Responsiveness in teacher explanations: A conversation analytical perspective on scaffolding

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ABSTRACT

The concept of ‘scaffolding’ introduced by Wood et al. (1976) figures prominently in educational research but lacks the empirical rigour that allows researchers to establish whether or not teacher assistance to students is an instance of scaffolding. We used conversation analysis to provide an empirical basis to the notion of ‘responsiveness’ (contingency) that Wood et al. treat as a fundamental characteristic of scaffolding. We analyzed dyadic teacher–student interactions in Dutch 1st grade secondary school mathematics classes and developed responsiveness as an interactional phenomenon: the concept has to rest on the analysis of how the learner’s actions and the tutor’s responses are interactionally brought about.

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1. Introduction

The last decade has seen an increasing interest in, and exploration of the possible contributions of ‘Conversation Analysis’ (CA) to research of ‘learning’. This interest has focused on learning as an interactional and situated activity, and the leading question has been what CA, as a theory of social interaction (e.g. Drew, 2005; Sacks, 1992; Schegloff, 2007) and a method for its investigation (e.g. Ten Have, 2007), can tell us about this activity. Outside CA, much of the interest in learning as an interactional and situated activity has been concerned with the concept of scaffolding. This concept was introduced by Wood et al. (1976) to characterize the support that a tutor gives to a tutee in the latter’s process of doing a particular task. Soon after its introduction, the notion of scaffolding was picked up by Vygotskian socio-cultural theory as a way of conceptualizing this theory’s ‘zone of proximal development’ (Kinginger, 2002; Stone, 1998). This amounted to connecting the notion of scaffolding to more general processes of child development and education and accounts for the concept’s popularity in numerous studies of adult–child (e.g. Kermani & Brenner, 2000; Wertsch, 1979) and teacher–student interaction (e.g. Cazden, 2001; Edwards & Mercer, 1987; Mercer & Littleton, 2007).

The concept of scaffolding must be credited for providing researchers with a tool for studying tutor–learner interaction and yet these studies also demonstrate that it is not an unambiguous tool. Studies of classroom interaction do not agree for example on what counts as scaffolding. Some researchers, such as Meyer and Turner (2002), find a considerable amount of scaffolding in the lessons they analyzed. They see every supportive intervention of the teacher as an instance of scaffolding.

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In contrast, others find little scaffolding. Myhill and Warren (2005) show that teachers use their instructions to control the interaction with their students. According to these authors, teachers’ utterances may appear to be scaffolding, but are only a means for eliciting particular responses from students.

In their study that introduced the concept of scaffolding, Wood et al. (1976) had 3-to 5-year old children perform a construction task assisted by an adult. The task was difficult enough for the children to need the adult’s help. Wood et al. introduced the concept of ‘scaffolding’ for characterizing the ways in which the adult structures the task in such a way that the child can make maximal use of his or her capacities. Analyzing the tutor’s contribution to the interaction with the child, Wood et al. discerned a number of scaffolding functions, such as directing the child’s attention to relevant aspects of the task and reducing the degrees of freedom for the child. In the scaffolding process the tutor does not provide just any type of help, but help that is contingent on and responsive to the level of expertise the child is showing. The tutor would for example give verbal instructions before intervening more physically; she would use deictic means before manipulating a piece of the construction materials herself. Wood et al. write that the tutor, for providing scaffolds to the child, needs two kinds of understanding. One is an understanding of the task and how it can be carried out successfully. The second understanding concerns the performance characteristics of the child. The tutor needs to follow the child’s task performance carefully and from moment to moment to provide “feedback (…) appropriate for this tutee in this task at this point in task mastery” (1976, p. 97; emphasis in original).

In our analysis of scaffolding in teacher–student interactions, we have taken the Wood et al. approach to tutoring as a point of departure. We have looked at how the interactional tutoring process involves the tutor’s provision of responsive or contingent actions, that is, actions adapted each moment to the level of task comprehension the child demonstrates. Even though an interactional perspective such as ours seems to be implied in Wood et al.’s original concept, the review by Van de Pol, Volman, and Beishuizen (2010) shows that many researchers look at scaffolding as a teacher strategy rather than as an aspect of a social interaction that involves both teacher and learner. They ignore the interpersonal aspects of the scaffolding process. Meyer and Turner (2002) for example focus on ‘teachers’ scaffolded responses’ as teacher actions that promote either understanding, student autonomy, or a positive classroom climate. They code these actions as independent actions and do not connect them to students’ preceding or subsequent contributions. Stone wrote in 1998 that there are “no direct analyses of the moment-to-moment contingent relationship between child behaviour and [tutor] support” (Stone, 1998, p. 355) and this situation has hardly changed since then. We argue that the question whether a particular action or utterance by the teacher is an instance of scaffolding cannot be answered in general terms. Scaffolding actions are responsive actions that take the competence the student demonstrates into account. Only by finding out whether a teacher is responsive to previous contributions by the student can we establish if he or she provides the kind of support that can be called scaffolding.

Recently, responsiveness has been attended to by researchers of tutor utterances in scaffolding interactions. Nathan and Kim (2009), in a study of whole-class interaction during mathematics lessons, and Pino-Pasternak, Whitebread, and Tolmie (2010) in a study of nine mother–child pairs during home work tasks, related the tutor’s instructions to the tutee’s understanding as demonstrated by the tutee’s reactions to the support provided by the tutor. Their coding systems allowed them to establish whether the tutor increased the cognitive complexity of elicitations as a response to correct answers by tutees and decreased the cognitive demands following incorrect answers. In comparison to earlier studies, the studies of Nathan and Kim and Pino-Pasternak et al. represent a step forward, for these researchers observe responses of both the tutor and the child and relate them to each other. However, their approach does not go beyond allocating preconceived categories to separate utterances; they do not consider the way the participants manage their interaction and over time build and maintain mutual understanding. Moreover, in the practice of coding utterances, the quality of the instruction is determined by the researcher: the perspective of the participants is not taken into account (cf. Van de Pol & Elbers, 2013). A tutor action that increases the level of instruction following a correct answer of the tutee will probably be coded as responsive. From an interaction perspective however, this decision should depend on how the tutee’s correct answer came about. As we will show below, if a teacher has cued a student to a correct answer, this teacher can act very responsively by repeating his explanation following that correct answer.

