tools for the empiricist way of learning (tables of true or false, programs for evaluating logical circles; I used EasySim program for designing or just looking at how digital circuits can be designed and tested on a screen so that you can understand logic gates and flip flops functioning). I used quite the same inquiry as earlier (Appendix B).

And I was right: in this course there was almost 50 students and 35 of them did answer my questionnaire about what they thought of my experiments (using computer to make observations about logic). 60% of students were empiricists (21), 17% were rationalists (6), 2 students were metaphorists and 17% of students (6) did have some kind of balance between learning styles.

There were some problems with the programs (they were not working well all the time). But the result was what I expected: the students learning style is more important than the subject’s logic. If the student is a clear empiricist, then student wants to learn with observations and not with rationalistic leading. I don’t know what is the best way to teach the metaphorist students to learn logic, but there were only 2 metaphorists (it was not surprising to me that they failed to carry out the course in the first attempt - they answered that they failed to understand the meaning of the course). I used almost the same inquiry as at the other small courses. Answers were similar to other courses: Empiricists like observations.

Of course logic is a very deductive subject, which means that students should understand the logic (some kind of rationalism), but the goal can be achieved also in other ways. Perhaps this students’ learning style will be extended to more sophisticated (balanced) learning. I noticed that also here computers allow more flexibility in learning.

5.5 More experiments with information superhighway course

From autumn 1988 till February 2000 I taught 12 groups in the “Information Super Highways”-course (I refer to Section 4.9). 6 groups were young secondary level students (mostly age 15–22) and 6 adult students groups (mostly age 25–50). I changed the course:

1. First, all students have to build their own homepage. I taught a very easy way to do that; students saved an existing web page and changed it with Word-program. Word is not a very good program for building a homepage, but it is sim-
ple and students had already studied that program. It was also possible to build the homepage with other methods (with notepad programming HTML or other ways – about 20% of students did so). The main reason for this change was that I felt that collecting information from www is not enough experience before the students are starting to conceptualise the phenomena.

2. At the end there was also a machine test; how to use the Internet (a part of ADP-driving licence see more: TIEKE, http://www.tieke.fi).

3. I also made some other preparations, but they were not big changes; the structure stayed quite the same as I described in Section 4.9.

There was about 300 students in my courses, but I got only 229 feedback inquiries from students (114 from young students and 115 from adult students). I used the same inquiry as earlier (Appendix B). The feedback was so similar comparing to the earlier studies that I won’t repeat it. Especially adult students were extremely grateful for the teaching (they said they needed knowledge and in this way they learned). More than 90% of adult students were very satisfied with the course. The only negative critique with adult students had was that it was too hurried and not enough computers (the critique was right, because I have had less hours with adults than with young students and there has been too many students in 2 adult groups). The young students didn’t criticise hardly anything; they liked the freedom to do learning in their own way (here I had to say that the least successful students didn’t answered the inquiry, because many of them were absent from the final test, where I performed the inquiry).

Of young students, 55 (48% of all) were empiricists, 26 (23% of all) were rationalists, 13 (11% of all) were metaphorists and 20 (18% of all) had balance between learning styles. Of adult students, 63 (51% of all) were empiricists, 20 (17% of all) were rationalists, 3 (2% of all) were metaphorists and 29 (14% of all) had balance between learning styles. From 3 adult groups I asked also background (working experience and experience with computers), but those things hadn’t a remarkable influence in differences between answers. I noticed here the same as earlier that learning style was the most important thing in differences between answers.

If I compare the learning results between young and adult students, I notice that adult students were much better (many of the adult students gave excellent answers). Most adults were working very hard and they needed more feedback than I could give. If I compare the learning results between different learning styles, I could not see big differences (about 60% of students answered the feedback inquiry with their own name. – I gave feedback about learning styles to such students.

Later projects
If I compare the results between the first version of the ISH-course (Section 4.9) and this version, I could say that the results were better with this version (students understood a little bit better experiments and concepts, but also the Internet becomes all the time more popular in society). Building own homepage helps to better understand the Internet, but still the main problem is: do the students really conceptualise their experiments in an adequate way.

Many students criticise homepage-building with Word program: it was not easy to put the layout the way they wanted. Especially metaphoric students wanted a better layout (I understood that building a homepage is very important for them to express their emotions). It is good to have an easy way to build homepage, but there should be better ways than the Word program to change the layouts and put links. That is why I decided that I taught Front Page Program, though that means an even more hurried course than earlier.

In spring 2000, I taught five groups in the “Information Super Highways”-course. 4 groups were young students (mostly age 15–22) and 1 adult students groups (mostly age 25–50). My colleague also taught 1 adult group with this same program. I changed the course:

1. I noticed that the homepage building with Word-program had problems.
   I taught Microsoft Front Page; students saved an existing web page and changed it with Front Page and then added more pages. Students did have freedom to make such pages as they wanted except information about drugs, porno and so on was forbidden. The Front Page is not very easy to learn, but I taught only the main features and gave freedom for the students. The students did this way although it caused lot of problems. I did not have enough time for guiding.
   I thought that the main thing to teach is not technical things but the idea; that the homepage consists of text, links to other internet-addresses and images. Also here it was possible to build a homepage in other ways (about 10% did so).
2. I tried to also make other preparations, but our network had some problems in the spring (sometimes pages could not be seen, mailing didn’t work and so on). I had a new version, but it had more problems than the old version. So I carried out the course with only small changes to the old version.

One troublesome item was that the young student groups were too large (about 30 students in a group). The problem was with building home pages; with Front Page-program it was difficult to guide at 2 classrooms (in a classroom there is only 20 PC:s). Most students were so enthusiastic about building their homepages that they forgot my advice.
Of young students 48 (48% of all) were empiricists, 18 (18% of all) were rationalists, 18 (18% of all) were metaphorists and 17 (17% of all) had balance between learning styles. Two students didn’t answer the learning style question. Totally 103 students answered my inquiry (2 students didn’t answer the learning styles question. I counted that 16 students didn’t answer - they were either absent from the course test or didn’t want to answer). 47 of those who answered the learning style question also wrote their name (of course it was not obligatory).

Of adult students 19 (66% of all) were empiricists, 4 (14% of all) were rationalists, no one was metaphorist and 6 (21% of all) had balance between learning styles. I didn’t get answers from 10 students. Adults were from 2 groups; the other was my own group and the other my colleague’s group.

Most of the empiricists in young student groups were satisfied with the course: 40 students (83% of all empirists) liked this kind of course. 4 empirist students said nothing and 1 student was totally critical and 3 students a little bit critical (so 8% of all empiricists were disappointed or critical). Some comments from satisfied students:

“good variation from normal theoretical teaching”
“first time in my life I did understand adp teaching”
“good and relaxing” (about 10 students did answer this way)
“freedom and own timetable suits me ... and when I seek information for myself I think I learn”

Critical empiricists were criticising the timetable and when they needed my guidance I didn’t have enough time for that: “Too quickly”, “More advice”, “Easier tasks”. This critique was correct (I even expected more critique). Writing a homepage with Front Page-program did mean a hurried course. I hadn’t enough time for all students and when our network didn’t work properly, that meant lot of problems.

Also most rationalists were satisfied with this course: 15 students (83% of all rationalists – the same as with empiricists). One student was disappointed and 2 didn’t answer anything (that is quite normal for a rationalist). Some comments: “Useful”, “I like the freedom”, “interesting”, “Teacher is not teaching enough ... don’t know what to do”.

The metaphorists were not so satisfied: 12 students (60% of all metaphorists) did like this course. 4 students said nothing and 4 students (20% of all metaphorists) were disappointed. Some comments: “Good and free working”, “really pleasant course”, “surprised when I understood so much”, “Too many tasks for this short time”, “Confusing all the time ... teach us! Don’t shout all the time”.

Later projects 129
All students with balance between learning styles were satisfied with this course. Two students did say nothing, but the other 15 students were satisfied. Some comments: “Really good”, “relaxing”, “useful”, “good course and teacher”.

In total 80% of the students were satisfied with this course and 9% were disappointed.

During the course I also made notes about how the students did work; did they work alone, did they work at home (because of network problems only 8 students did send their tasks through e-mail) or did they prefer co-operation. I made a remarkable finding: Students with clear empiristic or rationalistic learning style did work alone more than the other students did. Clear empiricist means: from 3 learning style questions they chose in all questions with empiricistic choice and at least in 2 of those empiricistic choice was the first choice (the same with clear rationalistic). Of course I could handle those who gave their names in my inquiry (but I don’t think this means failure with all students). 47 students did give their names. 20 students of those were clear empiricists and 6 of them were clear rationalists. Of those 26 students 14 did work alone in the classroom or did work mostly at home (7 of those students did at least half of their tasks at home). Of the other 21 students only 3 did work alone. My conclusion is that: if you are clear empiricist or rationalist you don’t need so much co-operation with other students. And of course the more you have metaphoric learning style the more you need co-operation (I did also check that with categories with no metaphoric features, a few metaphoric features and metaphoric students). The more you have metaphoric learning style the more co-operation increases (this is very obvious).

I tried to compare this conclusion with the earlier courses (Section 4.9). I hadn’t made notes at that time how the students had worked (alone or with others). The only thing I could check was the e-mails students had sent to me and especially those e-mails students had sent outside the campus-network (that means in most cases from home). I had big problems to check this, because I had saved e-mails, but some material was not so easy to read. From those who had given their names in the inquiry 79 were clear empiricists or rationalists and 84 others. 29 clear empiricists or rationalists and 8 others sent at least one task from home. I think this will support my conclusions.

The empiricist and rationalist students have been little bit more efficient than the others: at this course and at the earlier courses they have got 9–12% better points from the tasks and tests than the other students. But also those students, whose all learning styles have been in balance, have got 5% better points than the others have. When I have used category balance between learning styles that has meant also that only two learning styles have been in balance. When I speak about balance between all learning
styles, I mean that the student has features from all learning styles and they are in quite good balance. I added also some students from empiricists, rationalists and metaphorists whose learning styles are in balance and the main learning style is not dominating – about 20% of students belong to this category. Those students with only 2 learning styles with balance got even worse points from courses than the others.

Very clear empiricistic or rationalistic learning style is good for efficient learning, but it isn’t very creative way of learning. Students with this kind of learning style have probably noticed it useful to work that way they do. But it is only my “feeling” in this study that their tasks are not so creative, because I don’t know how I should recognise what is creative and what is not. In my mind I see most answers from empiricists and rationalists as good but sterile answers for new visions. I think these kinds of students only want to do their job in an efficient way and that’s it. But that is only my feeling, I can’t give more evidence for this finding exactly.

Producing homepages was important for most students and for metaphoric students it was especially important. Students answered in inquiry that producing a homepage was important and interesting and it helped to understand other things. 15 students did like this task (it is remarkable thing, because almost half of students just wrote comments “course was OK” and so on or didn’t answer anything). Some metaphoric students wanted to work with homepage almost the whole course (for example I said to two metaphoric students that they should work with the next tasks, but they wanted to add things to homepages). And to express feelings means much to metaphoric students. Also those students need a lot of contact with a teacher. If that is missing I felt that they were disappointed. Because our campus-network didn’t work properly, students had asked almost all the time when they could see their homepages and when it is possible to change those pages.

Though the campus-network didn’t work properly (it was not possible to send tasks through network as at early courses), I asked in inquiry do the students have the Internet-connection at home. 9 adult students (31% of adult students) had modem connection. 41 young students (40% of young students) had connection. 33 students had modem connection, 7 ISDN connection and 1 cable connection.
5.6 Summary and comparison of learning styles

I will summarise all the empirical studies about learning styles, what I have made in Chapters 3, 4 and 5. Also I compare these results with a large study in Canada in the 80’s.

Totally 587 students gave me feedback with my questionnaire. 565 different students answered the learning styles questions (6 students twice, but I could reject the second answers). There were about 800 students in those courses I studied. I got about 1900 e-mails from those students during the courses. Totally I got about 2700 learning tasks from students (through e-mail, in a paper or diskette). In Appendix C you can see the results of learning styles in a chart form. And I also refer to Section 4.6, where I reported teachers’ learning styles. Among 35 teachers were 15 empiricists, 9 rationalists, 4 metaphorists and 7 with no dominating learning style (chart at Appendix G).

From those 565 students, who answered the learning styles questions, 304 were empiricists (54% of all students and half of the empiricists clear empiricists). 98 students were rationalists (17% of all students and half of the rationalists clear rationalists). 62 students were metaphorists (11% of all students). 101 students had balance between learning styles; i.e. no learning style was dominating (18% of all students).

The polytechnic level students were more empiricists than the other students were. I got the learning styles feedback from 150 students. 92 of them were empiricists (61% of the polytechnic level students). 22 were rationalists (15% of the polytechnic level students). There were both 18 metaphorist and balanced students (both 12% of the polytechnic level students) (Appendix D).

There were 271 students at secondary level young students (means mostly aged 15–20). There were not so many empiricists among those as there were among polytechnic level and adult secondary level students. 130 young students were empiricists (48% of all young students). 52 students were rationalists (19% of all young students), and 41 students were metaphorists (15% of all young students). 48 students with no dominating learning style (18% of all students) (chart at Appendix E).

There were 144 students at secondary level adult students (means mostly aged 20–). There were almost as many empiricists as among the polytechnic level students, but the difference between these adult students and polytechnic students is the amount of metaphorists; among adult secondary level students there were almost no metaphorists. Totally there were 144 adult secondary level students. 82 of them were empiricists (57% of all adult students), 24 of them were rationalist (17% of all adult students), 3 of them were metaphorists (2% of all adult students) and 35 of them with no dominating learning style (24% of all adult students) (chart at Appendix F).

132 Later projects
In Ontario, Canada a study of epistemic learning styles among teachers and students in elementary and secondary schools was performed in the beginning of 1980’s (Rancourt et al. 1982). In that study there was more questions about epistemic learning styles, and so they could get more detailed learning style profiles. They noticed that persons mother-language did mean different learning styles (English/French). Also they noticed that teachers’ teaching subject influenced learning styles.

In the Section 4.6, I noticed also that teachers’ teaching subject influences the learning styles of teachers. The biggest difference between Finnish and Canadian students was that among the students in Canada there were not at all so many empiricists as in Finland. The empiricist learning style was not even the dominating learning style. Among the business study students the most dominating learning style was the rationalistic learning style. This result is quite similar with Rancourt (1986) and Leino (1987) studies on comparison between Canadian and Finnish teachers’ learning styles.

Because I didn’t study the learning styles at the same way and not in so detailed way as Rancourt, it is no use to compare more. The big difference tells that culture has influence also for how we get new information. In Finland we learn more through our senses, but in Canada more through rational thinking and metaphoric analogies.

