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The epistemics of student problems: Explaining mathematics in a multi-lingual class

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Abstract

Teachers in dyadic explanation interactions in mathematics lessons tailor their explanations to problems they assume, rather than to problems the students formulate. In these interactions, the teacher rather than the student is established as having access to the problem, and as a result it is the teacher's problem that gets to be explained. This analysis adds to recent Conversation Analytical studies of how participants in interaction deal with issues of knowledge (e.g. [Stivers et al., 2011a](#)). It also shows a case of educational interaction in a multi-lingual context. The students have diverse linguistic backgrounds, and work-aloud interviews with them have shown that their problem often is not with mathematics, but with understanding the texts of the assignments. As a result of the teacher's epistemic authority these language problems never surface in the interactions. The teacher casts the student's problem invariably as a mathematics problem, not as a language problem.

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1. Introduction

Students who ask their teacher for help with a learning problem are faced with the epistemic paradox of having to 'know what you don't know' or 'understand what you don't understand'. In this article I will use conversation analysis ([Pomerantz and Fehr, 1997](#); [Drew, 2005](#); [ten Have, 2007](#); [Heritage, 2008](#)) to look at how teacher and students deal with this paradox, how they establish agreement on the student's problem, and how in doing this, student and teacher negotiate epistemic authority over the problem. We will see how the teacher assumes knowledge of the student's problem, how students may challenge this assumption, but how the problem that gets to be explained is the teacher's rather than the student's problem.

The analysis and its results presented in this article not only contribute to our rapidly evolving insights in the interactional role of epistemics management ([Heritage, 1998, 2002, 2012a,b](#); [Heritage and Raymond, 2005, forthcoming](#); [Raymond and Heritage, 2006](#); [Raymond and Zimmerman, 2007](#); [Koole, 2010](#); [Koschmann, 2011](#); [Stivers et al., 2011a,b](#)), but also to our knowledge of the interactional management of multi-lingual contexts. The data that were used for this analysis were recorded in mathematics classes with students from different language groups ([Koole, 2003](#); [Deen et al., 2008](#)). Intriguingly however, this multi-lingual character never surfaces in these interactions and I will argue that the interactional management of the student's problem is responsible for this and establishes an interactional practice reminiscent of notions of 'safe talk' ([Hornberger and Chick, 2001](#)) and 'procedural display' ([Bloome et al., 1989](#)) that index the tendency of classroom interactions to move around and 'blind stitch' potential obstacles for its progressivity ([Stivers and Robinson, 2006](#)), such as language problems.

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2. Data

This study was carried out on a video corpus collected in two first grade mathematics classes in two Dutch schools of secondary education (students aged 12–13). The lessons were all concerned with learning to read and draw line graphs.

The two classes represent a lower level of secondary education and a feature of these classes that I will address in this paper, is that a substantial number of the students have text comprehension problems. Prenger et al. (2008) had the students from these two classes work aloud on the assignments from the text book, and found that many of them have problems with understanding the texts of the assignments, not only the students from immigrant parents (class 1: 49%; class 2: 62%), but also students whose parents speak Dutch as a mother-tongue.

The lessons all contain a phase in which students work for themselves on assignments, during which they can ask the teacher for help. These one-to-one interactions in which a teacher helps a student with a mathematics problem are the focus of my present analysis. One of the challenges for these interactions is for the teacher and the student to agree on 'where to start' the explanation (what is the student's problem?), and 'where to stop' (when is that problem solved?). In previous research I have looked at the latter issue (Koole, 2010), in this paper I will be concerned with the first question: how do teacher and student establish agreement on the student's problem?

From the perspective of mathematics education, students' problems with assignments can be either 'procedural' or 'conceptual'. A 'conceptual' problem would be that a student does not understand the concept of a line graph, for example that the line is made up of combined values on the vertical and the horizontal axes. A 'procedural' problem means that a student does not know which steps to take to do the assignment. And, as Prenger et al. (2008) have shown, a third potential problem, and one that is not mathematical in nature, is text comprehension. Perhaps the student did not understand the assignment.

In terms of epistemic authority, the question how teacher and student come to agree on the student's problem can be rephrased as: how do they deal with the epistemic rights of access to the problem? Common sense has it that in such situations the student 'has' a problem, and 'takes it' to the teacher. In my data a different picture emerges. The teacher does not treat the problem as 'owned' by the student. In contrast to many other problem-solving interactions such as those in medical interviews (Heritage and Maynard, 2006) or call-centers (Baker et al., 2005), these teacher–student interactions do not contain a phase in which participants explicitly sort out what the problem is. Rather, the student typically indicates the troublesome assignment, not the trouble, whereupon the teacher delivers an explanation of that assignment in such a way as to presuppose access to a particular problem with that assignment. In other words, the teacher acts as though he knows what the student's problem is and in acting this way proposes his problem definition for mutual agreement. If anyone acts as a problem 'owner' it is the teacher, not the student.

In the way teacher and student deal with the problem, they establish an interactional activity that is reminiscent of, yet quite different from the 'troubles tellings' that Jefferson (1984, 1988) investigated. Indeed, students in my data do not 'tell' their problem. They indicate that they have a problem and it is the teacher who presupposes a problem in the explanation he provides. I will show that these explanations are so organized that students have relatively few opportunities to show disagreement with the problem presupposed in it. It is particularly at the end of an explanation sequence that they sometimes hint that the problem just dealt with was not their problem. In the course of the explanation however, they are interactionally constrained to respond to local steps in the explanation, not to challenge the overall problem to which the explanation is oriented.