In the present study, we have used CA as a method for the analysis of interaction, to cast the notion of responsiveness, and as a result, the notion of scaffolding, in a more fundamentally interactional light than has been done so far in educational research. We have analyzed a corpus of video recorded teacher explanations to individual students in mathematics classes to see how CA can contribute to the empirical rigour of the concept of scaffolding, and as a result to the theoretical body of the concept.

2. Conversation analysis and learning

A conversation analytical interest in learning is by no means new and started as an interest in interactional classroom practices. Hugh Mehan’s book ‘Learning Lessons’ (1979) is often seen as the start of a CA concern with education since it guided conversation analysts to classroom practices as a topic of investigation (e.g. Macbeth, 1990, 1991). This interest has resulted in particular in detailed analyses of classroom interaction, some of which have dealt with between–student interactions (Ford, 1999; Glenn, Koschmann, & Conlee, 1999; Hellermann, 2008; Melander & Sahlström, 2009), while most have dealt with the practice of teaching as an interactional activity involving both teacher and students, focusing on issues...
such as the ways in which teachers elicit responses from their students (Lerner, 1995; Koschmann, Glenn, & Conlee, 2000; Koshik, 2002a; Margutti, 2006), the ensuing responses from the students (Elbers, Hajer, Jonkers, Koole & Prenger, 2008; Koole, 2010; LeBaron & Koschmann, 2003; Sahlström, 2002), and the subsequent teacher responses to the students (Hellermann, 2003, 2005; Koole, 2012a; Macbeth, 2004).

A CA concern with learning has emerged specifically in the area of second language learning, where conversation analysts have criticized main stream studies of second language acquisition (SLA) for looking at language as a static set of rules, rather than as a continuously developing set of practices, and at acquisition only as an individual and cognitive, rather than as a social and interactive, process (Firth & Wagner, 1997; Gardner & Wagner, 2004; Markee, 2000; Mondada & Pekarek Doehler, 2004; Mori, 2004; Seedhouse, Walsh, & Jenks, 2010; Seedhouse, 2004; Walsh, 2006, 2011; Young & Miller, 2004).

A CA perspective on learning would consist of studying understanding and knowing as interactional discursive objects and practices rather than as cognitive states or processes. Examples of this perspective can be seen in recent studies by Koole (2010), Margutti (2010), and a special issue of Journal of Pragmatics (Koschmann, 2011). A recent volume (Seedhouse et al., 2010), focusing on language learning, explicitly addresses the discussion between cognitive and interactional notions of learning, in which some contributors argue strongly for the former (Pienemann, 2010), others for the latter (Jenks, 2010; Pekarek-Doehler, 2010), while yet others attempt to bridge the gap and reconcile the two positions (Ellis, 2010; Seedhouse, 2010), arguing that “learning is...both a process and a product on both sides of the social/cognitive divide” (Seedhouse, 2010, p. 251). Or as Walsh contends, adopting Sfard’s distinction between the cognitive and the social perspective as ‘learning as having’ and ‘learning as doing’ (Sfard, 1998; Larsen-Freeman, 2010): “learning is [not] either having or doing; it is almost certainly both” (2011, p. 49).

Other CA researchers of learning processes have sought to connect their analyses to existing theories of learning that they consider to be compatible with CA. Recently, a number of CA researchers have used the learning theory of Communities of Practice (Lave & Wenger, 1991; Wenger, 1998) to study learning as changing participation in interactional practices (Young & Miller, 2004; Hellermann, 2008; Melander & Sahlström, 2009). Edwards (1993, 1997) proposes to heed the ethnomethodological principle of ‘public display’ and study learning as a participants’ concern. Others have joined forces with the enterprise to explore the interface and overlap between CA and socio-cultural theory (Brouwer & Wagner, 2004; Mondada & Pekarek Doehler, 2004; Vine, 2008), not just “CA as a tool in the service of a theory of learning” as Seedhouse (2005, p. 175) contends, but to “respecify crucial notions [... ] from a member’s perspective” (Mondada & Pekarek Doehler, 2004, p. 504). This is also the approach that we are taking in this paper. Our review of CA studies of learning, shows how CA offers analytical tools to those who study learning as a situated practice. CA not just adds ideas to scaffolding theory, but, as a theory of interaction, allows a clarification of what happens between tutor and tutee. It is such a respecification of the notion of scaffolding that we undertake in this paper.

3. Method and corpus

In order to explain how conversation analysis (CA) can be used as a method for analyzing scaffolding, in particular the ‘contingent’ (Van de Pol et al., 2010) or ‘responsive’ character of scaffolding, we need to say more on the notion of responsiveness, and on CA as a research method.

3.1. Responsiveness

A teacher can act in a variety of ways that can be called ‘responsive’, not all of which are the focus of this paper. A teacher can show what may be called long-term responsiveness to what the student has shown him in earlier lessons, or even outside these lessons, for example by referring to earlier exchanges between them, or to particular understandings or problems the student showed then. Indeed, the interactions we analyze below are all part of an ongoing exchange between teacher and student that neither started nor stopped with this particular interaction. Only a longitudinal study can reveal whether the design of a teacher’s explanation is responsive to what a student has shown the teacher, or alternatively based on a teacher bias towards that student. Moreover, it is not at all clear to what extent teachers use prior experience with a student in framing their here-and-now explanations. In our data we tracked one student who asked and received individual help in each of the subsequent lessons we recorded, and even though her problems seemed to be identical throughout these lessons, the teacher never showed an orientation to his prior explanations of the same issue.

