

TEACHER'S SCAFFOLDING BEHAVIOR IN CSCL

A Case Study

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Abstract: There is a gap in our knowledge about what cognitions play a role while teachers scaffold students in CSCL. A case study was performed that investigated a history teacher's behavior and cognitions. The quantitative results fit with what is known about teacher behavior, and the qualitative data adds an explanation of why the teacher acted the way he did. Major influences were the teacher's beliefs about effective instruction and his prior knowledge of the students. The results show that although often not done explicitly, there is indeed a phase of diagnosing and evaluating students' work connected to performing an intervention.

1 INTRODUCTION

One of the most important features of computer-supported collaborative learning (CSCL) is to facilitate collaboration, and ultimately learning, between students. Next to providing a means for student communication, CSCL environments often contain a number of task-related tools that help carry out the learning task. There is a vast amount of research focusing on student interactions and student learning outcomes. In these studies, support is given to students in various forms (Soller et al., 2005). It is striking that there often is no mention of the presence of a teacher, i.e., the students work on their assignment independently.

However, recently there has been a growing interest in the role of the teacher in CSCL (van Diggelen et al., 2008); (Asterhan and Schwarz, 2010); (De Smet et al., 2010), which suggests that the teacher retains an important role. CSCL environments offer teachers information not only of the learning result but also of the learning *process*. It may be easier for a teacher to *scaffold* students' learning processes, i.e. to offer *adaptive* support and to fade that help when no longer necessary (Van de Pol et al., 2010). On the other hand, having access to such amounts of information could also cause an information overload for the teacher (van Diggelen et al., 2008).

There is still a gap in our knowledge about what factors and decisions determine the way teachers act in a CSCL environment. Our primary aim is to

contribute to the empirical data by reporting a case study in which we not only try to explain *what* a teacher does, but also *why*.

1.1 Types of Teacher Behavior in CSCL

The various aspects of a teacher scaffolding students during CSCL have been described foremost in theoretical terms or in guidelines for teachers (for example Salmon, 2003). Recently, the focus has shifted to studying *actual* teacher behavior in CSCL (for example Asterhan and Schwarz, 2010). Scaffolding students in an online learning environment is as much of a challenge as it is in a regular classroom (Volman, 2005). The support teachers give is related to various aspects of learning.

It is generally considered important for teachers to scaffold students' cognitive (task-related) activities (Anderson et al., 2001), for example by explaining subject matter and deepening the discussion between students (De Smet et al., 2010). Next to that, it is also important that a teacher pays attention to social activities within a group (Kreijns et al., 2003), for example by expressing positive emotions and by intervening when a conflict emerges. These scaffolding activities are all aimed at what can be termed object level (Molenaar et al., 2011). There is also a meta level that denotes the regulation of the object level. For example, teacher scaffolding aimed at the regulation of cognitive

activities includes giving hints about strategies for solving the assignment (Anderson et al., 2001). Aimed at the regulation of social activities, teacher scaffolding may include helping with collaboration strategies and reflecting on the students' collaboration process (Kreijns et al., 2003); (Salmon, 2003).

1.2 Explaining Teacher Behavior in CSCL

Although the types of scaffolding a teacher performs are identified in a number of studies, the empirical data is still scarce and primarily focused on carrying out *exploratory* research: the way and the type of data that is collected, and the way of analyzing and interpreting that data varies considerably between studies (van Diggelen et al., 2008). Teachers differ in the "moderation style" they adopt (Gil et al., 2007); (Vlachopoulos and Cowan, 2010), focusing on one of the aspects of learning mentioned before. To understand *why* teachers perform particular behavior, it seems a wider frame is needed that also includes the choices and beliefs that precede this behavior (De Smet et al., 2010); (Gil et al., 2007).

It is generally believed that teachers' behavior is substantially influenced by their thought processes (Clark and Peterson, 1986); (Molenaar et al., 2011). In the remainder of this text, we will use the term 'cognitions', thereby denoting the intentions, knowledge, and beliefs that help explain why teachers act a particular way in a CSCL environment. It is also important to examine general cognitions concerning teaching and those occurring during the planning of lessons, because these influence specific teaching situations (Clark and Peterson, 1986).