3. Epistemics as an interaction concern

For a proper understanding of the way this paper treats issues of 'having' a problem or 'authority' over a problem, it is in order to say a bit more on the conversation analytical take on cognition in interaction. The role of knowledge distribution in sense making practices is not a CA discovery, but conversation analysis did add a particular ethnomethodological perspective to this field of study.

Already in 1957, before CA was ever heard of, Bolinger argued that a question such as "Isn't the sun shining" has a different meaning depending on whether or not the asker knows that the sun is shining. In the case where this question is asked by someone standing in full sunlight, the question gains a preference for a yes-response which the question does not have when asked behind closed curtains to someone who goes out with an umbrella. The first meaning can be glossed as 'don't you agree that x is the case' and the second as 'am I to conclude that x is not the case'. Access or not to the topic of the question thus makes it a different question.

Also speech-act theorists, from an equally non-empirical perspective, included knowledge distribution in their 'happiness' or 'felicity' conditions (Austin, 1962; Searle, 1969). For an utterance to be a felicitous question for example, it had to meet the condition that the addressee knows more about the question topic than the speaker. Labov and Fanshel (1977) took this line of thinking to the analysis of a therapy session when they distinguished between different possible epistemic constellations, A-events ("known to A, but not to B"), AB-events ("known to both A and B"), and B-events

(“known to B, but not to A”). They used this distinction as the basis for their analysis of what they called ‘B-event statements’: “if A makes a statement about B-events, then it is heard as a request for confirmation” (1977:100). Although their formulation of the rule for B-event statements is reminiscent of speech-act theory’s felicity conditions, they made the important step to an interactional perspective on empirical data. They observed that even an assertion is treated as a question when the addressee has access to the topic of that assertion and the speaker does not. Below is an example of a B-event statement from a news interview.

(1) Clayman and Heritage (2002)

IR: John Tusa, IE: David Owen

- 1 IR: → So in a very brief word David Owen,=you in no
 2 → way regret what you did er despite what has
 3 → (happened) in Brighton this week in the Labour Party.
 4 IE: n- In no way do I regret it.

Koshik (2002) makes the opposite observation and concludes that issues of epistemic access can make questions be understood as assertions. She studied empirical examples of questions of Bolinger’s “isn’t the sun shining” type. She calls the full-sunlight-version of these questions ‘reversed polarity questions’ since the question’s ‘negative polarity’ – caused by the negation ‘not’- is reversed into a ‘yes’- preference. This preference, Koshik argues, is a preference for an agreement with the epistemic stance embodied in the question:

“These questions may therefore be designed, in the first instance, not to display an expectation of a certain answer, but to display the epistemic stance of the speaker, sometimes acting more like assertions than questions.” (2002:1855)

Koshik adds an element to the analysis of epistemics that is typical of conversation analytical methodology as it is also used in this paper, and this is the notion of ‘display’. Conversation analysis has argued that the relation between knowledge distribution and interactional behavior is a reflexive relation such that participants not only use their orientation to knowledge distribution to design and make sense of utterances, but they also negotiate a mutual orientation in their interaction by rendering epistemic access and stance observable. Epistemics are shown in these studies to be a truly social and interactional phenomenon (Edwards, 1997; te Molder and Potter, 2005) just as any aspect of what can be glossed as ‘context’ (Duranti and Goodwin, 1992; Schegloff, 1991, 1997). The fact that person A ‘is’ more knowledgeable on topic x than person B, does not imply that in an interaction between A and B, A gets to be treated as more knowledgeable. And with reference to the present study, the pre-interactional reality that students in my data ‘have’ a problem does not in the interactional reality make them the primary source for establishing what that problem is. As Enfield (2006) argues:

“One of the man in the street’s great [] difficulties is how he can understand (and be understood to) his social associates solely on the basis of what is publicly observable” (2006:408).

Thus, for participants in interaction such as these students and teachers talking about problems, epistemic access is a publicly observable social and interactional phenomena, not a cognitive one, while, reflexively, participants make epistemic access an interactional concern because it matters for how they make sense of each other.

Indeed, epistemics have been shown to be a social and interactional concern in more than one respect. As interactants we deal not only with matters of epistemic access, but also with epistemic *rights* and *responsibilities* (Stivers et al., 2011a). The epistemic rights concern is with questions of ‘who has the right to make an assertion’, or ‘who should a question be asked to’. Among the interactional displays of epistemic rights are sequential issues (e.g. an assessment in first position claims epistemic authority over an assessment in second position; Heritage and Raymond, 2005) and issues of turn-design (e.g. oh-prefaced second assessments challenge the epistemic rights of the first; Heritage, 2002). Drew (1991) makes the point that epistemic entitlements are attached to categories and not to persons. Raymond and Heritage (2006) for example show how a grandmother claims epistemic authority on the topic of her grandchildren over her friend with whom she talks about these children. In the present analysis we will see how the category of teacher relates to the right to define the student’s problem.

4. The epistemics of the student’s problem

4.1. Indications of lack-of-fit

This analysis of the interactional management of epistemics in establishing the student’s problem was triggered by a number of occasions where students indicate a lack-of-fit between the teacher’s explanation and their problem. One occasion is the teacher’s explanation to Nirmala. The teacher is helping her to read a line graph in which she has to

establish the temperature (on the vertical axis) at specific points in time (on the horizontal axis). He goes for her through the procedure of moving from the horizontal axis to the graph and from there to the vertical axis and then concludes that the correct answer is “twenty two degrees” (line 30).