A teacher can also do multi-party responsiveness to the other students present in the class. It is important to realize that what we analyze below as dyadic (two-party) interactions between a teacher and a student, are really multi-party activities (cf. Koole, 2007) involving not only other students who interfere with the interaction, but also other students who sit or stand waiting for this interaction to end in order to be helped themselves (for an ethnographic account of this waiting behaviour see: Elbers et al., 2008). Thus, the sheer length, or rather brevity, of the teacher’s explanations may be a response to other students waiting.

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2 Rather than as a ‘conversation analyst’, Edwards would label himself as a ‘discursive psychologist’ (Edwards & Potter, 1992).
Neither of the latter two notions of responsiveness will be the focus of our analysis. We will follow Wood’s et al. (1976) understanding of responsiveness as local interactional responsiveness, which we will analyze in terms of observable teacher responses to equally observable prior student displays of competence or trouble with mathematics assignments. A second and no less important reason why we choose to look at students’ observable displays, is that also teachers can only act upon what students make observable for them. Thus, our analytical focus on interactional responsiveness and on students’ observable displays, is a focus on precisely the same interactional materials to which also teachers’ access is limited when they assess student competence or trouble.

3.2. Conversation analysis and responsiveness

CA investigates how participants in interaction display to each other both how they make sense of the other’s contributions, and how they want the other to make sense of their own contributions (Drew, 2005; Pomerantz & Fehr, 1997). Therefore, CA is concerned with what participants make observable for each other, in terms of, for example ‘what is the action performed by this utterance’, ‘in what type of activity are we involved’, or ‘what is the topic we are talking about’, and not with intentions or interpretations that participants keep to themselves. The theoretical starting point of CA methodology is the observation that the meaning of an utterance is established in the course of the interaction following the utterance. This means that CA investigates meaning as a social and not as a cognitive phenomenon. When participants treat an utterance in the same manner, for example when they both treat it as ‘a question’ or as ‘a point for speaker change’, they establish ‘intersubjective’ meaning (Schegloff, 1992). This notion thus indicates that participants treat an utterance in the same way, not that their individual intentions and interpretations are identical.

Let us offer an example. In teacher–student talk we often see situations in which the teacher asks a question such as “is that clear?”, the student answers “yes” and the teacher moves on to another topic without the student objecting to that. In such a case, both the teacher (by moving to a next topic) and the student (by not objecting) treat the “yes” as a token of understanding. They establish meaning as a social phenomenon. Of course, it is quite possible that the student still does not understand, or that the teacher still has doubts whether the student understands, but when they do not make this not-understanding or these doubts observable to each other, these do not play a role in the interaction and cannot have an impact on the socially shared meaning that is attributed to “yes”. For this reason, Sacks (1992) called such a “yes” a ‘claim’ of understanding, as opposed to ‘demonstrations’ of understanding wherein a student displays how he or she understands. In educational practice, teachers tend to treat claims of understanding as a sufficient ground for closing an explanation (Elbers et al., 2008).

From this short introduction to CA theory and methodology we can conclude that a CA notion of responsiveness is different from a scaffolding notion of responsiveness. From a CA perspective, an utterance is responsive in the way this utterance shows an understanding of the prior utterance. These responses may be designed to align more or less with the constraints established by the utterance to which they respond, as has been shown in studies of ‘preference’ organization (Pomerantz, 1984; Raymond, 2003; Sacks, 1987). Also less aligning responses, however, show a particular understanding of the prior utterance, for example by showing what sort of problem an answerer has with a question (Stivers & Hayashi, 2010). The primary CA question therefore is not the binary question whether an utterance is responsive, but how it is responsive. From a scaffolding perspective, however, an utterance can very well be non-responsive. Indeed, as we have seen, the primary criterion to call a tutor action a ‘scaffold’ is whether that action is responsive to the child’s displayed level of mastery (Van de Pol et al., 2010; Wood et al., 1976) and it is this latter notion of responsiveness that is the object of investigation in this paper. In other words, we will use CA to investigate the scaffolding-notion of responsiveness. We will do this by looking at what teachers and students make observable for each other, and in particular in what ways the teacher’s support is responsive to the performance level students have made observable in the preceding interaction.

When we argue below that a particular teacher utterance is responsive to the student, we are saying that the teacher’s utterance is contingent upon what the student has shown in the interaction so far. Thus, teachers act more or less responsively to the extent that their explanations are more or less oriented to what a student has so far shown in terms of problems, knowing, or understanding. When a teacher does an explanation in response to a display of not-understanding, one could argue that this is a responsive action, but we will look more specifically at what it is the student displays as not understood, and to what extent the teacher responds to that display.

3.3. Data and corpus

We base our analysis on a corpus of video recorded one-to-one teacher–pupil dialogues in mathematics classes. The corpus of dialogues was taken from a larger corpus of classroom interactions collected in 1999 and 2000 in two Dutch secondary schools The Sun and The Rainbow (Deen, Hajer & Koole, 2008). The original study also contained whole class teacher–student interactions. Both schools represent the level of lower general secondary education. The research involved two first grade secondary classrooms, with students of 12 and 13 years-of-age and their mathematics teachers. The teacher in The Sun, Mr. Boom, is an experienced mathematics teacher in his fifties; the teacher at The Rainbow, Mr. Jager, is in his fourth year of being a mathematics teacher. The video recordings were made during a series of lessons on the subject of ‘graphs’. Slightly different versions of the same textbook were used in the two classes. At The Sun, six lessons were spent on the chapter on graphs, whereas the class in The Rainbow needed nine lessons to complete the chapter. All these lessons were
recorded with several cameras while the teachers wore wireless microphones. The transcription followed the conventions introduced by Jefferson (2004).