The content of cognitions can roughly be divided into three domains (Clark and Peterson, 1986); (Kreber and Cranton, 1997). We follow the terminology of Kreber and Cranton (1997). The first type of cognitions, also called curricular knowledge, concern planning and goals. Secondly, pedagogical cognitions are about views of learning a teacher holds and the knowledge he has about his students. Last of all, there is instructional knowledge, which is about methods and strategies for instruction. These cognitions may concern different levels of specificity (Den Brok, 2001), for example a planning can be made for one lesson or for a complete semester.

The content and specificity of teachers' cognitions will be used as an explanation of teacher behavior, which in turn is studied using the

framework of scaffolding, explained in more detail below.

1.3 Scaffolding in CSCL

Scaffolding is assistance offered by a peer or tutor to help a student reach a goal that he would be unable to reach on his own (Van de Pol et al., 2010). Closely related to Vygotsky's (1978) idea of the zone of proximal development, it illustrates two important features of scaffolding: first of all, that it is necessary to offer help that is adjusted to the learner's needs. Next to that, the help the teacher gives will gradually fade as the learner gains more control over the learning task. Checking of understanding thus is important before *and* after an intervention to make sure the support is contingent and faded in an appropriate way.

Thus, there are three phases to be distinguished (based on the model by Van de Pol et al., 2010): 1) diagnosing the learner's current understanding/needs; 2) giving help, i.e. performing an intervention; and 3) evaluating the effect of the intervention. Assuming that cognitions influence teaching, we may link the three phases of scaffolding to the various types of cognitions.

1.3.1 Diagnosis

In a face-to-face setting, especially the phase of diagnosing is troublesome: the teacher has to tend to a whole classroom and can not spend a great period of time focusing on one group of students (Myhill and Warren, 2005). In CSCL, because every activity is logged, the teacher can reread conversations or contributions and thus has more "thinking time" to interpret the situation. While in a classroom a teacher often answers questions from students in a *reactive* way and adjusts his response on the fly (Rodgers, 2004), in a CSCL setting a teacher may *proactively* decide to offer help or guidance.

Whether a teacher studies students' social or task-related activities, will in part be determined by the teacher's beliefs about the characteristics of a successful learning process and his beliefs about effective scaffolding. Furthermore, the prior knowledge the teacher has about his students plays an important role. For example, when the teacher knows that a student has trouble with a particular subject, he might make sure to monitor that student more closely.

1.3.2 Intervention

After having reached a diagnosis of the current

situation, the actual intervention takes place. Support is considered *contingent* when the intervention is tailored to the diagnosis, i.e. to the learner (Vygotsky, 1978); (Van de Pol et al., 2010). In the current study, this may be visible in a difference in the quantity or quality of messages sent to different (groups of) students. In a recent literature review (Van de Pol et al., 2010), the types of interventions that teachers use whilst scaffolding were summarized. They include the provision of feedback, explanations, instruction, modeling, hints, and questions. While these categories denote the means of scaffolding, the focus or object needs to be specified as well. A possible framework is the four aspects of learning mentioned earlier: cognitive and social activities, and the regulative level of those activities.

A teacher has to decide what intervention fits the situation, taking planning into consideration as well. This instructional and curricular knowledge may have different levels of specificity. For example, if the teacher's long term goal is to teach students how to work independently, he may choose to avoid giving them direct instructions in a concrete situation.

1.3.3 Evaluation

The last phase of scaffolding, evaluation, is closely related to the phase of diagnosis. This is not surprising when scaffolding is thought of as a cycle (Van de Pol et al., 2010), moving from intervention and evaluation back to diagnosis. Both aim to find out the learner's state of understanding, albeit with a different goal. The goal of diagnosis is to be able to fit the intervention to the learner, while the goal of evaluation is to check whether the intervention was effective. The behavioral ways to do so are similar to those of diagnosis: a teacher may outwardly ask a student, or observe the student's work after the intervention (which, again, is logged by the program automatically) to see whether there is change or improvement in students' behavior.

