Claims and demonstrations of understanding in whole class interactions

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One aim of teaching mathematics is to develop students' understanding of mathematics. In this paper we examine how teachers and students do understanding in interaction, and how this understanding is handled interactively during whole class interactions. Taking a Conversation Analytic approach, we look at interactions between teachers and students where there is claim of understanding and where there is a demonstration of understanding. We show how these two situations are handled differently by the teacher and the students, with only the latter situation being concerned with students' understanding.

Keywords: Conversation Analysis, classroom interaction, understanding.

Introduction

One aim of mathematics teaching is to both develop students' understanding of key ideas, concepts and methods, and to respond to difficulties students encounter in understanding mathematics. Studying understanding in mathematics education is not original, but the existing research largely treats understanding as something real, as something that students do or do not have. However, understanding is also used by teachers and students in interaction for practical purposes, and this use or display of understanding is observable and analysable. The aim of the analysis in this paper is to show how teachers and students use words like 'understand', 'sense' or 'mean' to claim or demonstrate understanding and how these utterances are treated within the interaction. We use Sack's (1992) notions of claiming and demonstrating understanding as is observable in the interaction, rather than making any claims as to whether students actually understand or not, which is not directly observable in interaction.

Pedagogic interactions, and in particular teacher-student classroom interactions, are dominated by the IRE interactional structure. The IRE (or IRF) sequence, teacher Initiation-student Response-teacher Evaluation, has been written about extensively (e.g. Hellermann, 2003; Mehan, 1979; Sinclair & Coulthard, 1975; Wells, 1993). This characterisation, however, only focuses on the broad structure of the interaction, rather than the multiple activities being done within it. The third turn, the evaluation turn, in particular does more than evaluate a student's answer as correct or not, but also comments on its adequacy as a response to the initiation, and its appropriateness for the broader interactional and pedagogical purposes of the interaction (Macbeth, 2003), and influences the interaction that follows. What is being assessed or evaluated by the teacher in this third turn is not necessarily focused on the content of the student's response, but could also, or alternatively, focus on how the response enables the interaction to progress, they are task-oriented rather than content-oriented (Antaki, Houtkoop-Steenstra, & Rapley, 2000). Koole (2012) also showed that teacher assessments in this third turn can focus on students' knowing, students' doing or students' understanding. However, positive assessments largely focused on students' knowing, treating their

response as shared knowledge on which to build on, but negative assessments largely focused on students' doing or understanding.

In this paper we focus on IRE sequences where the content focus includes understanding, or not understanding. In particular, we examine instances where evidence of understanding (or not understanding) is displayed by teachers or students in whole class interactions. These instances can include situations where the teacher-initiation requests students to claim or demonstrate understanding, which might include teachers themselves claiming or demonstrating understanding or not understanding, or situations where it is the students who make claims or demonstrations of understanding relevant in their response turn, or finally situations where the teacher's evaluation turn treats the student's turn as a claim or demonstration of understanding. Our analysis of these sequences takes a Conversation Analytic approach drawing upon Sacks' discussions of 'how understanding is shown' (1992:II:140). We make use of Sacks' distinction between *claiming* and *demonstrating* understanding and show that the teachers in these interactions treat claims and demonstrations differently, being content-oriented when there are demonstrations of understanding but task-oriented when there are solely claims of understanding.

Methodology

This analysis was carried out on a video corpus collected in fifteen mathematics teachers' classrooms in ten schools in England of secondary educations (students aged 11-18). All names used are pseudonyms. These videos were transcribed using Jefferson transcription (Jefferson, 1984) and the analysis focused on these transcripts, but they are presented here in a simplified form for ease of reading. The transcripts of all whole class interactions in a total of 39 lessons were analysed using Conversation Analysis (CA) (Sidnell & Stivers, 2012). The CA approach was used to develop a collection of cases (Sidnell, 2010) examining how the topics of understanding and sense-making are treated by the teachers and students as they interact. These cases include 299 interactions where the teacher explicitly talks about understanding and 58 where a student explicitly talks about understanding (including interactions about making sense, getting it, and finding meaning). In this paper we focus on those interactions that broadly follow the IRE structure in that they involve both the teacher and the students, rather than those that occur during a teacher explanation for example.

From a CA perspective understanding does not refer to a cognitive state but to an interactional object where teachers and students do understanding as they interact. For example, a student saying 'I don't know' is often used to request help from the teacher, or to initiate a complaint about an explanation (Lindwall & Lymer, 2011). As such, we are not making any claims about what teachers or students understand, instead focusing on how they use understanding in interaction to achieve particular things. Within CA research a distinction is made between demonstrating and claiming understanding (Sacks, 1992). For example, a teacher can *demonstrate* understanding of what a student has said by responding with an alternative formulation as in the following extract:

25	Teacher:	… what is the difference then, what makes a histogram a histogram. Jin?
26	Student:	because the bars can be wider
27	Teacher:	exactly in a histogram, you can have different width um bars…

Extract 1: Tom's lesson on statistical diagrams

Alternatively, the teacher or student could just respond 'yes' or 'good' which would merely *claim* understanding.

