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Scaffolding in teacher-student interaction: exploring, measuring, promoting and evaluating scaffolding

van de Pol, J.E.

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SUMMARY OF THIS DISSERTATION

Scaffolding metaphorically describes support that is adapted to students' understanding and that is, just like a construction scaffold, taken away when not needed anymore. This powerful metaphor provides *researchers* with a means to analyse and describe the dynamic learning interactions between teachers and students. In addition, it provides *teachers* with a way to give shape to their role as a teacher. Teachers, especially in schools employing more innovative pedagogies that are related to sociocultural theories and social-constructivism, are increasingly expected to stimulate students' active knowledge construction and to differentiate support. The concept of scaffolding, describing adaptive and temporary support that is aimed at transferring the responsibility for learning to the student, represents a teaching method that meets the demands of this changing teacher role (e.g., Lin, Hsu, Lin, Changlai, Yang, & Lai, 2012). However, the exact characterisation of this theoretical concept diverges and the term scaffolding has been used loosely in the past decades, as a synonym for any type of support (as argued by Mercer & Littleton, 2007; Stone, 1998a). Thus, both on a theoretical and a practical level, scaffolding needs a clearer conceptualisation and needs therefore to be further *explored*.

Furthermore, no measurement instrument for measuring scaffolding in the classroom, that takes into account the dynamic nature of scaffolding, is available. Scaffolding in classroom practices has often been measured while focusing on teacher actions or strategies only (e.g., Meyer & Turner, 2002). However, scaffolding is a dynamic process that takes place in interactions between e.g., teacher and students. Therefore, both teacher and student actions need to be analysed in order to measure scaffolding. More specifically, scaffolding is about *adapting* support to students' understanding. So to measure scaffolding, it is not only needed to analyse both teacher and student actions, but it is crucial to map the dynamic *adaptation* of a teacher's support to a student's understanding. To enable any thorough scaffolding research that analyses scaffolding validly, developing a *measurement* instrument that takes into account the dynamic nature of scaffolding is crucial.

Probably because of the dynamic nature of the concept, performing scaffolding is difficult and therefore found to be scarce in classroom practice (Oh, 2005). Particularly diagnosing students' understanding and adapting support accordingly appears to be a major difficulty for teachers (Wittwer & Renkl, 2008). Yet, no professional development programmes for the promotion of scaffolding are available. Because scaffolding is an appealing concept and a teaching method that is expected to be effective, finding ways of *promoting* scaffolding is vital.

Scaffolding is theoretically expected to positively affect students' engagement and achievement. The concept of scaffolding is related to sociocultural theories (Vygotsky, 1978), that state that learning takes place (first) in social interaction and that learning is guided by others. Scaffolding is support given in social interactions and it guides students beyond their current understanding. "The child never succeeds too easily nor fails too often" (Wood, Wood, & Middleton, 1978, p. 144). In parent-child studies and one-to-one tutoring studies, scaffolding appeared to have positive effects on students' achievement on construction tasks, puzzle tasks and mathematics tasks (Mattanah, Pratt, Cowan, & Cowan, 2005; Pino-Pasternak et al., 2010; Pratt, Green, MacVicar, & Bountrogianni, 1992; Pratt & Savoy-Levine, 1998; Stright, Neitzel, Sears, & Hoke-Sinex, 2001; Wood & Middleton, 1975). However, little is known about the effects of scaffolding in classroom situations as few (quasi-) experimental studies have been conducted in such contexts. To develop our understanding and to investigate the potential of scaffolding in classroom situations, it is necessary to *evaluate* its effects in practice.

Exploring and conceptualising scaffolding and finding ways to measure and promote scaffolding is thus essential in enabling research on scaffolding and specifically to enable research on the effects of scaffolding in classroom situations. The aims of this dissertation are to:

1. *Explore* the notion and process of scaffolding
2. Develop ways to *measure* scaffolding
3. Find ways to *promote* scaffolding
4. *Evaluate* the effects of scaffolding on students' engagement and achievement

In **Chapter 1** of this dissertation, the theoretical background of the concept of scaffolding was elaborated and an outline of the dissertation was presented.