The cognitions associated with evaluation are assumed to be related to those of planning: the effectiveness of an intervention is related to what goal the teacher had in mind for a particular interaction with a group of students. Other types of cognitions may be involved as well, for example a teacher may use instructional knowledge to think of which effect he should see in a group of students, based on his experience.

Again, the combination of thought and behavior leads to a wider understanding of what a teacher

does when scaffolding students' learning in a CSCL environment.

1.4 Research Questions

Our aim is to try to diminish the knowledge gap mentioned before, using the theoretical framework of scaffolding and the concept of *contingency* of support, and by expanding our study to include the teacher's cognitions. This combination of factors will result in an explanation not only of *what* a teacher does, but also *why*. The practical relevance of this case study is that CSCL environments may be adjusted to a teacher's needs. That is, supporting tools may be conceived that can help the teacher in the three phases of the scaffolding process. For this case study we have formulated the following research questions:

- Question 1: What scaffolding behavior (diagnosis, intervention, evaluation) does the teacher display?
- Question 2: Which cognitions play a role in the teacher's scaffolding behavior, and what is their nature?

2 METHOD

2.1 Participants

One secondary education male teacher, aged 43, participated in this study. He has 15 years teaching experience in history education. Thirty-nine students in two classes were involved in the study, who were all enrolled in the third year of the pre-university education track. Mean age of the students was 15 years ($SD = 0.6$). Students were assigned by the teacher into groups of three or four students, which made a total of 13 groups. Although Dutch secondary education students and teachers are familiar with collaborative, project-based learning, use of CSCL is still rather uncommon in Dutch classrooms. The participants therefore had little or no prior experience with online collaboration.

2.2 Assignment

During this study, students collaborated on a group task whose theme was 'The Cold War'. The task was split into three parts, which all focused on reading, comprehending, and synthesizing historical sources, and all resulted in writing an argumentative task. The first class worked on this task for nine

lessons, due to time constraints the second class worked for seven lessons. Each lesson lasted 50 minutes. Students worked on separate computers in a computer room in the school. During the lessons, teachers were online (see section below) to answer questions and provide information related to the task.

2.3 CSCL-environment

Students collaborated in a CSCL-environment named *Virtual Collaborative Research Institute* (VCRI, see for example Janssen et al., 2007). The assignment involved exploring the topic of the project by reading historical sources in the *Sources-tool*. Students could discuss the information through the synchronous *Chat-tool*. Students used the *Debate-tool* to construct a shared diagram of their arguments. Students used the *Cowriter*, a shared text processor, to write their texts.

An alternative version of the VCRI-program was available for the teacher, which allowed him to monitor the online discussions of the students in the *Chat-tool* in real-time and send messages in order to answer students' questions. Messages can be sent to a group, more than one group at a time, or the whole class. Teachers can examine the texts students are writing in the *Cowriter* or the diagrams they are making in the *Debate-tool*. The teacher thus was monitoring six or seven groups at a time by opening the tools the groups are working in. The program offered the teacher some basic statistical information about students' activities in VCRI's tools (e.g., the number of keystrokes per student), but to study the content of their work, the teacher had to decide for himself which tools to monitor.

2.4 Research Question 1

To answer the first research question, a coding scheme was created to code all teacher utterances that the teacher typed in the chat tool during the lessons that the two classes worked with VCRI. The utterances were coded on two aspects of scaffolding: the *means* and the *focus*. Van de Pol et al. (2010) use the terms *means* and *intention*, but because our study is also about teachers' intentions for the scaffolding process in general, we decided to substitute this term with *focus*. Two researchers independently coded the teacher utterances of two lessons (for each class one lesson). The overall Cohen's κ for scaffolding *means* was .77, and the overall Cohen's κ for scaffolding *focus* was .76.

