Uses of "understand" in science education

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Try not to think of understanding as a 'mental process' at all. – For that is the expression which confuses you. But ask yourself: in what sort of case, in what kind of circumstances, do we say, 'Now I know how to go on' (Wittgenstein, 1953, no. 154)

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Laura:  yeah we get it
Karen:  shall we go on then?
Laura:  yeah hu hh
Karen:  otherwise we could sit here until h .hh fi(h)ve
Laura:  I just wanna test the next one (.) I'll just check how it
        was (.) yeah but we get that one, we know that,
        [we've tested that]
Karen:  [we've already] ne:x::t (.) yeah exactly=
Laura:  =we did that
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1. Introduction

Wittgenstein, in the opening quotation, recommends philosophers interested in the analytic phenomenon of understanding to examine actual practices in which people "know how to go on," rather than to approach understanding as a mental process in need of theoretical explanation. One example of the sort of circumstances in which someone *says*, "now I can go on" is found in the transcribed exchange that follows the quotation. In this short sequence, two students, who are carrying out a lab assignment in mechanics, agree that they "get it" and decide to go on. Here—as well as in other episodes where students attempt to complete educational tasks—the unfolding of the activity and utterances, such as "we get it" or "we understand that," are intrinsically related. While not being the same thing as ”knowing how to go on," and thereby not delimiting the *analytic phenomenon* of understanding, such uses of ”understand" or ”get it" display the participants' ongoing

analyses of the situation and are, in turn, consequential for how their work proceeds (cf. Garfinkel and Sacks, 1970).

In our data—thirty hours of video recorded lab work at a Swedish teacher education program—utterances that include ”understand” or ”get it” are both frequent and central. This has motivated us to analyze their positioning, use, and interactional significance. One initial finding is that understanding features almost without exception as a *verb*; words such as ”förstå” (”understand,” lit. ”fore-stand,” cf. German ”Verstehen”) and ”fatta” (”get,” lit. ”grasp”) are common, whereas the noun ”förståelse”—the closest Swedish correlate of the term ”understanding” as found in the title of this special issue—is only used twice. We will come back to this general observation; for now, it is enough to note that the title of the study, through avoiding the term ”understanding,” highlights its notable paucity in the talk of the setting and points to the relative prevalence of the verbs ”get” and ”understand.”

Taking an interest in understanding and formulations of understanding in science education is hardly original. The aim and focus of this study can be placed in relation to, but also contrasted with, an immense body of *educational research* where theoretically developed and motivated formulations of understanding are used as rationales for the choice of certain educational activities rather than others, as rhetorical means for advocating such activities, as resources in the design of assessments, and in empirical research. In these texts, formulations of understanding are commonly used as *Linnaean devices* (Macbeth, 1996:274), parsing acts and activities by, for instance, distinguishing students who understand from those who do not, or by describing certain ways of organizing education as particularly conducive to fostering understanding in students. Largely, this literature reflects the field’s concern with understanding as something real and potentially problematic, that students have, do not have, or have in various degrees. In relation to the sequence presented above, some typical research issues would be to investigate if the students have really understood, what

their understanding consists of, how one should go about assessing this understanding, and how the situation could be re-designed so as to improve the students' understanding. Notable is also that understanding is massively present in the literature as a noun. It is the 'thing' that educational research is geared towards analyzing and assessing, and whose development educational innovations are attempts at facilitating.

These same concerns are also constituent for the work and achievements of teachers, whose job it is to foster understanding in students, and who orient towards this as the point and sense of what they are doing. In this way, understanding, as prescriptively defined or discussed in the educational research literature, is paralleled in educational practice. The formulations in the literature, however, although being formulations *of* and *for* science education, are not formulations *in* the practice of science education. There, students and teachers topicalize understanding for various practical purposes, and in so doing make specific interactional moves. By sharing the concerns of science educators—including efforts to foster, improve, and evaluate—research in science education has tended to overlook this practical and interactional character of educational encounters. As argued elsewhere, "professional understandings designed for *the working of* educational practice—the teaching, design, and evaluation that constitute it—are not designed primarily for the disciplined study of its interactional achievement (Lindwall and Lymer, 2008:181, paraphrasing Schegloff, 1996:211-212) For the latter, another order of inquiry is needed.

