AN ACTION RESEARCH PROJECT IN THE LIGHT OF COGNITIVE APPRENTICESHIP

BLEKINGE INSTITUTE OF TECHNOLOGY

HUMANS, COMPUTERS & WORK

BACHELORS THESIS, 20 P

BY EMMA HARALDSSON

SUPERVISORS: DR BERTHEL SUTTER & BJÖRN STILLE

ABSTRACT

Computer supported collaborative learning, CSCL, is a relatively new focus for research within Instructional technology. It focuses on the process of learning in a computer supported collaborative environment.

In this report I will use a model for designing effective learning-environments, called Cognitive Apprenticeship to highlight areas of importance when arranging CSCL-environments. Cognitive apprenticeship is an attempt to combine apprenticeships and in-school-work. It focuses on the facilitation of development of theoretical and practical skills in an in-school-setting. But even though the model has been described as successful, there are some drawbacks. Different conditions for school and work makes it difficult to transfer the successful apprenticeship-model to an in-school-setting.

KEYWORDS

CSCL, cognitive apprenticeship, school, computer-based projects, multimedia, designing effective learning environments.

1. Introduction

During spring 2003 I got the opportunity to participate in a project that took place at a middle school in Denver, USA. The trip was made possible by support of the EU/Fipse-project[1] and was arranged as an exchange between Blekinge Institute of Technology and the University of Colorado, Denver (UCD). The exchange lasted for three months, during which I participated in two in-school-projects. Both projects were included in a greater action research project performed by UCD, called *"The American Engagement of Low Income African American and Latino Middle School Students: A Multi-Level Action Research Project"*. The Action Research-project was a three-year-study, arranged in cooperation with Smiley Middle School, located in north Denver. The reason for choosing Smiley Middle School as the object for observation was that it is a very low-income middle school and has shown low achievement test scores on yearly CSAP-exams[2].

The Action Research-project was based on socio cultural learning theory and its aim was to find *"ways to improve the academic engagement of African American and Latino students in school by studying activities with which selected students hold back or resist"*(Davis A. Clarke M. 2002)

The first year of the Action Research-project, aimed at studying activities that engaged students. Some of the preliminary findings from these studies said that;

- *"Working in groups can enhance engagement, but great care must be paid to group dynamics."*
- *"Students engage more readily in an activity when it links to activities they already care about."*
- *"Students are more likely to actively promote an activity when they can shape it themselves through the exercise of choices and directives and when they can be persuaded to appropriate a goal for the activity that they care about."*
- *"When students authentically teach, present or explain things to others engagement is dramatically different from situations in which they are demonstrating understanding through tests and routine assignments."* (Davis A, Clark M. 2002.)

These findings constituted the platform for both projects within which I participated. The first project was a PowerPoint project, in which students were supposed to work in teams to produce a PowerPoint-presentation of a topic decided by their teachers. The project was a six-week-project and my participation took place during the last two weeks. The second project was a twelve-week multimedia-project. Both projects involved cooperative learning and student influence. The second project, the multimedia-project, is the project which I will focus on in this report.

Cooperation to enhance engagement was one of the basic characteristic of both projects. According to Salomon, (1995) computers can be used to enhance cooperation. But it is not enough to just add computers to a project. Effective use of computers includes the

[1] A global cooperation between the EU and the USA, called Cooperation in Higher Education and Vocational Education and Training between the European Community and the United States of America. International Post-secondary Learning in the 5:th Dimension: A Distributed Consortium Approach.

[2] The CSAP exam (Colorado Student Assessment program) "*is a test designed to measure student achievement in relationship to the Colorado Model Content Standards. These standards measure what students should know at particular points in their education. As a result, CSAP provides a series of snapshots of student achievement in reading, writing, math, and science as they move through grades 3-10"* http://www.cde.state.co.us/cdeassess/pdf/ParentsGuideENG.pdf

whole learning environment, i.e. teachers, students and tools. The computer is just a tool which can be used to pursue a change in the learning environment.

The shift that Salomon is talking about is the paradigm shift in Instructional Technology that Timothy Koschmann has named CSCL- Computer Supported Cooperative Learning. (1996). The difference between Koschmanns paradigm, CSCL and earlier paradigms such as the CAI-Paradigm (Computer Assisted Instruction), ITS-paradigm (Intelligent Tutoring System) and Logo as Latin-paradigm is based on underlying disagreement in pedagogy and instruction. Pedagogy and learning according to the CSCL-paradigm is based on the sociocultural theory and instruction is based on collaboration between supervisors and peers.

1.1 CSCL, school and Cognitive Apprenticeship

CSCL is a relatively new field of study and it has gained its research traditions from disciplines such as;

- Social anthropology - studies of social and ethnological systems and cultures.
- Sociology - studies of the human society and the social collaboration amongst people in the society.
- Linguistics - studies of the development and use of the language in different settings.
- Communication science - studies of the technological aspects of the transfer of information.

Koschmann writes that "[CSCL] reflects another view of learning and instruction, one that brings these social issues [mentioned above] into the foreground as central phenomena for the study" (1996. p.11)

Many kinds of models for designing effective learning-environments in an in-school-environment have been used in the purpose to support CSCL. One of them which I will focus on in this report is the Cognitive Apprenticeship model. (Collins et al. 1989)

The cognitive Apprenticeship model springs from the model of traditional apprenticeships (Lave, J & Wenger, E. 1991).

The learning-model of apprenticeships has been used for centuries; it was used long before the scholastic world had evolved. In the apprenticeship-model, learning takes place as the apprentice actively participates in a cultural activity and performs authentic tasks. The apprentice is dependent on having supportive relations to experts and peers in their present. Tasks are gradually advanced when the apprentice becomes more skilled.

The division between the cognitive apprenticeship-model and traditional apprenticeship-model is that cognitive apprenticeship is designed to support educational purposes in a scholastic world, and traditional apprenticeship is designed for an organization in which education is not the main goal. The cognitive apprenticeship-model has shown positive effects, when engaging students in solving authentic tasks in collaboration with experts and peers, though it is not unproblematic (Nielsen K., Kvale S. 2000).

