Scaffolding and interventions between students and teachers in a Learning Design Sequence

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One of the aims of this paper is to develop knowledge about scaffolding as meaning for learning when students in compulsory and upper secondary school use digital educational material. The other aim is to investigate if teachers support or prevent the students' learning process when they are working with ICT during a Learning Design Sequence (LDS). The theoretical framework is primarily based on a socio-cultural perspective drawn from Neo-Vygotskian theories. The results indicate that scaffolding occurs in all parts of a learning design sequence but are most common in the shaping part in this study. Most of the teachers and students, in this study, think that using digital educational material requires more and other forms of scaffolding. The results concerning teacher interventions indicate that teachers interact both supportively and restrictively for the students' learning process. Some reasons for that are connected to the content of the intervention and whether teachers intervene together with the students or not.

Keywords Information and Communication Technology; ICT; digital educational materials; artefacts; cultural tools; learning; scaffolding, interventions

1. Introduction

This paper is written within the research project, "Digital Teaching Aids and Learning Design Sequence in Swedish Schools – Users´ Perspective". The study is in the research field of ICT and it is based at the Stockholm Institute of Education. The project's purpose is to deepen the understanding of how digital media are used as a resource for learning in education. The project runs for three years, from the year of 2004 to 2007 and is led by professor Staffan Selander.

Ten schools were selected by their active use of ICT. Students are from 6 to 19 years old and they are observed in different subjects. In this paper three schools in the suburbs of Stockholm are chosen from the material. The subjects that were included in the Learning Design Sequence in these three schools are Swedish language, Music, ICT, Home economics and Social science. The students' are 8, 13, 14 and 17 years old.

The theoretical framework is primarily based on socio-cultural perspective drawn from Neo-Vygotskian theories. The method and analysis we have employed is qualitative. A characteristic of many digital educational media is that they are multimodal. The interaction with the artefact as well as with other people in the classroom can be seen as multimodal. In our material, modes according to the artefact could be written text, images, animations or films. Communication and interaction in different modes could be spoken and written language as well as gestures. We view the notion mode as a mediating resource [1]. The importance of the different modes alters according to the research question.

We have used different methods of data collection – as field observation, video recordings, informal and formal interviews with both students and teachers. The material is gathered in classrooms when students use digital teaching aids in their daily work. It can for example consist of Internet, different software as Word, Power Point and Illustrator, Learning Management systems, digital cameras or scanners. The main part of the material consists of videotaped film.

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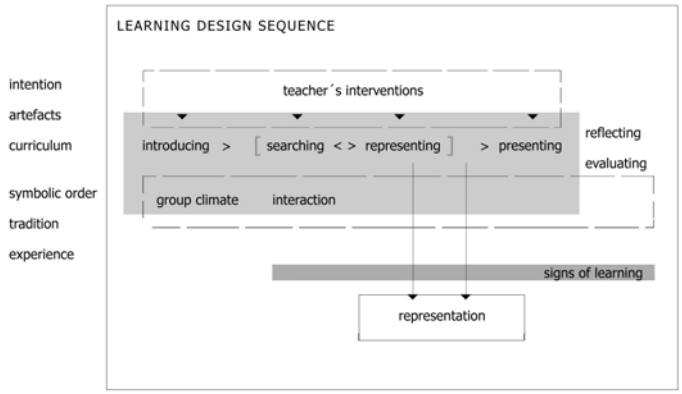
All material is not transcribed; instead we transcribe critical incidents [2] that we choose according to the questions at issue. Each research member transcribes and analyses sequences according to his or her individual research questions. The analysis is made according to the LDS model below.