5.7 Conclusions

The most important conclusion is that learning is always more efficient when it is based on learner’s own experiences. I noticed especially with Socrates-project and with course “Information Super Highways” that when students think learning is Their Project; it is easy to teach new things. Of course that sounds very obvious, but it is not very easy to motivate students to feel learning as their own project. It is matter of feelings and emotions and when a learner is quite a young person; you can’t just tell student you have to be motivated. In my mind, motivation comes from the feeling that student can learn the issue in own way; or when student is doing his/her own self-fulfilment. That means also that you can learn in your own learning style.

In Chapter 3, at learning styles the metaphoric learning style was concerned with creativity. I agree with that fact. In my mind, the empiristic features are quite easy to design in these electronic courses. But the metaphoric features are very difficult to implement. Those things mean in most cases personal contact. In my mind it is not possible to compare does the computer aided learning environment mean less or more work for the
Later projects

teacher, because it is a matter of qualities (learning will change what we think is important). Some features of the teaching are quite easy to automatise, but some features are not. If a student doesn’t have very good motivation and student’s ability to learn is not very sophisticated (for example learning styles are not in good balance), a student needs to be guided and feedback is necessary. So in learning situation the metaphoric and rationalistic features mean someone to guide and give feedback to the students.

If own experiments are the base of conceptualisation, then it means that tacit knowledge can create better learning (more creativity). Then the biggest problem is whether there really does happen enough conceptualisation. If a student only expresses his/her emotions and couldn’t relate to his own tacit knowledge in explicit form, then in most cases (at least issues I teach) learning is very deficient. It is easy to teach some technical issues, but if you want that students really understand them in real life, students’ own experiments must be the base. Own experiences come, for example, with some orientated task. A teacher or a co-ordinator can design these tasks quite easily, but the next step is more difficult. Conceptualisation is important, but for that the teacher must work very hard. That means feedback and real understanding for the student’s opinions of taught issue (teacher can understand them through orientated tasks). Computers can help in working with orientated tasks (give more and flexible material), but especially when a learner is young, conceptualisation means that it is necessary to give advice to a learner.

If computer mediated learning material is produced so that learning can flexibly happen with your own learning style, it gives much better results in real learning. In this research I noticed that students own learning style is even more important than the taught subject’s logic. Students learn even the taught issue’s logic better, when the learning can happen through the student’s own learning style. Especially I noticed that when I taught (computer-) logic for polytechnic students. Logic is a quite deductive issue, but students understand logic best with their own learning style (and that style is in most cases empiristic – which means more inductive method). Of course one goal for teaching is to make more possibilities to learn in different ways (with different learning styles or so that learning styles are in balance with each other). In this research it is not possible to show if my way promotes this (because it means a long time change). In Chapter 3, I described a case, where I tried to design different learning environments for different learning styles. That was, in my mind, a mistake. Student’s learning style should be changed, but I think the change comes through the way that student finds him-/herself some other sophisticated way better. Learning style is one part of the concept “learning how to learn”. Traditional teaching concentrates on efficient learning because of resourc-
That means in most cases, one-sided teaching (at business studies mostly empiristic teaching). In my mind computers allow more flexibility.

Students with different learning styles help each other to learn when it is a matter of common tasks (when students can set their own goals together and learning environment supports that way working). I noticed that especially in the Socrates project. Computer mediated learning environment is no barrier to co-operation. Electronic communication perhaps even helps the students to learn, because when you have to communicate, you have to formulate your thoughts in explicit form. That is very important element in learning. The Socrates project showed me that point.

But do computers help in learning comparing with traditional learning environments? That is not so easy to answer, because it is a matter of qualities. Computer mediated learning will change (at least in my courses) the way of organising the learning function, and that also meant changes in objectives of learning. That happened in all of my cases. Computers allow more possibilities, if the teacher and/or designer of course can notice the fact. And to my mind the flexibility to organise the learning in different ways is one of the most important things with computer mediated learning. I used three learning styles, but it is even possible to organise learning with more points of view. It is only a matter of resources. In a normal teaching environment (not computer mediated) it is of course possible to be flexible (also concerning these learning styles), but it means that the teacher should all the time observe the learning event. With computers some routines could be organised more easily.

The fact that computer aided-learning environment is not much dependent on time and place is important for some students. It increases most students’ motivation. For some students also freedom in social relations is important (some students don’t want to answer in classroom, but answering is much easier through a computer). In my cases I allowed also more social co-operation with students. To my mind, a well-designed computer aided learning environment helps the social contacts comparing with normal courses.

Empiristic learning style is dominating at my college (and also at polytechnic). 61% of polytechnic students had an empiristic learning style and 47% of college students had that learning style.

If I compare the students nowadays and the students in the beginning of the 80’s, I see clear changes (I haven’t used any inquiries etc. to study this, but this is only my standpoint). Almost twenty years ago students were much better in finding analogies. During those days students could relate concepts better to other concepts. Nowadays students have much greater intensity in doing things than students twenty years ago.
Nowadays all of society and especially media is full of information. Most students nowadays live quite intensively, but they could not relate concepts to each other. What nowadays students are missing is to understand phenomena and to make analogies with concepts. I am sure that global computer-aided learning environment is good for students nowadays, but that learning environment should not only be collection of data. Much more important is to conceptualise phenomena.

Nowadays deductive thinking is not taught at schools as much as 20 years ago (not only teaching mathematics). Elementary teaching of deductive thinking probably also helps deductive thinking in other issues. 20 years ago it was easier to make analogies, because concepts didn’t change so often. It was possible to manage in a society with stable concepts and analogies. Nowadays knowledge is changing rapidly and stable concepts and analogies won’t help in the long term. So I think it is very important to teach students to learn to make analogies.
6 Epistemological Learning Model

Here, I will first introduce some new studies about learning and especially concerning learning styles (6.1) and network learning (6.2). I then present what computers mean to vocational education (6.3). Because I have noticed that also the network-based learning environments should be human systems, I present some aspects about designing programs for this purpose (6.4). I then present what different constructivist standpoints mean to network-based learning (6.5) and present how I see the didactical process (6.6). I then present studies about different learning environments (6.7). Finally, I am introducing my model of learning and its epistemological aspects (6.8–6.9).

6.1 More learning studies

There are lot of studies on cognitive styles (Saracho, 1998, pp. 171–185). Cognitive (learning) styles introduced by Witkin are not exactly the same as Royce/Rancourt epistemological styles. There were two styles; the one making perceptions (empiricists) and the other analytical learners (rationalists). But there are also theories. Riding, Cheema and Rayner (1998, pp. 286–290): introduced a theory of two fundamental style dimensions: the Wholistic-Analytic and the Verbal-Imagery. I will not write more details about these theories, but I will tell, how Saracho summarizes the results of many studies: “Cognitive style, an integrated component in the individuals’ psychological differentiation, determines the individuals’ responses and functioning in numerous situations. It represents one dimension of individual differences and includes stabile attitudes, choices, and habitual strategies related to an individual’s style of perceiving, remembering, thinking, and solving problems… Recent studies on cognitive style suggest a mean of dealing with individual differences. Specially, it is imperative that students experience alternative teaching techniques and a broad range of expected learning outcomes. In responding to the students’ individual differences, educational settings need to be modified to promote the students’ learning.” Saracho tells of 4 important issues to discuss:

1. Matching learning tasks to the students cognitive style
2. Developing cognitive flexibility
3. Creating curriculum flexibility
4. Matching teachers to students’ cognitive style.

I have also found these to be important in my studies, although I have used slightly different terms.
My pilot project was a study of a philosophy course with polytechnic students. And I then found that the learning style was very important. I found a very interesting article also studying a philosophy course and finding that learning styles were a very important thing in learning. The learning styles studied were different from I have used, and I haven’t heard of that classification. The learning style classes were: deep, surface and strategic (the classification of the first two I have heard, but the third of these made me wonder about the differences – I couldn’t get the book referred to this classification). Gibbs wrote 1999: “Many students find theoretical subjects hard and challenging. Although they may pass modules in the subject, they often fail to attain a deeper, conceptual understanding. coMentor, a virtual learning environment on the www was developed to support such conceptual subjects by providing facilities for debate, discussion, groupwork, resource sharing and vicarious learning. The system was evaluated through undergraduates taking a philosophy module. Although there was no unequivocal evidence of gains in the final assessment in those using the system, there was evidence of other forms of learning. Students learned from seeing each other’s work, from having to ‘write’ down their ideas and share them with others and they adopted learning styles that were beneficial to learning a theoretical subject matter. Using a Learning Styles Inventory Scale, those using coMentor showed higher levels of deep learning and significantly higher levels of strategic learning than those who used the system little.”

My pilot course with philosophy was not so good in teaching philosophy or learning to think. The coMentor system was, according to Gibbs, quite a good success, not only for learning philosophy, but more learning to learn and on developing the learner’s learning strategies.

Because I found out that the polytechnic students were quite empiricist-oriented, I found an article about students’ learning profiles and teaching methods at polytechnics (Määttä 1995). In the beginning of the new polytechnic reform (years 1992–3) the teaching was mostly quite traditional (lecturing and guided traditional forms 73,8% of all learning in business departments). This was a little bit surprising, because the aim was to teach more through self-directed learning method. Korhonen (1995) studied the learning styles of polytechnic students using Jaakkola’s (1988) and Ropo’s (1984) classification. The benefit-directed and practice-directed learning styles were the dominating styles among business students.

I think that the result are very much the same kind as I have found. I tried to understand the differences between these learning styles and epistemological learning styles. I noticed that these learning styles were almost the same as empiricist learning style in my study (of course not exactly the same).
I studied with polytechnic-level students and how they learned computer-logic. I found out that most students couldn’t learn through deductive reasoning (rules of logic). Most students learn better with more empiricistic methods, where computers can help as tools. Malinen (1993) studied quite the same issue with young students; can Finnish elementary school pupils think logically? He noticed that “the weakest reasoning (approximately one fifth) did not have any clear model of thinking. Most pupils were uncertain in their inferences and occasionally formed situation-specific models of thinking, using causal or analogical explanations. Only about one quarter of the pupils made logical inferences in the majority of situations. … The pupils’ deductive reasoning also fairly generally involves content-specific thought, which is also acceptable in teaching on constructivist lines.”

The results were the same kind as I got. For most students (even in higher levels) nowadays it is impossible to use deductive reasoning with rules of logic. Of course I accept flexible ways of getting information. It is possible to use deduction, induction, analogical reasoning, creative thoughts and various combinations of these. But if a learner can successfully use all of these methods, then a learner’s metacognition is advanced and learning process can be well managed.

In adult learning, it is not only getting information, but also participating in that process (Hakkarainen 2001). Especially adult people want to know the value of some knowledge in their own life (Hakkarainen 2000, Brown and Duguid 1999). That is why for example, mathematics and logic are very difficult to teach to adults (I think what is written here for adults nowadays concerns also younger people). Referring to Boland and Tenkasi (1995) the networks should not be used for spreading out information, but for supporting communities of knowledge and reflecting the experiences; for making perspective and taking perspective in communities of knowing.

The Internetix learning environment pedagogues had said that important theory for them has been (they have followed in designing process) Howard Gardner’s theory about multiple intelligence MI (Gardner 1983, Sarja 2002, Uusikylä 1996). Gardner’s book, “Frames of Mind” enlightens to many experienced teachers, to the fact that we have students who didn’t fit the mould; we knew the students were bright, but they didn’t excel on tests. Gardner claims that there are several different kinds of intelligence. We would look at what they could do well, instead of what they could not do. Gardner introduced seven different kinds of intelligence:

1. **Linguistic** intelligence: a sensitivity to the meaning and order of words
2. **Logical-mathematical** intelligence: ability in mathematics and other complex logical systems
3. Musical intelligence: the ability to understand and create music
4. Spatial intelligence: the ability to “think in pictures”
5. Bodily-kinaesthetic intelligence: the ability to use one’s body in a skilled way, for self-expression or toward a goal
6. Interpersonal intelligence: an ability to perceive and understand other individuals – their moods, desires and motivations
7. Intrapersonal intelligence: an understanding of one’s own emotions

The theory of multiple intelligence suggests that there are a number of distinct forms of intelligence that each individual possesses in varying degrees. According to Gardner, the implication of the theory is that learning/teaching should focus on the particular intelligences of each person. For example, if an individual has strong spatial or musical intelligences, they should be encouraged to develop these abilities. Gardner points out that the different intelligences represent not only different content domains but also learning modalities. A further implication of the theory is that assessment of abilities should measure all forms of intelligence, not just linguistic and logical-mathematical. Gardner (1983, p. 390) describes how learning to program a computer might involve multiple intelligences: “Logical-mathematical intelligence seems central, because programming depends upon the deployment of strict procedures to solve a problem or attain a goal in a finite number of steps. Linguistic intelligence is also relevant, at least as long as manual and computer languages make use of ordinary language...an individual with a strong musical bent might best be introduced to programming by attempting to program a simple musical piece (or to master a program that composes). An individual with strong spatial abilities might be initiated through some form of computer graphics – and might be aided in the task of programming through the use of a flowchart or some other spatial diagram. Personal intelligence can play an important role. The extensive planning of steps and goals carried out by the individual engaged in programming relies on intrapersonal forms of thinking, even as the co-operation needed for carrying a complex task or for learning new computational skills may rely on an individual’s ability to work with a team. Kinaesthetic intelligence may play a role in working with the computer itself, by facilitating skill at the terminal ...”

If I think about a normal teacher designing material for Internet, I see it quite difficult to adapt all those different types of intelligence. But I also want to adapt a little of Gardner’s theory in my future designing process (perhaps not so much in this research). Musical and spatial intelligence is very important when students are building www-pages. Also my tasks nowadays overemphasise linguistic intelligence. The way Gardner in-
Introduces theory about different intelligences is not exactly different learning styles, but quite close to that concept. And I think that if a learner is good at some type of intelligence, it is a good starting point, but to be a better learner that learner should also train other kinds of intelligence.

Learning strategies refer to methods that students use to learn. This ranges from techniques for improved memory to better studying or test-taking strategies. For example, the method of loci is a classic memory improvement technique; it involves making associations between facts to be remembered and particular locations. In order to remember something, you simply visualize places and the associated facts.

Some learning strategies involve changes to the design of instruction. Research on metacognition may be relevant to the study of learning strategies in so far as they are both concerned with control processes. A number of learning theories emphasize the importance of learning strategies including double loop learning (Argyris 1984).

Metacognition is the process of thinking about thinking. Flavell (1976, p. 232) describes it as follows: “Metacognition refers to one’s knowledge concerning one’s own cognitive processes or anything related to them, e.g., the learning-relevant properties of information or data. For example, I am engaging in metacognition if I notice that I am having more trouble with learning A than B; if it strikes me that I should double check C before accepting it as fact.” Flavell argued that metacognition explains why children of different ages deal with learning tasks in different ways, i.e., they have developed new strategies for thinking. Metacognition has to do with the active monitoring and regulation of cognitive processes. Metacognition is relevant to work on cognitive styles and learning strategies in so far as the individual has some awareness of their thinking or learning processes.