The Cognitive apprenticeship-model has resembling similarities with the project in which I participated. I will start by giving a general view of the foundation stones of the multimedia-project. I will then explain what the Cognitive apprenticeship model is. The third step will be a description of my empirical study, an Action Research-project in a middle school in United States of America. Finally I will discuss the project in the light of the cognitive apprenticeship-model

1.2 The design of the multimedia-project

The goals of the multimedia-project were from the perspective of the Action Research-project to[3]:

- Engage students in multi-media productions through which they develop skills in the use of technology.
- Study how students in the class engage or resist over time and identify important elements in their engagement/disengagement.
- Record students' perceptions of what kind of school- and after-school activities are engaging/ disengaging to them.

During the earlier project we had seen problems engaging the students in topics that did not appeal to them. To help encourage the engagement of the students we wanted to create a learning environment that:

- Had supportive relationships.
- Had students reflect on identity and roles.
- Increased the complexity gradually.
- Had personally relevant and authentic payoffs for students (products they want to show to their friends)
- Was influenced by the Vygotskian theory of "the zone of proximal development".
- Shifted balance of power to students, giving them increasing autonomy and choice.
- Let students determine some of the schedule.
- Let students have a say in choosing their group.

By means of the findings in the Action Research-project, we designed a learning environment based on characteristics of authentic team-work were each member had its own role and assignment and was going to contribute to the team by its own expertise. Each team was assigned one head-instructor, and two to three instructors helped students independently of which team they belonged to. The instructors' tasks were to guide, support and instruct the students in all aspect of the project.

1.3 What is Cognitive apprenticeship?

Cognitive apprenticeship is a model developed by Collins, Brown and Newman, to help teachers design effective learning environments. It is based on the apprenticeship-model which is a model that *"embeds the learning of skills and knowledge in their social and functional context."* (Collins, Brown & Newman. 1991. p.454). The cognitive apprenticeship model was developed as a means to remedy the abstraction of knowledge and skills from the real world that appear in in-school-learning. It was an attempt to combine the traditional apprenticeship-model with, engagement and schoolwork.

I base my description of cognitive apprenticeship on Collins', Brown's and Newman's paper; *Cognitive Apprenticeship: Teaching the crafts of Rreading, Writing, and Mathematics.*

[3] In accordance with a mail sent during the planning stage of the Multimedia-project. 2003-03-02

1.3.1 Traditional apprenticeship

An apprenticeship is a method for developing skills and knowledge in a cultural organized activity (Rogoff, B. 1995). In the apprenticeship-model, learning takes place in the environment in which the skills and knowledge will be used, a so called community of practice. A community of practice is by Lave and Wenger defined as "*a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice*"(Lave & Wenger. 1991. p.98.) The members of a community have a common goal towards which all members are working. Initially the apprentice only contributes to the community as a peripheral participant but as the apprentice develops skills by the help from more experienced members, the apprentice moves to become a full participant (Lave & Wenger. 1991). The social relations in the community, in which the apprenticeship takes place, are therefore of great importance to the apprentice. Without the help and acceptance from other more experienced members, the apprentice will not develop necessary skills.

Traditional apprenticeship is according to Collins *et al.* based on three methods for learning and three methods for teaching. The methods for learning are;

- Observations
- Coaching
- Practice

The methods for teaching are:

- Modeling
- Coaching
- Scaffolding and fading

The apprenticeship starts with a period during which the apprentice observes the master while he/she is doing ordinary tasks (modeling-observations). This gives the apprentice the opportunity to create a conceptual model over the process as a whole. The apprentice then practices her observations under the supervision and support of one or several experts (coaching-practice). According as the tasks becomes more difficult, the expert has to offer different kinds of help to the apprentice. This can either be oral help or physical help (scaffolding). According as the apprentice develops skills, the master takes a more unobtrusive role and allows the apprentice to work more and more on its own (fading).

1.3.2 Cognitive apprenticeship

The model for learning in the *Cognitive apprenticeship* is also based on "learning-through-guided-experience" but the central point is not physical processes as in traditional apprenticeship, but cognitive processes as those taught in school. Collins *et al.* do not want to separate the learning of physical and cognitive processes but acknowledges that *"there are differences that have practical implications for the organization of teaching and learning activities and teacher- learner interactions.[…] Cognitive apprenticeship methods are designed to bring these tacit* [cognitive] *processes into the open, where students can observe, enact and practice them with the help from the teacher and other students."* (Collins *et al.* 1989, p 457*)*

The basic methods for learning and teaching in a cognitive apprenticeship are still the same, but since the processes that are taught are processes that according to Collins normally occur internally instead of physically, some amendments need to be made.

The learning methods in cognitive apprenticeship compared to traditional apprenticeship are;

- Observing
- Coaching
- Practicing
- Articulation
- Reflection
- Exploration

Traditional apprenticeship

Cognitive apprenticeship

The teaching methods in a cognitive apprenticeship are;

- Modeling
- Coaching
- Scaffolding
- Articulation
- Reflection
- Exploration.

Traditional apprenticeship

Cognitive apprenticeship

The first three methods are the same as in traditional apprenticeship, but the last three are specific for cognitive apprenticeships. Articulation is the method for articulating the tactic knowledge that is not visible to the eyes. Reflection is the method for helping students reflect on their own learning and choice of process. Exploration includes methods for making the student further explore subjects of interest for them as individuals.

The environments in which cognitive apprenticeships take place are different from the ones that traditional apprenticeships take place. Traditional apprenticeship is modelled and defined by the specific setting that has developed over a period of time. The cognitive apprenticeship environment at the other hand is modelled and defined by a teacher who wants to *"illustrate the power of certain techniques or methods, to give the students practice in applying these methods in diverse settings, and to increase the complexity of task slowly, so that component skills and models can be integrated.*"(Collins *et al*. (1989) p.459) One important aspect of cognitive apprenticeships is that the knowledge that the students gain during participation in such a setting should be applicable to other situations met outside school. The processes that students learn in traditional apprenticeship are normally only applicable to one specific setting.

Cognitive apprenticeship is influenced by the Vygotskian theory of *The zone of proximal development* (ZPD). The zone of proximal development is the zone in between what a student can perform by him/herself and what he/she can perform with the help of others. By working in close relation with the students the teacher, or peer students, can help the student solve problems that are more difficult than he/she normally could solve.

1.4 Educational framework of cognitive apprenticeship

Collins et al mentions a framework for designing effective learning environments which includes four dimensions; content, method, sequence and sociology.

The content of the learning environment is what the student is going to learn out of being in such an environment. Content should not only contain facts and procedures that can be read about in books. It should also contain problem-solving strategies, management and administration strategies, knowing how to choose among problem-solving strategies

and when to change strategy, and finally learning strategies such as knowing how to find information and how to take advantage of people and artefacts in their surroundings.