Within our research group we have constructed a model which we refer to as an LDS – Learning Design Sequence [3]. The teacher and sometimes teachers and students are deciding the contents of an LDS. There are many underlying processes that have an impact on learning in an LDS, such as intentions, curriculum, traditions, group climate and students' opportunities to reflect and represent the LDS. Scaffolding and teacher interventions occur in different ways along the whole LDS, from the start to the end. An LDS can consist of a few hours session up to a big thematic work that extends over a whole semester. We follow an LDS from start to end. In other words, we document a sequence from introduction to evaluation. We have documented these sequences with a digital video camera and field observations. Interviews with both teachers and students take place after the Learning Design Sequence. Student's representations are gathered, sometimes as a CD, caught with our video cameras or in printed form. The members of the research group look into different areas within an LDS, see the figure, with help of their own individual research questions. In this paper we will look at scaffolding and teachers interventions.

2. Scaffolding

Vygotsky's sociocultural theory of learning points out that human intelligence stems from the culture we are living in. Human cognition occurs in the first place on a social level in interaction with other human beings and thereafter inside the individual [4]. When learning is shaped by the social environment every person, has a larger extent of potential for learning than the definite capacity of the individual when learning is facilitated just by someone with larger knowledge [5]. This range of a person's potential is called the zone of proximal development and is essential according to Vygotsky's ideas. Learning in the zone of proximal development is a combined activity in which the teacher simultaneously keeps an eye on the goals of the LDS and on what the student with assistance is capable to do. Scaffolding is a strategy that teachers use to move learning forward in the zone of proximal development. It is a collaborative process. It involves negotiation of meaning between the teacher and the student about expectations and how to improve the learning processing the best way [6]. Examples of scaffolding could be when the teacher provides the student with different kinds of support e.g. hints, encouragement, cognitive structures and reminders during the learning process through an LDS [7]. A striking example could be when a student is stuck in the searching phase of the LDS and she/he can't find information the teacher may then suggest a new search term or help the student to limit the subject matter.

Regarding all research questions about scaffolding the material is chosen from three different schools and three LDS'. The students are 8, 14 and 17 years old. Concerning our first research question about scaffolding: "What kinds of scaffolding occur when students use digital educational material and where in a learning design sequence do they occur?" we have analyzed the video material from Hill and Hannafins [8] four types of scaffolds; conceptual, metacognitive, procedural and strategic. Conceptual scaffolds could be maps, outlines and clarifying examples which support the student to make choices about the selection or to prioritize what is important information. Metacognitive scaffolds may include reminders to reflect on the goal or a cognitive model, which helps the student to focus on the target or to estimate what he/she knows and what to do next in the learning process. Procedural scaffolds could be textual charts, graphic representations, site navigation maps or instructions about the working procedure which help the student to value resources and at the same time reduce the cognitive load in the procedure of navigation. Strategic scaffolds may include suggestions for alternative approaches to tackle a task that helps the student to develop an alternative perspective of an issue for example.

The results indicate that all types of scaffolds occur in every part of an LDS. The most common type of scaffold was the procedural type in all the three LDS'. The most common phase where the scaffolds occurred was in the shaping part, between the searching and representing part, in this study. In the upper secondary school different types of structures were a common form of scaffolding. In this class we recognized that the students created their own structures in the working process and we interpret that as they used scaffolding as a mediating resource.

Concerning the second research question "Do students understand the same phenomena of scaffolding as teachers?" we have taken our point of departure from the interviews. We have compared the teacher's answer with the students' answers at each school. The results differ a lot between the schools. In one of them the teacher's view of scaffolding is quite similar to the students'. In another school the answers differ totally between the teacher and the students. What is considered as procedural and metacognitive scaffolding from the teacher's point of view is not at all understood or used as scaffolding. In the third school the answers and the descriptions of scaffolding are very similar between the teacher and the students.