(2) Nirmala ZO-091199

- 29 Teacher hoe hoog was de temperatuur (0.8) toen?
 how high was the temperature (0.8) then
 30 (0.6) sst tweeëntwintig graden.
 sst twenty two degrees.
 31 (1.5)
 32 Teacher zo werkt [dat.
 that's how it works.
 33 Nirmala → [maar ik snap niet
 but I don't understand
 34 → hoe ik die ee:h hoe ik die n (0.5)
 how I uu:h how I n (0.5)
 35 → ja weet ik niet wat ().
 well I don't know what ().

Nirmala's response to this explanation in lines 33–35 indicates that she still does not understand, and that she finds it difficult to say what it is she does not understand. However, in spite of this less than specific response, she does make one thing very clear. What she says here cannot be glossed as ‘your explanation has not been successful’ but as ‘your explanation did not fit my problem’. She says “but I don’t understand how I [x]”, and whatever element x is to complete this phrase, she makes clear that x is her problem and that x was not addressed by the teacher’s explanation. In other words, she indicates a lack-of-fit between her problem and the teacher’s explanation.

Another indication of lack-of-fit is produced by Patricia in extract 3. In this extract the teacher comes to Patricia's table and formulates her request for help: “you wanted to know if this one is correct right?” (line 5).

(3) Patricia ZO-091199

- 5 Teacher jij [wilde weten of dees goed was he?=
 you wanted to know if this one is correct right?
 6 [(((points in Patricia's note book))
 7 Patricia → =en die ()
 and that ()
 8 → maar ik snap nog niet helel maal eigenlijk<.
 but I still don't quite understand actually
 9 Patricia ((points in her note book))

Instead of confirming the teacher's formulation Patricia does two consecutive things. First she adds something to the formulation (7: “and that ()”), and then she counters the formulation by indicating that she is concerned with more than just a confirmation that her answer is correct (8–9). Like Nirmala did with the teacher's explanation, Patricia here indicates a lack-of-fit between her problem and the teacher's formulation of it. While Nirmala produced her indication of lack-of-fit at the conclusion of the teacher's explanation, Patricia here does this at the point where the teacher formulated the problem.

A little later she also produces an indication of lack-of-fit in response to the first item in the teacher's explanation. In lines 17–20, the teacher looks at Patricia's work and tells her that when designing a coordinate system, she should place the values (19: “the stripes”) on one of the axes (19: “this one”) at regular intervals (20: “have equal space between them”).

(4) Patricia ZO-09199

- 17 Teacher: °het eerste wat me opvalt is° (0.4) e::h
 the first thing I notice is (0.4) u::h
 18 dat (0.6) je wel moet zorgen
 that (0.6) you have to make sure
 19 dat op deze (0.6) de streepjes
 that on this one (0.6) the stripes

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- 20 steeds evenveel tussenruimte hebben.
 have equal space between them.
- 21 Teacher: [((looks at Patricia))
- 22 Patricia: → [nee dat had ik niet
 no I didn't have that
- 23 → want ik [snapte het niet.
 because I didn't understand that.
- 24 Teacher: [dat is niet helemaal gelukt he?=
 that didn't go quite well did it?

This may seem to be a rather straightforward instruction on the part of the teacher, transferring a piece of mathematical knowledge ('equal intervals'), but Patricia responds to it as a matter of 'understanding' rather than 'knowing': "no I didn't have that because I didn't understand that" (22–23). She does not say that she did not 'know' the mathematical procedure of using regular intervals, but she mentions an understanding problem that is different from the 'knowing' problem addressed by the teacher.

The epistemic work the students do in these extracts is a display of disagreement with the problem the teacher presupposes in his explanation. With this notion of disagreement, I follow the distinction made by [Stivers et al. \(2011b\)](#) and [Hayano \(2011\)](#) who use the notion of '(dis)agreement' for (in)compatible epistemic *content*, and '(in)congruence' for (in) compatible epistemic *stance*. Nirmala and Patricia in the above extracts disagree with the presupposed problem, but continue to allow the teacher to presuppose their problem. In other words, they do not challenge his epistemic stance.

4.2. Establishing the student's problem

These indications of lack-of-fit raised my interest in how teacher and student get to agree on 'the problem' that is to be explained. What do student and teacher do to establish the nature of the student's problem?

When we now look at the start of the Nirmala explanation at which we looked above for her indication of disagreement, we see an interactional procedure for establishing the problem that forms a recurrent pattern in the majority of my explanation data. This pattern consists of two basic steps, the student who localizes the problem, and the teacher who starts an explanation.

(5) Nirmala ZO-091199

- 3 Nirmala 1→ ik snap c en d niet.
 I don't understand c and d.
 ((another student intervenes))
- 8 Teacher c en d. (1.2)
 c and d. (1.2)
- 9 2→ .hh KIJK op welke as twintig uur staat
 .hh LOOK on which axis it says twenty hours
- 10 hier staan de uren,
 here are the hours
- 11 (0.4)
- 12 hier staan de graden
 here are the degrees

The first step is done by Nirmala in line 3 when she says "I don't understand c and d". C and D are the third and fourth elements of an assignment, and by stating her problem thus, Nirmala refers to the parts of the assignment with which she has a problem, but she does not say what her problem is. She localizes her problem, but does not specify it.

In response, the teacher first acknowledges the localization (line 8) and then starts his explanation of the assignment. He first reads a part that instructs students to read off the axis of the coordinate system (9: "look on which axis it says twenty hours"), and then shows Nirmala how to go about it: "here are the hours", "here are the degrees".

In extract 6, we see the same pattern.