2.4.1 Scaffolding Means

By the means of scaffolding, we denote which phase of scaffolding the utterance belonged to. As was explained, scaffolding cycles consist of diagnosis, intervention, and evaluation. These are the main categories of the coding scheme for the means of scaffolding (see Table 1). Diagnosis and evaluation show itself through the use of questioning. Intervention is split into six types: feedback, hinting, instructing, explaining, questioning, and prompting questioning (based on the review study by Van de Pol et al., 2010).

2.4.2 Scaffolding Focus

Table 1: Coding scheme for scaffolding method.

Type	Definition
<i>Diagnosis</i> (<i>DiagQst</i>)	Questions to understand the current situation, without giving help. Asking what the problem is / about students' understanding of the topic on hand.
<i>Interventions</i> (<i>Int</i>)	
Feedback (<i>Fdb</i>)	Direct evaluation of the behavior/work of the students
Hinting (<i>Hnt</i>)	Giving a hint or a reminder, without supplying the solution or detailed instructions. Students are still required to think for themselves. A hint can take the <i>form</i> of an instruction.
Instructing (<i>Ints</i>)	The teacher instructs students to do something. Recognizable mostly by the use of an imperative, but this is not necessary.
Explaining (<i>Exp</i>)	Providing information to elaborate on something, to make it clearer. After giving an explanation, the students(s) are able to continue their task immediately. Includes short answers to questions posed by students.
Questioning (<i>Qst</i>)	Request for a piece of information
Prompting (<i>PrQst</i>)	A question that is meant as a hint (see <i>Hinting</i>)
<i>Evaluation</i> (<i>EvaQst</i>)	Asking whether an intervention was effective/sufficient
Other (Oth)	Remaining utterances Correcting a previous statement

The second part of the coding scheme denotes the focus of scaffolding (see Table 2). Here we distinguished between scaffolding for cognitive (task-related) activities and social activities, and separated each of those into two categories: object

level and meta level. A similar approach was used in for example Janssen et al., (2007). As explained, the meta level denotes the regulation of the object level (Molenaar et al., 2011).

Table 2: Coding scheme for scaffolding focus.

Type	Definiton
Cognitive activities (Cog)	Utterances about task content (i.e. domain specific)
Regulation of Cognitive activities (RegCog)	Utterances about planning of the task / time management Utterances about task strategies
Social activities (Soc)	Utterances that contribute positively to the mood within a group or the class Utterances that express discontent or negative emotions
Regulation of Social activities (RegSoc)	Utterances about the collaboration process Utterances about strategies for collaboration
Other (Oth)	Information about (using) the program (VCRI) Remaining utterances that do not fall under any of the other categories

2.5 Research Question 2

2.5.1 Interview at Start of Project

Before the start of working with VCRI, an interview was held with the teacher. We first asked the teacher about his *general* knowledge and beliefs: concerning *pedagogy* we asked about beliefs concerning collaboration and the teacher’s role during collaborative work, concerning *instruction* we asked what aspects of learning he focuses on and what methods of instruction he uses in the context of collaborative work, and concerning *curriculum* we asked what the teacher wants to achieve by letting students collaborate. We proceeded to ask about *specific* plans for the assignment: what role as a teacher he intended to take on, what aspects of the assignment he would focus on, and what he wanted the students to learn. The interview was transcribed and analyzed. A summary was made of the teacher’s utterances concerning his knowledge, beliefs and intentions, from which expectations were drawn for the teacher’s behavior in VCRI. This profile compared to the coded protocols to determine the congruence or lack thereof between the expected and the observed behavior.

2.5.2 Stimulated Interviews during Project

Each week, the teacher was interviewed about the two lessons of working with VCRI that took place that week. He was first asked to share his general

impression of the lessons. The teacher was then shown fragments of the chat conversations, and was asked about his thoughts at the time. For each group of students, one fragment was chosen that involved interaction between the student and the teacher. The stimulated interviews were transcribed and then analyzed. Each of the teacher’s utterances was coded as to which kind of knowledge it denoted, i.e. pedagogical, instructional, or curricular knowledge, and to which phase of scaffolding it related, i.e. to diagnosing, intervening, or evaluating. We thus combined the theoretical frameworks of both behavior and cognitions when we analyzed the stimulated interviews.