In classrooms teachers generally ask questions that they already know the answer to, and as such student responses are demonstrations that they also know the answer. However, students can respond in a way that shows *that* they have understood, or in a way that shows *what* they have understood (Koole, 2010). Whilst showing *that* they have understood can involve either a claim or a demonstration of understanding, showing *what* they have understood requires a demonstration of understanding. Koole (2010) also showed that teacher questions of the form "do you understand" are usually followed by a *claim* of understanding and not a *demonstration* of understanding.

Results

In the data we present here we will demonstrate that *claims* of understanding support the smooth progression of interaction (Stivers & Robinson, 2006) that is underpinned by shared understanding (Weatherall & Keevallik, 2016). That is, *claims* of understanding are affiliative joint accomplishments that enable the interaction, and the lesson, to continue, but tell us nothing about what students understand. On the other hand, *demonstrations* of understanding tell us something about what students do or do not understand, but also lead to more extended interactions that focus on the content of these demonstrations, rather than moving the interaction on.

Claims of Understanding

Claims of understanding usually follow an understanding check by the teacher, such as "do you understand?" or "does that make sense".

70	Teacher:	is (.) does that make sense?
71	Students:	yeah
72	Teacher:	okay Simone did you do it exactly the same. (.) no slightly different. thank you Steve. er Simone could you (.) explain what you did. was it-

Extract 2: Becca's lesson on multiplying fractions

Here the students have made a *claim* of understanding in their answer yeah in turn 71, but there is no evidence of what they understand or the nature of their understanding within the interaction. The teacher acknowledges this claim in turn 72 before moving on to a different student and asking them to explain their method.

Another situation where there is a *claim* of understanding but without a *demonstration* of understanding is given in extract 3.

173	Teacher:	numbers pick one of the numbers as a value for n. work out the missing numbers, using the same shape, apply that rule to somewhere else, see if you can add them up to be um using this rule like this one if I draw that C anywhere else I should find that I get er five n add two will tell me, if I draw a C in here, er draw this c in one two three four five. five times thirty-two is a hundred and sixty, add two makes a hundred and sixty-two. SNAME
174	Student:	I don't understand

175 Teacher: okay I'll come and see you. it will be seven minutes, to have a go, starting now.

Extract 3: Ryan's lesson on a hundred square investigation

In turn 173 the teacher Ryan is describing how to draw a letter C on a hundred square and then sum the numbers in the letter C by treating one of the squares as n. In turn 174 a student makes a *claim* of not understanding but does not add anything that would indicate what they do not understand, so no *demonstration* of understanding or not understanding. This claim is requesting help from the teacher. Ryan acknowledges this request but defers dealing with the issue before continuing to talk to the rest of the class.

These teacher turns that include understanding checks are not always followed by student responses as in extract 4:

178 Teacher: …but if I drew another rectangle and had that as two and four, that isn't similar to that cus they're not in the same proportions, yeah? does that kind of make sense? It's a bit of a weird mathematical word. right? but we have to get used to it in a mathematical thing, so it doesn't quite but congruent certainly is going to come up. okay. so we're going to start with reflections, but…

Extract 4: Imogen's lesson on transformations

Here Imogen asks "does that kind of make sense?" but without pausing and without any students responding and she continues her turn before moving on to a new topic at the end of the extract.

Where there is a *claim* of understanding (or not understanding) but no demonstration of understanding, the interaction continues without any reference to what has, or has not, been understood. Where the teacher has invited a claim of understanding but no student response is given, again the interaction continues without any reference to what has, or has not, been understood. Since 'do you understand' or 'does that make sense?' questions prefer a *claim* of understanding rather than a *demonstration* of understanding (Koole, 2010), when no response is given it is a *claim* of understanding that is 'noticeably absent' (Bilmes, 1988) and in every case in this data where there is no response, the interaction continues in the same way as if there had been a positive *claim* of understanding. In contrast, as we will show in the next section, when there is a *demonstration* of understanding, or not understanding, the following interaction focuses on the content of the understanding and extends the IRE sequence (Schegloff, 2007).

Demonstrations of Understanding

Teachers can explicitly ask students a question that requires them to *demonstrate* their understanding. In extract 5, the teacher Fiona asks the student to explain so that she and the other students can understand, and the student gives an explanation in turn 188. In the turn that follows Fiona focuses on one part of the student's explanation and asks a follow up question.

187 Teacher: right explain it to me so that I understand but also so that people that haven't done this one understand 'cause I know that there's quite a few people who haven't done it

188	Student:	is it because Rio is forty degrees and I've worked out that Khartoum is thirty-five degrees you just add five
189	Teacher:	right where did you get thirty-five from for Khartoum, was that one of the ones that we've worked out

Extract 5: Fiona's lesson on negative numbers

In extract 6, the teacher Tom is asking why it makes sense to take a moving average over four points when dealing with quarterly sales of ice cream. The student, Sayed, gives an explanation which Tom then follows with a prompt to be more specific in turn 70, to which the student responds with more detail.