(6) Ionica ZO-101199

- 1 Teacher: zeg het es meisje
 tell me dear girl

- 2 Ionica: 1→ () snap ik niet
() *I don't understand*
- 3 Teacher: 1→ welke (0.8) dertien?
which one? (0.8) thirteen?
- 4 Ionica: 1→ dertien
thirteen
- 5 Teacher: 2→ eh, je moet dus een horizontale
uh, you have to draw a horizontal
- 6 en een verticale as tekenen,
and a vertical axis,
- 7 he, dat [is dit werk
right, like this
- 8 [(points))
- 9 Ionica: ja
yes
((continued))

In lines 2–4 (arrows 1), student and teacher collaborate in localizing the problem (in assignment 13), and from line 5 onward (arrow 2) the teacher moves into an explanation of assignment 13.

Extract 7 shows the same pattern.

(7) Bart RB-291199

- 1 Bart: °°Ik snap 't niet°°. (.)
I don't get it
- 2 ((other student interferes))
- 3 Bart: 1→ hier (ga e::h) ging het hart van Janneke
here (is u:h) Janneke's heart starting to
- 4 1→ sneller of langzamer kloppen.
beat faster or slower.
- 5 Teacher: 2→ dit is: van Janneke.
this is Jannekes.
((continued))

The student localizes his problem by reading out loud the problematic part of the assignment (arrows 1). Note that the question read out by Bart is the question in the assignment as a way of indicating where he has a problem, it is not Bart's question to the teacher. The teacher responds to this by moving into a demonstration of how to do this assignment (arrow 2).

Sometimes, as in the case of Patricia (extract 3), the teacher refers to a prior mention of the nature of the problem, but in the vast majority of cases we come across the pattern exemplified here in which the student localizes but not specifies a problem, and the teacher treats this localization as a sufficient ground for entering into an explanation. As I argued above, this establishes a marked contrast with other institutional (e.g. Baker et al., 2005) as well as non-institutional (Jefferson, 1988) practices of talk about problems that all contain a recognizable delivery of the problem.

4.3. Response to lack-of-fit

As we have seen, a student may respond to the teacher's explanation with an indication of lack-of-fit. Let us therefore first look at how these indications are dealt with by the teacher. In extract 8 we see how the interaction between Nirmala and the teacher is continued after her indication of lack-of-fit.

(8) Nirmala ZO-091199

- 33 Nirmala maar ik snap niet
but I don't understand
- 34 hoe ik die ee:h hoe ik die n (0.5)
how I uu:h how I n (0.5)

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- 35 ja weet ik niet wat (.).
well I don't know what (.).
- 36 Teacher 1→ [bij welke?
with which?
- 37 [((looks at Nirmala))
- 38 1→ (.) bij 5c
(.) with 5c
- 39 (2.2)
- 40 2→ kijk op <de as> waar zestien gra:den staat.
look at the axis where it says sixteen degrees.
- 41 2→ (.) °hierzo°. *here*

As we have seen, in lines 33–35 Nirmala indicates that the teacher's explanation so far did not address her problem, and here we see that in response the teacher reinstates the pattern that we saw in the previous section. He asks Nirmala to localize the problem and concludes that it is “with 5c” (arrows 1) and then starts his demonstration of how to tackle this assignment (arrows 2). In other words, his response consists of an explanation along the same lines as the previous explanation, this time addressing a different part of the assignment.

In extract 9 we return to where we left Patricia in extract 3. Prior to this extract the teacher formulated his version of Patricia's problem as “you wanted to know if this one is correct right”. Then Patricia in line 8 less than agrees with this formulation as we saw above.

(9) Patricia ZO-091199

- 8 Patricia maar ik snap nog niet hele↓maal eigenlijk<.
but I still don't quite understand actually
- 9 ((points in her note book))
- 10 Teacher °Oke nou° (0.6) .hh gaan we eventjes e::h > (0.7)
okay well (0.6) .hh we'll just u::h (0.7)
- 11 [goed dat je dat door blijft vragen hoor<,
good of you to keep on asking
- 12 Patricia [ik zal hem even om-
I will turn it rou-
- 13 [((turns her note book to the teacher))
- 14 (1.3)
- 15 Teacher → [ik zal dinge:n vertellen die mij opvallen.
I will tell you things I notice.

If we now look at how the teacher responds to Patricia, we can see that he starts to proceed on the basis of his formulation of the problem. Although he first encourages Patricia to keep on asking (line 11), his continuation of the interaction is less aligned with her attempt to formulate her problem than with his own previous formulation. “I will tell you things I notice” (line 15) is an announcement that the teacher will be going through Patricia's work so far – and indeed this is what he does following line 15 – and thus a way of dealing with “you wanted to know if this one is correct”.

We see a similar teacher response to Patricia's second indication of lack-of-fit in extract 10. As we saw above, Patricia rejects the teacher's treatment of her problem as a knowing' problem and turns it into a problem of understanding. In response the teacher treats it as a 'doing' problem, a mistake in performance (24: “that didn't go quite well”) that suggests that 'knowing' or 'understanding' are not the issue.

(10) Patricia ZO-091199

- 22 Patricia: [nee dat had ik niet
no I didn't have that
- 23 want ik [snapte het niet.
because I didn't understand that.
- 24 Teacher: → [dat is niet helemaal gelukt he?=
that didn't go quite well did it?

4.4. Conclusion of the explanation sequences

Our next consideration of these explanations concerns the way in which they are concluded. We want to know what problem eventually gets to be explained. Is it the problem that the student is hinting at or the problem that the teacher is orienting to.

As we have seen in extract 8, in the explanation to Nirmala, the teacher responds to her indication of lack-of-fit with an explanation of a different part of the assignment, but oriented to the same type of problem as his prior explanation. This second explanation is organized again as a form of information-delivery (Peräkylä, 1995), the teacher producing a discourse-unit in which the student at times is invited to produce acknowledgements. This is concluded in extract 11.