The lessons in the two classroom consisted of an alternation of whole class teaching and periods of individual seat work in which the students worked at assignments on their own. The teacher–student dialogues occurred in periods of individual seat work, when the teacher was available for consultation by individual students. When we started making observations we noticed that these consultations were organized in very different ways in the two classrooms. At The Sun, Mr. Boom typically responded to students’ requests by approaching them and conferring with them individually. Individual assistance was regularly followed by brief periods of whole class teaching. His interactions with the students typically consisted of a teacher monologue followed by student tokens of understanding. At The Rainbow, Mr. Jager stayed seated behind his desk at the front of the classroom and students went to him when they needed his help. This situation often led to the formation of a queue of students waiting for their turn. These interactions typically followed a Initiation–Response–Evaluation (Mehan, 1979) pattern in which the teacher helped students by asking questions and assessing their answers.

For the present analysis we selected all dyadic teacher–student interactions in the corpus which (1) dealt with mathematics, and (2) involved at least three turns. This selection resulted in a corpus of 52 dialogues, 33 from The Rainbow and 19 from The Sun. The exchanges analyzed ranged in duration between 10 s and 4:15 min, with one exception of a very long dialogue of almost 9 min in The Sun.

4. Analysis and findings: responsiveness as an interaction phenomenon

In this section we will first introduce the distinction between claims and demonstrations of understanding and next we will examine various examples of responsiveness and non-responsiveness to claims and demonstrations of understanding and non-understanding. The distinction between ‘claims’ and ‘demonstrations’ of understanding or not-understanding derives from Sacks (1992), who used an example of the following type:

(1) Tatjana RB-101299 (see Appendix A for transcription conventions)
23 Teacher: teken een assenstel met een zaagstaand ((reads))
          draw a coordinate system with a saw tooth
24 Tatjana: weet je wat een zaagstaand is?=
          do you know what a saw tooth is?
25 Tatjana: ja dat is dat ding he?
          yes that’s this thing right?
26 Tatjana: \[((points))\]

If we apply Sacks’ distinction to example 1, we can argue that when in line 25 Tatjana adds “that’s this thing right”, she does more than claim knowledge (“yes”) of the ‘saw tooth’ – a particular symbol in a coordinate system. She adds a demonstration of her knowing (“that’s this thing right?”). In this vein we also distinguish between claims and demonstrations of understanding. As Koole (2010) has shown, students may use different tokens for doing claims of understanding (e.g. ‘yes’, ‘hmhm’, nod, ‘oh’) and thereby additionally signal their understanding of the teacher’s explanation as either still being underway, or having come to a conclusion. ‘Oh’, for example, a claim that is used as an “explicit effort to convey a cognitive event” (Heritage, 2005, p. 189), is sequentially used by students as a “possible sequence-closing” turn (Schegloff, 2007, p. 119) to indicate that the explanation has come to an end (Koole, 2010, pp. 192–194).

An exchange between a teacher and a student, discussed by Van de Pol and Elbers (2013, p. 35), provides an example of a demonstration of not-understanding. The fragment is part of recorded interactions in a lesson about the European Union (part of social studies) in a classroom with students of 12–14 years-of-age (translated from the Dutch).

(1)Teacher: Do you know what a parliament is?
(2)Student: That is a group of people.
(3)Teacher: Yes, that is correct, but what does this group of people do?
(4)Student: They check the European Commission.

The student shows in (2) that she does not know the answer to the teacher’s question. This fragment is also an example of responsive or contingent teaching. The teacher does not react to (2) by correcting the student or providing the correct answer himself. Instead, he acknowledges the student’s answer and asks her to elaborate on it. The student’s answers in (2)

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1 Three turns are the minimum amount needed to establish intersubjective understanding: (i) A says something, (ii) B responds and thereby shows an understanding of A, (iii) A (often tacitly) accepts this understanding whereby A and B have interactionally agreed on the meaning of A’s initial utterance.

2 The research reported here resulted from the collaboration between a linguist (the first author) and an educational psychologist (the second author). We examined the teacher–student dialogues in the corpus because we wanted to see if there were instances of scaffolding and responsiveness. The first author was a member of the team that collected the classroom data. Transcripts were made by research assistants, but were checked by the authors.

3 Sacks in fact used the invented example
A: How long are you going to be there
B: Till Monday.
A: Oh, just a week.

According to Sacks, in this example ‘just a week’ provides a demonstration of understanding. Extract 1 is from our video corpus, just as the other data extracts.
and (4) allow the teacher to respond to the student and provide the right level of challenge, neither giving too much help nor too little.

In our analysis of responsiveness in dialogic interactions we will concentrate on three contexts. From the perspective of scaffolding theory it is relevant to look at situations where students produce tokens of not-understanding. Here we will distinguish between (a) situations in which a student claims not-understanding, and (b) situations in which a student demonstrates not-understanding. From a scaffolding perspective we may expect these two situations to lead to some form of action by the teacher to find out the gaps in the student’s knowledge or skills, and to ascertain that he or she offers support that is to the point and relevant. A third context (c) is one in which a student provides a token of understanding or knowing. In this analysis we will look not only at the ways teachers respond to tokens of knowing or understanding, but also at how students are led to produce these tokens.

4.1. Teacher responds to a claim of not-understanding

The opening of the explanation exchange between teacher and student shows a particular pattern. The student requests help and the teacher signals his availability to listen to the student’s question. In response, the student phrases or indicates his or her problem. Our observations show that students tend to formulate their questions in general and unspecific terms (Koole, 2012b). Rarely do students give a specific explanation or elaboration of their difficulty. In most cases, they tell the teacher that they do not understand an assignment or a particular part of it. Often they point to the textbook to identify part of the text in their book. The student’s request is the start of a dialogue in which teacher and student talk about the assignment. This means that the exchange in most cases opens with a claim of not-understanding.