At Internetix (Sarja 2000, Harris 1995) they see that learning in a network environment should be much more than surfing or gathering information. The following seven different methods are based on Judy Harris’ article:

1. Information gathering should mean solving problems
2. Electronic process writing: to see things in different standpoints
3. Periodical creating: one writes an article and others are continuing that writing process
4. Parallel problem solving: groups solving problems and comparing to other groups
5. Virtual meetings
6. Simulations
7. Social activation
I have noticed all these methods important in my teaching. The first principle is always important, because otherwise we just surf and learn all kinds of irrelevant facts (see Section 4.3). The other methods my students have used, for example, on the EU-project (Section 5.3 — the students decided mostly the working methods) and on the accounting information system course (Section 4.7). But on my normal courses I mostly stress the first method, because virtual meetings and simulations, in my mind, are more suited to the advanced learners’ methods.

Tests at virtual learning environment could be (Karjalainen 1995):

1. **Natural tests**: real problem solving
2. **Simulated tests**: tests imitating real problem solving
3. **Transforming tests**: like natural tests but imitating reality
4. **Traditional tests**

I don’t know why tests are important at all in a virtual environment, because if we use, for example, Harris’ methods presented above we could evaluate the learning through that process. In the previous Section I argued that in network-based learning it is important to give an opportunity for the students to create new material, which perhaps in the future other students may use. In some of my projects the students designed almost all the material. In the main project the students designed only a small part of the material or nothing (mostly just their own home pages). In new learning environments there are automatically always possibilities for students to create their learning products so that also others can see them (see Section 6.8). The way of learning is important because:

1. For the students creating new material means that they experience learning as their own project (this increases the metaphoric point of view and that way creativity)
2. Future students probably understand this material better (see Vygotsky Section 2.7)
3. Teacher gets better feedback on what the students find interesting in a course

But when students are designing learning material also it has problems:

1. They don’t know educational objectives. Students perhaps know only details
2. Their products aren’t technically good enough (pages don’t work etc.)

I use normally in students’ evaluation process their learning products (Chapters 3, 4 and 5), but I also want to test my students with so-called “concept tests”. Student’s learning products are the most important thing, but with that test I only check, that the students
have understood the main concepts (so I’m not only testing the students but also my own teaching success).

Koivisto and Ilomäki (2001) studied the use of information technology in secondary level vocational education in Helsinki. Mostly the information technology was used for seeking information from the computer-network. Technology was not used for collaborative knowledge building. The students continually got more information about technology equipment, but there were very few machines for only teachers in their working rooms. This was especially the factor, which prevented the efficient use of information technology.

I agree with the critique, because the teaching is not only a technical action. It is also a matter of the teacher’s learning action. Efficient teaching requires that the teacher not only know the programs functions, but also is able to design the learning tasks for students.

6.2 Networked learning

Teachers and students use Information Technology in different ways (Ilomäki et al. 2001). The differences were found in a study in Helsinki elementary and secondary schools. Most teachers use IT as a tool for working. To most students, IT means more a life style. Also, there were differences between men and women. For male teachers and students it was easier than female ones to use IT.

McKenna (2001) says that learning strategy is decoupled from programming style and the hypothesis that women are more likely than men to prefer a concrete style of programming, is tested by means of examining responses to practical examples of concrete and abstract styles. The responses show that there is no significant difference between women and men in their attitude toward a concrete style of programming.

Vescoukis et al. (1999) wrote that when the students themselves produce more learning material for the lesson, this motivates the learner’s to learn and it gives better user-enriched educational material. The writers continue (p. 220): “Concerning the use of networked technology, it is found that when network learning is viewed as a tool that plays a complementary role in the learning process, most of its shortcomings disappear, while practically all of its benefits are still evident. Concerning the learner-centered approach of the hybrid learning environment, it is seen that students like acting not only as passive entities but also active constructors of learning material”.

I have also found the same thing: when learners produce their own material, they are more motivated and learn better. And if I can use that material for the next students,
they find it easier to understand than some other material made by a more experienced writer. Perhaps I have to refer here to Vygotsky (see Section 2.7). He wrote about the concept “zone of proximal development”. Students understand material better, which is closer to their own thinking and developing level.

Manninen (2001, p. 68) argues an important thing concerning time and learning through network. Though we can use the network any time we want, we have to have a timetable for learning and doing the learning tasks.

I have noticed the same problem with students’ learning in the so-called “evening-courses”. They work in the daytime and study in the evening (having lectures). We nowadays try to shorten the time they are studying in our institute offering some parts of the courses in the network. Students have complained about an impossible timetable. The students don’t have any extra time, so if they send their answers for the learning tasks, the results are not at all good (most students didn’t send the tasks during the first year of the new “network-based system”).

Though the aim of the learning environment is that the learner is self-steering, there is a need for a good guiding and supporting system. The learning process should be supported (Kiviniemi 2001).

Nevgi and Tirri (2001) studied the factors, which supported and prevented the network-based learning in the Helsinki University virtual learning environment (HEVI). The students and teachers thought that mostly the network-based environment supported the learning (the teachers thought this more than the students). Teachers’ feedback was a very important factor in the students’ reflection on the learning process. The results also showed that there should be a more learner-centred environment to support the individual differences.

Just as the learner constructs genuine learning, so are the portfolios, which provide a direct indicator of students’ experiences for themselves as well as for other stakeholders, teachers, parents, evaluators, and employers (Bergman 1999, p. 17). The Internet has opened the pathway for a new learning and assessment environment, which can be made visible in the digital portfolio. Through digital portfolios (Kankaanranta et al. 1999, pp. 211–242; Tynjälä 1999a) we have an opportunity to take a look at expertise in different fields, at its construction and development and underlying factors such as education, usual work tasks and processes, collaborative relations and future prospects. New technologies seem to create a portfolio environment that encourages creativity, experimentation and innovation. Also the view of expertise proved broad in digital portfolios. The digital portfolios enriched the communication, evaluation, self-orientation and whole learning process (Niguidula 1993, Kankaanranta 1997, Karimäki 1999).
The benefits of electronic portfolios over traditional paper-based portfolios are as follows (Barrett 1998 and 1999, pp. 45–46):

1. They make student work in many media accessible, portable, examinable, widely distributable
2. They make performances replayable and reviewable
3. Hypertext links allow clear connections between standards and portfolio artifacts
4. Creating an electronic portfolio can develop skills in using multimedia technologies
5. A teacher with an electronic portfolio will be more likely to have students with electronic portfolios
6. It is easier to manage the portfolio process, especially storage, presentation, and duplication

The digital portfolios give much more flexibility in the learning process, especially if I study that issue through different learning styles (not only epistemological learning styles). Pictures, figures and voices give many students better ways to express themselves. I have suggested that our secondary level students should report their learning tasks on work periods through digital portfolios and perhaps even produce a graduate learning report as a digital portfolio (that change was later carried out). I have noticed that some students have problems in writing text, but many of those can express themselves with metaphores etc. So they have tacit knowledge, but they can't put it in explicit form. I'm sure a digital portfolio helps in this problem and in communication with employees (learning at work) the digital portfolio gives better opportunities.

What is an information society? I'm not going to make an analysis of the information society, but technically information itself isn't, in my mind, the answer to successful learning. K.S Gill is critical of the information society (1997, 5–12): “One of the paradoxes of the information society is that while knowledge is seen as the new social and economic resource, the techno-centric focus of technology lends to homogenisation and standardisation of communication. This techno-centric view of innovation tends to eliminate diversity, thereby limiting the potential of new technology as a tool for knowledge transfer and cohesion. … We need a new vision of information society, which seeks social cohesion by promoting a culture of shared communication, values and knowledge, seeking coherence through valorisation of diversity. … The tacit dimension of knowledge needs to be brought back into the broader knowledge base as a way of preparing individuals to master the technology, rather than technology mastering them.” Gill continues (1997, 39) “The human centred model of cohesion promotes a social dimension of
information society and builds upon the notions of communication and learning. Central to the social dimension are the notions of the ‘learning society’ and ‘valorisation’ of diversity. The idea of the learning society centres on transfer knowledge and sharing of experiences. Knowledge society is more than information society, it is about the transformation of data into information, and information into knowledge, knowledge into action and action into wisdom.”

I agree with Gill’s critique. In education, we must stress the active use of knowledge to actions. And we must also use active social co-operation through the network. I stress also the understanding of the information we seek from networks. If the information is connected with the learner’s own experiences, I think the understanding will succeed better.

6.3 Vocational education

I have studied this issue from a single learner’s point of view and studied mostly how the learner works with quite small tasks. The reason for this was the fact that I teach mostly elementary computer courses and there we must first study elementary knowledge with small tasks. But when we want to teach the students to be vocationally capable in working life, we have to study education from a broader point of view. In my mind, a good standpoint for studying network-based learning in vocational education is Aarnio’s and Enqvist’s studies.

Aarnio and Enqvist (2001a, 2001b, Aarnio 1999, Enqvist 1999) say that a learner’s own activity and working is the starting point for all successful learning. Why is it that often the student’s enthusiasm just disappears? They think that teaching is in most cases too far from the learner’s own thinking; there is no bridge between concepts, acts and thinking so that the learners are able to understand the teacher’s aims. They ask how it would be possible that a teacher just assists and supports the learning process. They say that learning through the computer network changes the teacher’s work. The change is a long process. No one is a good teacher at once. You have to carefully study the learning process and develop yourself professionally in order to be able to assist in the learning process. The learner should be active. Aarnio and Enqvist suggest a dialogic knowledge construction as the crucial issue in network-based learning in vocational education. They call their model the Diana-model. They define the concept dialogue; so that is means that people can equally participate together in the thinking process and become familiar with some issue or act.
The Diana model means (Aarnio et al. 2001b):

1. Learning is authentic problem solving and the problems are real working life problems
2. Problems are solved in a dialogue between learners and teacher
3. It is important to together decide the aims, schedule, communication ways and other matters
4. Teacher helps the students to co-ordinate the learning tasks to real working life and technically assists the information seeking
5. Learners define their own conceptual tools for the problem solving

I agree with Aarnio’s and Enqvist’s standpoints in the Diana-model. I have studied network-based learning from a different point of view, but Aarnio and Enqvist are right that learning should be thought of in a totally new way. I have done quite small tasks in network-based learning (except the Open to Europe project Section 5.3) and mostly I have decided the tasks (even some details of what students should study). My courses have mostly been first year courses (for ex. what is Internet). So I think that many students also like that I guide them more than third year students. But when it is matter of more sophisticated issues, the standpoints of Diana-model are good. Aarnio and Enqvist stress the learner’s own activity. That of course also means that the learner can do it in his/her own way (including learning style).

I claim that the teacher should also be aware of different ways of learning. The change from traditional teaching to more network-based learning changes the learning styles, but I am sure that there will be different ways of learning (or perhaps even more variations of learning styles than nowadays). If the traditional teaching has stressed more empirical learning style teaching, the Diana-model changes the teaching a little bit to metaphoric (dialog) and perhaps also to a rationalistic (own conceptualising) direction. In my mind the Diana-model enriches the learning process. In Section 6.5, I’m also a little critical of the use of the Diana model in all kinds of cases.

In vocational education, the meaning of the education is to learn some occupation. And more and more that means a combination of theoretical and practical things. In Finnish secondary level vocational education, there is not only teaching at school but also teaching at work in obligatory periods working at work places. And it is not the only intention, that the students just go to the work places, but also that they do certain learning tasks in working periods. I participated in a project supported by Opetushallitus (Tietosuomi 1999), where we built virtual learning tasks for the working periods. In my mind, that kind of learning enables a more flexible way of performing the tasks.
The follow-up project is building an even more sophisticated database for the learning tasks, which enables communication between student, teacher and work place contact person. My idea was also to enable performance of tasks in a flexible way (for example to enable the use of different learning styles). Referring to Kolb (Section 2.8) it is important that we combine theoretical issues with observations and even make it possible to enable innovations. I think it is possible for some young students that they can even give some new ideas to their training work places. The idea is that the students are training all of their training periods (half a year in 4–5 times during 3 years) at the same work place. I suggested that the students should make a multimedia report in www-pages. It should be possible for all kinds of information (text, pictures, music etc.). Nowadays, students just make their reports in a certain form and tell the same things in teachers’ given tasks. The www-form, in my mind, enables a more flexible way to show your learning. And I think, referring to Nonaka (Section 4.1), that that kind of reporting gives better learning (including different learning styles).

Aarnio, Enqvist and Helenius (2002, Resnick 1987) say that schools have been criticised for living their own life as isolated islands and not caring about outside society. Then learning at school is different from other learning. They also use the term authentic learning, which means real and true learning. This means that the learner him-/herself can study some issue. The prerequisite for authentic learning is that we create dialogue (Taylor 1995). An outside given knowledge is not real knowledge, because the connection between reality and learner’s creative activity is missing (Hannula 2000, p. 93). Hakkarainen (1998) proved that even quite young people are able to handle knowledge in a scientific method. In the dynamic learning process the first inexact questions become exact through both theoretical knowledge and practical experiments (Bereiter and Scardamalia 1996). Kearsley (1996) claims that the most important feature of www-environment is that the border between school and real life disappears. Salomon and Perkins (1996, 116–122) think that computers allow some opportunities for learning: effective learning, if learners are actively committed to seeking and working with the information. And learners could have social interaction and distribution; situated, generalised and self-regulated learning is possible.

Vygotsky Aarnio, Enqvist and Helenius (2002 pp. 36–54; Vygotsky 1978, pp. 84–91; Bullen 1998; Harasim et al. 1995; Muukkonen et al. 1999; Brown et al. 1989; Dillenbourgh 1996) use the concept “zone of proximal development”. In network learning this means; a teacher should follow students’ working and dialogue in the network and through that process notice what kind of guidance and support they need. It is a matter of the idea of scaffolding (right time support). That means that the students should
have enough support so that they manage to perform the complex learning tasks, but no more. To be successful, this is a very demanding learning process and needs much for the learning dialogue. Dialogue is not just discussion (Aarnio et al. 2002, Bohm 1996). Dialogue is a dynamic process, which can be divided into certain stages. With dialogue we build new knowledge.

I agree with what Aarnio, Enqvist and Helenius say about network learning. They said that learning tasks should be quite large and during the learning process the dialogue guides the learning. I mostly studied learning with small tasks. The small tasks are good when we study some elementary technical things, but when we study more sophisticated issues, I agree that the suggested process of dialogue is better. I quite failed to guide the learning process in the pilot project (Chapter 3). In that philosophy course, the principles of dialogue would have been very good for guiding the learning process.