Regarding the third research question " Do students and teachers believe that schoolwork with digital educational material demands more, less or other kinds of scaffolding for learning?" we have used the interview material for analyzes as well. Among the younger students the teacher and the students agreed upon that schoolwork with digital education material demands more scaffolding to handle the digital artefact. In another school the students express their increased need of scaffolding in the searching phase of the LDS. They express that it is more difficult to understand the information they get at the Internet compared with traditional educational material. The teacher in this school also thinks that it is necessary with more scaffolding to deepen the understanding for the students because it takes a lot of time to handle the artefact and get the technique working smoothly. The teacher in the third school thought more scaffolding is needed in form of metacognitive as well as procedural scaffolding since the information on the Internet is far more comprising than traditional educational material which requires more preparation from the teacher. The students were also of the opinion that working with Internet as a resource requires more cognitive scaffolds to help them to focus on the target.

To sum up most of the teachers and students, in this study, think that using digital educational material requires both more and other forms of scaffolding compared to other forms of educational material.

3. Teacher interventions

In order to investigate if teachers support or restrict the students' learning process we first have to define what we mean by learning. According to sociocultural theory learning occurs in a practical and communicative setting. Learning is situated and we imitate and perceive knowledge from our fellow-beings during social interaction. Communication is a social act through language, by which we can ask for and exchange information and knowledge. We develop knowledge and mediating tools (artefacts) to think with and our perception of the world is visible through the language. Learning occurs through

participation in activities. Persons are involved in social practices and learn how to act in different social settings. People in the same social setting use common ways of communication and acting. Communication is the link between culture and thinking, and cultural tools are given to others in a communicative setting [9] [10]. Hence it is important to enable group participation and dialogic interaction to create a good learning environment in Vygotskyan footsteps [11].

Teacher interventions occur in different ways during a whole LDS, from start to the end. The empirical results are collected from inter-subject thematic work in two different compulsory schools, both with classes selected from later years. In both classes they do thematic work, involving teachers in different subjects. Both these LDS last for almost a whole semester.

The results concerning teacher interventions indicate that teachers intervene both supportively, restrictively and sometimes even disruptively for the students' learning process. One of the reasons for that is connected to what the teacher is intervening about, technology concerning ICT, the content of the subject or a combination of these. If teachers are intervening towards and with the student or not is important for whether student learning is prevented or supported. We also look at the focus of the intervention and give some examples of various interventions that were seen during field observations and recording with video camera. One of the interventions is when the teacher is focusing on the artefact and not on the student at all. The teacher and the student don't interact, discuss or even look at each other. The teacher takes over completely, and, as a result, the student doesn't participate in problem solving and doesn't know what has happened, neither on his screen nor with his work. He is not told how to solve similar problems in the future and doesn't get the tools for future development. The 'Zone of proximal development' is not used here even though it could have helped the student a lot [12].

Another type of intervention occurs when the teacher shows the student everything. The student is watching, being told exactly what to do and then follows the instructions. The teacher is the guide that leads the student forward. In this situation the teacher is intervening both restrictively and supportively. As a result, the student doesn't have to think about problem solving by himself. Moreover, the content of the work is not interesting, rather the ICT and the teaching of the artefact. Some interventions involve more than one student. We have examples where the contents of the work and interaction with the students are in focus, while the artefact is of secondary importance. The teacher is interacting with the students all the time, looking into their eyes and discussing the contents of the work. This has great potential, since the student receives knowledge and skills from the teacher and other students during interaction. As a result, the students think together and collaborate, which is important, since their views are widened and they are given different perspectives. This agrees well with sociocultural theory, a central thought of which is that individuals receive knowledge through the communicative processes.

We have also discovered interventions that focus on subject contents. When teachers intervene with a group, it is their subject skills that are in focus. The students will ask the social science teacher questions about social science, the ICT teacher ICT-related questions and so on. The ICT teachers never comments on thematic contents, nor does the math and science teacher comment on social science work. With this approach, each activity is defined within a certain subject or discipline.

Another example of restricting the learning process is when the teacher interrupts ongoing activity. This teacher action is obstructive since the teacher actually interrupts students' work with irrelevant things. One example is when a group of students are focused, and the work with digital artefacts progresses in a steady flow. The teacher steps forward and shows the results of an essay. After this, the students can't find their way back to the working flow again, not even when the teacher has left.