(11) Nirmala ZO-09119

- 57 Teacher → snap je 'm nu?=
do you understand it now?
- 58 Nirmala → =ja.=
yes.
- 59 Teacher =°oke°.
okay

In line 57, the teacher asks for a claim of understanding (Koole, 2010), using a question-format that embodies a strong preference for a yes-answer. The format 'do you understand (it)' alone already prefers a yes-answer, but the use of "now" (line 57) increases this preference with the contextual constraint that this was not the first time it was explained. The sequence is closed when Nirmala produces the preferred answer (58: "yes") and the teacher acknowledges this answer (59: "okay"). With this answer, Nirmala not only claims that she now understands, but in contrast to her prior indication of lack-of-fit, she also accepts the teacher's explanation as having addressed her problem.

The explanation to Patricia is concluded in the same way. This time the teacher does not address her problem as a problem of 'knowing' or 'doing' as he did earlier in the interaction (extract 4), but as a problem of understanding.

(12) Patricia ZO-091199

- 86 Teacher nou snap je 't wel?
now you do understand?
- 87 Patricia ja.=
yes.
- 88 Teacher =oke.
okay.

As in extract 11, his question "now you do understand?" strongly prefers a yes-answer, and in providing that answer Patricia not only claims understanding, but also aligns to the teacher's orientation to the nature of her problem.

4.5. The sequential organization of the explanation activity

Before we move to sum up our findings, we need to make a last important analytic step. We need to establish what structural positions students have for disagreeing with the teacher's problem orientation, and when I say 'structural positions' I am referring to the way in which the explanations are organized in terms of action sequences (Schegloff, 2007). The importance of sequential organization for our present analysis lies in the fact that between actions in sequences there exist normative relations to the extent that an action of one participant puts normative constraints on the possible next actions that another participant can perform. Therefore I will look here at the overall sequential organization of the explanation activities to argue that the way the teachers do their explanations, they partition the explanation into chunks, and put normative obligations on students to respond to the immediately prior chunk of explanation, rather than to the entire problem presupposed by the ensemble of chunks.

They offer the student only two occasions, two sequential positions, to potentially display disagreement with the problem the teacher presupposes, and we already saw these two positions in the data discussed above. One is the position where the teacher's explanation has come to a conclusion, the other position is the rare case where the teacher starts the explanation by formulating the student's problem. Nirmala's display of lack-of-fit in extract 2 is produced in the former sequential position, after the teacher comes to a possible close of the explanation with "that's how it works". Also

Patricia's display in extract 4 follows the teacher's potential closing of one particular explainable. With "the first thing I notice" (line 17) he makes it clear that he is going to deal with more than one explainable, the first of which, 'equal space between the stripes', is proposed for closing in line 21 when he directs his gaze to Patricia. And it is in these structural positions, following a proposed closing, that both Nirmala and Patricia display their disagreement with the teacher's problem. The second sequential position, following the teacher's formulation of the student's problem, was illustrated in extract 3 where a student produces a display of disagreement after the teacher formulated Patricia's request for help: "you wanted to know if this one is correct right?" (line 5).

The overall organization of the explanation is such that students have no other sequential positions where a display of disagreement is relevant than the two mentioned above. The explanations are organized in the two sequential formats that Peräkylä (1995) also found in HIV-counseling, the information-delivery format and the interview format. As a matter of fact, one teacher predominantly uses the former (extracts marked as ZO) while the other teacher predominantly uses the latter (RB).

An example of the information-delivery format is the explanation to Ionica that we saw in extract 6 and that is presented here in an extended version as extract 13.

(13) Ionica ZO-101199

- 1 Teacher: zeg het es meisje
tell me dear girl
- 2 Ionica () snap ik niet
() I don't understand
- 3 Teacher: welke (0.8) dertien?
which one? (0.8) thirteen?
- 4 Ionica: dertien
thirteen
- 5 Teacher: eh, je moet dus een horizontale
uh, you have to draw a horizontal
- 6 → en een verticale as tekenen,
and a vertical axis,
- 7 → he, dat [is dit werk
right, like this
- 8 [(points))
- 9 Ionica: Ja
yes
- 10 Teacher je moet zorgen dat op de horizontale as (.)
you have to take care that on the horizontal axis
- 11 → de tijd en de uren >komen net als daar.<
you get the time and the hours just like there.
- 12 Ionica hm[hm
hm hm
- 13 Teacher → [je moet beginnen met zes.=
you must start with six.
- 14 Ionica =ja.
yes
- 15 Teacher → ↑he. (.) de tempera↑turen moeten er op passen
right (.) the temperatures must fit on it
- 16 → dus (.) je moet temperaturen ma↑ken (.) ja?
so (.) you have to make temperatures (.) right?
- 17 → die moeten beginnen met vijf↑tien (.)
they have to start at fifteen (.)
- 18 → want anders kan vijftienhalf d'r niet ↑op (.)
cause otherwise fifteen and a half doesn't fit on it (.)
- 19 → en die ga je door tot vijfen↓twintig
and there you go on until twenty five
- 20 ○want (.) anders pas je die getallen
cause (.) otherwise your numbers

- 21 → in de twintig d'r niet op
in the twenties do not fit on it
- 22 → en >vierentwintig en een half<
and twentyfour and a half
- 23 → dus (.) dan begin je hier met vijftien
so (.) you start here with fifteen
- 24 → en dat gaat door tot vijfentwintig_o
and that goes on until twentyfive
- 25 → je zet dat en dat er↑bij, (.) [ja?
you put that and that as well, (.) right?
- 26 [((looks at Ionica))
- 27 Ionica [ja
yes
- 28 Teacher en dan heb j:e het ↑assenstelsel kla[ar.
and then your coordinate system is ready
- 29 → [((looks at I.))