What I claim is that in the process of dialogue all the learners don’t behave in the same way. The learners with metaphoric learning style want to have more personal contacts and the learners with rationalistic learning style in most cases even avoid being guided (they think their ideas are good enough – why do they need dialogue process). And the learners with empiricistic learning style many times want more guiding. I think one important thing, that the teacher should be aware of is the differences between learning styles. Most advanced teachers have noticed that difference, and I think in network learning that thing is even easier to take into consideration. But if we succeed in putting learners with different learning styles working together, I’m sure we get better learning results (referring also to Kolb and Nonaka).

Hendry and Caley (1999) say that traditional vocational developing trust in technocratic model, where knowledge is got and updated and it can be used in well-formed problems. The traditional model is not based on learner’s needs. Nowadays we can’t trust in certainty and stability. Instead we need to understand the contextual situation in learning at work. Araujo (1998) says that the limits between working, knowing, learning and making innovations are disappearing. Järvinen A. et al. (2000) have studied the influence of organisational structure on learning. They noticed that hierarchical structure prevents learning. Instead working in teams enabled young workers to develop themselves at work.

In my mind, close co-operation in the training periods between work place personnel, teacher and student will do the same. The students should not only report about some formal facts, but also some non-formal things at work. I think this performs best in at www-based multimedia reports, when students not only write about facts, but also write about what they felt and what problems they had.

Epistemological Learning Model   149
6.4 Designing programs

In the previous Section, I argued that in network-based learning it is important to give opportunity for the students to create new material, which perhaps in the future other students may use. In some of my projects, the students designed certain parts of the material. In new learning environments there are automatically always possibilities for students to develop their learning products so that also others can see them. This method is important because:

1. For the students creating new material means that they experience learning as their own project (this increases creativity)
2. Other students understand better this material than advanced educators’ learning material (see Vygotsky Section 6.2)
3. Teacher gets better feedback on what the students find interesting in a course

But when students are designing learning material that means also some problems:

1. They don’t know educational objectives. Students perhaps stress details
2. Their products aren’t technically good enough (pages don’t work etc.)

In Section 4.2 I tried to think about principles, which have to be taken into consideration when designing educational programs. In Chapter 4, I mentioned some problems when designing www-pages. I have to admit I took the wrong standpoint; designing an educational system is different from, for example, designing an office system:

1. The working process is at least as important as the learning products
2. The products mostly have free form (not traditional data-bases)
3. The communication in the system is more important than in many traditional systems

According to Walsham (1993) the key points of strategy, evaluation, designing, development and implementation have developed in a persuasive way and interpreting Giddens:

1. The design of an IT-system is a social and political process, where formal rational mechanisms play an important role
2. The IT-systems and formal rational mechanisms are the standpoints of the organisational context, and this context is not neutral; the individuals and the groups can mobilise and have benefits for that context in order to have an effect on final products and legalise privilege decisions and acts
3. The designing process of IT-systems strategy has a dynamic and reciprocal causal relation with inner and wide contexts, where processes are embedded

150  Epistemological Learning Model
Klein and Lyytinen (1985) argue that the managers should explain how their standpoint differs, when designing adp-systems, from the way adapted in a totalitarian communities. In designing adp-systems, the systems should be designed with people for people to people.

In educational institutions these problems are also acute:

1. In institutes there are one or perhaps a few adp-experts, and they form an alliance with the head of that institute. Mostly because of this fact the educational systems become quite technically oriented
2. In bigger educational concerns, the adp-systems are too centralised on the adp-support department
3. In governmental and ministry level they build very large systems, which also are too technically oriented. In fact I have noticed, that many times they build systems and then they want to test if those systems are suitable for education.

I think a better adp-policy would be such kind teachers build very small prototype systems (with students) and those systems are tested in learning situations. If the systems are good, then the adp-experts help to build better systems. Nowadays there are easy tools for building www-pages. This is no problem at all. Too often the learning courses for the Internet are built for the final heavy version at once without testing it in a real learning situation. And too often these systems are minor failures.

Orlikowski and Robey (1991) have argued that the adp-systems are not only objective things, but there are also subjective features. And the adp-systems are not only technical systems, but are also socially constructed. This fact should be clear in educational systems, but it isn’t.

Basden (1994) also criticised the naive model, that provision of technological features will lead to success when the software or hardware artefact is applied. He refers to Hart’s taxonomy in understanding an information technology artefact and its implementation in the working environment, and he proposes three levels at which benefits accrue:

1. Feature benefits, which are advantages that arise from technological features of functionality and user interface
2. Task benefits, which arise from using the artefact to support a task, and include, for instance, greater speed in arriving at an initial estimate of cost and greater ease of refining the estimate
3. Role benefits arise from the effect the artefact has on the roles or how the user fulfils or hinders certain roles
Then Basden (1994) introduces a model of the effect of inserting a technological artefact into a working situation:

1. Provision of technological features enables their use
2. Use of features supports, hinders and changes tasks
3. Carrying out tasks helps fulfil or hinder certain roles
4. Fulfilling useful roles brings success

In educational computer systems this means, that you have to understand how learners are learning with those systems. When they have a certain task, how are they working with it? Does this working support learning or is the working only, for example, mechanical writing of required answers. Referring to Kolb’s learning model we have to understand the whole process, not only some details. Does the system support learning process?

Ciborra and Lanzara (1994) write what groupware systems mean for an organisation, but what they write also suits educational systems. The writers in describing a new, post modern style of systems development, oriented to change and innovation rather than to the reinforcement of existing routines, suggest that “designing a system means, to a large extent, changing and restructuring the institutional bonds and background conditions upon which, even at the microlevel, people establish and enact their practical dealings and relations”. In other words, designing groupware applications has very much to do with re-thinking and re-enacting what we have called “the structure of care”.

I think that we should not create large technical solutions for education, but think of how we can support learning with computers and how we can get better learning with computers. Of course we have to understand how we evaluate certain learning task without computers, but we have to also think of whether we could change something with computers and are we able to prepare a more innovative learning environment.

I am not against big national or international educational computer systems, but referring to my own empirical studies those systems have limitations: if material is based on deductive structure of learning material, then we could achieve only limited results with empiricistic or rationalistic learning (style). That suits technical and natural science issues. That environment is not very creative and it won’t support learning to learn functions.

Big national and international systems are good, when they are large information retrievals, meeting places for learners or there we could find good multimedia material. I later call this level “Global learning material level”.

152 Epistemological Learning Model
Educationally, a better level for good computer systems is when teachers (or educators) meet the learners. Then we could think of what the learners should learn or how they should learn. In my mind, learning environments (for example in Internet) should be designed with a step-by-step method (that was the method I worked on). Then we could see what and how the learners are really learning (referring to Basden the success of roles and tasks is the most important). Designing learning material in Internet is continuously becoming easier, so I hope teachers and other educators is build more learning material in the future. I call this level “Pedagogical level”.

But there is also a third level: “the student’s learning level”. More and more in interactive learning environments the students are building material for themselves, for evaluation and for the future students (this feature insists automatically in learning environments – see Section 6.7). That is also interesting, but I think that the second level is the most important, because that pedagogical level binds together both global and students’ level learning material.

1. Global learning material.
   Material which is not designed for concrete learners.

2. Pedagogical level.
   Material which is designed for certain learners and tutors the learning process with human way.

3. Student’s learning level.
   Learning products.

**Figure 12 Own model about learning levels**

### 6.5 Pragmatic constructivism

I understand learning in an information society as surviving in society. Learning is to me, a pragmatic thing. We use information and theories as tools, as we use machines and other tools in working with concrete things.

Education and educational theories have changed a lot during the last decades (Panzer 2001). The technological change has been very fast. Many times the reason technology hasn’t been taken into use has been old teaching plans or the fact that teachers prefer good
old pedagogical solutions. The pedagogical theories influence how and what technological solutions we use. First, computer aided learning solutions were mostly based on behaviourism. Then some applications were based on artificial intelligence theories and information processing theories. Now computer network learning solutions are mostly based on constructivism (of course many solutions don’t have a conscious theory base at all).

But there is not only one interpretation of constructivism. The main standpoint of constructivism is that a learner’s learning is always an individual process. Indeed there are at least three different interpretations (Pantzar 2001, pp. 114–117):

1. Radical constructivism.
2. Social constructivism.
3. Pragmatic constructivism.

Pantzar says (2001, pp. 114–115; von Glaserfeld 1989, 1999) that radical and social constructivisms seem to differ more than expected (because theories have the same epistemological background) in adaptation in learning process. According to Pantzar, dogmatic radical constructivism won’t accept any other learning than direct learner’s observation. That means lot of difficulties in network-based learning. In radical constructivism the responsibility in learning is always on the single learner. Constructivism denies metaphysics. The title of von Glaserfeld’s article tells the truth; “knowing without metaphysics” (my own comment: denying metaphysics also metaphysical statement). Von Glaserfeld defines radical constructivism with the following two basic principles:

1. Knowledge is not passively received either through the senses or by way of communication, but is actively built up by the cognising subject.
2. The function of cognition is adaptive and serves the subject’s organisation of the experiential world, not the discovery of an objective ontological reality.

Even the name of social constructivism tells the standpoint of that interpretation (Pantzar 2001, pp. 115–117). In social constructivism the learning process means that learners are processing information together. Pantzar asks whether, in social learning, a single learner’s observation is direct and whether a single learner truly adopts other learners’ knowledge structure.

Tynjälä (1999b) says that the starting points of constructivism are the ideas presented by Kant, Dewey, Piaget, Vygotsky and Engeström (and many others). Radical (cognitive) constructivism is based on Kant’s and Piaget’s ideas and social constructivism is based on Vygotsky’s ideas. In social constructivism the reality is the social construc-
tion produced in interaction between individuals. Tynjälä also says (1999b, pp. 56) that constructivism denies the fundamental epistemological question; how do we get right knowledge (empiricism or rationalism)?

To me, denying the fundamental epistemological question doesn’t sound very smart. And I think that Tynjälä should mean that social constructivism denies that question. Radical constructivism is based on Kant’s and Piaget’s ideas, and I can’t understand that we should not think then epistemological questions, because of Kant’s and Piaget’s thinking was based on epistemology.

I wanted to re-check Tynjälä’s writing about the epistemological question, and I found, in Winch and Gingell, the following sentences, which prove, that only social constructivists deny the epistemological question. Winch et al. (1999, pp. 42) argue that “Constructivism is a set of related doctrines about learning. Conceived of by Piaget as a way of incorporating the best insights of both empiricist and rationalist accounts of learning, it develops the Kantian claim that information from the world is arranged by our psychic constitutions into a form that is intelligible to us.”

Tynjälä says (1999b, pp. 61–67) that standpoints of constructivism stress:

1. The learner’s own activity
2. The learner’s own knowledge is the base for new knowledge
3. The development of metacognitive skills (self-regulation)
4. Understanding is more important than learning by heart
5. Taking different interpretations into consideration
6. Not stressing facts but problems
7. Taking the context of learning into consideration
8. Developing a diversified representation (transfer)
9. Social interaction
10. Developing new evaluation methods
11. Showing the relativity and way of producing knowledge
12. Developing teaching plans

Jonassen (1994) proposed that there are eight characteristics that differentiate constructivist learning environments:

1. Constructivist learning environments provide multiple representations of reality.
2. Multiple representations avoid oversimplification and represent the complexity of the real world.
3. Constructivist learning environments emphasize knowledge construction instead of knowledge reproduction.
5. Constructivist learning environments provide learning environments such as real-world settings or case-based learning instead of predetermined sequences of instruction.
7. Constructivist learning environments "enable context- and content-dependent knowledge construction."
8. Constructivist learning environments support "collaborative construction of knowledge through social negotiation, not competition among learners for recognition."

The roots of pragmatic constructivism are the thoughts of James and Dewey (Pantzar 2001, p. 117; Dewey 1938). They both stressed that in learning both the aim and adaptation are important. Dewey stressed the idea of learning-by-doing. The function of learning is to help the individual to survive. Learning is only a tool in adaptation process. In Finland the standpoints of pragmatic constructivism has presented by Johan von Wright.

J. von Wright (1996) said that traditional learning psychology stressed to teaching skills in all kinds of learning. It then rejected behaviourism and focused on teaching concepts, experiential learning, creative actions etc., but forgot the central meaning of skills in individual actions and teaching of those skills. Constructivist standpoint doesn’t mean that the role of skills is not important. But in teaching skills, understanding is the most important thing. And a very important misunderstanding with constructivism is, that we don’t need teaching ("lassez faire" – let the children construct the knowledge for him-/herself alone). Von Wright refers to Dewey (1938); that the teacher should guide construction processes, otherwise a lot of wrong decisions will be made – “the self-regulation is the aim, not the starting point”. The key concept is the understanding. But a prerequisite for understanding is always a broader context, how we understand the concept, event, action etc. A teacher should be aware of how students are sketching the problem: what do the students see as the problem, to which questions they seek the answers.

One of the oldest and most difficult problems in educational research is transfer (von Wright pp. 17–21). The study of transfer was almost forgotten for many years, but
now it is becoming again an actual thing. Behaviouristic theories were focused on skills learning and transfer. On psychomotoric skills it still seems to work. On conceptual interpretation transfer seems to be much more; understanding. Certain concepts and our actions become automatic and our thinking gets tacit knowledge. Critical thinking develops when we train it in many connections and many ways. When we learn metacognitive skills and self-reflection we have to be ready for new problems and to meet new challenges. There have been a lot of studies about problem-solving transfer. Essential in that problem solving is to promote active transfer when starting the learning process: encourage making experiments, trying to seek analogies, new ideas and give reasons for the ideas. A detailed teaching plan, teaching with well-structured, specified knowledge, and guaranteeing that students understand teaching in the same way is a little bit strange from the constructivist standpoint, but anyway von Wright says that those things are necessary in teaching process.

Davson-Galle (1999) criticises “the subjectivist/sceptical/solipsistic philosophical theses that make constructivism seem inimical to science’s assumptions of an external world that is cognitively accessible to us.”

Davson-Galle comes from analytic philosophy interpretation. I don’t accept that interpretation, but what is important is, that he criticises the way radical constructivists see learning, pedagogy and scientific theories. A constructivist has to build everything for him-/herself, and not accept any given theories. I don’t accept the subjectivistic standpoint, but I accept that learning is always an individual process. A learner always builds his/her own knowledge, but that learner’s mind is connected with nature and culture.

I here refer to Popper’s theories about 3 worlds (nature, human being’s mind and culture – see Section 2.6). I don’t accept the sceptical thoughts of radical constructivism. Though we build our consciousness, we are still connected with the outside world. I’m not at all sceptical of the outside world’s existence. I think it is quite stupid not to accept what other people have discovered earlier. But as von Wright said, we have to understand what we are learning. So it is necessary, that we constantly ask; why is that thing important?