68	Teacher:	yeah it is because of that so why, why does that make sense, can you say so why does that makes sense to use four in the numbers. it is something to do with the fact that it's quarterly. Sayed?
69	Student:	because there's four quarters
70	Teacher:	where
71	Student:	in the end, in a year
72	Teacher:	yeah there's four quarters in a year but, so, you know so …

Extract 6: Tom's lesson on moving averages

One of the most common ways that teachers ask about students' understanding is in relation to the meaning of mathematical vocabulary.

11	Teacher:	ah that's a good word isn't it isosceles. what do you understand by isosceles
12	Student:	erm two lines that are perpendicular they're straight lines and then they have two of the same angles
13	Teacher:	we're getting lots of different mathematical words aren't we. um two lines are perpendicular what do you mean perpendicular.

Extract 7: Dave's revision lesson

In turn 10, before the transcript begins, a student has given a justification for an angle having a particular value as being because the triangle is isosceles. The teacher Dave follows this up in turn 11 by asking this student what he understands by isosceles, which he explains in turn 12, (inappropriately) introducing the word perpendicular to describe the two sides with equal length. Dave then follows up on this and returns the turn to the student to explain what he means by perpendicular.

In these three extracts the teacher's initiation includes an explicit request for a *demonstration* of understanding, which the student gives in their response, and which is followed by the teacher asking a follow-up question focused on the content of the students' demonstration which returns the turn to the student. Demonstrations of understanding can also occur when a student is indicating that they do not understand something. In extract 8, a student has given the equation of a straight line using the gradient and the y-intercept which Dave repeats in turn 71. Dave then opens up the floor to invite questions from the students at which point a student asks how to find the equation and states that he does not understand. This is both a *claim* of not understanding and a

demonstration of what it is that is not understood[1]. The teacher follows this with an explanation for how the class found the equations of straight lines in previous lessons as well as giving a rule.

71	Teacher:	…yes three x plus one. um okay that's fine. who wants to ask anything about the first side, you do. go on
72	Student:	um how do you find out the um equation I don't understand it
73	Teacher:	no okay. this three I remember we went to the computer room and drew some things didn't we this three turned out to be the gradient and this one turned out to be where it goes through the y axis. so once you've found out the gradient is three you can just stick it in there um that requires quite a bit of thought doesn't it um at this stage with the exams coming up just stick it in there in front of the x and you put plus one on the end because of that and it all fits in with the pattern we saw when we drew lots and lots and lots of these in the computer room …

Extract 8: Dave's revision lesson

Furthermore, whilst the student in turn 72 treats the issue as one of understanding, the teacher's following turn treats it as an issue of remembering (Koole, 2012).

In each of these cases where there is a demonstration of understanding, or not understanding, the teacher's follow up turn focuses on the content of the students' responses. This is in contrast to the situations where there was only a *claim* of understanding where the teacher's follow up turn moved the interaction on. This arises both in situations where the teacher has asked students about their understanding as well as where students indicate that they do not understand. However, this second situation is rare in whole class interactions. Also, where the teacher has requested the demonstration of understanding in their initiation, the teacher's third turn also returns the turn to the same student. The preference for moving the interaction on following *claims* of understanding is reinforced by the numerous occasions where teachers ask "do you understand" but does not wait for an answer before moving on to the next topic (as illustrated in extract 4), which occurred in just over 40% of cases of understanding checks in this data (in contrast to Koole (2010) where the students always responded).

Conclusion

In this paper we have focused on how *claims* and *demonstrations* of understanding are dealt with by teachers and students in their interactions. Within the IRE structure, teachers can invite either *claims* of understanding or *demonstrations* of understanding in their initiation, and this distinction is further supported by the students who in their responses give either a *claim* or a *demonstration* as required by the teacher's initiation. However, teachers and students are doing different things when they invite or give *claims* to when they invite or give *demonstrations*. Claims of understanding are treated as ways of supporting the progressivity of the interaction (Stivers & Robinson, 2006) and do

[1] Whilst the student utterance of "how do you find out the um equation" could be interpreted as an issue of knowledge or knowing, the student treats it as an issue of understanding by following it with "I don't understand it" rather than "I don't know".

not deal with the content or issues of what is or is not understood. In contrast, *demonstrations* of understanding lead to the interaction focusing on the content of these demonstrations and an expansion of the IRE structure.

Transcript Notation (Jefferson, 1984)

[text]	Brackets	Indicates the start and end points of overlapping speech.
(.)	Micropause	A brief pause, usually less than 0.2 seconds.
.	Period	Indicates falling pitch or intonation.
?	Question Mark	Indicates rising pitch or intonation.
,	Comma	Indicates a temporary rise or fall in intonation.

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