In extract 2, Latifa comes to the teacher with a problem with an assignment in which a graph has to be drawn on the basis of numbers in a table. The numbers represent a patient’s pulse, measured every three hours. The assignment reads: “Draw a coordinate system and choose a partition on the axes.”

(2) Latifa RB-101299
1 Latifa ik snap de toel niet I don't understand this one
2 (2.5)
3 Teacher je t Kent eer een assenstel j sel= you draw a coordinate system again
4 Latifa =dat weet ik. I know
5 Teacher oke. op de horizontale ↑ as(.) komt de ↑ tijd(.) <nul drie zes> okay, on the horizontal axis (.) you get time (.) zero three six
6 (1.0)
7 Latifa ( .)
8 Teacher oke. hh wat is hier het kleinste getal en tje okay. hh what is the smallest number here
9 Latifa een eh vierentachtig one uh eighty four
10 Teacher vierentachtig nou en dan stel ik voor dan beginnen we bij ↑ tachtig eighty four well and then I suggest then we start at eighty
11 Latifa Ja Yes
12 Teacher .hh en daarna nemen we stapjes van? .hh and then we stake steps of?
13 Latifa vijf. Five

Latifa phrases her request for help as “I don't understand this one”. In response the teacher first directs her to the assignment (line 3: “you draw a coordinate system again”), then he instructs her ‘how to’ partition the horizontal axis (line 5) and then leads her through the steps of partitioning the vertical axis (line 8 ff.).

If we want to know how the teacher’s response is ‘responsive’ to the way the student phrased her problem we must look at what Latifa shows the teacher in formulating her problem the way she does. Latifa provides a localization of the problem (‘this one’), but she does not say what the nature of her problem is. Thus, the teacher’s choice to start an explanation of ‘how to’ draw the coordinate system is not interactionally responsive to the student’s problem formulation. The teacher orients to the design of the coordinate system as Latifa’s problem – and for all we know he may be right – but we can also say that his explanation is oriented to a problem that is not present in the student’s problem formulation.

In order to understand that indeed, the teacher’s orientation to a ‘procedural’ problem (‘how to get to the correct answer’) represents a choice amongst alternative problem perspectives, it is relevant here to know that from a mathematics education perspective, a problem can also be ‘conceptual’ (e.g. ‘what is a line graph’, ‘what is represented by it’), while additional research in these two classes has shown that many of these students have a language problem with understanding the assignments in the text book (Koole, 2012b; Prenger, Berenst, De Gloppe, & Hacquebord, 2008). Thus, there are at least two other problem types the teacher could have chosen to orient to.
Because students only indicate that they do not understand the assignment, assistance by the teacher could be expected to involve an exchange between teacher and student for clarifying or specifying the student’s difficulty. Indeed, this is what we see in other institutional contexts where experts are asked to help solve a problem such as call-centres (Baker, Emmison, & Firth, 2005) or health-visit exchanges (Heritage & Sefi, 1992). The student’s message that he or she does not understand would seem to be an insufficient base for an intervention by the teacher. If the teacher wants to help the student, he could need more information on the nature of the student’s difficulty. From the perspective of scaffolding theory, the teacher can only be responsive if he has been able to make a diagnosis of the student’s problem. Responsiveness demands a prior diagnosis (Van de Pol et al., 2010).

We found in our corpus no single case where teacher and student stop to establish what the problem is. Confronted with the claim of non-understanding teachers typically do not wait for the students to elaborate on their difficulty, nor invite them to provide such an elaboration, but start an explanation. This does not mean that the teacher’s explanation is irrelevant with respect to the student’s difficulty. Indeed, the teacher’s explanation is responsive to the extent that the explanation recognizes that the student has a problem and seeks help to solve this problem rather than for example expressing empathy (cf. Jefferson & Lee, 1992). But on the content level, the teacher’s explanation is not interactionally responsive to the students’ request for assistance since there is no prior attempt to construct a common understanding of the problem.

4.2. Teacher responds to a demonstration of not-understanding

We have just looked at students’ claims of not-understanding. The next question is by what standard we can call an utterance a ‘demonstration of not-understanding’. An example of such a demonstration can be found in extract 3, line 6. Azzedine’s task, as Latifa’s (extract 2), is to design a coordinate system and draw a line graph on the basis of numbers in a table.

(3) Azzedine RB-101299
1 Teacher nou mag je dus- (.) wat is hier het hoogste getal?<
   so now you can- (.) what is the lowest number here?
2 Azzedine eenentwintig (.) nee vierentachtig=
   ninety-one (.) no eighty-four
3 Azzedine ([leans over the book and points])
4 Teacher vierenachtig.
   eighty-four
5 Teacher —
6 Azzedine η en zes.
   and six.
7 Teacher j-a die maken dan niet zo heel erg veel uit.
   ye’s those are not so relevant
8 Teacher η[(points in assignment)]
9 Azzedine vierenachtig.
   eighty-four
10 Teacher ([.) dus dit is vierenachtig
   ([.) so this is eighty-four
11 ↑ nou dan beginnen we bijvoorbeeld met tachtig (.)
   well then we start for example with eighty
12 en dan alles daar onder laten we weer weg
   and then we leave out again everything lower than that
13

The explanation is initiated by the teacher’s question: “what is the lowest number here?” Azzedine looks at the assignment and after a mistake he self-repairs to answer “eighty-four” (line 3) which the teacher assesses as correct by repeating it (line 5). Then in line 6, Azzedine volunteers another lowest number: “and six”. 84 is the lowest number in the upper row of the table, and 6 is the lowest in the lower row while the two rows in the table correspond to different axes of the coordinate system. The teacher responds: “ye’s those are not so relevant”, probably referring to the lower row in the table, whereupon the student in line 9 shows his understanding that 84 is the lowest number the teacher was looking for. We can say that the teacher here successfully directs the student to 84 as the relevant lowest number, rather than 6. At the same time however, we can say that the student’s “and six” demonstrates that for him 6 was just as relevant as 84, or perhaps just as irrelevant. In other words, he demonstrates that he does not fully understand why he was asked to look for a lowest number in the first place. Or rather he demonstrates two things at the same time: he demonstrates that he ‘knows’ the smallest number, and also that he does not quite ‘understand’ why the smallest number in the top row of the table is more relevant than the smallest number in the bottom row. The teacher proceeds in a way that focuses the student away from the irrelevant lowest number and builds his explanation on the student’s knowing that 84 is the lowest number (lines 10 ff.). This however does not address the student’s demonstrated not-understanding and is therefore not responsive to it.