In a cognitive apprenticeship students are going to gain knowledge through observations, coaching and practice and this is therefore the basis for the teaching methods. Teachers are going to work with modelling, coaching and scaffolding to support their students. Modelling is the phase during which the student has the opportunity to observe the expert/teacher when performing a task. During this phase, the student has the opportunity to build a conceptual model of the process. Coaching is the supervision of students when performing a task. Teachers offer hints, support, feedback and reminders.

The teacher also has to sequence the events and adjust them to the students' capability. The degree of difficulty is supposed to increase gradually according to the individual progress. The global understanding has to be developed before the details.

The sociology of the learning environment is of great importance in the cognitive apprenticeship-model. Collins et al. has summarized five characteristics that affect the sociology of learning;

- *Situated learning*- An authentic environment and authentic activities creates an environment in which the complexity of the world is a natural ingredient.
- *Culture of expert practice*- Students should interact with experts, not only observe them when they are working.
- *Intrinsic motivation*- Motivation is an important aspect in learning and it should come from true interest for the task.
- *Exploiting cooperation*- Collaborative learning. Students should work cooperatively to learn how to solve problems in a team. This will also give the students the opportunity to try out different roles.
- *Exploiting competition*- Students should compare the procedure which they have used to solve a problem.

2. Methodological approach

2.1 Part I - Empirical study

The three-year study, which included the multimedia-project, was based on an Action research-approach. Action research is characterized by the combination of action and research, of theory and practice. (Svensson, L. *et al.* 2002). Action research has grown out of the trade-unions attempt to reform the conditions of working life. The research aimed at developing and changing a social setting of the employees.

The action research-approach demands cooperation between researchers and participants. The cooperation facilitates the development by allowing the members to be active in the change of their own surroundings. By closely cooperating with the participants the researcher may obtain a clear insight into the complexity of the setting. The methods used in action research are amongst others, participant observations, which give the researcher the opportunity to participate in an activity as a complete participant, and at the same time, examining the practice critically. The initiators of the Action Research-project based their choice of the action research-approach on a belief *"that systems are most likely to improve when change is prompted from within and when participants respond reflectively to feedback – positive notices of a difference – rather than to mandates prescribed from without."* (Davis, A., Clarke, M, 2001. p.5) They wanted to involve the teachers at Smiley Middle School in the research.

I participated in the multimedia-project as a member of the action research team, and by doing so I had the opportunity to closely observe the culture and the environment of the school. I got to know the students and the researchers whom I worked with and they considered me to be a member of the project. My participation in the project was affected by the fact that I neither did have the experience from being a student at an American middle school, nor did I master the English language faultless. But I had full access to the project at all levels, both planning and performance. I was an instructor for one of the teams and I will therefore argue that I was a so called *complete participant*. (Kullberg. 1996. p.68, Hammersley & Atkinson. 1995. p.104).

Methods used during the project were, except observations, writing of field notes and tape recordings. Communication by mail was also an important source of information since many decisions concerning the project were made by mail.

2.2 Part II - Theoretical study

Historically, Action Research was not developed for research in school. It was founded by trade unions in their work to reform the working conditions for their members. The purpose of the action research project at Smiley Middle School was to improve the learning conditions for its students. But the action research methods do not offer any evaluative methods for what I wanted to concentrate on, namely CSCL-environments. To highlight parts of the project of interest for me, I have chosen to apply the Cognitive apprenticeship-model to the computer-project which I participated in. I wanted to focus on the organisation and outcome of a relatively unusual computer-project in a middle school. As already mentioned, Cognitive apprenticeship is a theoretical model developed to design effective learning environments. However, the cognitive apprenticeship-model is not immaculate, which I will write about in my discussion. Nielsen and Kvale also call attention to this in their book *Mästarlära,* (Nielsen, Kvale. 2000).

3. Empirical Study- The multimedia-project at Smiley Middle School

The multimedia-project took place during a computer class at a middle school as an in-school-project. Its theoretical framework was based on a sociocultural learning theory where the environment and the participants have an important role for the individual's learning. The project took place during a 12 week period where the students met three times a week during a 47 minutes long period. The goal of the project was to engage the students in multimedia productions through which they were to develop skills in the use of technology. The final product was going to be an e-magazine which was to be published on the Internet[4]. The activities included in the project were; selection of topics for the e-magazine, class- and team discussions to plan and to discuss the work in progress, creation of web pages, animations, pictures and short movies, writing of articles, finding information about topics which included Internet searches and surveys in school and putting together all the parts.

What we wanted to achieve was to create a learning environment which would engage the students and support both individual learning and cooperative learning.

3.1 Overall structure

The foundation of the project was designed by the adults in charge of the project, but this was also going to be a pupil-guided project. We wanted the students to participate in the planning process and therefore we restricted us to only create a frame within which the students could chose the content. With this as a base we decided that we would let the students create their own e-magazine since almost all topics are suitable for an e-magazine, and several different applications can be used. Thus the e-magazine became our frame for the project. By allowing and encouraging the students to choose the topic themselves, we hoped that they would be more engaged, interested and willing to participate actively. The topic was a means to tempt the students to work with the tools that we provided. Their goal should be to produce something about a topic that interested them, and to produce something they had to use the tools that we provided.

We wanted to create an authentic environment, in which students in the same team were partly dependent upon each other, as people are in working life. We also wanted the students to understand that the tools that they were going to use were also used by experts in working life and that they were usable in other areas than in school.

Examples of other student's work were an important ingredient in the project. By showing the students examples of what other students in their own age had done, we wanted to help them understand what they were about to do and what they could do with the tools supplied by us.

3.2 The participants

21 students participated in the project, 10 girls and 11 boys. All students were between thirteen and fourteen years old. The neighbourhood, surrounding the school, was populated mostly by middle-class families, but most students at the school came from poor families. 75% of the students at Smiley Middle School received free lunch every day[5]. The school

[4] Look at the final webpage at http://thunder1.cudenver.edu/citt/smiley/

[5] To be allowed to receive free lunch at the school, the total income of a family of four people, must not exceed 18000$ (12750 Swedish kr/month) a year.

differed from many American schools in the sense that the majority of the students comes from a minority of the American population. 76.3% of the students were of African American extraction. 15.4% of the students were Spanish, 7.5% were White, 0.4% was Asian and 0.4% was American Indian.