In this explanation, the teacher produces a discourse unit (Houtkoop and Mazeland, 1985), a monologue-type of extended turn in which the recipient may produce occasional tokens of acknowledgement and understanding or tokens of not-understanding after which the primary speaker will continue, or redo part of, his extended turn. The arrows indicate the turn-constructional units (Sacks et al., 1974) that form the building blocks of this discourse unit, each of which makes relevant the student's production of such tokens. Sometimes, as in line 12, the student indeed produces such a token, at other times (line 25) the student is actively invited to produce one – although by the way, Ionica does not wait to be invited but produces her “yes” in overlap with the teacher's invitation (ll. 25 and 27). However, this organization of the explanation invites the student to produce tokens of (not) understanding, continuers, and acknowledgement that are locally relevant to the chunk of explanation contained in the immediately prior TCU. Displays of disagreement with the problem presupposed to the entire explanation are not sequentially relevant responses, or phrased metaphorically, the student is invited to jump on a train and while in motion the train ride provides the context for the relevance of student responses, the ride itself cannot be challenged.

A different train ride, but a train ride nevertheless, is provided by the interview-format explanations. In this format the teacher provides an explanation by asking the student a series of questions that constrain the student to providing explanation-relevant answers to those questions rather than offering options for the student to disagree with the problem presupposed in the question. Extract 14 is an example.

(14) Erik RB-101299

- 1 Teacher welke vraag
which question
- 2 Erik e:h a.
u:h a.
- 3 Teacher [hoeveel graden is één hokje op de v:verticale ↓as.
how many degrees is one square on the v:vertical axis.
- 4 [((looks in book))
- 5 → welke is verti↓caal.
which one is vertical.
- 6 Erik e:h ditte=
u:h this
- 7 Teacher =nee das hori[zontaal.
no that is horizontal.
- 8 Erik [oh ja zo.
oh yes like this.
- 9 [((points at vertical axis in book))
- 10 Teacher → nou hoeveel is één hok↑je.
well how much is one square.
- 11 Erik e:h twee.
u:h two.

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- 12 Teacher → twee ↑wat twee KOEIEN?=
two what two COWS?
- 12 Erik =centimeter.
centimeter.
- 14 Teacher → nee (.) [twee
no (.) two
- 15 Erik [twee e:h graden.
two u:h degrees
- 16 Teacher twee graden, hartstikke goed.
two degrees, good for you.

In this explanation format, the teacher asks Erik a series of questions (arrowed in the transcript) that invite the student to answer and at the same time restrict the student's contributions to these answers and no more than these. As in the information delivery format, the student can participate, but only in terms of the constraints established by the teacher's questions. The explanation does not provide structural positions where the student could challenge the problem it orients to, and as a result it is only when the teacher proposes a closing of the explanation that students are relieved of this sequential mould and can display disagreement.

4.6. *The epistemics of the explanation activity*

The analysis shows these teacher–student interactions to consist of a trajectory of three basic steps:

1. student presents the problem in terms of a problem localization
2. teacher treats the problem localization as a sufficient ground for engaging in an explanation
3. teacher requests and student provides a claim of understanding.

As we have seen, this trajectory can show some variance. Instead of step 1, the teacher may present the problem in terms of how he understood student's prior request for help, and prior to step 3 there may be intermediate student displays of not-understanding or lack-of-fit. All explanation interactions however, are concluded with step 3. Also we have seen that the explanation in step 2 is so organized as not to provide sequential positions for the students where a challenge of the oriented-to problem is relevant.

In terms of epistemic access to the problem, therefore, we can conclude that the teacher assumes and is assigned authority. At the start of the explanation the teacher assumes authority when he treats the student's problem localization as a ground for starting the explanation of a problem that is not present in the student's request for help. Sometimes the problem, not the authority, is disputed when students produce indications of lack-of-fit between their problem and the problem oriented to in the teacher's explanation. Yet these indications are invariably responded to with another teacher explanation in which the teacher assumes access to the problem. The conclusion of the explanations show how the students align to the problem that was oriented to in the teacher's explanation.

We see here an interactional practice in which a teacher and a student deal with a problem that never gets to be formulated. In institutional problem talk, it is a quite common phenomenon that the talk about the problem does not leave the problem as it was initially formulated unaltered. Research on emergency calls (Whalen and Zimmerman, 1987, 1990) and on calls to call-centers (Houtkoop-Steenstra et al., 2005) have shown for example how problems are specified in the course of the interaction, or recast it in a way this particular institution can deal with it. It is also well established that institutional clients (students, patients, etc.) bring more or slightly different problems to service-encounters than they formulate at the start of these encounters (e.g. Heritage and Robinson, 2011). Yet what we have seen in these educational data is a problem delivery that is extended to include the solving of the problem. Even in the extended request sequences investigated by Lee (2009), where what is being requested is interactionally produced and the initial requests of prospective air travelers (“I’d like to make a reservation for a flight ticket”; 2009:1252) do not provide the details of the request, all details of the request get to be formulated overtly in the encounter. In the educational data we look at here, however, the explainable does not get to be formulated. It is only at the very closing of the encounter, and indeed by the very act of closing the encounter with a request for and a claim of understanding, that the explained and thereby the explainable gets to be mutually agreed on.