Thus, extracts 2 and 3 offer examples of different kinds of teacher non-responsiveness. While in extract 2, the teacher is not responsive by addressing a problem the student did not indicate, in extract 3 we see the reverse as the teacher does not address the problem the student just demonstrated.
4.3. Teacher responds to a student’s token of understanding or knowing

In this section we will look at how teachers respond to students’ tokens, both claims and demonstrations, of knowing or understanding. Before we can address the issue of the teacher’s responsiveness however, we need to look first at the tokens of understanding or knowing, for we can only analyze teachers’ response if we have insight in the interactional status of these tokens.

Student tokens of understanding or knowing are often produced in response to teacher questions. Englert (2010) distinguishes three question types in Dutch, the polar (or yes/no) question, the content (or wh-) question, and the alternative question, which contains answer options connected with ‘or’. All three question types are used in our data to ‘cue’ (Edwards & Mercer, 1987) correct answers, be it in different ways.

Polar questions can embody a mechanism of social interaction that is known within CA as ‘preference organization’ (Pomerantz, 1984; Sacks, 1987; Schegloff, 2007). With reference to polar questions, ‘preference’ means that the two answer options of this question type, ‘yes’ and ‘no’ are organized as not “symmetrical alternatives” (Schegloff & Sacks, 1973, p. 314). A yes/no question may be tilted towards a yes-answer (positive polarity), or towards a no-answer (negative polarity), or in CA terminology, the question may ‘prefer’ either a yes or a no answer, where ‘preference’ refers to a characteristic of the question, not to the individual preference of the speaker. This preference can be brought about by the design of the question such as the inclusion of a ‘negative polarity marker’ like “really” which lends a yes/no question a preference for a no-answer: ‘are you really going to?’. And it can also be brought about by the sequential context of the question, that is, by what precedes the question. Think of a teacher asking a student if she has understood an assignment (i) before engaging in an explanation, (ii) after having given an explanation, or even (iii) after having explained twice. While the question in context (i) may still be neutral, in contexts (ii) and (iii) it gains an increasing preference for a ‘yes’ response. The characteristic of question preference that is central to our present argument is that a participant can derive the answer from the question design and/or its sequential context, and does not need to know the answer prior to the question. A question about mathematics can thus be answered on the basis of interactional competence rather than mathematics competence.

In extract 4, Nynke’s problem concerns an assignment that contains a graph representing the changing temperature during a specific day, placed next to four short texts with descriptions of the weather on four different days. The task is to establish which of these four days is represented in the graph.

(4) Nynke ZO-081199

73 Teacher: okay → zie je?<
    okay → you see?

74 Teacher → (((looks at Nynke))
75 (3.3)

76 → gezien? kan het die → dag ↑ zijn?
    you see? can it be that day?

77 Teacher → (((looks at Nynke))
78 (1.1)

79 Nynke: ↑nee
No
ne, want het is bijna tien graden.
no, because it is almost ten degrees.

dat kan niet, hé?
that can’t be, right?

The teacher in line 76 produces a reversed polarity question (Koshik, 2002b) that ‘prefers’ a no-answer, and indeed, “no” is the answer Nynke gives, interestingly ‘try-marked’ (Sacks & Schegloff, 1979) with a question intonation, thus showing that although this is her understanding, she is not certain of its correctness.6

The teacher, in extract 4, leads the student to produce a correct answer. He does this by establishing interactional constraints on the student’s turn in such a strong way that the student is enabled to produce the correct answer without having to understand why the answer is correct. Nynke can answer “no” because the teacher’s question ‘prefers’ a no-answer. Koole (2010) calls these questions ‘knowledge producing’ since they are a means for the teacher to bring the student to produce the correct answer which is, at the same time, a doing knowing of that correct answer. This is very apparent also in extract 5 where again a student (Martijn) has to design a coordinate system and asks which of the two rows of a table, the upper or the lower row, corresponds with what axis of the coordinate system: the vertical (2: “the side”) or the horizontal (3: “the bottom”). In response, the teacher at the same time asks (line 5) and provides (his gesture in line 6) the correct answer, and thereby his question and gesture produce the student’s knowledge rather than check it.

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6 In Sacks and Schegloff’s (1979) first analysis of this phenomenon, ‘try-marking’ is used to refer to a person by name, and at the same time display doubt whether the recipient will be able to recognize that name. Thus while both practices display forms of doubt, Nynke’s “no” displays epistemic trouble on the part of the speaker whereas the person reference practice projects potential trouble for the recipient.
Here it is perhaps helpful to remind the reader of our previous discussion of CA methodology that looks at knowing and understanding as social and interactional rather than cognitive objects. So even though we learn from the teacher that he has given Martijn this information before (line 4), and from a cognition perspective we could suppose that Martijn’s knowledge is already in place, in need of refreshing, what counts interactionally is that Martijn presents himself as not-knowing in lines 1–3 and as knowing in line 7, even though his low voice (‘horizontal’) indicates tentative knowing.