In Section 6.3, I presented the DIANA-model. That is based on social constructivism. I also wanted to study some application based on radical constructivism. I found many of Haapasalo’s studies about mathematics teaching with radical constructivism method (1991,1992). He writes (1993): “One of the basic questions of mathematics learning, even within constructivism, is the relationship between conceptual and procedural knowledge. ... Because in constructivism the pupil is considered to be a subject who is
actively acquiring, processing and retaining information, it requires us to see acquiring knowledge as a dynamic process which is carried out in a situation which is meaningful for the pupil. Contextual problems, which are interpretable through the mental models of the pupil, can be used for concept orientation. By finding the attributes of a concept the pupil can fix the relevant determinants of the concept. This second phase of the concept building is called concept definition. In the phases of orientation and definition, creative heuristic thinking and productive working by the pupil is needed. In problem solving and mathematics learning, the ability to classify and model situation, and formulate verbal, symbolic and pictorial definitions is probably the most important goal.”

Keranto (1993) also criticises constructivist mathematics teaching: “not enough attention is given to developing the pupil’s thinking and his skills of information acquisition and processing. Instead of just distributing information and teaching ready-made models of solution, the teaching-learning processes should be made more pupil- and problem-centred.”

Leino J. (1993) writes: “constructivism means a big step forward in making teaching and learning process active and seeing knowing and knowledge as problematic. …As a theory of science, constructivism is, in mathematics, much more and older than cognitive psychology or Piaget’s studies and theories of learning. … If we take as the goal in mathematics teaching to develop the students’ mathematical knowledge and, in particular, its meaningful uses in their living environment, it is much more difficult a task for the teacher than just knowing and being capable of presenting certain fixed mathematics, concepts, numerations or operations. …For this reason I have recommended the so-called project study or project method.”

I’m not at all against neither social nor radical constructivistic applications. I think they are very good in certain situations. But I’m especially against the theory base of social constructivism; that knowledge is created only by social interaction. I want to stress a pluralistic epistemology. In my mind, that gives much better creativity in learning (I am not only referring to my own studies, but more to Nonaka’s, Kolb’s etc. theories). In my mind, von Wright and Leino explained the principles of good learning and that is also a good orientation base for designing network-based learning environments. My empirical findings support the importance of different epistemological learning styles. Learners just learn in different ways. I think behaviourism made the learning in very one-sided epistemological model. In my mind, if we only use the social constructivistic model, that might mean similar kinds of troubles (it’s not a big threat, because teachers nowadays have power to carry out teaching in their own way – not with orders from a ministry). It is very good to have different computer-based learning environments.
Many solutions are mostly based on empiricism. I don’t even think that some old applications, based on behaviourism, are bad in learning some skills. The applications, based on social constructivism, are good in supporting social co-operation (and that develops intuitive, metaphoric learning). In my mind it is good, if a learner can use different ways in learning (including different epistemological learning styles). In an information society we have to also teach metacognitive skills in getting different kinds of information. Learning to learn continually becomes more important. It is good, if we can learn knowledge from different sources; we can learn from observations (empiricism), we are able to do analogies (rationalism) and we can learn from social interactions (intuitivism). And I think teaching at a certain level is always necessary for non-advanced learners. I don’t believe that learners find, in all cases, good solutions for all learning situations, just for themselves (for ex. with collaborative method). For many centuries it has been discussed whether we need teaching or not (I refer to Rousseau and Illich 1970, 1972).

6.6 Didactical process

It has been proved that in constructivist learning theories the cognitive strategies and metacognition play important role (Lehtinen et al. 2002). Already adopted beliefs guide our learning process. Many times, wrong beliefs are a barrier to new learning. Dewey (1933) showed that young students made mistakes with mathematical calculation in school but they made no mistakes with the same calculations in the situations (when buying things in the shop). That shows that motivation is in important thing in a learning situation. Lehtinen et al. (2002) argued that those constructivists, who claim that students are able to build large theories for themselves or claim that the teacher should not teach the children theories, have understood the learning situation totally wrong. Reusser (1994) has criticised some beliefs and taboos that have arisen in pedagogical thinking with constructivism:

1. Overstress the meaning of students’ innovations
2. The teachers’ role in the learning situation is only a technical assistant
3. To avoid all didactical tradition concepts

I wrote about the teacher’s role in Section 4.5. I agree with the critique of Reusser, J. von Wright and Pantzar (Section 6.5). We still need pedagogical guiding, but the teacher’s role is changing “From the Sage on the Stage to the Guide on the Side” (Tella 1997, p. 55).
Hakkarainen (1997) and Järvelä (1997) studied how the students learned in a Computer-Supported Intentional Learning Environment (CSILE). Students learned with problem-based learning method. Hakkarainen noticed that the system CSILE itself didn’t mean success. The most important thing in cognitive learning success was the pedagogical arrangement and co-operation between teachers and students.

Lehtinen writes (1997a, p. 38) how we want to learn and seek information through computer-networks, depends on how our thinking has developed. So the computer does not replace the teacher. We have to learn to organise our knowledge and learn to be critical when seeking information on the computer-network.

Lehtinen (1994, p. 62) has defined the learning guiding as; ”such a dynamic action from an adult educator, where the educator helps the learner to achieve independently those learning objectives, which the learner has set from his own needs.” When talking about guiding the learning act, we use, for example, the terms of facilitator, mentor, councilor and tutor. Lehtinen (1997, p. 51) has described the teacher’s and student’s pedagogical relation and its guiding process as a term; “scaffolding”. He writes the following definition: “Scaffolding includes the metaphor of the teacher’s role of the supporter of the student’s construction process. The teacher’s task is not acting directly on the student’s ‘knowledge house’ building, but the teacher should be able to give to the student strategic tips at the right time and guide the student in evaluating his/her own performance.”

The didactical principles are of course the same whether we teach by traditional method or by computer assisted method. Uljens (1997, p. 133) tells of the philosophical starting point of didactical process: ”The psychological question of learning is connected with the epistemological question of what it is to know something. If knowing is to be conscious of something in a specific way, and learning is about changes in this conscious of something, then there is a clear connection between learning and epistemology”. And Uljens continues (p. 135): “the process of learning as an ontological problem. … Assuming that learning is related to a change in an individual’s awareness, the question is how we should describe that change. … The language in which we discuss about a mental state is considered pedagogically relevant since this language gives us the instrument for describing changes in human understanding”.

Then Uljens (1997, p. 137) introduces the ontological model of learning referring to Popper’s theory of three worlds (Section 2.6): ”The analysis of how learning is understood within cognitivism required instruments that were offered by the philosophy of mind. The motive for choosing that level of analysis was that every learning theory specifies, explicitly or implicitly, what an individual is aware of in having conceptual knowledge.
and also how this awareness should be described. Using Popper’s terminology, the
attention of the study is first focused on World 2, i.e. how the psychological reality
should be described (the ontological mind-world problem), and further how this reality is
to be understood with World 1 objects, in this case brainphysiological processes. Second,
we turn to relation between World 2 and World 3, i.e. how the psychological reality
is related to the logical structure of some subject matter within an instructional context.
Observe that as these World 3 objects (cultural products) are manifested in World 1
objects (physical things), the epistemological mind-world problem similarly concerns the
relation between World 2 and World 1 objects”.

Uljens ontological analysis of learning is much better than the strict radical or so-
cial constructivist definition ones. I accept the division of individual learning process
and on the other hand cultural learning material. Learning from computer learning pro-
grams is not easy to explain from a strict radical constructivist viewpoint (I refer to Sec-
tion 6.5). The social constructivists do not explain the learning process in a clear way at
all (how the learning process is at the same time individual and necessary co-operative
action). To that explanation Uljen’s theory is a good answer.

Then Uljens (1997, p. 155) writes about metacognition: “the view that learning is
highly cognitive and occurs within the individual is also evident from the interest that
has developed in meta-cognitive activities, i.e. in higher-level processes in learning. This
interest is primarily focused on individual regulation, planning, predicting and monitor-
ing one’s own learning process.”

Uljens (1997, p. 193) is analysing more the philosophical standpoint of the learning
process: “From an epistemological perspective on the mind-world problem, learning is
close to the assimilative process through which information is incorporated into the in-
dividual’s conceptual structure. In order to discuss how the content of mind changes in
learning, the ontological level was a necessary level of analysis.” And more about that
ontology (p. 195): “Concerning the result of learning in a ontological perspective, all
approaches argue that it should be described on a representational level, i.e. on a lev-
el independent of the physiology of the brain. Learning was claimed to result mainly
in descriptive, propositional and analogical knowledge structures stored in a long-term
memory. The information could be stored as concepts, propositions or schemata. There-
fore the structure and function of different types of memories were emphasised”.

In my research epistemology is an important thing. Uljens (1997, p. 203) is analys-
ing also the epistemological standpoint of learning on a more conceptual level: “The
epistemological mind-world problem focuses on the relation between an individual’s
psychological reality and the (semantic) structure of some external learning content. The
pedagogical problem is how a teacher may influence the relation between an individual’s understanding and external reality in order to assist learning."

One standpoint for this epistemological mind-world problem is what I have studied in my research. When analysing how and what kind of knowledge the learner can and will get, it helps to influence the relation.

From the philosophical analysis Uljens (1997, p. 211) is writing about the consequences in the learning process: “… teaching is not only supporting the increase of new information in the learner’s cognitive system, but also, and rather, to facilitate a change in the individual’s mental representation. The major method of doing this was to turn the learner’s attention to their own model and in various ways to help the learner to reflect upon the differences between it and the goal model … the teacher’s role is both to provide information to be processed and to suggest how it could be interpreted.” And a little bit more (p. 212) about the thing I am most interested in (what directs learning – for ex. learning styles): “as has been shown, the individual is viewed as an active constructor of his representation: cognition directs perception. Although this is generally accepted as more or less self-evident, it seems that the teacher is conceived of as a subject having access to the true picture of the world. … Naturally a teacher is also an active constructor of his or her own internal representation. If both the teacher and the students are in a constructivist position of the world, the question is on what grounds the teacher is given the right to evaluate the correctness of the student’s representation.”

Uljens (1997, pp. 220–222) is finally telling his didactical advice on how the learning should happen. He has quite the same things, as what I have noticed being important in the teaching process (information processing strategy etc.): “As learning is thought to occur as the result of applying the strategies indicated above to different forms of information (concepts, propositions, schemata), a general educational equivalent is to teach effective information processing strategies to students, especially to weak learners (see also Uljens 1989, pp. 59–62). First the teacher has to decide how new information should be structured in advance and presented to the students, i.e. if teaching should be started by introducing new concepts, propositions or schemata. The decisions should be related to the students’ previous knowledge of the subject matter in question. The second major problem is deciding what information processing strategy is the most appropriate for manipulating the information presented. … The concept of metacognition or metacognitive processes reflects an important part of the cognitivist paradigm on learning.”

Uljens was writing about teachers’ decisions, but the same thing concerns designing computer-based environments. Uljens saw the introduction process in teaching as very important. I agree with that. I see it as very important for the learner’s processing strat-
ogy (for different learning styles it is important that the learner understands and accepts the learning task). Uljens stressed the decision of right processing strategy. I agree, but I also see allowing different strategies as important. An advanced teacher allows that, and when we also use computers as tools, we can increase the possible different strategies in the learning process. Learning style is one thing in the learner’s metacognition.

Uljens (1997, 228–231) writes more about metacognitive strategies: “The act of studying can be related to a reflective mode of thinking. We can be more or less aware of what we do in a goal-oriented study process; we can consciously try to apply different approaches or styles or strategies. A study strategy thus belongs to the cognitive domain. It is metacognitive in the sense that the students may direct their attention to the way in which they try to reach competence. … The question of how the semantic and episodic memories are interrelated thus has pedagogical implications. For example, if the teacher is expected to organise meaningful learning environments, then one question is how relevant content (episodes) is chosen from the student’s perspective and from the perspective of the general principles that are the goal of teaching.”

Uljens’ didactic theory is important for my study, because the standpoint is philosophical. Uljens saw the clear connection between learning and epistemology. That I have also found to be important in my study. But the more important thing was that Uljens showed the importance of the ontological dimension. This makes it also possible to use that dimension in my own learning model (Section 6.8).

6.7 Learning environment

There are lot of definitions about what is learning environment. Traditionally (Pantzar et al. 1996) the concept of learning environment meant formal school institutions or even the school buildings. Especially open and distance education have changed that concept. Pantzar defines the concept (Pantzar et al. 1995, 86): “A learning environment consists of the physical, mental, and learning material framework and prerequisites for goal-oriented learning. These can be provided by the organiser of the education or selected by the learner him-/herself.

“Epistemological shifts in the 1990’s have engendered a variety of innovative and provocative learning environments (Land et al. 2000, pp. 1–2). For example, renewed interest in student-centered teaching and learning has yielded a myriad of approaches purported to provide flexible and powerful alternatives to the design instruction. Such environments, tacitly or explicitly, are purported to reflect constructivist epistemology.
They are designed to support individual efforts to negotiate meaning while engaging in authentic activities. Student-centered, learner-centered environments provide interactive, complimentary activities that enable individuals to address unique learning interests and needs, study multiple levels of complexity, and deepen understanding. Technology is frequently employed as a tool to support experimentation, manipulation, and idea generation.”

Wilson (1996) defines a constructivist learning environment as: “a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities” (p. 5). He emphasizes learning environments as opposed to ‘instructional’ environments in order to promote “a more flexible idea of learning”, one which emphasizes “meaningful, authentic activities that help the learner to construct understandings and develop skills relevant to problem solving” (p. 3).

Many of the learning environments described in Wilson’s book are based on similar principles. Wilson has organized these learning environments into three categories: computer microworlds, classroom-based learning environments and open, virtual environments. In the category of computer microworlds there is the simulated work environment for specialized, avionics, electronics, maintenance training called Sherlock. The training system is an intelligent tutoring system designed to “accelerate the development of complex, technical problem skills” (p. 37). It provides extensive practice with coaching through a series of authentic problems which is an extension of students’ actual working environment and which operate at “the highest levels of real world difficulty”. An essential part of Sherlock is “the tools for post-performance reflection” or the opportunities the environment provides for the student to review a record of her problem-solving activity.

In the category of classroom-based learning environments is a collaborative problem-solving project using the “Jasper” videodisc series as designed by the Cognition and Technology Group at Vanderbilt. Young, Nastasi and Braunhardt who served each as teacher and researcher for the study completed the project in the context of a research study. During a period of three months, a group of fifth grade students were involved in a “complex, realistic problem-solving situation” using interactive videodisc technology and telecommunications. Although the specific focus of the problem solving was in the area of mathematics, the content of the problems also involved other areas such as science, reading, writing, physical education and geography. During the course of the project, the students solved three problems, which required planning, information finding and cooperative group problem solving.
The project was described as an experiment in “situated learning” or “situated cognition”. By “situated” is meant, “co-determined by the attributes of the context along with the attributes of the people involved” (p. 121). For this reason, considerable attention was paid to social interactions as well as academic behaviours. An important role of the teachers was to manage and guide the interactions among the groups of students.