These interactions show an interesting paradox with respect to whose problem gets to be explained. On the one hand, the interaction is oriented to a problem of the student who requests for help, and is invited to acknowledge that the problem is solved. On the other hand, the teacher assumes access to the nature of the student's problem, and students eventually align to a problem that was not stated by them but was presupposed in the teacher's explanation. What gets to be explained is the teacher's problem rather than the student's.

5. Dealing with the language problem

So far we looked at how teacher and student deal with the epistemics of the student's problem, but let us now look again at this analysis from an interest in the multilingual context of these interactions. As we saw in the 'data' section, many students in these two classes are from families where Dutch is not spoken as a mother-tongue, and many students have been shown to have problems with understanding the texts of the mathematics assignments (Prenger et al., 2008).

A important observation from this perspective must be that as far as the interaction is concerned, multilingualism is completely and utterly absent. There is nothing in these exchanges that suggests that these speakers may have different mother-tongues, let alone that one of them has a language problem. Though we know that quite a few of these students have a language problem when reading the assignments, teachers and students do *not* interactionally establish language difference or language problems as a context for their exchanges (Schegloff, 1991).

Also in the 'data' section, it was argued that in establishing what the student's problem is, there can be potentially three types of problems: a 'procedural' problem concerned with how to do the assignment, a 'conceptual' problem concerned with mathematical concepts, and as Prenger et al. showed, a 'textual' problem concerned with the comprehension of the assignment. What we see in this data set, is that all explanations are concerned with the mathematical 'procedure' for tackling the assignment. Students may learn procedures for reading line graphs. For example, first look at the values on the two axes (extract 5: "here are the hours, here are the degrees") and then move from a value on one of the axes (extract 8: "look at the axis where it says sixteen degrees") to the line graph and from there to the other axis (extract 2: "how high was the temperature then. twenty-two degrees. that's how it works."). Or they learn a procedure for designing a coordinate system (extract 3: "make sure [] that the stripes have equal space between them"). What we see then is that not only are conceptual problems never addressed, but also the textual problems, of which we know that they are real problems for many of these students, never become the topic of an explanation.

With this in mind, our analysis above of epistemics in interaction gains a new importance. The interactional management of epistemic authority is a way of establishing what – and whose – knowledge can be brought to bear in the interaction. This can result in obscuring non-authorized epistemic elements such as knowledge or experience, potentially brought in by not-authorized participants. And if this should sound like a structuralist view of power relations, the reader is kindly referred to the analyses above where it was argued that epistemic authority is not fixed but an interactional achievement.

In my dyadic classroom data, the management of epistemic authority of the problem to be explained results in obscuring the language problems that we know some students experience, not in the interaction with the teacher but in reading the mathematics assignments. This is not to claim that in all the extracts above, the students' problem was a text comprehension problem that were not addressed by the teacher. Perhaps they all were, and then again perhaps none of them were. The issue is that we know that quite a few of the students in these two classes have comprehension problems with the texts of their mathematics assignments, and that teacher and students have organized their interaction so that the teacher exerts authority over the problem and casts it as a procedural mathematics problem, never as a language problem.

Studies of interactions in multilingual contexts have shown before how interactional procedures can work to obscure language problems, or framed more positively, how they can work to overcome language problems. Hornberger and Chick (2001) studied classroom interaction in the post-colonial contexts of Peru (Hornberger) and South Africa (Chick) where respectively Spanish and English are used as languages of instruction with students with often a low proficiency in these languages. They found that in these classes whole-class chorus answers are used as an interactional method for keeping the interaction going in spite of the language problems. Mets and van den Hauwe (2003) found in Belgian primary school classrooms with recently immigrated students that teachers allow students to participate by phrasing their questions so that students can reply with single-word answers.

When we compare these interactional practices to the practice we have seen in the data above of obscuring a potential language problem by orienting to mathematical problems of the procedural type, we should first point to an obvious difference. In the Peruvian, South-African, and Belgian classes, the language problem was one that could potentially obstruct the interaction between teacher and students, whereas in these Dutch mathematics classes this does not seem to be the case. Here, the language problem potentially obstructs the reading and understanding of mathematics assignments. Yet, these practices also have two features in common: (i) the interaction is so organized that language differences and language problems become invisible, and (ii) the interaction is so organized that the progressivity of the interaction (Stivers and Robinson, 2006) gets priority over teaching and learning outcomes.

The issue is not the level of teacher awareness involved in these practices. The Belgian primary school teachers of Mets and van den Hauwe as well as the teachers in Peru and South Africa may have been very much aware of the low language proficiency of their students – especially the South Africans since their first language is not English either – while the teachers in my data were not acutely aware of the textual problems of their students. The issue at hand is that interaction in multi-lingual contexts can get organized in such a way that the language issue is rendered invisible, and interactionally unproblematic.

Even if from an educational perspective these practices may be assessed as problematic – for example because in my data, student problems may not be addressed and solved –, the interaction proceeds unproblematically.

Indeed, it seems likely that practices of obscuring student problems are not particular of multi-lingual contexts, but are part and parcel of 'doing teaching' and 'doing being a teacher'. Bloome et al. (1989) have labeled this tendency of teacher–student interaction to favor its smooth production 'procedural display', and Hornberger and Chick use the terms 'safe time' and 'safe talk'. These terms refer to a preference in educational contexts that Stivers and Robinson (2006) have shown to be a more general 'preference for progressivity' in interaction, a preference to keep the interaction from break-down. The interactional practices that are used to accomplish this progressivity include the different question types documented by Hornberger and Chick and Mets and Van den Hauwe, and, as Gardner and Wagner (2004) have observed for other phenomena of second language conversations, although observed to manage potential language problems, they are ordinary interaction practices that in themselves have no particular relation to issues of linguistic diversity.