3 RESULTS

3.1 Expectations of Teacher Behavior based on First Interview

To the participating teacher, collaboration is a means and a goal of learning. Students can learn from each other and it is a nice change of the regular setting. Some students do not like collaborative work, but the teacher believes students need to be able to collaborate when they leave school. During collaboration, the teacher feels he has less control over what is happening. The teacher tries to keep students focused and motivated by asking questions, checking whether students understand subject matter, and prompting them to talk about what they discovered. He is available for answering questions and walks around the classroom.

The teacher does not have any specific plans for the way he will scaffold his students while working with VCRI, due to his lack of experience with CSCL settings, but he hopes it will give him more information about each student’s part in the collaboration process. For the assignment, the teacher does have specific goals: 1) the most important goal is for students to get a firm grasp on the subject matter, as they will perform a written test about it; 2) the teacher wants to check what each individual’s role has been within a group, to avoid free riding effects; 3) students should learn how to use arguments in their written texts, to discuss and critically reflect on historical sources; 4) students should collaborate in an appropriate way: critically reflect on each other’s contributions, share the work in an equal way, and treat each other respectfully. These four goals are the starting point for our explanation of the teacher’s behavior.

3.2 Teacher Behavior

Table 3 shows the total of number of messages sent by the teacher to classes 1 and 2. In table 4, the number of messages is shown per group. Within each group, the messages to the whole class are counted as well, so the totals of Table 4 do not match with those of Table 3, in which class messages are only counted once.

Table 3 shows that most teacher actions are interventions. The focus of the teacher's scaffolding has primarily been cognitive activities and the regulation of cognitive activities. Table 4 shows there are some notable differences between not only the number, but also the type of messages that different groups have received. In the next section, we discuss these findings and combine them with the data from the stimulated interviews.

3.3 Explaining Teacher Behavior using Stimulated Interviews

3.3.1 Goal 1: Subject Matter

The teacher wanted the students to get a firm grasp of the subject matter. In Table 3, it is visible that the teacher explained a lot, and that the focus was often at cognitive activities. When asked about this, the

teacher admits that he was a bit disappointed about the students' level of understanding. He sometimes found it hard to explain topics through the chat tool. Also, he feels that students may have been reluctant to ask him questions: "Some students may have been struggling with something, and did not ask me for help soon enough. I think this is in part their responsibility, and that I can expect students in this class to ask for help themselves."

From Table 3, it becomes clear that not all interventions were followed by evaluation. This may have to do with the teacher's belief that students have their own responsibility. When asked about his way of evaluating, the teacher says: "Even if I give help, I can't expect them to process this immediately. I expect to see the effects of my help in the texts students write. Some students have not grasped the main idea yet, but I am patient. I want them to figure it out themselves. Some students will manage, but from others I expect less." The teacher thus did not outwardly perform evaluation, but checked this through monitoring the students' work.

3.3.2 Goal 2: Individual Differences

The teacher also wanted to make sure that each group member had an equal share in the assignment. The teacher said that if there were problems within a

Table 3: Number and types of messages sent by the teacher.

	Scaffolding means										Scaffolding focus					
	Diag	Int						Eval								
	Qst	Exp	Hnt	Fdb	Qst	PrQst	Ints	Qst	Oth	Cog	RegCog	Soc	RegSoc	Oth		
1	75	100	36	84	4	49	20	5	18	166	157	29	25	14	391	
2	46	39	17	57	7	4	28	-	13	62	96	32	11	10	211	
	121	139	53	141	11	53	48	5	31	228	253	61	36	24	602	

Table 4: Number and types of messages sent by the teacher per group for class 1 and 2.