Phase 1 – Exploring Scaffolding

In Phase 1 of this dissertation, we focused on the *exploration* of scaffolding. The central research question of this phase was: How can scaffolding be conceptualised and characterised? In **Chapter 2**, a systematic literature review of scaffolding in teacher-student interaction was described. It focused on the conceptualisations, appearances and effects of scaffolding in teacher-student interaction. A decade ago, Stone (1998a) noticed that scaffolding was often used beyond its sociocultural context and that it was often used as a synonym for just any support. Reviewing the last decade's relevant scaffolding literature, we conceptualised scaffolding as support with three distinctive

but interrelated characteristics: (1) contingent, (2) faded over time, and (3) aimed at transferring the responsibility for learning or for a task to the student. Support that is contingent is adapted to a student's current understanding and is thus differentiated. The support given must also be temporary and taken away if not needed anymore by the student. Finally, the support must be aimed at transferring the responsibility for a task to a student. In other words, the support is meant to empower the student in future learning situations and to help students reach their full potential.

Furthermore, we focused on the appearances of scaffolding in the empirical studies that were reviewed. To get a grip on the variety of appearances encountered in the reviewed articles, a framework for the analysis of scaffolding strategies was developed, making a distinction between scaffolding means (e.g., questioning, giving feedback, or modelling) and scaffolding intentions (e.g., focusing on students' metacognitive or cognitive activities or on students' affect). This framework is useful for the analysis of teachers' scaffolding strategies in classroom situations.

Finally, we reviewed the evidence of the effectiveness of scaffolding. Overall, few (quasi-) experimental studies were found, probably because scaffolding is so difficult to measure and to perform. Indicators of positive effects of scaffolding on students' cognitive and metacognitive activities were found. The evidence of the two effectiveness studies on the effects of scaffolding students' affect was mixed.

In **Chapter 3**, a case study into teachers' patterns of contingent teaching was described as few systematic analyses of scaffolding in naturalistic settings are available. Scaffolding appears to be scarce in classroom practice. In innovative pedagogies, teachers are expected to stimulate students' active knowledge construction and to differentiate support. This connects to sociocultural and socioconstructivist perspectives in which learning is seen as a constructive and socially embedded activity in which the learner is an active participant. Scaffolding addresses these teaching and learning issues to a great extent.

We observed the lessons of three social studies teachers of innovative (prevocational) schools because we expected to observe much scaffolding in these lessons. Three lessons per teacher (year 8), in which the students worked in small groups, were observed and after the last lesson, the teachers participated in a stimulated-recall interview. The teachers' scaffolding behaviour was analysed using a model of contingent teaching (based on Ruiz-Primo & Furtak, 2007). The model of contingent teaching consisted of three steps, namely: (1) using diagnostic strategies to determine students' understanding, (2) checking the diagnosis by asking students' whether their idea of the students' understanding was correct, and (3) using intervention strategies or scaffolding strategies (we used the framework of scaffolding strategies developed in Chapter 2). In addition, we determined whether the teacher helped the students

with exactly that which the students were struggling with to evaluate their contingency. Surprisingly, noncontingent interactions dominated. Within these noncontingent interactions, diagnostic strategies (step 1) often lacked and teachers mostly used the scaffolding means of instructing (i.e., telling students what to do). In the contingent interactions, diagnostic strategies (step 1) and the scaffolding means of questioning were often encountered. To be able to adapt support to a student's understanding, determining that understanding seems necessary. Using diagnostic strategies and helping students by using questions stimulated interaction and apparently facilitated contingent support.

Phase 2 – Measuring Scaffolding

In Phase 2 of this dissertation, we focused on *measuring* scaffolding because no measurement frameworks to evaluate scaffolding in classroom situations were available. The central research question of this phase was: How can classroom scaffolding in teacher–small-group interactions be analysed from a contingency perspective that takes the interactive nature of scaffolding into account?

In **Chapter 4**, two such frameworks to describe and analyse scaffolding interactions were developed and presented. The first framework was a qualitative framework that was based on the model of contingent teaching. This model was further developed and consisted of four steps: (1) using diagnostic strategies, (2) checking the diagnosis, (3) using intervention strategies, and (4) checking students' learning. With the fourth step (checking students' learning) the teacher could ascertain a student's understanding of e.g., a concept on which he or she had just received help. The central idea behind this model was that using diagnostic strategies and checking one's diagnosis, facilitates and enables contingent support. Exploring a student's current understanding will enable the teacher to connect to the student's understanding and to adapt the support accordingly. The fourth step (checking students' learning) enabled the teacher to decide whether the help could be faded or not. This model of contingent teaching provided us with insight into the phases that a teacher passes through with his or her students while scaffolding.