The separation between students and teachers were strict at Smiley Middle School. No students were allowed to call any teacher by his/her first name. According to the school regulations all students had to call the teachers by last name.

The computer class was called "an eligible class", but this does not mean that the students were there of their own free will. Every year the students had to choose a class from a set of classes; Music/Drama, Visual Arts, Foreign Language, Consumer and Family Sciences, Technology, Keyboarding, or Physical Education. All students had to take all classes sometime during their time at Smiley Middle School. This means that the students could only choose when to take the class, not if they were going to take the class. It is more correct to say that the students participated on a rotating basis.

The computer skills in the class varied from early beginners to experienced computer users, from not knowing how to draw a circle with the mouse in an application for drawing, to already having created their own web pages.

Six adults participated in the project. The adults in the project were; the teacher responsible for the class, a professor from University of Colorado Denver (UCD) - initiator of the action research-project, a web designer, a multimedia student, a graphic artist, and my self. One researcher from UCD also participated periodically. All adults participated in the planning of the project and worked as instructors helping the students with whatever they needed help with.

My role in the project consisted of being a part of the team who planned the project. I was also a supervisor for one of the groups.

3.3 The Computer lab

The multimedia project was held in an ordinary computer lab, which had about thirty computers, both PC's and Mac's. The lab was furnished as an ordinary class room, were all desks were pointed towards the front of the classroom. There was only one desk where no computer was placed.

All computers were connected to Internet by a T1 line[6]. Every class had a class account, that is, all students logged in to their computers with the same username and password. For example, students that had computer class from 7.30-8.17 logged in as Class1 and students' that had computer class from 8.20-9.07 logged in as Class2, and so on. All classes had the same password. Work done by a student was saved locally on the computer.

The computer lab was equipped with a projector, which was used regularly during the project, both for showing examples of similar projects available on the Internet and visually showing instructions regarding the applications used in the project.

3.4 Planning of team work

A foundation stone of the project was to let the students work in teams. Every student belonged to two teams. All of them were members of one out of four "topic-teams" and one out of three "tech-teams". The instructors divided the students into different teams based on individual wishes. All teams had between five to seven members. The students were

[6] USA standard for the telecommunication rate, approximately 1,5 Mb per second.

grouped into teams according to their wishes regarding what topic and tool they wanted to work with. Within the team, the students were assigned to different professions. Students working with Macromedia Dreamweaver were "web designers", students working with Macromedia Flash were "animators" and students working with Adobe Photoshop were "graphical designers". We wanted them to understand that the tools they were about to use were used in actual work settings.

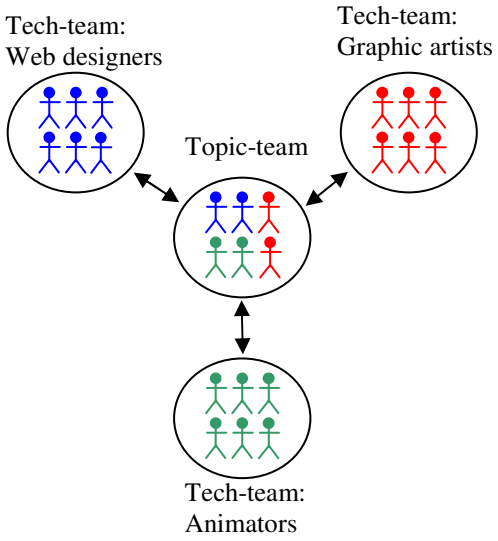
3.4.1 Topic-teams

After a class discussion, the students decided to have four different topics in the e-magazine; sport, music, fashion and music & school. All topics were of great interest to the students. Since we had four topics, we created four topic-teams.

Work in topics teams consisted mainly of discussions and collection of information which was going to be published in the e-magazine. During discussions decisions were made concerning what to put on the web page, who was going to do what and planning how and where everything was going to be displayed. The discussions were "technology free", i.e. the tools that were used were pen, paper and mind maps[7], all well-known to the participants. Each team had one instructor that helped them in their discussion. In topic-teams the instructor were supposed to help the students come up with ideas and making them understand what was possible, team dynamics and making sure that the project was progressing.

3.4.2 Tech-teams

Three different tools were used in the project therefore we arranged three tech-teams. Every tech-team had one instructor who was expert on the tool. All work in tech-teams was computer based. Besides the instructors, there were supervisors who helped the students independent of which team they belonged to.



Since the division into tech teams was done based on the tools, students in the same tech-team worked with the same application. By doing so we wanted to create communities

[7] Mindmap is a map on which all participants write their ideas and suggestions in short sentences. This map works as a base for further discussions.

were members could cooperate and help each other. In tech-teams instructors were supposed to help students with technical problems.

3.5 The Applications

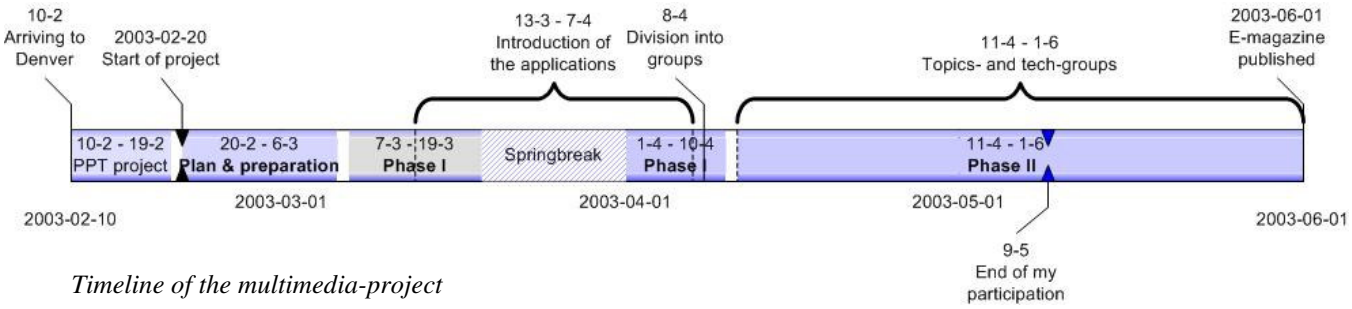
The multimedia project was an extensive project and it involved several advanced applications. All suited for an experienced audience. The applications used during the project were Macromedia Dreamweaver MX for the development of the skeleton of the webpage, Adobe Photoshop 5.0 for the design of the graphics and Adobe Flash LE for the creation of the animations.