This is no different for the epistemics work we find in my data. The interactional concern with 'epistemic primacy', as Stivers et al. (2011b) label the interactional work on the right and authority to know, pervades our interactional exchanges, and the practices for negotiating these concerns are ubiquitous. The practice I showed above with which teachers claim authority on the problem to be explained is one of these practices. It may be extraordinary, as I argued in the preceding section, when compared to other institutional service-encounters, but this is because of the way teacher and students come to agree on the problem, not because it deals with language problems. Yet we have seen that these practices can have as a result that real language problems of students remain unnoticed and not dealt with, and that the potential context of linguistic diversity remains invisible.

6. Conclusion

Participants' orientation to cognition is a resource for the way they organize interactional activities and give meaning to each other's contributions. The last decade of conversation analytical research in this area has shown us that this resource is fundamentally social and interactional. Aligning participants' epistemic stances is itself object of a range of interactional practices. Division of knowledge, rights to knowledge, forms of epistemic access such as understanding do not stick to participants and their biographies, but are objects of interactional accomplishment. What matters in interaction is not who knows more but who is established as the more knowledgeable. This shows in the dyadic interactions on which this article reports, in which teachers explain mathematics assignments to students. Even though the help seeking student can be said to be the more knowledgeable on what the problem is, we have seen that the teacher claims access to the particular student problem, and is established as epistemic authority. The practice by which the teacher's epistemic authority over the problem is established is one that has not been documented before. Instead of inviting the student to formulate the problem, as we see it in for example call-center exchanges (Baker et al., 2005), the teacher starts an explanation that is oriented to a specific problem and the student is invited to align to this orientation. We have seen a few instances where students do not agree and instead indicate a lack-of-fit between their problem and the teacher's explanation, but also in these cases the students eventually come to accept the teacher's orientation as the common ground for the explanation activity. As Heritage contends, "outside of very specialized contexts such as psychoanalysis, the thoughts, experiences, hopes, and expectations of individuals are treated as theirs to know and describe" (2012a:6), and it seems that education is a similar specialized context where students' problems are not treated as 'theirs to describe'. Student and teacher orient to an asymmetry in which the teacher has 'epistemic primacy' (Stivers et al., 2011b:13ff.) on the problem. The teacher has the right to establish the explainable, and as a result the problem that gets to be explained can be characterized in terms of the interactional work on epistemics as the teacher's rather than the student's problem. Moreover, the consistency of this epistemic asymmetry throughout the data suggests that the right to define the problem is related to the category of teacher as oriented to by both teachers and students.

In our data we have seen how the interaction starts with the indication of a problem, while only at the very closing of the interaction the participants come to agree on the explainable when the student accepts the explanation and thereby the explainable implied in it. The activity is organized as a continuous process of making sense of the problem to be explained, in which each step in the teacher's explanation adds a new element not only to the explanation, but thereby also to the oriented-to problem. The latter is a characteristic of problem-solving interactions in general, in which each step in a proposed solution or an explanation casts the problem in a particular way, and the educational data presented here show how that problem can remain implicit and oriented-to rather than being formulated. It is also a more general characteristic of the process of sense making in interaction in which mutual, or 'intersubjective' understandings (Heritage, 1984:254ff.; Schegloff, 1992) are produced post hoc, or retrospectively.

An important consequence of this retrospective nature of interactional sense making is that meanings in interaction are not speaker meanings. What is treated as the explainable is not a concern only of the student who introduced it, nor is it a concern only of the teacher, it is an interactional concern of both participants which implies that the resulting explainable need not be identical to the problem the student experienced prior to the interaction. We have traced the process in which

teacher and student come to agree on the explainable, starting with the student's localization of the problem, followed by the teacher's treatment of the explainable as a procedural mathematics problem, the student's occasional disagreement with this, and the eventual mutual agreement on a mathematical procedure as the explainable.

One accomplishment of establishing the teacher as problem authority is that other potential student problems do not get treated in the interaction, a case in point being the established problem of many of these students with understanding the texts of the mathematics assignments. Rather than having a problem with the mathematical content of the assignment, many students have been found to experience difficulties in reading and understanding the assignment text, often as a result of their linguistic backgrounds in other mother-tongues than Dutch (Prenger et al., 2008), but since these are not the problems the teacher orients to, these language problems remain invisible in this classroom. The interaction progresses without reference or orientation to the multi-lingual context.

Several studies of educational interaction in multilingual contexts have documented how interactional practices deal with differences in linguistic competence and also in our data we have seen the epistemic asymmetry by which the teacher renders students' language problems invisible. Having spoken much in this paper about the epistemic work of the participants in my data, I would like to conclude by stating my own epistemic claims. Hornberger and Chick (2001) as well as Mets and van den Hauwe (2003) present the interactional practices they observed as designed to overcome language problems. They are probably right that these practices developed from the need to deal with interaction break-downs resulting from students' lack of linguistic proficiencies, but it is not at all clear that this is also true for my data. I started this article by pointing out the learner's problem of having to 'know what you don't know' or to 'understand what you don't understand' and it is quite conceivable that the normative asymmetry we see in these data is a response to students' inability to answer the question 'what is your problem' rather than a response to their linguistic skills. At the same time, the interactional practice discussed here of dealing with student problems and the way in which the teacher is cast as problem authority has similar results as those in the South African, Peruvian and Belgian contexts. Whatever the obstacles the teacher's epistemic primacy is designed to deal with, it succeeds in having the students board a sequential train that secures the progressivity of the explanation interactions, and in doing this it prevents other potential student problems from surfacing in the explanation interaction.

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