Furthermore, we focused on one step in particular of the model of contingent teaching, namely the step of providing intervention strategies (step 3) or giving support. A second, quantitative and micro-level framework focused specifically on the contingency of support. This contingent shift framework was based on the work of Wood and his colleagues (e.g., Wood, Wood, & Middleton, 1978) that focused on the contingent support of parents and tutors in one-to-one situations. When providing support, different degrees of control can be exercised. A high degree of control is for example exercised when a teacher gives an explanation or provides the answer whereas

a low degree of control is exercised when a teacher asks an open question. Adapting the degree of control to a students' understanding is considered contingent if one of the following contingency rules is followed: (1) the degree of control is increased upon students' poor understanding, (2) the degree of control is decreased upon students' good understanding, or (3) the degree of control is kept the same or increased upon students' partial understanding. To establish contingency, we thus also had to code the students' understanding. In addition, in analysing students' responses, we distinguished between claims of understanding (e.g., "I get it") or demonstrations of understanding (e.g., an explanation or elaboration). We argued that only students' demonstrations of understanding provide teachers with enough information on a students' understanding. To determine contingency, the contingent shift framework requires that the teacher's degree of control exercised in the support, a student's understanding, and a student's mode of expression (i.e., a claim or a demonstration) was determined. After having coded all teacher and student utterances with regard to these three variables, the contingency of each sequence of a teacher turn – student turn – and teacher turn could be determined using the rules of contingency. This contingent shift framework enabled detailed analyses of teachers' adaptations of the degree of control exercised. In other words, the key characteristic of scaffolding, i.e., contingency, could be determined with this instrument.

Phase 3 – Promoting Scaffolding

In Phase 3, we focused on the *promotion* of scaffolding. Scaffolding is found to be scarce, probably because it is so difficult to perform. While scaffolding, a teacher needs to carefully listen to a student and diagnose his or her understanding before giving (contingent) support and each student needs to be supported differently depending on his or her current understanding. However, no professional development programme for the promotion of scaffolding was encountered in the literature. Therefore, the central research question of this phase was: How can teacher scaffolding be effectively promoted?

In **Chapter 5**, a small-scaled, exploratory study aimed at the development of such a development programme was described. During two terms, we cooperated with four social studies teachers (year 8) of two innovative prevocational schools to develop such a programme. The model of contingent teaching that – at that time – still consisted of three steps (i.e., using diagnostic strategies, checking the diagnosis, and using intervention strategies) was used as a starting point for the programme. We hypothesised that this concrete step-by-step model, that was previously used as a measurement framework, could facilitate teachers in learning how to scaffold.

During nine lessons, the teachers experimented with these steps and each lesson was reflected upon with the researcher using video material of that lesson. The model of contingent teaching served as the central framework throughout the terms both during the lessons while practicing scaffolding and after the lessons while reflecting. The teachers' developing knowledge about scaffolding (using writing assignments), their scaffolding practice (using the model of contingent teaching and by determining contingency) and their reflections on their own lessons were analysed.

Mainly teachers' understanding and use of the first step, that of diagnostic strategies, appeared to increase. The occurrence of the second step (checking the diagnosis) stayed somewhat low which was partly related to the teachers' more variable understanding of this step as well as mixed personal attitudes towards this step. The teachers' degree of contingent support increased noticeably. Furthermore, while reflecting with the model of contingent teaching, the teachers realised that they: (1) had become more open to the students' understanding and that their students had become more open to display their understanding and ideas to them, (2) focused more on students' understanding in interactions with students and more on what students already knew instead of what they did not know yet, and (3) not just transmitted their knowledge but that they constructed new knowledge together with the students. Finally, a fourth step was added to the model of contingent teaching because the teachers felt the need to be able to establish whether the support that they provided had been effective. The step that was added was that of checking students' learning. While using this step, a teacher can determine whether support can be contingently faded or not. Summarising, working with the model of contingent teaching was associated with an increased understanding and use of diagnostic strategies and appeared to result in three important insights with regard to openness, a focus on students' understanding and co-construction. Importantly, the teachers support became increasingly contingent.