These kinds of programs are so called "tool-applications". They were originally developed for productive use, not merely for schoolwork and because of this they were pretty complicated for the students. The target group was not school children, but a more experienced audience, with basic knowledge about computers and the equipment belonging to them.

When learning how to use a new tool or a new tool-program, the initial phase has to be to understand the field of the application (what you can use it for) and then the procedure when using it (how to use it). In the multimedia-project we started out by demonstrating what the student could do with the tools by showing example of e-magazines produced by other students in the same age as themselves, to help the students to build a conceptual model of what the final product was going to look like.

3.6 Phases of the project

The multimedia-project can be divided into two stages.



Timeline of the multimedia-project

3.6.1 Phase I: Planning

During the first stage, students were introduced to the concept of an e-magazine. Students gave suggestions of topics for the e-magazine and democratically chose four topics out of 41 suggestions. Examples of e-magazines made by other students in the same age were presented and each instructor showed work done by him/herself.

Introductions of each application were arranged in class. Finally students were divided into topic-teams based on their wishes. Each team decided which student was going to be in which tech-team.

All students in each topic-team got their own work title (web designer, animator or graphical designer), and grouping into tech teams were made based on their titles.

3.6.2 Phase II: Design and Production phase

All work was from now on divided between work in topic-teams and work in tech- teams. This phase was the actual development of the website.

Guidance and assistance differed when working with topic and tech-teams. Instructions were now mainly based on questions asked by the students. No predefined handouts or assignments were handed to students.

4. Result - The multimedia-project in the light of cognitive apprenticeship

In this part I will look at how we designed our learning environment in the light of the cognitive apprenticeship-model developed by Collins, Brown and Newman.

The basic principles of cognitive apprenticeship, which I will focus on is the methods for teaching; *Modeling, Coaching*, *Scaffolding, Articulation, Reflection and Exploration.* I will also look at how we designed the multimedia-project in comparison with the frame work advocated by Collins et al.

I have divided the methods into two subgroups; Reflective methods for developing practical skills and Practical methods for developing cognitive skills.

Why I have chosen this division might seem odd since cognitive and practical skills are dependent upon each other. But according to Collins et al, there are different ways of teaching cognitive and practical skills and therefore I argue that this division makes sense. "Reflective methods for developing practical skills", are supposed to aim at how practical skills are promoted by theoretical methods into cognitive skills, (for example building a conceptual model of a task) by the use of the three initial methods (modeling, coaching and scaffolding). "Practical methods for cognitive skills" are supposed to aim at how cognitive skills are made explicit through the use of the three last methods (articulation, reflection and exploration).

4.1 Reflective methods for developing practical skills

The models similar in both apprenticeship and cognitive apprenticeship are modeling, coaching and fading.

4.1.1 Modeling

During Phase I of the multimedia-project several periods were spent on showing students how each application worked. Short handouts were put together to show the basic principles for each application. Each student was given a sample of the handout where they could read the assignment. One of the instructors showed what the application could be used for and how to use it by going through the assignments orally at the same time as he/she showed the procedure on a large-screen computer. The remaining instructors helped individual students when they got stuck. It was up to the student to choose way of working.

The high availability of instructors allowed students to work as they preferred. They could choose to listen and imitate an instructor, work on their own with just a small guidance from an instructor or even work with an individual instructor. This would be the teaching method that Collins et al would call *Modeling;* an expert showing the students how to use the application at the same time as he/she tells the students how each step in the process affects the outcome.

Our reason for having short introductions before the student made their choice about what topic to work with was to let all students try each tool and give them a hint of what they were able to do with the tools. We wanted them to create, what Collins et al call, a *conceptual model* of the field of the application.

4.1.2 Coaching

During Phase II, students started to work and practice using the application. Each student now had their own aim and direction and therefore the role of the instructor switched from just showing how to perform a task to discussing the aims of the student and come up with ideas about design issues or problem solving strategies. Students, for example, had to be shown how to do internet-searches and how to choose search words to find the right information. Instructors also had to go through copyright laws, since students wanted to publish mp3-files on their web sites, which is illegal. Coaching also consisted of trying to get the students to think about not writing anything on the website that could offend people.

4.1.3 Fading

Fading, as Collins et al calls it when the expert takes a less active role, did not occur in this project. Student needed constant help and the final steps to publish the website had to be done by an instructor since there was not enough time to let the students do it. Students never reached the knowledge-level where the applications became tools, so they could never start use it completely on their own.

4.2 Practical methods for developing cognitive skills

The distinguishing characteristics between traditional apprenticeship and cognitive apprenticeship are the articulation-, reflection-, and exploration-phase.

4.2.1 Articulation

During *articulation*, students are exhorted to verbally express thoughts about their process of working, together with experts and peers. During the modeling-phase, teachers express their thoughts about their process of working, and during the articulation-phase it is time for the students to do the same thing. By formulating their thoughts, students have the opportunity to organise their knowledge, their reasoning and their choice of processes for problem-solving.

Discussions concerning the strategies in the multimedia-project were mostly kept within topic-teams. During those meetings students got the opportunity to explain how and with what they were working. By doing so, other members in the group could give suggestions to help each other. They also had an opportunity to discuss the dynamics of the group and who was going to do what. Instructors also got an idea of their intentions and could, if their intentions were not practicable, guide them into the right direction. Articulation also happened naturally when students had to explain their intentions and desires of their own work to get technical assistance from an instructor. One example is when a boy was going to do a collage in Photoshop. He was going to put different pictures of rap-stars together. He had downloaded pictures from the Internet, but could not resize them. To make the instructor help him, he had to articulate his intentions and wishes.

4.2.2 Reflection

Reflection is the process during which students *"compare their own problem-solving process with those of an expert, another student, and ultimately an internal cognitive model for expertise."* (Collins et al, 1991, p483). In the planning-phase of the project the intention was to have some kind of reflection in the end of the project. But time-restrictions made it impossible. The reflection was more a comparison of final products. It consisted of showing the students the final e-magazine in class. Collins et al, mentions that *"competition is a powerful motivator"*, but the *"comparisons must be made not between the products of*

student problem solving, but the processes" since there is a possibility that students *"believe that making errors or being wrong about some process might make them "dumb""*. (Collins et al. 1991. p490)

There was not enough time to compare processes in class. But since all products were made of a team of students, no individual could be blamed for not having produced a website as good as any others.