2. Understanding and uses of "understand"

In a text on understanding in the analysis of natural conversation, Moerman and Sacks (1971/1988) ask, "what forms of social organization secure the recurrence of understanding among parties to conversation, the institution of language use?" They answer this question by characterizing the conversational sequencing by which an interlocutor displays an understanding of previous turns. In this way, understanding becomes analytically

approachable as something witnessably oriented-to and produced by participants in interaction. In the words of Schegloff, conversationalists' responses to each other's actions "make available to the analyst a basis in the data for claiming what the co-participants' understanding is of prior utterances, for as they display it to one another, we can see it too" (1984:38). Moreover, by refraining the use of external criteria to assess whether people 'actually' understand or misunderstand, the issue of understanding becomes "a practical matter, handled to whatever degree is required (and no more) as part of the talk's sequential organization" (Edwards, 1997:101).

With an interest in how understanding surfaces in the interaction among students and teachers, and considering that each utterance shows an understanding of the prior, one could look anywhere in the interaction for such displays. That is, understanding as a potential *analytical phenomenon* is massively present in all ordinary interaction, including, of course, lab work in science education. In this study, however, we focus exclusively on episodes where the participants make explicit *use* of "förståelse"/"understanding," "förstå"/"understand," and "fatta"/"get." In thirty hours of video-recorded and transcribed interaction, we have found 284 utterances that include "get it," "understand," or any of their conjugations, which corresponds to one turn of 130 or approximately 10 formulations per hour; 2 instances have been found where understanding features as a noun. It is these utterances and their circumstances that serve as the basis for our empirical study.

Again, focusing on these formulations is not to say that we make understanding tantamount to verbal formulations of understanding or "understand." As pointed out by Wittgenstein, "understanding is like knowing how to go on, and so is an ability: but 'I understand,' like 'I can go on' is an *utterance, a signal*" (1980:I, no. 875). Saying "I understand" is not just reporting on states of affairs—it is not, "*eo ipso* to understand, and is not necessarily said *because* one really does understand; one can think that one understands

and be shown to be wrong." (Coulter, 1989:63) Also, one might say that one understands and know that one does not. As with the issue of trust (cf. Koschmann et al., this issue; Garfinkel, 1963), moreover, understanding is usually taken for granted and only explicitly topicalized when something is at stake or becomes problematic. The issue in most of the investigated instances is thus not "to understand," but "to *not* understand." To repeat what was stated before, however, the aim of this study is not to assess whether people 'actually' understand or misunderstand something, but to investigate what uses of "understand" do in their practical circumstances. "I don't understand," for instance, is often used to request help from a teacher or to initiate a complaint sequence. Students jointly decide that they "get it" in order to continue with an assignment and they terminate a teacher's explanations of some content by replying, "now I understand." Teachers ask if the students "got understanding from it as well" and highlight that some specific issues are "important to understand." With a focus on such uses of "understand" as they feature in practical action, the investigated material is organized in five themes: students requesting help from other students; students requesting help from teachers; students asking other students if they understand; uses of "understand" in the closing of a task; and teachers' uses of "understand."

3. Formulations of understanding in educational lab work

The recordings investigated in this paper were made in a lab course in mechanics that was part of a teacher education program. Throughout the lab course, the students used *probeware*, a computer-based technology involving various sensors making it possible to measure and graphically represent phenomena such as force and velocity. The technology was used in accordance with a so-called *predict–observe–explain* procedure in which students first should state a hypothesis and justify it, then conduct an experiment and observe the results, and finally discuss any discrepancies between hypothesis and outcome and decide if they were to perform a new test. In describing the rationale for the set up, the instructor in

charge pointed out that the procedure and technology used together are particularly well suited to "guide students towards a conceptual and qualitative understanding of physics and graph interpretation," an opinion that is paralleled in the literature (e.g., Thornton, 1995; White and Gunstone, 1992). The lab was thus framed with a particular theoretically informed formulation of understanding in mind. The eight lab groups recorded, consisting of two to four students per group, worked at desks equipped with the materials needed, including the probeware technology, pencils, paper, and lab descriptions with space for answering questions and writing predictions. Apart from the instructor in charge, other instructors, teaching assistants, and professors visited the lab and interacted with the students. The students had little or no familiarity with the relevant mathematics or physics. Consequently, the instructors and assistants became of central importance when it came to helping the students with their tasks.