While collaboration is an important aspect of the situated learning project, it becomes the primary focus in the CoVis Project, which Wilson has included in the category of open, virtual learning environments. CoVis or Learning Through Collaborative Visualization Project is described as “an integrated software environment that incorporates visualization tools for open-ended scientific investigations and communication tools for both synchronous and asynchronous collaboration” (p. 161). Participating high school students are involved in authentic scientific practice using modified versions of scientists’ tools in a social context including students, teachers and scientists. Communication and collaboration are the central components of the philosophy behind the project. Learning is enhanced by communication with student interactions and conversations resulting in new knowledge, reorganized knowledge or additional understanding. As well, learners are provided with the opportunity to communicate and develop relationships with practicing scientists.

Classrooms are equipped with computer workstations supporting high-speed video and a data network over ISDN, digital phone lines. E-mail, Usenet groups, Gopher, desktop video-conferencing, remote screen sharing and a collaborative notebook are some of the tools students can access as part of the project. The primary component of the project is three scientific visualization environments covering three aspects of atmospheric science. Students can access and manipulate data, generate questions, develop plans for identifying and exploring data as well as create artefacts to demonstrate their findings. Throughout the entire process, students can collaborate and communicate with each other and with scientists to share concepts and viewpoints and to pose questions.

Riesbeck (1996) argues, “Constructivism is not a particular model of learning, however. It does not describe a process or set of mechanisms by which this construction occurs” (p. 49). Nonetheless, Honebein (1996) in his description of two learning environments, Socrates and Lab Design Project, illustrates how constructivist principles can provide a guide or framework to build constructivist learning environments. Drawing on the work of Cunningham, Duffy and Knuth (1993), Honebein explains how LDP and Socrates were designed with pedagogical goals, which provided the theory on which the design of the environments was based. These principles or goals can be summarized briefly as follows:

1. Provide students with experience with the knowledge construction process
2. Provide experience in and appreciation for multiple perspectives.
3. Maintain the authentic context of the learning task.
4. Allow for a student-centered learning process whereby students play an important role in setting the goals for learning.
5. Provide for collaboration
6. Use multiple modes of representation

We need to organise learning environments and activities that include opportunities for acquiring basic skills, knowledge, and conceptual understanding, not as isolated dimensions of intellectual activity, but as contributions to students' development of strong identities as individual learners and as more effective participants in the meaningful social practices of their learning communities in school and elsewhere in their lives. (Gree-no et al. 1998, p. 17)

There are lot of Internet/WWW-based learning environments. A group was analysing (Korte et al. 2000), what were the main features and how the learning environments were suitable for learning. The analysed learning environments were (Blackboard, WebCT, Woppi):

- A&O,
- Blackboard CourseInfo 4.0,
- Lotus LearningSpace Forum,
- TopClass 3.01,
- WebCT 2.0
- Virtual-U.

All the learning environments were based on client/server-solution and they were used through Internet-network, with WWW-browser and with plug-in -programs. In all learning environments there are the similar actors (perhaps with slightly bit different names): a tutor, student and maintainer. There were three different ways of producing learning material:

1. Own editor.
2. It is supported for taking material from other tools.
3. It supports transfer of HTML- and text-files.

In all of those learning environments the real time communication (chat and whiteboard) was possible. The normal not real time communication tools (mail, news and bulletin board) were in all learning environments. News and bulletin board were working quite similarly in all learning environments, but they were called by different names.
The groupware tools could be used in two different ways:
1. The tools gave extra information for other users.
2. Or they supported group working in a concrete way (timetable, file control, group chat and bulletin board).

In all of those learning environments, the knowledge building tools were quite similar. They were provided with learning tasks and evaluation process and the possibility of arranging the learning material in a personal way. There were differences in the registration of the users. Some environments did support registration from already existing student database. All the users had a personal user name and password possibility.

Piukkula (2001) writes that Tampere University täydennyskoulutuskeskus (TYT) is an experienced user of network-based learning environments. They were used from 1996. In the world there are totally thousands of different network-based learning environments. TYT personnel and students have been quite satisfied with the learning environments. In the future, the learning environments will be developed a lot, but also many learning environments just disappear. That is why the Tampere university vice-chancellor Kari-Jouko Räihä said, that there is no need to choose only one environment for network-based learning.

Matikainen et al. (2000, p. 10) defines: “A network-based learning environment is based on hypertext and -media, there is a possibility of interaction (e-mail, news and chat) and it uses different kind of databases … A learning environment can be defined as place, space, community or action practice, which promotes learning.”

The best applications based on information technology are breaking the boundaries of traditional learning plans and tasks (Tirronen 2001, p. 86). And they look more like knowledge building than traditional learning. New technology itself does not mean better results, but the results depend on how we create it with learning culture. The teachers should have enough time for designing the courses and guiding the learning process.

In the 1990’s there has been lot of new virtual learning environments. I have used much material from Internetix (2002, Sarja 2002). That material was only part of my learning tasks. So the Internetix is not, to me, a virtual learning environment. A real virtual learning environment is not only pages and material but also learning tasks and active interaction between learner and educator.

Pantzar (1996) says that sharing learning material in the Internet doesn’t mean a virtual environment. In most cases the concepts and even working methods have been taken from traditional school environments. Virtual learning environment means a much
deeper concept. New environments have seen, in many cases, an end to the monopoly of the traditional schooling system. Even the idea of society without schools (Illich 1972) has had new supporters at virtual learning environments.

Ropo (1996) had analysed the concept learning environment. He said that concept is quite complex (because we could see the formal environment and the environment every learner sees in a different way). Even the best environment gives opportunities but doesn’t guarantee learning. Ropo says that environment should be goal-oriented, complex, authentic and have real learning tasks. The learning environment should promote dialog and give feedback. And environment should give opportunities for self-orientation (so that learner really thinks that learning material is important for him/her).

The Finnish government (Hallitus 1995, Opetusministeriö 1995, Suomi tietoyhteiskunnaksi 1995, Liikenneministeriö 1994) has seen it as very important that the Finnish educational system should give the possibilities of network-based learning. Also libraries have big opportunities in that change. Sarja (2002) says that producing material at Internet is cheaper than traditional learning materials (books etc) and Internet gives possibilities to produce different, complex material (it means of course also problems). Sarja continues that many studies have shown that in traditional learning environment teachers lecturing is about 75% of the learning time; so the teacher normally dominates the learning situation. This doesn’t mean very individualised learning. If material is on the net the teacher could advise students. That means much more individualised learning (though at 45 minute lessons with 30 students, this means only 1.5 minutes per student). The Internet also gives better opportunities for co-operation with other teachers and other students).

My learning environments are not virtual environments, but more traditional environments, which I am carrying out on the Internet. In most situations, I use quite traditional methods. My main motivation for this is educational; I want to give the student more individual learning experiences than with traditional teaching (I refer to what Sarja wrote above).

In the future, one important thing, also in the learning environments, will be the mobile technology network and wireless technology (Ahonen et al. 2003). Mobile learning (mlearning) gives freedom to move and change place. Mobile learning means the combination of distance-learning and mobile technology. There are some teaching experiments with mobile technology:

1. The Helsinki University (HY OTK),
2. The Pedanet,
3. EU-project (MOBILEARN).
Mlearning could give more possibilities in learning environments, but I don’t see that as so important when analysing the pedagogical standpoint. Especially I don’t think that mlearning will change much, if the standpoint is the learning styles. I am afraid that mlearning is concentrated on technology too much nowadays. It is not so important in the learning situation to get information in real-time as having time to process the learning tasks.

I produced one course for myself on WebCt (just a new version of the course Information Superhighways), but I was disappointed because I noticed that I would not get any benefit compared to the way I produce normal course material at www-server. In my courses, students can work as a group, but they don’t need groupware tools. The students can send me the tasks through network, give a floppy disk or just give a paper. I want to give feedback, if it is possible, in a face-to-face contact. So my courses are not in most cases “distance courses”. WebCt meant too much bureaucracy for me with almost no benefit in the learning process. I have noticed a lot of the same kind of difficulties with other teachers in our institute. Many times just a few www-pages for a course would be enough. The students should be introduced very carefully to using the environment. There should be a careful study of the ways that learning should be done. Otherwise the learning will be too technology-oriented (very much work, but almost no learning results). In the next Section I will tell more, on what technology-oriented learning can mean in a learning process. There was great enthusiasm a few years ago about using these virtual learning environments. I won’t say that they are total disappointments, but these environments don’t give enough benefit, if we think of how much work and money we spent in designing those environments. In many learning situations they just mean too much bureaucracy. Many users have had the same kinds of experiments as I. (I refer here for example the discussion which has been held in virtual eOppl.net).

In the last years the learning environment discussion has meant quite much discussion about virtual learning environments. I think if we only discuss about computer-networks and technical issues, we make the same mistakes as traditional learning environment discussion about school institutions and even school-buildings. I refer here, for example, to Pantzar’s definition, that it is not only a matter of physical (or virtual) material but also mental character. In my empirical study I have found it important that the character of learning material and other arrangements influence how different learners learn the learning material.

In the next Section, I want to clarify my thoughts and present my own learning environment model. In a learning environment it is important to see both the ontological and epistemological dimensions. I am not only referring to Uljen’s didactical process.
(Section 6.6) and my own studies, but also to the theories in this Section on learning environment theories, when saying that we have to study new ways of learning from an epistemological point of view. Different ways of learning mean also different epistemological points of view. The problems are no more technical ones, but I think it is more important to put those two dimensions together: 1. how we learn / how we get new information (the core question of epistemology) and 2. how we put the learner and learning material in connection (the ontological dimension).

6.8 Epistemological learning model

I try here to clarify my thoughts introducing a model about what is important in teaching and learning. I refer here to Uljen's book about school didactics and learning (Section 6.7). Uljens referred to Popper's ontological theory about three-worlds (see also Section 2.6). Learning ontologically means how psychological reality (World 2 – learner's subjective mind) is related to the logical structure of some subject matter (World 3 – culture and especially language). World 3 means the concepts and theories, not any physical objects (books, computers etc. – those belong to the mediating element I present). In other words, World 3 is an abstract world. Sometimes no one beforehand knows, what the concepts and theories in World 3 are, because then learning is a real discovery process. These two worlds have their own logic, though they are naturally dependent on each other. I believe in constructivist theory, that learning is always an individual process. In Section 6.5, I criticised both radical and social constructivism. I am not against practical solutions based on these theories, but I am against the ontological (metaphysical) structures of those theories (the ontological structure may lead to dogmatic consequences). Old behavioristic learning theory tried to lead the learner's subjective mind's content from objective knowledge (that is very dangerous, because it may mean some kind of psychological violence).

In this model I don’t want to discuss detailed knowledge but more the character of World 2 and World 3. I mean what the metacognitive character skills of a learner are (learning style etc.) and what kind of knowledge some subject matter is (is it a deductive theory, list of important things, voices, pictures etc.). Of course I am not saying that learning style is the only important thing in a learner's metacognition; there are lot of other important things too. But I am presenting that because I have studied this subject in my research.
To my mind, what to learn and how to learn are dependent on each other, but I showed in earlier Chapters and Sections (both empirically and theoretically) that you can't say explicitly how one learning task should be organised from the subject matter being learned. For example, if I am teaching how to use computers the issue won't tell me the best way to teach. The best pedagogical way depends on both the learner's subjective mind and the structure of the subject matter. There have been many failures just because the best way to learn had been derived from the learning material (behavioristic learning theories especially). Flexibility in building the learning material is a matter of resources (it is very expensive to offer a large number of flexible features). Computers allow a great possibility to build more flexibility in learning environment.

In this learning situation, I want to present a third mediating element: the learning environment. This means all kinds of things that put the subjective mind and the logical structure of some issue together. Referring to Popper's theory, things that belong to learning environment could come from World 1 (computers, books etc.), World 2 (teacher's learning arrangements etc.) or World 3 (learning theories, school didactics etc.). In Section 6.7, I criticised all definitions about learning environment. That is why I want to present my own definition. In the learning environment there are:

1. How the learning situation is organised? Do we use passivating lectures (that doesn't mean only that the teacher is lecturing, but it could mean that a computer is lecturing etc.) or more active methods? Or is the knowledge to be learned already known or the learners are asked to seek the information. Or are the learners working alone or co-operatively when they are learning etc. Working alone does mean a more rationalistic style (I'm using the same concepts as in the learner's learning styles) and co-operation more metaphoric style (it is not so easy to describe other factors' meaning, but all arrangements more or less support a certain style).

2. What is the character of the learning task? If the task is to learn some skill, it is either rationalistic (if it is to clarify concepts) or empiristic (if it is doing some practical task) style. If it is a bigger learning task with no clear solution, it is a matter of more metaphoric style.

3. What is the character of guidance? If there is not much human guidance, that means more rationalistic or empiristic style (teaching only with lecturing or only computer program logic guiding). Feedback doesn't mean that it is only metaphoric, but more feedback means more metaphoric style (the character of feedback could be more rationalistic, empiricist or metaphoric). I have noticed that stressing motivation helps the metaphoristic learners.
4. How are we using the tools in teaching? The character of books and computer material is different. And all computer programs are not the same kind. In Section 6.4, I showed that information systems are socially constructed; a computer system’s designing principles also influence the system’s character a lot (how much the system controls the user). The characteristics computer-aided programs in the beginning of 80’s and network-based programs nowadays are different.

All learning environment arrangements influence how the learner is developing his/her metacognition (i.e. learning to learn process). The more we use empiristic teaching methods the more probably the learners prefer empiristic learning style.

In my model there are three circles: 1. Learner’s mind (and especially the learning style) 2. Mediating learning environment character (how it enables to learn) and 3. The characteristics of taught subject matter. The first two circles I divide with three sectors: empiristic, metaphoristic and rationalistic styles. The third circle I divide also into three sectors: inductive, abductive and deductive character of taught issue. The learner’s learning style is a “hole”. If learner could learn only with one way, the hole is very small. And if the learning environment is not flexible, then also that “hole” is very small. Learning will succeed if all the three elements are in balance. I want to show this by drawing a line through the “holes”.

**Figure 13** Kilpinen model (learning styles in learning environment)
In this first figure everything is in balance. For example, this figure could mean that the student with a very empiricistic learning style is learning in an empiricistic teaching style inductive issue (business studies are mostly inductive issues). I showed in Chapter 4 that teachers at our college and polytechnic are mostly empiricists. This situation is quite familiar (that doesn’t mean automatically that the empiricist teacher only allows empiricist methods). But if a situation is not so clear, then perhaps troubles arise. Most cases are not at all clear and it is not at all clear that some arrangements mean a certain learning style. It is the learner, who decides what and how to learn. If the learner doesn’t like the teaching, he/she learns something other than what was expected.