If we now address the question of responsiveness, we have seen two different ways of acting responsively. In the case of Nynke (extract 4) the teacher does not treat the student’s correct answer as a display of conclusive evidence that she now knows or understands. In the case of Martijn (extract 5), the teacher does treat his answer as an opportunity to bring the exchange to an end. In most cases where the teacher uses knowledge producing questions, he does not end the interaction after the student’s correct answer, but adds further explanation. In response to Nynke’s “no” (extract 4), the teacher produces an explanation why ‘no’ is a correct answer, thereby treating Nynke’s answer as not showing full understanding. Though we may be tempted to interpret correct answers as tokens of understanding, teachers tend not to treat these answers as such, as we have seen in the example of Nynke. This is not only so in cases when the answer is ‘try-marked’ as in Nynke’s answer is, but also when the student’s prosody is more affirmative. Teachers’ continuations after these correct answers can be said to be responsive to the status of these correct answers as results of interactional mechanisms, rather than as demonstrations of understanding. In a different way, also the teacher’s treatment of Martijn’s correct answer is responsive. Although unlike in extract 4, in the exchange with Martijn (extract 5) the teacher does conclude the interaction (8: “right”) after the student’s correct response “horizontal” (line 7), this is still responsive since Martijn’s question states a problem of ‘knowing’ (‘which part of the table corresponds to which axis in the coordinate system’) rather than a problem of ‘understanding’. Thus, closing the interaction after Martijn has displayed that he now knows can be called responsive.

In interactions such as the following, where the teacher checks Patricia’s understanding at the end of his explanation, he acts less responsively:

### (6) Patricia ZO-091199

<table>
<thead>
<tr>
<th>Line</th>
<th>Speaker</th>
<th>Utterance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teacher</td>
<td>((looks at Patricia))</td>
</tr>
<tr>
<td>2</td>
<td>Patricia</td>
<td>ja</td>
</tr>
<tr>
<td>3</td>
<td>Patricia</td>
<td>yes</td>
</tr>
<tr>
<td>4</td>
<td>Teacher</td>
<td>ja?</td>
</tr>
<tr>
<td>5</td>
<td>Patricia</td>
<td>ja.</td>
</tr>
<tr>
<td>6</td>
<td>Teacher</td>
<td>Nou snap je ’t wel? now you do understand?</td>
</tr>
<tr>
<td>7</td>
<td>Patricia</td>
<td>ja.</td>
</tr>
<tr>
<td>8</td>
<td>Teacher</td>
<td>oke. okay.</td>
</tr>
</tbody>
</table>

Interactions such as these typically occur at the closing of monologic explanations by the teacher (Peräkylä, 1995): ‘information delivery format’. Rather than leading a student to a correct answer in the way we saw in extracts 4 and 5 where the teacher uses knowledge producing questions, the teacher here produces a monologue in which he shows the student how to go about in doing this assignment. These monologues are closed with exchanges such as the one in extract 6: the teacher checks whether the student has understood by explicitly asking, the student claims that she has understood and the teacher treats this as a satisfactory answer and closes the interaction.

The teacher’s questions in lines 4 and 6 are designed as yes/no-interrogatives with positive polarity which means that they ‘prefer’ a yes-answer. The “yes?” question (line 4) invites the addressee to agree. The “now you do understand” question

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1 In our data set, try-marked student responses are quite rare and do not permit a systematic analysis of teachers’ treatment of affirmative versus try-marked responses.
(line 6) employs a combination of turn design and sequential context to produce its preference for a ‘yes’. With “nou” (‘now’) the teacher refers to the explanation he has just given, and with the stressed particle “wel” (translated as stressed ‘do’) he marks a contrast with a former state of not-understanding. The question can thus be glossed as ‘did my explanation change your not-understanding into understanding?’, which strongly prefers a ‘yes’-response. And as in extracts 4 and 5, the student provides the projected answer. In contrast to extracts 4 and 5 however, the teacher’s questions in extract 6 ‘check’ Patricia’s understanding, rather than ‘produce’ it. We can therefore say that Patricia’s ‘yes’-answers are interactional products and claims of understanding, not answers that demonstrate understanding. However, closing the interaction after the repeated yes-answers treats them as the latter rather than as the former, and is therefore not responsive to the level of competence displayed by the student. Thus, the interplay between mechanisms of social interaction for cuing a particular student answer on the one hand, and pedagogical aims for which the interaction is used on the other, may sometimes produce a contradiction.

5. Conclusion and discussion

In this study of dyadic teacher–student interactions we investigated the scaffolding theory notion of responsiveness. In scaffolding theory it is assumed that proper instruction requires the teacher to be responsive to the mastery a student is showing. An analytic principle of CA methodology is a focus not on what speakers possibly intend or understand in terms of cognition, but on how they show their understanding or knowing to the other participants in the interaction in which they are engaged. Thus, when we conclude that a teacher’s turn is or is not responsive to the student, this means that it is (or is not) responsive to what the student showed the teacher in the prior turns in terms of her understanding or knowing. Possibly the student understands more than she shows, but the teacher, in the course of the interaction, has no way of knowing this. He must act upon what the student shows him. Therefore, we have used the student’s observable displays of competence as the basis for our analysis of responsiveness.

Responsiveness in this study is thus an interactional concept that should not be confounded with an educational notion of responsiveness. This interactional concept does not carry the connotation of ‘good education’ that an educational concept might. Although many educationalists treat scaffolding, and by implication responsiveness, as a valuable interactional practice, our analysis does not imply a valence but instead has aimed to provide the educational notions of scaffolding and responsiveness with a more solid interactional empirical basis.

One context we investigated is the interaction following a student’s claim that she does not understand the assignment. We saw that the teacher acted responsive at the action level of recognizing the student’s contribution as a display of not-understanding and a request for an explanation. However, at the content level it was not responsive to the performance characteristics of the child since the teacher made no attempt to find out what the student’s problem was, and started the explanation on the basis of a hypothetical problem, rather than a problem that the student showed him.