4.2.3 Exploration

Exploration is the phase during which students start to solve problems of interest to them. Students should according to Collins et al be driven by a real interest for the task. By allowing students to work with topics chosen by themselves, we tried to make them really interested in the topics.

From the perspective that the students were going to explore how to use a specific application, exploration was very hard to create. To start finding its own solution, a student needed to have knowledge about what was possible to perform by using the application. For a few students, who already had basic computer skills, it was possible to start to explore the application already at an early stage. But for the most part of the class, it was out of their zone of proximal development. The applications were too complicated.

Some students were familiar with the applications and could for example start to use the drawing functions in Macromedia Flash already from the beginning. They recognized the interface from similar drawing applications and knew how to use it. These students could explore the functions which they already recognized but when it came to the functions specific to Flash, for example creating animations for the web, they could not solve problems or explore by themselves.

4.3 Reframing the multimedia-project in the light of cognitive apprenticeship

The framework for designing educational environments that Collins et al suggested was based on four characteristics. These were; content, teaching methods, sequence and sociology.

The *content* of the multimedia-project was, according to the curriculum, to learn how to use technological tools. But since we designed the environment based on a collaborative approach, students were faced with problems not directly connected with the actual use of the applications. This was an "intentional side effect", of the project, which according to Collins et al. are called problem-solving strategies and management and administration strategies. These "side effects" are all necessary parts of the learning environment advocated by Collins et al.

During the second phase of the project the *teaching methods* or instructions were going to be performed through individual and group-guidance. Students were encouraged to receive help from both instructors and each other. What we wanted to accomplish was what Rogoff calls "*guided participation"*. (Rogoff. 1995) Guided participation is based on the Vygotskian theory of the zone of proximal development. The expression is *"meant to focus attention on the system of interpersonal engagements and arrangements that are involved in participation in activities, which is managed collaboratively by individuals and their social partners in face-to-face interaction, as well as in the adjustment for each others' and their own activities"*.(Rogoff. 1995. p.146). Guided participation can, according to Rogoff, both be performed by experts and peers and be intentional or unintentional. Intentional in the sense that teachers and peers instructed the student and unintentional in the sense that

the student accidentally observed or overheard a task or a conversation and this in turn helps the student in choosing of procedure.

Sequencing is the division of a task into different levels of complexity which is adapted to the individual student capability. Global skills should, according to Collins et al, be taught at an initial stage of the process of learning. By showing already developed examples of e-magazines and having short introductions to each application, we wanted to help students gain a global knowledge. When starting to work with the applications the complexity increased and students needed much more guidance.

The *sociology of learning,* which is advocated by Collins, have a few characteristics that should be taken into consideration when designing a cognitive apprenticeship. These were; situated learning, culture of expert practice, intrinsically motivation, exploiting cooperation and exploiting competition. The initial goal of the multimedia-project was to have a student-guided environment, an environment in which students' motivation was partly based on having them decide what they were going to focus on, and by doing so we hoped that students would be intrinsic motivated. To work both in teams and individually, supported both cooperation and competition. Cooperation in the team was necessary since the development of a webpage includes a lot of work. Students were dependent on each other, if one student did not finish his/her part, the website would not be finished. Easy access to instructors, or experts, allowed us to use fairly complex tools. Without the access to experts, it would not have been possible to perform an extensive project like the multimedia-project during the short time-period.

4.4 Classroom management from a teacher perspective

A great difference between the multimedia-project and ordinary schoolwork was what I call "the classroom management". The teacher's role in the multimedia-project was foremost as a classroom manager, making sure that students were active and the project was running smoothly. The teacher responsible for the multimedia project found this way of working much more fun for both her and the students, but it was much more difficult to maintain control[8].

A change in the educational environment also changes the conditions for the classroom management. Cuban and Tyack (1995) wrote that one of the difficulties when changing a learning environment is for the teacher "*to replace old behaviour with new"* (p.108).

During a concluding discussion after the projects realization, the teacher and the instructors were interviewed about what they thought of the project. The teacher had some aspects that she considered to be problematic. *"-During the process it's hard to tell how much they are working. Are they working? Are they getting things done? How much are they doing? How much did they like it?"* It was not possible for the teacher to keep track of every student since all students in the multimedia project worked on their own. No predefined steps were to be followed by the students that could be milestones or general outlines when trying to judge the students progress. The grammar of schooling demands that the teacher has individual control of what each student is working with, since grades should be passed on the student, not the entire group.

When asking the teacher to compare the project with one of her ordinary classes, where she was the only adult and the students worked individually, she explained that "*-Classroom management was much easier [in the ordinary project]. But it was much more* boring*." [The multimedia project] "…was much more chaotic, but much more creative"*.

[8] According to a transcript from the final meeting concerning the multimedia-project.

The teacher saw disadvantages of having short periods of 47 minutes, and also having project limited to a few months. She thought about trying to arrange a similar project later on, but the time-restrictions were problematic. "*–With a year long course, it would have been easier. Because I would then spend some time learning everybody. […] In the 12 weeks, we jumped in to doing a major project, and the kids did not know the programs first. They could barely do a little with six people. It would have been impossible with just one teacher."* She draws the conclusion that it is not possible to arrange a project as extensive as this, without help from others. The degree of difficulty of the applications would have made it difficult to maintain a productive learning environment without having easy access to a group of experts.

4.5 The multimedia project and the curriculum of the school

As already mentioned, the project took place three times a week during twelve weeks. The total amount of time each student spent on the project was 28 hours (disregarding potential absence). Since the project was divided into short periods of 47 minutes, the actual working hours were much less. The short period made it difficult to get the students working effectively. Every period started with a few minutes of confusion, when all students tried to remember what they did last time and where they saved their work. When they finally started to work, one third of the period was over. The students worked for a couple of minutes until the period was running towards its end. Then all students started to get ready for leaving the class and a few minutes before class was over most students were ready to leave. It took only one moment from the signal rang until the classroom was empty.

The actual time the average student worked actively was about fifteen minutes every period and that is just about nine hours totally. A few times we tried to squeeze in work in both topic and tech teams during the same period so they could discuss and show their work. But we quickly understood that this was not possible. These periods were chaotic and the students did not get very much done.