4. Conclusions

Our conclusions about scaffolding are that the comprehension of scaffolding depends on the view on learning and knowledge. An example of that is when the teacher had prepared different types of scaffolding but the students didn't comprehend them at all as scaffolds. It is also even more important with more and different types of scaffolding in all phases of the learning process when you are working with digital material. In the beginning there is huge need of scaffolding to handle the artefact so the students can be

more independent and focus on the content and the task instead of technical matters. It is obvious that the students in all schools of the study look upon their teacher as the most important scaffold and support for their learning.

We also can see a need for more reflection and consciousness from the teacher's side when it comes to interventions. In what directions is the teacher working? Does he recognize himself as someone who mostly interacts with the students or has the artefact as a focus? In the later years of the compulsory schools, there is a consciousness about how much the subject on one hand and the identification of the teacher's role with the subject on the other hand impact the behaviour. During these classroom interventions, the students primarily turn to the teacher and ask questions of relevance for the teacher's subject. They don't discuss the contents of the presentation with other teachers than the one teaching the relevant subject. The identification of teachers with their subjects is the starting point for the students during their work.

Our conclusions lead us to further questions. Could the digital educational material be designed in another way including more scaffolds? Would it then be possible for students to realize the affordances and use the technique to decrease the intellectual load? Could this deepen the learning process? When the digital artefact was used as a scaffold in itself could this usage release intellectual capacity? Do we only give the students small pieces of the cake and leave it to them to create an entirety? Each teacher is mainly commenting on student activities within his own subject, but what support do the students get for obtaining the whole view of the subject? It is important to consider such questions when planning thematic work. Who has the subject specialty and who is responsible for the context and total view? Which is the best strategy for dividing teaching hours between teachers - maybe several teachers are needed during student presentations?

References

[1] G. Kress, C. Jewitt, J. Ogborn, and C. Tsatsarelis. Multimodal teaching and learning. The rhetorics of the science classroom. London, New York. Continuum. (2001).

[2] D. Tripp. Critical incidents in teaching: developing professional judgement. London. Routledge. (1993).

[3] S. Engström, A. Hössjer, S. Selander, and A. Åkerfeldt Forskarens öga Om att använda video som metod. (2006).

[4] L. Vygotsky. Mind in society. The development of higher psychological processes. Cambridge, MA : Harvard University Press. (1978).

[5] J.V. Wertsch. Voices of the mind: A sociocultural approach to mediated action. Cambridge, MA : Harvard University Press. (1991).

[6] L-A. Shepard. Linking Formative Assessment to scaffolding. Educational leadership November. (2005).

[7] D. Wood., J.S. Bruner. And G. Ross. The role of tutoring problem solving. Journal of Child Psychology and Psychiatry, 17(2), pp. 89-100. (1976).

[8] J. Hill and M. Hannafin. Teaching and learning in digital environments. The resurgence of resource-based learning. Educational Technology Research and Development No.3, (2001).

[9] R. Säljö. Lärande i praktiken. Stockholm. Prisma. (2000).

[10] R. Säljö. Lärande och kulturella redskap : om lärprocesser och det kollektiva minnet. Stockholm: Norstedts akademiska förlag. (2005)

[11] A-L Brown., K.E Metz and J.C Campione. Social interaction and individual understanding in a community of learniners: The influence of Piaget and Vygotsky. In Piaget-Vygotsky. The Social Genesis of Thougt. Eds. Tryphon, A and Vonèche, J. Hove:Psychology Press. (1996).

[12] S. Chiklin. The Zone of Proximal Development in Vygotsky's Analysis of Learning and Instruction. In Vygot
sky's Educational Theory in Cultural Contex.eds. Kozulin, A. et al. Cambridge: Cambridge University Press.
(2003).