We also looked at students’ demonstrations of not-understanding. Though scarce, these examples are interesting because a student makes a contribution to the interaction that shows that a prior correct answer was given but not understood. In these contexts responsiveness would mean that the teacher deals with this display of not-understanding rather than take the earlier correct answer as a basis for the further interaction.

The third phenomenon we looked at are teacher responses in contexts where students do a display of knowing or understanding. These student displays characteristically result from teacher questions in which he exploits the interactional mechanisms of ‘preference organization’ to lead the student to a particular answer. In many cases a teacher uses this to lead students to a correct answer, such as the answer to the assignment. The analysis showed that these questions should be seen as interactionally producing the student’s correct answer – rather than as checking their knowledge. And indeed teachers in these contexts act responsively when they treated these answers not as the end of the explanation, but as a display that should be followed by further explanation.

There were other instances, however, where the teacher checks the student’s understanding with questions that interactionally ‘prefer’ confirmations. We found these checks following the monologic explanations by the teacher (see ‘data and corpus’): the teacher typically asks whether the student has understood the explanation and in almost all instances the students tell him that they have, thereby providing the preferred answer. When teachers treat this claim of understanding as sufficient evidence and close the conversation without asking the student to further demonstrate her understanding, this can be seen as interactionally not-responsive, since this treats the answer as evidence of the student’s understanding, rather than as a response that was projected by the teacher’s question.

Compared to other institutional contexts, our observations reveal many sequences in which the teacher’s response(s) could be classified as non-responsive to a student’s display of trouble or competence. As we pointed out before, in contrast to the practices in our data, professionals in call centres and health care visits do ask clients to elaborate on their requests for help (Baker et al., 2005; Heritage & Sefi, 1992). This form of non-responsive may be characteristic of teacher–student interactions in classroom. The patterns of responsiveness and non-responsiveness observed in this study show that the institutional context of the classroom differs from other institutional interactions. The notion of responsiveness turns out to be yet more complicated if we realize that interactions in classrooms often, if not always, involve more participants. In actual classroom practice, the audience of the teacher’s explanation encompasses more students than the one he may be addressing at the time. The institutional role of teacher, therefore, involves being responsive not only to the student but also to the larger
audience of students who can overhear what he has to say, even if the teacher addresses one student. Non-responsiveness at the level of the dyadic interaction may therefore be produced by teachers’ institutional role to address the collective.

In this study, we presented analyses of the moment to moment support provided by a teacher to individual students’ tokens of understanding and not-understanding. We did not examine another characteristic of scaffolding: the gradual hand over of responsibility to the student: how the support asked for the student and provided by the teacher changes over time. Connecting the analysis of responsiveness to the student’s growing competence would amount to showing how the level of challenges provided by the teacher changes over time, as the student learns. Longitudinal studies of scaffolding are rare and this is obviously an important issue for future research. Another issue that we could only mention briefly was the extent to which the teacher’s and the student’s expectations and contributions are the result of previous interactions. The teacher’s explanations often appear to be based on an assumption of the nature of the student’s difficulty, rather than on a diagnosis of the student’s understanding, as in the majority of the dialogues in our study. The complexity of responsiveness includes the extent to which teachers may adapt their support not only to the demands of the subject dealt with in the lessons, but also to the characteristics of the individual students and their learning history.

With these analyses, we have meant to contribute not only to the empirical analysis of the process of scaffolding, but also to the theoretical concept of scaffolding. Responsiveness is a multi-faceted phenomenon: we have shown responsiveness, and scaffolding of which it is a central characteristic, to be a truly interactional phenomena. The analysis of responsiveness must rest on how the learner’s action and the tutor’s response to it are interactionally brought about.

Appendix A.

Transcription conventions

<table>
<thead>
<tr>
<th>word</th>
<th>overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>word</td>
<td>‘latching’: two turns without minimal pause in between</td>
</tr>
<tr>
<td>==word</td>
<td>louder than surrounding talk</td>
</tr>
<tr>
<td>‘word‘</td>
<td>softer than surrounding talk</td>
</tr>
<tr>
<td>word</td>
<td>stressed syllable</td>
</tr>
<tr>
<td>w:ord</td>
<td>lengthening</td>
</tr>
<tr>
<td>&gt;phrase&lt;</td>
<td>produced faster than surrounding talk</td>
</tr>
<tr>
<td>&lt;word&gt;</td>
<td>produced slower than surrounding talk</td>
</tr>
<tr>
<td>‡</td>
<td>rising syllable intonation</td>
</tr>
<tr>
<td>†</td>
<td>falling syllable intonation</td>
</tr>
<tr>
<td>.</td>
<td>falling phrase intonation</td>
</tr>
<tr>
<td>,</td>
<td>rising phrase intonation</td>
</tr>
<tr>
<td>?</td>
<td>rising phrase intonation</td>
</tr>
<tr>
<td>Ø</td>
<td>phrase-final absence of punctuation: level intonation</td>
</tr>
<tr>
<td>.ih</td>
<td>audible inbreath</td>
</tr>
<tr>
<td>wo-</td>
<td>cut-off</td>
</tr>
<tr>
<td>{(points)}</td>
<td>transcriber comment</td>
</tr>
<tr>
<td>()</td>
<td>inaudible talk</td>
</tr>
<tr>
<td>()</td>
<td>pause shorter than 0.3 s</td>
</tr>
<tr>
<td>(1.5)</td>
<td>pause of 1.5 s</td>
</tr>
</tbody>
</table>

References


   In J. Deen, M. Hager, & T. Koole (Eds.), *Interaction in two multicultural mathematics classrooms: Mechanisms of inclusion and exclusion* (pp. 139–170). Amsterdam: Aksant.