In **Chapter 6**, we investigated the effects of our professional development programme on the teachers' scaffolding behaviour into more depth and on a larger scale. Thirty pre-vocational social studies teachers (year 8) participated in this experimental study: 17 teachers participated in the professional development programme on scaffolding (i.e., the scaffolding condition) whereas 13 teachers did not. All teachers taught a five-lesson project about the European Union in which the students (N=768) worked on several assignments in small groups. The professional development programme consisted of a theoretical session in which scaffolding theory and the model of contingent teaching in general and in the light of classroom practice (using video examples) were discussed. Furthermore, the teachers practiced each step of the model of contingent teaching in the consecutive project lessons. Each lesson was videotaped and reflected upon afterwards, using the model of contingent teaching

and the concept of scaffolding as a central framework.

The first lesson and the last lesson were analysed to determine the effects of the professional development programme. The quantity and the quality of each step were determined for both measurement occasions. For diagnostic strategies (step 1), checks of the diagnosis (step 2), and checks of students' learning (step 4), the quality was determined by ascertaining the focus of that step and the mode of expression that was elicited. A focus on students' conceptual understanding (e.g., asking them about the relation between concepts) was considered of higher quality than a focus on students' factual knowledge (e.g., asking for the reproduction of a definition of a certain concept). With regard to the mode of expression that was elicited, eliciting a demonstration (e.g., an explanation) was considered of higher quality than eliciting a claim of understanding (e.g., "I get it"). For the intervention strategies (step 3), the quality was determined by analysing the contingency of the support in two ways. First, we evaluated contingency by determining whether the teacher adapted the degree of control adaptively to the students' understanding, using the contingent shift framework. Second, we also included a measure of uptake to determine a teacher's contingency with regard to what students actually said. Uptake was considered to take place if a teacher acknowledged and used the students' terminology and wordings in the ongoing conversation.

The quality of the steps of contingent teaching, rather than the quantity, appeared to increase in the support of the teachers who participated in the professional development programme, especially with regard to the mode of expression that was elicited in students' responses. Particularly while using diagnostic strategies (step 1) and checking students' learning (step 4), teachers in the scaffolding condition increased the elicitation of students' demonstrations significantly more compared to teachers in the nonscaffolding condition. Eliciting elaborate answers provides the teacher with detailed information on a student's understanding which enables the teacher to adapt the support to the understanding of the student. Moreover, the contingency of the support of the teachers who participated in the programme improved substantially, both in terms of the adaptation of control and in terms of uptake. These teachers appeared to adapt the degree of control that they exercised in their support contingently to the students' understanding, that is: giving more control upon poor understanding, giving less control upon students' good understanding, or giving the same amount of control or more control upon students' partial understanding. Furthermore, these teachers also appeared to be contingent in terms of uptake (cf. Nystrand et al., 2003), that is, they connected to what students said in interactions by using students' conceptions and wordings in subsequent support.

The model of contingent teaching appeared to be a powerful tool in promoting

teachers' scaffolding behaviour and the professional development programme that was based on this model proved effective.

Phase 4 – Evaluating Scaffolding

In the last phase of this dissertation, Phase 4, the effects of scaffolding on students' engagement and achievement were *evaluated*. Although scaffolding is often claimed to be effective (Roehler & Cantlon, 1997), hardly any empirical evidence exists. The central research question of this phase was: What are the effects of teacher scaffolding on students' engagement and achievement?

The experimental study that was conducted to answer this research question was described in **Chapter 7**. Thirty prevocational social studies teachers participated with 768 students (year 8). Seventeen teachers and 455 students formed the scaffolding condition (these teachers participated in the professional development programme on scaffolding) and 13 teachers and 313 students formed the nonscaffolding condition (their teachers did not participate in this programme). The intervention on scaffolding appeared successful (see Chapter 6); students in the scaffolding condition were exposed more to scaffolding in the postmeasurement (compared to the premeasurement) than students in the nonscaffolding condition who were exposed to little scaffolding on both measurement occasions.