The structure of the school system are based on blocks or a *Carnegie unit* (Cuban. 1995), were each unit is assigned to one class. Every day was divided into several units. A few minutes was put in between the units so that the students could walk between different classrooms. Every day had the same schedule, and it was not possible to reorganize periods and allow students to work in the same class during several units, since that would have affected all teachers and students at Smiley Middle School. This turned out to be a problem in the multimedia-project. According to Lindh, multimedia-projects need to be performed during half- or full days (Lindh. 1997. p.287), but this was not possible, since it would have demanded a change of the educational system at Smiley Middle school.

5. Discussion

This discussion will be divided into three parts. The first part will deal with one of the main preconditions for the project namely student engagement. The discussion concerning student engagement is mainly based on a transcript from the final meeting of the multimedia-project.

In the second part I will look at what the cognitive apprenticeship has to offer when creating a CSCL-environment in school. As mentioned earlier, the cognitive apprenticeship-model was designed to make better use of computers in school. By applying the model to the multimedia-project I wanted to structure my experiences of the multimedia-project in a way that highlighted important aspects of a CSCL-environment. By doing so, I hope to be able to evaluate some of the problems when arranging such an environment in the school-setting of today.

The multimedia-project in which I participated was just a short project within the frames of a greater Action Research-project. It is important to understand the underlying purpose of arranging such a complex project, since it would be hard to arrange a similar project within the limits of a school, without experts and instructors from outside school. I will therefore dedicate the last part of the discussion to broaden the view of the multimedia-project.

5.1 Engagement in the multimedia-project

One of the main questions at issue of the multimedia-project was to record students' perceptions of what kind of school activities that were engaging to them. In this project we wanted to see if students would be more engaged, if they had more to say about their own studies, when working with computer-based projects.

When comparing the initial project, the PowerPoint-project, and the Multimedia-project, we could see a difference in the engagement of the students. In the PowerPoint-project students worked with topics which adults thought were interesting. In the Multimedia-project students worked with topics they showed obvious interest in.

Students were already enthusiastic when the project idea was introduced. Some of them had heard about the PowerPoint-project and some had seen the presentations. The idea of an e-magazine was a great idea from several perspectives. There are almost no limits of what can be written in a magazine and by introducing an idea about a magazine, the student recognized the basic characteristics of the outcome of the project (since all students know what a magazine is). The discussion that followed the introduction was loudly and around 40 topics were suggested.

Instructors felt that it was easier to motivate the students to work with topics that were chosen by the students themselves instead by teachers. Since the applications used during the project were highly advanced, the topics were used to encourage students to work with them, and it seemed to work. The teacher was impressed with what the students managed to accomplish.

Working in groups had, according to previous findings in the action research-project, shown signs of making students more engaged than working individually. Our hopes were that the students would motivate each other by collaborating and being responsible for the same product. In one of the groups students' started to make demands on each other when the project was running towards its end. But in most groups, it was difficult to establish that kind of relations.

The project differed a lot from ordinary school-project in the sense that six adult were "at the students service". All adults had been working with multimedia-presentations before

and three of them made part of their living out of it. Students had great access to skilled experts. The number of experts was a necessity, since the students needed much help to be able to use those kinds of applications. The large number of experts made it possible to offer more individual attention to each student. Students did not need to wait very long for help since they could ask either the instructors or their peers.

I believe that the fact that student did not need to wait very long when needing help, was one of the reasons for students doing so well. Not only because easy access to experts did help students to understand and to solve problems faster, but it also helped them keep the good spirit up, although the applications were a bit too advanced for the students. The applications were in the higher zone of the students' proximal development and the access to experts kept students from getting frustrated and loose interest in the application.

5.2 CSCL, school and Cognitive apprenticeships

In a CSCL-environment teachers and students have to reconsider their own role in the learning-process. Students are supposed to take a more active part in their own learning and teachers have to adapt their teaching-methods to support new kinds of school-work. Even though there are problems with the cognitive apprenticeship, I believe that it is a great model for fostering such a change. Problems with the cognitive apprenticeship-model lie instead in the conditions for arranging real apprenticeship in school.

5.2.1 Different circumstances

In school the goal for the teacher is to teach, and for the students to learn. In an apprenticeship, the goal for the master, the journeymen and the apprentices is the same. They are all working towards the same goal. Apprentices are working to become a part of a community and they learn on their journey to become full participants. The goal is to stay within the community. For the students, the goal is usually not to stay in the community and become teachers; it is to get out of school. Students are always encouraged to do well in school and the motive for getting a good grade is for the students to "get a job".

The community, in which an apprentice participates, often consists of several masters and journeymen, which the apprentice can receive guidance from. The school consist of students and most often only one teacher. The apprentice can observe masters or journeymen in action, whenever needed. Even though we tried to model the use of the applications to the students in the multimedia-project, this was only done during the first part of the project. Students could not observe one master in process of working during the entire project. Learning in an apprenticeship is based on sequencing. The master or the journeymen decide when the apprentice is ready for a new assignment based on how well the apprentice achieves previous tasks. The sequencing is based on the apprentice's present skills.

Cognitive skills are not as easily determined as practical skills, since they are not as easily observed. And the sequencing is therefore much harder to adapt to individual students.

5.2.2 Combination of theoretical and practical skills

Even though cognitive apprenticeship is an attempt to combine theoretical and practical skills, there are some difficulties when doing so.

The curriculum of the school has some predefined topics which the student should overcome within a certain timeframe. These topics are mainly aimed at theoretical knowledge and skills. The practical knowledge, similar to what is taught through apprenticeship, is not in balance with the theoretical knowledge. It is hard to maintain

balance between them, since practical skills are not mentioned as important in the curriculum.

In the multimedia-project our focus was on the practical skills, learning how to use the tools. We could have focused more on theoretical skills such as basic principles of the Internet or facts concerning development of products for use on the Internet. But the timeframe limited us to work with the tools most of the time. When necessary, theoretical information was given to the students, for example; when students wanted to bring CD's to school, convert the wave-files into mp3-files and publish the files on their webpage, an explanation of copyright laws was necessary.

5.2.3 Time restrictions, production, and learning

The school system divides the semester into separate classes, and each school day into different units. When a class is over, no time has to be spent on repeating what has been learnt. One of the methods in the cognitive apprenticeship-model was the Exploration-phase. The exploration-phase allows the student to explore the topic by them self. But when looking at the multimedia-project, there were no such phase. The tools were too difficult and the timeframe was too limited. Students had no possibility to play, learn and produce something. If there would have been a follow-up-project, the progress would have been visible.