In this second figure there are some problems. This figure could mean that the deductive issue (could be mathematics) is taught through a very rationalistic way and the students are strict empiricists by learning style (in our college I knew this kind of situation). Although the teacher knows very well the taught issue, and explains theories and tasks in a very clear way, the students could not at all learn. In this situation the student’s learning style is not flexible (he/she could not learn in different way). Students have learned everything earlier in the same way. Learning style won’t change much in the short term (in long term it is possible and even an important thing to happen). If the student’s motivation to learn or capability for changes is low, then this model could be “iron bar” (student will only learn in one way – learning is not very sophisticated). Of course a long-term aim for the learning should be to change the students learning style into a more sophisticated form (so that learning styles are in balance). But not only the stu-

Figure 14 Kilpinen model (when something goes wrong)
dent’s learning style should be flexible. It is possible to make the learning environment more flexible. I showed in Chapters 3, 4 and 5 that computer aided learning environments allow more flexibility, if the designer wants that flexibility. The learner could be strict empiricist and taught issue is quite deductive, but if the learning environment allows flexibility, learning is possible. To my mind, this changes the student’s learning style in the long term. Also in Sections 6.1, 6.2 and 6.5 there were examples of successful mathematics teaching, where they used the learners’ experiences in helping to understand deductive thinking (and that is the character of mathematics). I think that is little bit the same, as what I noticed in teaching logic (Section 5.4). Nowadays students don’t like to study deductive thinking in a theoretical way (as a method, which they can perhaps use later in their life).

In most cases, the flexibility of the learning environment is a matter of resources: the teacher is not very experienced, there is lack of good material, there is not enough time for learning etc. To my mind, computer technology helps to change this situation. If the designer enables flexibility (different material, different tasks or tasks with different point of views, different ways to implement tasks etc.), then learning is more possible with different learning styles. In creating new knowledge co-operation with students helps. Computers help to broaden this flexibility and create new knowledge.

In creating new knowledge, a computer aided environment helps at communication, information seeking and model building (especially hypertext form). This way it means also more flexibility. To my mind, not only student groups but also learning environment flexibility helps to better create new knowledge. Co-operative learning could help the learners to understand different points-of-view (and perhaps learners’ different

Figure 15  Kilpinen model (flexible learning environment)

In creating new knowledge, a computer aided environment helps at communication, information seeking and model building (especially hypertext form). This way it means also more flexibility. To my mind, not only student groups but also learning environment flexibility helps to better create new knowledge. Co-operative learning could help the learners to understand different points-of-view (and perhaps learners’ different

174  Epistemological Learning Model
learning styles). But I’m against dogmatic solutions that learning is only co-operative action. We have to learn to also learn alone. Certain skills we have to learn (I’m not denying co-operation during that kind of learning) through our own thinking. For example, learning deductive thinking we have to use flexible methods. Deductive thinking means understanding. Perhaps co-operation and also some empirical methods will help in this situation, but the thinking process of concepts and relations between those concepts everyone have to do in his/her own mind. Referring to Vygotsky perhaps the best to teach deductive thinking is that learners are at the same learning level (classmates), but everyone has to do the thinking process do in own mind.

Perhaps the most important thing in flexibility of learning situation is how the learning task is introduced. I refer here to Engeström’s learning theory (Section 2.8) especially the concept orientation to learning. In orientation, there should be (if learners are not very advanced) some kind of idea for telling the main idea to study (rationalistic feature), motivation for the importance of the learning task (metaphorical feature), and some kind of advice for the learning task (empiristic feature). The orientation helps a little in making the learning process more flexible, but of course for non-advanced learners, human guidance is the most important thing.

![Figure 16 Kilpinen model (co-operative learning)](image)

The student’s learning style will change, but in a much longer term than learning certain knowledge. If the student learns in other ways than normally, then he/she probably will change his/her learning style (I haven’t studied this, but I am quite sure it would happen). I think that the problem with traditional learning environment has been because there is in-efficient learning resources. So the learning environment is tried to design in
a sterile way (all arrangements with the same way and no disturbing matters). This is maybe efficient in the short term, but it won’t promote creativity. Computer-aided flexible learning environment promotes some creativity. Of course to show how this exactly happens, I should have studied more (concept creativity is not easy to study). In the long term the aim should be to broaden a student’s learning style, learning environment flexibility and of knowledge studied issues. In Section 6.4, I wanted to show that any learning material in the Internet itself isn’t a very flexible tool for learning. There is a need for a pedagogical level. We have to know what are the learners’ metacognitive profiles (we don’t know that exactly, but certain important things we know). A learning environment for all Finnish people can’t be a very good one, but a course for business institute students could be better. But for not very advanced learners, the personal guidance is necessary to guarantee flexibility of learning.

If the learner is an advanced learner (his/her metacognitive skills make it possible to learn in different ways), then he/she can him-/herself broaden the learning environments flexibility. Though there is perhaps very one-sided Internet material, he/she finds elsewhere other material for learning. An advanced learner has such sophisticated metacognitive learning abilities that he/she finds solutions for the best learning. I agree with J. von Wright and Pantzar (Section 6.5) that self-regulated learning is the aim, but it is not the starting point. It is important to teach the learners to learn. The learning environment also has an important function to not only teach some subject matter, but also to teach metacognitive items. I consider the flexibility of learning environment very important in this teaching.

Figure 17 Advanced Kilpinen model (an advanced learner is learning in a flexible learning environment and product is creative new knowledge)
6.9 Learning process model

I want to also present another model to show in a more detailed way my conclusions both from empirical and from theoretical studies. The starting point for this model is Engeström’s learning model (Section 2.8) and the Popper’s metaphysical (Section 2.6). I am also combining to that model elements from Kolb’s learning model (Section 2.8), the psycho-epistemological learning style theories (Section 3.2), the knowledge creating theory of Nonaka (Section 4.1), theories about reflection (Section 2.9) and the Uljen’s didactical theories (Section 6.7).

The similarity between Engeström’s learning model and Popper’s metaphysical is that they have the same ontological elements in their models with slightly bit different words: 1. Engeström uses reality, praxis when Popper uses the concept World 1, nature. 2. Engeström uses learner’s knowledge when Popper uses the concept World 2, subjective consciousness. 3. Engeström uses learning content when Popper uses the concept World 3, culture. Because I am supporting constructionism, I don’t accept the relationships of reality/praxis to learning content. That relationship always goes through the subjective consciousness. David Hume proved that we can’t conclude values from facts (Hume). So in my model the relations go the same way as in Popper’s model. My concepts have a little bit different meaning than Engeström used. I accept the concept of motivation, but referring to psychology, that concept belongs to subjective consciousness (World 2). We can try to arouse motivation, but that mental action is a personal thing. Engeström used a term “motivation task” to arouse the action, but many times it is difficult to find a good task for that purpose (, if the learning issue is very abstract). The “orientation base” is an important element in Engeström’s model. I also see it as very important. Engeström put the relation of reality (World 1) to learning content (World 3). I see the relation of learner’s knowledge (World 2) to learning content (World 3). The meaning of the orientation is, referring to Engeström, to arouse the conflict between learner’s knowledge structures and learning content knowledge structure. I divided the content “internalisation” into two different actions: Internalisation is a right term from learning content to learner’s knowledge, but that kind of learning is also possible from reality (World 1) to learner’s knowledge (World 2), when a learner is observing the nature. Of course the learner relates the observations to knowledge structure, but the source is from nature. I divided also the concept “analysis” into two concepts: The passive form of it is when the learner is learning to make deductive conclusions from given concepts and the active form of it is when the learner is making his own conceptualisation. Engeström uses the term “control and evaluation” for the learner’s deeper analysis for his/her own learning.
I want to use the concept “reflection”, because it is used normally for that purpose. That action belongs to subjective consciousness, although it is related to the learner’s thinking and observation actions. And I added also one element to my model from Nonaka. That is “tacit knowledge”, which belongs to subjective consciousness, because we can’t put that knowledge into world 3 explicit knowledge. My model is the following:

![Learning Process Model](image)

**Figure 18 Learning process model**

In the psycho-epistemological learning styles the empiricist learner is good in points 3 and 4. A rationalist learner stresses points 2 and 5 and a metaphorist learner points 1, 6 and 7. In good learning, it is of course important that we can use methods in a flexible way (all of these methods). Engeström’s model (Section 2.8) learning started from motivation (1) and continued with orientation (2). I agree that in good learning these elements should be first (but many times the learners don’t start learning that way). After the beginning, the learning process with different learners just doesn’t continue in the same way (different learning styles just do it in a different order or even reject some parts of learning). If we want to also teach the learners learn-to-learn actions, we should teach all of these good learning actions. But the fact is that learners will do learning in a different way and it is important that we allow them doing it in different ways. Computers allow do this individualisation better, if designers are aware of giving these possibilities.

*178 Epistemological Learning Model*
7 Discussion

Here I will present my conclusions. First I write about experiential learning and epistemological aspects in learning (Section 7.1). Then I write about new possibilities through computer networks and designing programs (Section 7.2). Then I write methodological aspects about my research quality criteria (Section 7.3). Finally I write about recommendations to practitioners and limitations of the study (Section 7.4) and prospects for the future research (Section 7.5).

7.1 Experiential learning and epistemology

In my empirical studies I agree with Kolb’s theories about experiential learning (see Section 2.8). When students could combine their own experiences with new knowledge that thing meant remarkably better learning. It was very important that students felt learning as their own project. I agree with Kolb (1984, p. 38) “learning is the process whereby knowledge is created through the transformation of experience”.

From the philosophical point of view, I ask what is good education? Of course that is too broad question to answer in a complete way. To my mind good education gives a learner tools on managing his/her own life by life long learning process. New knowledge should always be related to learners’ own life experiences and future expectations. In information society I think it becomes more important to learn also how to learn (learning to learn). Important aspect in learning to learn is the epistemological point of view I studied in my research. It is good that we can get the knowledge in a way we want to learn, but we have to all the time develop our metacognition by learning new ways to get information and thereby new kind of knowledge. A sophisticated learner is able to use all the epistemological ways to create new knowledge. He/she is able to make observations, is able to see analogies with new ideas and is able to learn at social interactions. A sophisticated learner changes his/her strategy at different situations. But in many cases that sophisticated metacognition is not developing at it. The metacognition should be trained. In learning environment should be all kind of learning and learning material; inductive, deductive and intuitive methods.

Kolb says (1984, pp. 36–37): “learning is the process of creating knowledge. ... It is surprising that few learning and cognitive researchers other than Piaget have recognised the intimate relationship between learning and knowledge and hence recognised the need for epistemological as well as psychological inquiry into these related processes.”
Piaget writes (1978, p. 651): “Either knowledge comes exclusively from the object, or it is constructed by the subject alone, or it results from multiple interactions between the subject and the object – but what interactions and in what form? Indeed we see at once that these are epistemological solutions stemming from empiricism, apriorism, or diverse interactionism”.

These elements are with little bit different words the same what I have studied during my research. In my research I asked in the pilot project (Chapter 3) students’ Kolb model (Section 3.3) learning styles, but I couldn’t notice any remarkable relations with students’ other answers. I had to admit that I made mistakes in translating questions and answers. But I noticed remarkable relations with other learning style theory (Royce/Powell theory and Rancourt/Leino questions Section 3.2). Kolb’s model tells us both how we adapt new knowledge and how we are going to use that information. There are those both elements. Royce/Powell theory tells only how we adapt new knowledge. That theory is simpler than Kolb’s model, and later I noticed that it is more suitable for my studies than Kolb’s model. In my mind epistemological learning style is more stable than Kolb’s learning styles (Kolb’s learning styles include also the same epistemological elements as Royce/Powell theory). And in my late projects I noticed the big importance of epistemological differences in learning. Epistemology is in my mind very important thing in learning.

In Sections 6.9, I wanted to stress on the meaning of orientation base as the starting point of learning process (see Section 2.8 – Engeström’s learning model). The orientation base should contain different elements; the main idea of the learning task (for rationalist point of view), the main guiding advice for learning task (for empiricist point of view) and motivation; why this issue is important (for metaphoric point of view). This orientation base should be for not very advanced learners.

I have criticised dogmatic theories and practices in learning. In section 6.5 I criticised both radical and social constructivism about one-sided learning method. They give good models for learning, but if we follow them in a dogmatic way, we get only one-sided learning model. In section 6.2 I criticised network-based learning environments, when the learning material is designed in a technical oriented and one-sided way. The learning environments give wonderful opportunities to many-sided didactics, but the learning material and didactic arrangements are too often designed in a one way. The reason for this is, because network-based learning environments are thought to be solutions themselves for learning, but they are only tools as books etc. If learner is not very advanced, then he/she needs pedagogical guidance. In section 6.4 I wanted to show, that a pedagogical level is always needed in network-based learning environments. Many times
a network-based learning environment gives a one-sided learning; it stresses too much, for example, one epistemic way of learning. And when a learner is not able to learn that way efficiently, then comes troubles. It is good, if the learning environment could give flexible ways to perform the learning, but in most cases the best way is that in guidance process the learner is guided in a flexible way.

In section 6.4, I wanted to show that computer-based learning environments are not only technical but also social systems. I wanted to show those learning environments and learning material is one level. When learner is not an advanced learner, the pedagogical level is necessary. And it is also a learning process for the teacher (or what we call the guide). Even if the teacher is an advanced teacher, but starting to use computers, then he/she needs lot of time to learn the character of the computer-based learning environment. The computer-based learning environments are also socially constructed.

Also Nonaka’s and Takeuchi’s theory (Section 4.1) includes these same epistemological aspects (though they mentioned only empiricism and rationalism, but the third element comes from Japanese culture, it means tacit knowledge, and Nonaka said in Ilkka Tuomi’s academic dissertation that he is himself as an intuitionist). I doubt a little bit their theory about how companies create new knowledge (the spiral – does it happen just that way every time). Perhaps that theory works in Japanese society, but in Finnish society there will be differences. I haven’t studied that same thing, but referring to my empirical projects people’s epistemological learning styles influence a lot how they get new creative ideas (but I don’t know what group working means in this issue). But important is that Nonaka and Takeuchi saw that epistemological aspect also very important.