	Class 1							Class 2					
	1	2	3	4	5	6	7	1	2	3	4	5	6
Total	73	125	65	88	107	80	152	95	88	76	76	68	67
DiagQst	20	23	14	18	22	18	20	18	16	15	8	11	8
IntExp	12	32	15	24	25	18	31	16	17	12	17	12	13
IntHnt	8	14	8	8	10	10	15	11	9	10	11	10	11
IntFdb	10	18	7	13	15	11	34	24	16	12	11	10	9
IntQst	1	1	-	1	1	-	-	2	2	1	-	1	1
IntPrQst	1	14	-	3	8	-	23	-	1	1	2	-	-
IntInts	9	10	11	10	15	11	14	15	19	15	17	15	17
EvalQst	1	-	-	1	1	1	1	-	-	-	-	-	-
Cog	4	49	4	16	26	7	61	19	11	10	20	11	15
RegCog	42	51	41	54	55	49	62	45	52	47	38	38	36
Soc	13	11	12	10	11	12	19	19	14	12	9	10	8
RegSoc	9	2	3	3	9	6	4	10	6	5	4	5	5

group, he noticed this immediately by the students' complaints in the chat tool. "In a regular setting, students often complain after the assignment is done, but now I could watch each step of the process." On the other hand, the exact contribution of each student was not completely clear. "I could check some statistics, but these do not offer any information about the quality of each student's work." VCRI does not display which students has written what piece of text. In practice, this resulted in the teacher giving feedback on a group level, not necessarily on individual work. This turned out to be not a problem: "I noticed that once one of the group members got the idea, they would start explaining it within the group."

The number of messages per group does differ, especially in class 1, as can be seen in Table 4. The teacher says he sent each group a few messages about their work, based on what he read. On the other hand, often the group that was asking for most attention also received more messages: "In the beginning, all chats were moving so fast that I was acting in a reactive way. The nice thing is that I could have quite detailed conversations with some groups. In class I usually can't do that, because I might embarrass students. Here, nobody but the group members notice." The teacher was thus not always able to diagnose all groups, but once he got into a conversation, these were quite detailed. See Figure 1 for an example.

[14:31] Lars	Sir, if that source is not about domino theory, then what is it about?
[14:31] Teacher	which theme does it belong to?
[14:32] Lars	the role of the sovjet union in theme 3
[14:32] Teacher	what is the subject of theme 3?
[14:32] Lars	about how the cold war ended?
[14:32] Teacher	so it's not about domino theory but about the role of the SU in ending the cold war
[14:33] Lars	right

Figure 1: Example of a conversation between teacher and students in the chat tool.

3.3.3 Goal 3: Argumentation

Another goal was to let students critically reflect on historical sources and to let them use arguments in their texts. As was said, the teacher was a bit disappointed about the students' grasp of the material. He tried to stimulate them by giving a lot of hints that would make them think. When shown fragments of the chat protocol in which the teacher gives prompting questions, he often mentions

pedagogical knowledge about the students he was chatting with. For example, on one fragment he commented: "I gave hints here on purpose. This boy usually has a laid-back attitude, so I thought I would make this a little game. I could have revealed the answer, but I didn't. In the end he got it. Well, great!"

This example shows that the three phases of scaffolding often occur while only the intervention was visible in the chat protocol. The diagnosis consists of the teacher noticing student behavior in the chat tool and his prior knowledge of the students, the intervention occurs in the chat tool, and finally, the evaluation occurs through the evolving understanding that the student displays.

3.3.4 Goal 4: Collaboration

The teacher wanted the students to collaborate in an effective and respectful way. Surprisingly, there are not many messages sent that focus on social activities or regulation of social activities (see Table 3). In the beginning, the teacher sent messages in which he instructed them to not simply divide the work, but to negotiate on each subtask. He let this go once it turned out the assignment was quite a lot of work: "We were running short of time, so I let the students divide the work. This was the most practical solution." He did watch as the students cooperated: "When they transferred their diagrams [in the debate tool] into text, you could see they were collaborating and arguing about which sources were important."

Some students' social processes attracted the teacher's attention because of his prior knowledge about them. For example, there was one girl who is extremely shy. He noticed she did not say much in VCRI, either, although he had expected her to open up. The teacher did not take action because he believed it would only make her more shy.