Students' engagement and knowledge were measured before and after the intervention. Students' on-task behaviour, as an indicator of behavioural engagement, was measured using a questionnaire and observations. Students' appreciation of the teacher's support and the task, as an indicator of emotional engagement, was measured using a questionnaire. Students' knowledge or achievement was measured using a multiple choice test and an assignment.

Students appeared to appreciate contingent support. However, surprisingly, students in the scaffolding condition appeared to show a greater decrease in on-task behaviour than students in the nonscaffolding condition. Finally, no direct effects of scaffolding on students' achievement were found. However, when controlling for the negative effect on on-task behaviour (i.e., when keeping this variable constant in the analysis), scaffolding did have a positive effect on students' achievement. The negative effect of scaffolding on students' on-task behaviour was probably due to practical issues: scaffolding support takes longer so other students have to wait longer for help and may get off-task more easily. Scaffolding appeared to have the potential to have positive effects on students' achievement.

In **Chapter 8**, the contributions, suggestions for future research and implications for practice were discussed.

Future Research

In exploring scaffolding in practice, we mainly focused on the key aspect of scaffolding, i.e., contingency. The aspect of contingency is considered a necessary condition for scaffolding to occur. If support is faded or the responsibility for a task is transferred in a noncontingent way (e.g., if the student still has a poor understanding), the support cannot be considered scaffolding. However, to deepen our understanding of the full scaffolding process, more explicit attention should be paid in future research to the conceptualisation and processes of fading and the transfer of responsibility.

In measuring scaffolding, we focused on the different phases of the scaffolding process, using the model of contingent teaching. More specifically, with the contingent shift framework we focused on the contingency of the step of giving support. In analysing scaffolding, we only used that information that was – at that moment – visibly available to both participants in a certain interaction. However, information that was not visible within teacher-student interactions (e.g., things that have happened in previous lessons or in between lessons), may also determine whether support is contingent or not. Future research could investigate to what extent such information – that is not visible in interactions – determines the contingency within interactions.

In promoting scaffolding, we worked closely and intensely with the teachers. In its current form, the professional development programme is a fairly labour-intensive programme with many observation and reflection occasions. Although exactly this intensity might have contributed to the strong effects, future research could focus on ways to make the programme more feasible and efficient without losing its effectiveness. Peer observations and reflections amongst teachers could for example be a valuable modification that would make the programme less labour-intensive for the supervisor.

In evaluating scaffolding in classroom situations, practical issues arose, namely, that of the possible longer duration of scaffolding support which might have resulted in a longer waiting time for the other students. These practical issues need to be addressed in future research to optimise the implementation of scaffolding in classroom practice. Students' self-regulative skills and the way they ask questions could be important areas of exploration in this regard.

Practical Implications

This dissertation has implications for (initial) teacher education and continuing professional development. Teachers, especially in schools that adopt innovative pedagogies, are expected to take on a new role. They are expected to stimulate students' active knowledge construction and to differentiate support. In other words,

they are expected to *scaffold* their students. The concept of scaffolding in and the four-step model of contingent teaching are especially useful and effective in this regard. The model of contingent teaching makes the theoretical notion of scaffolding more tangible and concrete and it provides teachers with means to shape their new role.

The beauty of the scaffolding concept is that it balances between more traditional forms of guiding learning in which the teacher is regulating the learning and newer or innovative forms of guiding learning in which often only the student is supposed to regulate the learning. In scaffolding, the teacher provides the support that is necessary, while still acknowledging and stimulating the students' active role in the learning process as the ultimate goal of scaffolding is to transfer the responsibility for learning to the student.

General Conclusion

Scaffolding is an appealing concept that represents a complex interactional process. The dynamic nature of the process makes the measurement difficult. Nevertheless, this dissertation provided a solid starting point for the dynamic measurement of the degree of contingency of teachers' support. Although scaffolding is found to be scarce in classroom practice, teachers were able to learn how to scaffold while using the model of contingent teaching. Students appreciated scaffolding and it appeared to be potentially effective with regard to student achievement.

Scaffolding is a powerful concept that should receive continuing attention from researchers and practitioners. It represents a way of supporting students while fully acknowledging their potential. The student is empowered, but never left to his or her own devices.