7.2 New possibilities through computer networks

Automatisation has changed a lot of industrial production and nowadays also office working. Automatisation in education has thought to be quite strange element. After my studies I am now not at all afraid of automatisation in education, I even want to increase automatisation. If resources for education remains at the same level as now and automatisation are build in a right way, learning will be better. I am sure that resources for education in our society (and in other societies too) will not increase remarkably. Still education will be more important in information society. Automatisation mainly nowadays means that different learners can use the same learning programs and material through the Internet.
From epistemological point of view good learning (and education) is based on all kind of sources: inductive, deductive and intuitive ways of learning. In my studies I noticed that computing systems quite easily support inductive learning. My early experiments with computer-aided learning had shown that most programs had based on inductive learning (and if a teacher wants to also have other ways, he/she has to put those for him-/herself). Computing systems could also support a part of deductive learning. But intuitive (metaphoric) learning is very difficult to be supported by computing systems (or should say computers themselves). We can support metaphoric learning by using discussion in the network, but of course the computers are not discussing but users of those computers. That learning needs human communication otherwise it won’t work and many times the discussion in the network isn’t enough (metaphoric learner needs more human connection than only words in the network). In information society everything is changed very rapidly (facts, concepts and so on). In old educational theories efficient learning was the objective. Nowadays it should not be the goal. Nowadays we should concentrate on understanding and learning to learn process.

How I see the computer’s most important role in education process is the access to all kind of information (there are lot of facts etc.). It is very difficult for a computer network (without communication among people) to start the learning process or enable creative new views. That is possible for advanced learners, but not for most students in the beginning of vocational studies. So let us put the computers in the role, where they are the best (big world wide information source). I see “automatisation” in that way, that the computer network takes some teacher’s tasks so that the teacher can concentrate on guiding the learning process. In this process it is also important that the students are allowed to use different ways in learning (to be able to use different learning styles).

In Section 6.4, I wrote about three different levels on the computer-based learning (global learning material, pedagogical level and learner’s learning level). The reason for this was the fact that I don’t believe that the same global learning material for itself isn’t good for all learners. The Internet is full of all kind of information. Everyone can much learn from it, but if we have aims for learning, the results are not so good without some guidance. Different learners (or learner-groups) need different kind of guidance. I studied differences on learning styles, but of course there are lot of other differences in learning process. That is why we need the pedagogical level. It is possible that the teacher (or guide) makes the guiding process to be seen in the network or the guidance just happens more with traditional way (and I think it is even better first just to do it traditionally and with more experiments to write guidance in the network). More and more there is also the third level in the network; learners’ learning products (discussion, other writings, even web-pages etc.).
When I started my experimental studies, I thought that I must construct some special learning environments. Now I am much more aware of the fact that there is so much information in the Internet that it is not necessary for the teacher to do all things him-/herself. “Automatisation” means much that you know what elements you can pick up from the Internet in students’ learning processes.

In traditional learning students have produced much text in showing their learning. In many cases that kind of learning is good, because putting your knowledge you make your knowledge into explicit form. But all students are not good in producing text (I refer here to different learning style theories – not only epistemological learning styles – see Sections 3.1–3.3 and 6.1). In the Internet students can produce their learning tasks in a more complex form. One possibility is to use portfolios on the web. In vocational education the use of portfolios gives much opportunities for better communication on the periods in working life training; the learning could be reported not only with texts but also with other ways (this means flexible epistemic ways to show what you know).

Computers and computer-networks are only tools. They are cultural artefacts. Learning is always personal action, where learner creates new knowledge for him-/herself. So the starting point is learner’s own interest. Computers give more flexible possibilities than, for example, books, but in many cases good learning for not very advanced learner needs personal guidance or interaction with other learners.

7.3 Methodology

The title of my study tells that there are two levels; the first level is to describe my own learning process on building a learning environment for the students, and the other level is the findings of epistemological learning styles concerning importance on learning process. I made many mistakes during these twelve years of my study (1991–2002). I don’t want to deny that. That is why I wanted to present also the research process with changes in what I thought was at time interesting. The motives for my study were that I wanted more carefully to understand significance of computers meaning in the learning process more carefully than only when surviving in the normal teaching routines. I wanted to be a reflective teacher. My research question changed many times during this process.

Orlikowski and Baroudi (1991, Heiskanen 1994 pp. 202–203) note that there are three main philosophical research stances: positivist, interpretative, and critical. The positivist research philosophy maintains that the physical world is objective and exists
independently of human beings. Positivist research is value-free and the researcher is a neutral observer. The interpretative research philosophy emphasises the importance of subjective meaning, political and symbolic action, through which people construct and reconstruct their reality. The critical research philosophy differs from the two previous ones because it challenges the status quo, which is only explained or predicted by the other approaches. It aims to change the world. The task of a critical researcher is to bring the conditions of the status quo into the open. By this means she or he is aiming to start a social change to remove alienation and domination. The researcher has two options, either only to start the reflective process of the participants or to actively participate in effectuating the social change. Reflection-in-Action is rather closely related to the critical tradition.

The starting point of positivist research criteria is (Yin 1989, pp. 40–45) that there are four components for judging the quality of the research: construct validity, internal validity, external validity, and reliability. Guba and Lincoln (1989, pp. 233–250; Heiskanen 1994, pp. 207–213) presented the quality criteria for interpretative research (suitable for Reflection-in-Action better than positivist criteria). The quality criteria are as follows (the positivist parallel is mentioned as parenthesis): credibility (construct and internal validity), transferability (external validity), dependability (reliability), and confirmability (objectivity).

The credibility criterion as a measure for validity means isomorphism between the constructed realities of the participants and the reconstruction attributed to them. The second level was to study the students’ opinions about the learning environment. I think the more important issue was what factors were important to take into account in building process (of course the already built environment influences on students’ answers). I found the central findings of my study in the pilot project. I tried to make sure of my findings through triangulation; I studied students learning products and those confirmed my findings. I used the same triangulation little bit also in the later projects. Of course I could check only those students’ answers, who gave me their names (most of them did, and I gave them feedback about what their learning style was and explanation of epistemological learning styles). I asked quite simple questions, but it is of course, when it is matter of quite young people, that they understood questions in a wrong way. I in all my empirical studies showed, that the open questions (concerning how students felt about the course) did support the answers about learning style questions. I also studied what was the epistemological character of students learning products (which confirmed my findings).
The external validity deals with the problem of knowing whether the findings are generalisable beyond the immediate case. In this respect we must adopt the term “transferability” suggested by Guba and Lincoln (1989, Heiskanen 1994). The findings I noticed seem to be all the time the same kind of. I have no doubt that the most important findings could be generalisable in other learning situations (that epistemic learning style in a certain way influences on network-based learning).

The goal of reliability is to minimise the errors and biases in a case study (Yin 1989). The technique for enhancing dependability is the dependability audit, like the fiscal audit (Guba & 1989, pp. 242; Heiskanen 1994). Like a fiscal auditor, the inquiry auditor should make sure that “data” (facts, figures, and constructions) could all be traced to original sources.

Confirmability is parallel to the conventional criterion of objectivity (Guba et al. 1989, pp. 242–243; Heiskanen 1994). It is concerned with assuring that data, interpretations, outcomes of inquiries are rooted in contexts and persons apart from the researcher. The findings should be based on data, not on the imagination of the researcher. Confirmability can be secured in a confirmability audit which can be performed together the dependability audit.

The questionnaire of my study was quite simple (see Appendix B). I made categorising from the open questions and students’ learning products. I reported those categories in Chapters 3,4 and 5. I think anyone, who follows those can have the same results as I did. And of course I have all the students’ answers to questionnaires and most students’ learning answers in my archive. I think there is no problem to show the dependability and confirmability audit.

7.4 Recommendations to practitioners and limitations of the study

For a teacher I can recommend to study epistemological learning styles. The learning styles are important either in traditional or in network-based learning environment. Many times taking into account these differences means that a teacher just allows the students to do things in a way they want to do. In teaching situation it is important to tell the aims of learning and let the students to study the issue mostly by the method of learning-by-doing.

For a teacher it is good to know, how the students mainly get the information (the epistemic learning styles). This fact influences how the teacher can motivate the students in a best way, how the students process the information and what kind of feedback the
students want. An advanced teacher knows in most cases with intuitive way students’ learning styles, but teachers should also know how to handle with these differences.

For a designer of a network-based learning program and/or environment it is also worth to know to whom the learning should be designed. Of course flexibility is good, but it is no use to try to please all users in a perfect way. We can design the environment/program for the common learning profile as quite good one. Then we can take into account the flexibility of other learning style profiles a little bit. I also recommend that there should be two designing levels (or even to be aware of the fact that we can’t please all kind of learning situations with one learning environment in the network). There should (in institutional learning) always be a pedagogical level (to guide the learners with traditionally way or network based).

For the developing process of computer-based learning I recommend that the change from traditional learning environment to computer-based learning environment is not easy. The change needs time and teachers (guides) need time for learning process. It is much better to take small steps than to change everything (it means in most cases total failure).

For a learner I will recommend to study what kind of learner you are (including epistemic learning styles). It helps you to develop you as a better learner and you will be aware the ways that you develop your metacognitive skills.

To my mind a limitation in this study has been the fact that my dual role of the investigator as a practitioner have limited my access to some data that might be accessible to a stranger. I may be too close to my own teaching and I can’t see some problems.

7.5 Prospects for future research

I studied the meaning of epistemological learning styles in computer-based learning not in a detailed way. For me it was important to just notice the importance and use that factor as one base for developing my own learning material. I think that the epistemological learning styles influence a lot for following issues:

1. The epistemological learning styles have lot of influences what is the best way to orientate and motivate the learner to new teach issue. There should be more detailed pedagogical advise for teachers than I could give

2. When seeking information from the Internet, the seeking strategies of different learners are not at all the same. It would be useful to study how can we help learners with different learning styles to develop their seeking strategies
3. The guiding process for different learning styles is different. Is it possible to have effective learning environment for every kind of learner, or should we just trust the personal guiding process to please all kind of learners

4. Also the feedback’s meaning for different learners is different

5. The need of the social connections is different for different learners

That is why there is a place for detailed study of how different epistemological learners learn and seek information on computer-based environments.

Also it would be interesting to know to whom (especially studying epistemological styles) the designers think they are designing the new learning environments. I am sure that many times the designers are not aware of flexibility of learning, but the designers just design for one kind of learner.


190 References


References 191


http://www.hameenkesayliopisto.fi/itk01/index.html


194 References


References 195


Lahti business institute/Lahden kauppaoppilaitos. http://www.salpaus-edu.fi/1kol

Lehtinen E. 2002. Verkko

198 References


References 199


200 References


References 201


Popper K. 1965. Conjectures and Refutation


Qvortrup L. 1992. Learning at a Distance. Proceedings from the European Symposium on "Community Teleservice Centres: Training and Education in Rural Areas". Printed at Odense University, Denmark.


202 References

References 203
Tietosuomi 1999 Työssäoppimisen sivut

References 205
von Wright J. 1996.
Appendix

Appendix A: Inquiry into the pilot project *(originally in Finnish)*

20.1.1995

In the following inquiry I’m asking about your learning and other experience. The data you give is absolutely confidential. I won’t show anyone’s private data in the final report.

You are ( ) woman ( ) man

Your age is ____ years

What department in the polytechnic are you studying in?

__________________________________ department

__________________________________ study direction

Where have you studied before you came here (after elementary school)?

institute years specialization

Do you have working experience (also summer jobs etc.)

work years and months character of the work etc.
How have you managed in the following issues?

Mathematics  ( ) very well  ( ) pretty well  ( ) not so well  ( ) very bad
Foreign languages  ( ) very well  ( ) pretty well  ( ) not so well  ( ) very bad
Arts  ( ) very well  ( ) pretty well  ( ) not so well  ( ) very bad
Sports  ( ) very well  ( ) pretty well  ( ) not so well  ( ) very bad
Human relations  ( ) very well  ( ) pretty well  ( ) not so well  ( ) very bad
Practical skills  ( ) very well  ( ) pretty well  ( ) not so well  ( ) very bad

Tell in a few sentences what you think about a concept of INTELLIGENT/SMART LEARNING ENVIRONMENT

What nick name do you want me to use when I'm writing the final report :

-------------------------------

What is your e-mail address  ______________@ _______________

I thank you for your answers

Kari Kilpinen

208  Appendix
Appendix B: Inquiry into the courses  *(small changes in courses, originally in Finnish)*

Name___________________________ *(not obligatory, but I give feedback if you give your name and your data is absolutely confidential)*

In the following questions tell what you think is the best and the second best alternative:

1. The teacher’s most important task is to help the student
   a. to think logically
   b. to make observations
   c. to get a self-confidence  Best alternative ___  2nd Best _____

2. How should the student best be taught? By encouraging
   a. to seek information and act for him-/herself
   b. to think and get enthusiastic for his/her own ideas
   c. to show his her emotions and will  Best alternative ___  2nd Best _____

3. The best ideas and innovations I have made
   a. by insight and by accident
   b. by observation and experiences
   c. adapting theories and rules  Best alternative ___  2nd Best _____

Do you have a home-connection to the Internet:
   a. no connection
   b. modem-connection
   c. something else (ISDN ...)  What _________________

What did you dislike in this course?

What did you like in this course?

How should this course be developed?
Appendix C: All students’ learning styles

- Rational: 17%
- Metaphorical: 11%
- Balance: 18%
- Empirical: 54%

Appendix D: Polytechnic level students’ learning styles

- Rational: 15%
- Metaphorical: 12%
- Balance: 12%
- Empirical: 61%
Appendix E: Young secondary level students’ learning styles

Appendix F: Adult secondary level students’ learning styles
Appendix G: Teachers’ learning styles

- Empirical: 43%
- Rational: 26%
- Balance: 20%
- Metaphorical: 11%
Appendix H: Advice when designing www-based learning material

The courses, where this advice should be followed, are mainly using inductive learning material (I refer to my Information Superhighway-course). The method for learning should be learning-by-doing, because that method allows the learner to use his/her own way to learn. The advice is for traditional teaching courses (not modern distance learning).

It is not even necessary to have own www-pages, because tasks can be presented also for example on blackboard. Perhaps that method is even better for designing new courses (first version on blackboard and next versions in www-pages). For many issues it is better not to have too much material for the designer. There is enough material for many issues in the world-wide-web. When learners seek material for the learning task, they can better use their own learning style. If the issue is not very easy for the learners, it is good if the designer gives some good links for seeking. Very many links to other pages is also a danger, because www is in a big change all the time. Also links direct perhaps too much the learning process, because learners are many times seeking only those pages. If there are links, it should be checked that those pages give pedagogically good material.

The teacher/pedagogue should present the main idea (orientation base) to the learners. How the orientation base should be presented depends on dominating learning style among the learners. Many times orientation base and learning task are connected with each other. So for the empiricists it is good to present the main idea with simple step by step-method (to tell what should be done in every step). Although the issue is very rationalistic one, it is better not only present the rationalistic theory or idea, because rationalistic students anyway find the answers, but the other students do have problems when they try to understand the issue. If the learning task is good, the learners understand finally the theory or idea doing the task in their own way.

In the www-pages it is possible to use all multimedia features in presenting the orientation base. Especially some empiricist learners learn much better when different senses are active. For metaphoric learners it is possible to give in the www-pages alternative orientation with metaphors (a link to other www-page, where metaphor is presented).