4 CONCLUSIONS AND DISCUSSION

4.1 Research Questions

The aim of the case study was to explain a teacher's behavior in a CSCL environment by studying his scaffolding process and the cognitions that underlie this behavior.

The first research question was what scaffolding behavior the teacher displayed. The majority of the teacher's actions were interventions, while diagnosing and evaluating did not often occur

explicitly. This is in line with research concerning scaffolding in face-to-face settings (Myhill & Warren, 2005). The primary focus of the teacher's actions was cognitive activities and the regulation of those activities. Based on the literature, we expected to see more focus on (regulation of) social activities (Anderson et al., 2001).

The second question was how we could explain this behavior using the teacher's cognitions. In the previous section, the teacher's intentions were related to his behavior and to his reported cognitions at the time. Some of the goals the teacher had set were clearly visible in the quantitative description of his actual behavior. For example, his goal to achieve understanding of the subject matter was reflected in the high number of messages that focused on cognitive activities. From the stimulated interviews we learned that this did not guarantee that his goal was accomplished. The teacher felt like the students were not at the level he had desired.

Another result from the combination of studying behavior and cognitions was that it could be explained why there were relatively small numbers of diagnosing and evaluating questions. The teacher was sometimes quietly watching the conversations between students unfold, and keeping track of for example the way they were collaborating. The teacher was not able to translate this way of monitoring into action: he declared that especially in the beginning, the amount of information could be overwhelming. Compared to asynchronous settings (for example, De Smet et al., 2010), the teacher had more pressure to act on the spot. Besides that, when the assignment turned out to take more time than expected, the teacher was forced to make choices in his scaffolding behavior: students' social activities were scaffolded less.

The teacher's cognitions helped explain his scaffolding behavior. Some decisions were influenced by general beliefs, for example that the teacher expected students to ask for help when they needed it, and others by quite specific ones, for example his decision to let students divide the assignment instead of work together when they were running short of time. The theoretical framework we used for categorizing the teacher's cognitions worked quite well, and there seems to be a relation between scaffolding phase and the type of cognitions that plays the biggest role: diagnosis is often influenced by pedagogical knowledge, interventions are often related to instructional knowledge, and evaluation is related to curricular knowledge. This is not to say that these combinations are the only possible ones; for example, our data shows that choosing an

intervention is also related to prior knowledge about a student (pedagogical knowledge), not just about which interventions work well (instructional knowledge).

4.2 Future Directions

There are several limitations to the study reported here. First of all, we did not discuss the development of the teacher's scaffolding behavior across time. The teacher worked with VCRI for 9 weeks, so we can expect a more dynamic view of the teachers scaffolding (Molenaar et al., 2011), i.e. the focus of his scaffolding may have changed as time progressed. Related to this is the concept of fading. While some comments were made about the teacher distinguishing between groups and students, and thus about his contingency of support, we did not examine whether the amount of messages or the type of scaffolding diminished as the weeks passed. The question is whether the assignment the students worked on in this case study is 'suitable' for fading. The assignment may have such complexity that scaffolding is needed at all times. A possibility is that *some* areas of scaffolding do diminish, while others don't. For example, it might be the case that scaffolding of *regulation* of cognitive activities is not needed anymore after a few weeks when the students have become used to the new way of working, but that regulation of cognitive activities remains important throughout the assignment.

Furthermore, we did not report on the co-occurrence of the scaffolding means and focus. It would be interesting to see whether there is a pattern in combination of means and focus. Another line of analysis we intend to pursue is sequential analysis. It can be used to examine to what extent scaffolding phases in a CSCL context occur together. It was shown for regular classroom settings that scaffolding cycles are often not completed (Myhill & Warren, 2005). We have shown a possible explanation for this finding, namely that not all phases are observable. On the other hand, there were quite a few instances of explicit diagnosis in our data, so we could check whether these were always followed by interventions.

A last limitation is that we performed a *case study* and thus did not compare a large sample of teachers, which would lead to a broader view of knowledge and beliefs that play a role during CSCL, but also take a considerable amount of time. With this case study, we hope to have offered a new perspective on teachers' scaffolding behavior in CSCL.

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