In a production-based project, as the multimedia-project actually was, the process of learning is demonstrated by the final product. Since it is an in-school-project, the teacher has to assign a grade to each individual student. The information that the teacher has to base the grade on is how active the student has been during the development process. But when learning a tool, part of the learning process has to be on trying and playing with the tool. Playing with a tool might not directly contribute to the production and it might look like the student is wasting time. If the teacher is focused on the final product the importance of playing with the tool might not be visible to the teacher. The timeframe might not "allow" students to play since the student has to work with something that contributes to the final product. What I mean with this is; that the importance of the process of production might prevail over the process of learning. And in a CSCL-environment, focus should be on the process, not the outcome.

5.3 The multimedia-project from a wider perspective.

The reputation of the multimedia-project circulated amongst the students at Smiley Middle School and some students expressed enviousness of not having the opportunity to participate in a similar project. Unfortunately students at Smiley Middle School might not have the opportunity to participate in such a project again, since this was a one-time project and the resources to perform such an extensive project are limited. Therefore the purposes of the multimedia project might seem incomprehensible. But the multimedia-project was only a small part of a large scale Action Research-project. One of its purposes was to see if a structural change into a student centred learning environment could increase students' engagement.

The initiators of the Action Research-project were not only focusing on the multimedia-project. Their research perspective included the entire school. The school was going through major changes at the time of my visit. It had for several years shown bad test scores on the yearly CSAP-exams and many parents in the neighbourhood sent their children to other schools. Even though the school had a capacity of 950 students, only 493 students attended the school. If there would not be an improvement of the test scores, the

school would become a charter-school[9] and that is something that no teacher of Smiley Middle School wished for.

The initiators of the Action Research-project participated during meetings with teachers and the principal, where conceivable changes and improvements were discussed. By being involved in different levels of the school; the principal-level, the teacher-level and the student-level, the researchers had the opportunity to further develop their understanding of the problems that Smiley Middle School faced.

By organizing an extensive project like the project in the computer class, the researchers tried to find alternative learning environments that would better suit the students of Smiley Middle School and therefore also increase the engagement, the motivation of the students and, in the longer run, also affect the results on the CSAP-exams. The project also gave the teacher, responsible for the project, a chance to reflect over the learning environment which she created and how she could better adapt it to her students.

[9] A charter school is a school which is governed by people outside the school. Teachers at the charter school have less to say in decisions regarding the school.

Acknowledgements

I would like to give my greatest acknowledgement to the people in Denver for their hospitality and generosity; they made my visit in Denver an experience for life.

Thank you

Dr Berthel Sutter and Björn Stille, for guiding me through the entire project.
Dr. Honorine Nocon, for her hospitality when inviting me to her home, allowing me to use it as my own and for helping me during my entire visit.
Professor Alan Davis and Professor Mark Clarke, for inviting me to the project with open arms.
Mrs. Betty Becker, for answering all my questions about school in the USA and allowing me to work in her computer lab every day, even when she had other classes.
Mrs. Venita Doughty, for her helping to find interesting writings to my report.
Mrs. Maria Thomas-Ruzic, for keeping her home open for me whenever I wanted to visit and who took me on a trip to explore the wonderful nature of the USA.
Finally I would like to thank my family and my boyfriend Christian, who have supported me through the entire project.

References

Collins, A., Brown, J.S., Holum, A. (1991) *Cognitive Apprenticeship: Making Thinking Visible.* http://www.21learn.org/arch/articles/brown_seely.html [2003-08-18]

Collins, A., Brown, J.S., Newman, S.E. (1989) Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L.B. Resnick. *Knowing, learning and instruction: Essays in honor of Robert Glas*er.(p453-494) Lawrence Earlbaum Associates

Cuban, L. (2001) *Oversold & underused - Computers in the classroom*. Harvard University press

Cuban, L., Tyack, D.(1995*) Tinkering toward utopia - A Century of Public School Reform.* Harvard University Press

Davis, A., Clarke, M.(2001) *The Tools Club: The Fifth Dimension in Colorado.* Report for the Trans Atlantic Training and Education Conference

Davis, A., Clarke, M.(2002) *Grant Performance Report, The Academic Engagement of Low African American and Latino Middle School Students: A Multi-Level Action Research Project.* University of Colorado at Denver

Hammersley, M., Atkinson, P.(1995) *Ethnography- Principles in practice*. Routledge

Koschmann, T.(1996) *CSCL: Theory and Practice of an Emerging Paradigm.* Lawrence Erlbaum Associates, Publishers

Kullberg, B.(1996)*Etnografi i klassrummet*. Studentlitteratur.

Larsson, M. (2002).*Lärkraft om forskning kring datorstött lärande.* KK-stiftelsens skriftserie. http://www.kks.se/assets/F3FF50E8-97E8-454C-9EF3-BAC726AFA7D7/Dokument/larkraft_30914.pdf [2003-06-01]

Lave, J., Wenger, E.(1991) *Situated learning Legitimate peripheral participation.* Cambridge

Lind, J.(1997). *Datorstödd undervisning i skolan- möjligheter och problem.* Studentlitteratur

Liu, M.(2001) *Middle School Students as Multimedia Designers: A Project-Based Learning Approach.* National Educational Computing Conference, "Building on the Future" 1 July 25-27, 2001—Chicago, IL http://confreg.uoregon.edu/NECC2001/program/research_pdf/Liu.pdf [2003-08-06]

Nielsen, K., Kvale, S. (2000) *Mästarlära – Lärande som social praxis.* Studentlitteratur

Rogoff, B. *Observing Sociocultural activity on three planes: participatory appropriation, guided participation, and apprenticeship*. In Wertsch, J., Del Rio, P., & Alvarez, A. (Eds.) (1995). Sociocultural studies of the mind. Cambridge: Cambridge University Press.

Salomon, G. (1995) *What Does the Design of Effective CSCL Require and How Do We Study Its Effects?* CSCL95, Indiana.

http://www.uni-leipzig.de/~sander/uebung/salomon.htm[2003-05-03]

Svensson, L., Brulin, G., Ellström, P-E., Widegren, Ö. (2002). *Interaktiv forskning – För utveckling av teori och praktik.* Arbetslivsinstitutet

Säljö, R.(2000) *Lärande i Praktiken- Ett sociokulturellt perspektiv*. Prisma