The episodes presented have been transcribed following the conventions developed in conversation analysis (e.g., Jefferson, 1984a; ten Have, 1999). In the transcripts, pauses are represented as numbers of seconds within brackets, with (.) indicating micro pauses. Co-occurring talk is horizontally aligned, with square brackets marking the onset of overlap. Extended vowel sounds are marked with colons, as in e:::h. Underlining indicates stressed syllables or words while the degree symbol ° means the enclosed speech is noticeably quieter, >talk< indicates that it was delivered more rapidly than the surrounding talk, and <talk> that it was delivered more slowly. Extra-linguistic action is included as comments within double parentheses. The names of the instructors are marked by capitalized letters. Furthermore, some of the transcripts are supplemented by pictures that represent the computer screen and some gestures of the instructor and students. It is important to note that—with the exception of Excerpt 5.3, which represents an episode where a guest lecturer from Germany interacted with the students—the original material is in Swedish. With our

interest and analytical starting point, the aim has been to translate the interaction, what students and teachers do by talking, gesturing, and acting, and how others respond these doings, rather than the words and sentences at their face value. For discussions on how to translate transcripts and analyze interaction in foreign languages, see Bilmes (1996) and Moerman (1996). Although a word-by-word translation including the Swedish original would have been ideal, only the English translations are included, due to limitations of space. The original video and/or audio sequences with English subtitles and detailed transcriptions in the original language can be obtained from the authors.

An important finding is that ”understand” is only used in circumstances that could be described as lab or task related. To be more precise, the things that stand in object position in utterances making use of the verbs ”understand” and ”get” are without exception some aspect of the lab (e.g., a graph) or the task (e.g., what to do next). The formulations are therefore tightly coupled to the ways in which the lab work proceeds and must accordingly be analyzed in relation to what the students are doing. As much of the talk is indexical to what is shown and seen on the screen, additional pictures have been added together with descriptions of what the students and teachers are doing. Still, there are much more to say about these episodes—especially concerning the use of eye gaze, body posture, and gestures—that only are touched on briefly due to limitations of space and focus. The presentation of the results thus reflects a compromise between, on the one hand, the importance of capturing the work that the students were involved in, and, on the other hand, the need to provide an overview of the collection of instances.

3.1 Students requesting help from other students

A majority of the explicit uses of ”understand” in the investigated lab work concerns some kind of stated lack of understanding: for instance, “but I don’t get it,” “we don’t understand how we can read off,” and “now I don’t understand anything.” In this first

section, episodes where students use such utterances in requesting help from their peers are examined. Commonly, the claim of not getting it is followed by a question that specifies the problem. For instance, “I don’t get it (.) how do you see that?” (Excerpt, 1.1) or “I don’t get it (.) why is it below zero then?” (Excerpt 1.3). It is also quite common that the student specifies the request by stating what is not understood, as in “I still don’t get why it becomes minus” (Excerpt 2.2). As requests can be accepted or declined, the uptake of these uses of “not understanding” varies. In the first episode (Excerpt 1.1), for instance, the request is met with an extended instructional sequence, which after a number of turns is closed by a student claiming that “now I understand.” This can be contrasted with the third episode (Excerpt 1.3), in which the recipient replies to the request by stating that they have to deal with it later.

Before the first episode (Excerpt 1.1), two students had walked in front of a motion sensor so as to mimic a velocity vs. time graph (Figure 1). After their first attempt to replicate the graph, an instructor approaches them, pointing at the part of the graph representing constant positive velocity while asking, “when you were there what did you think then.” To this question, one of the students replies, “you should stand still there,” thereby confirming an incorrect interpretation already suggested to the instructor by a visible discrepancy between the two graphs (as indicated in the left part of the graph in Figure 1): the students had stopped when they in fact should have walked backwards with constant velocity. Knowing that students often make this mistake, it is possible for a teacher to move around in the room in search of it. The technology and the task make the students’ faulty interpretations materially present; they are there to be seen, pointed at, and talked about. Responding to the students’ interpretation, the teacher points out that the graph in Figure 1 is a velocity vs. time graph, implicitly contrasting it with the position vs. time graphs the students had confronted previously. After having verbally walked the students through the motions, and ratified one of the students’ interpretations as correct, the instructor leaves the group. The other student,

however, had repeatedly said and in other ways displayed that she did not follow the instructor's comments and questions, and after the instructor had walked away, she requests further guidance from the student whose answers had been approved.

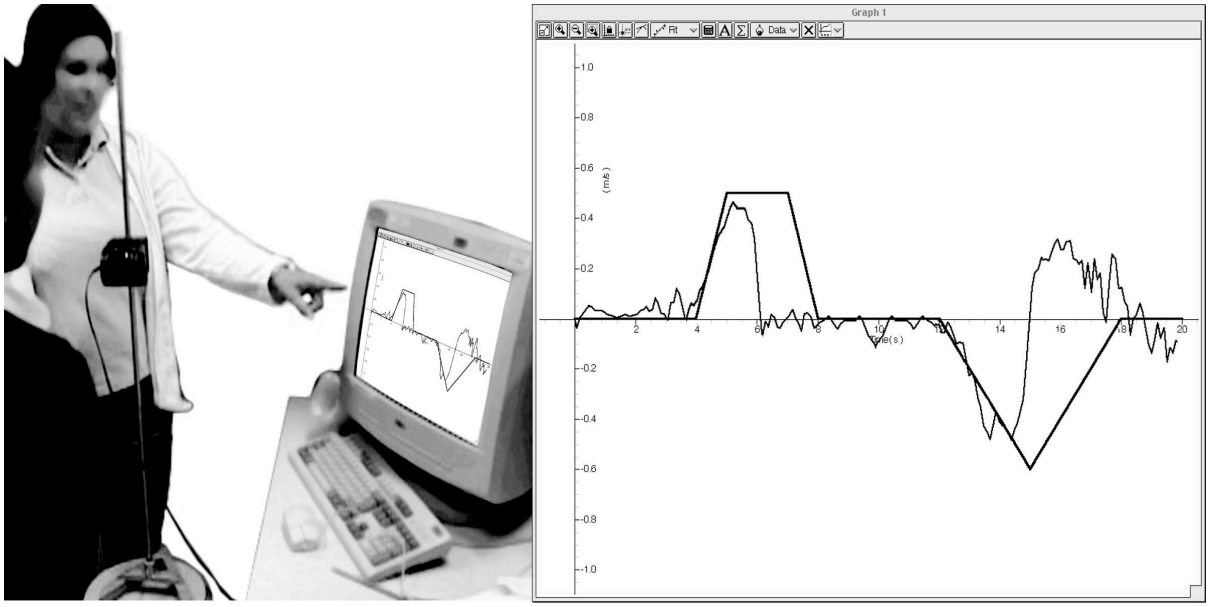

Figure 1.

Excerpt 1.1

→ 1 Karen: I don't understand? (.) how do you see that?

2 Laura: but here you see (.) ((points at the negative y-axis)) here
3 it's minus:.
4 Karen: m::=
5 Laura: =>and here ((points at the positive y-axis)) it's plus.<=
6 Karen: =m[:]
7 Laura: [he-] ((points along the initial zero velocity)) here you
8 stand still.
9 Karen: m:=
10 Laura: =and then (.) eh ((points along increasing positive
11 velocity)) you walk backwards and then ((points repeatedly at
12 the point where increasing velocity becomes constant velocity
13 while looking at Karen)) with the velocity you have [there]
14 Karen: [okey]
15 then I have ((points at the graph)) [quite a high velocity]
16 Laura: [((points along constant
17 positive velocity)) then you keep] (.) yes ((points along
18 constant positive velocity once more while looking at Karen))
19 and then you keep walking
20 (0.5)
21 Karen: [m::]
22 Laura: [with] that velocity and=
23 Karen: =m::

```
   24 Laura: and then you ((points along decreasing positive velocity))
   25        h::: um (.) ((points along decreasing positive velocity once
   26        more)) lower the velocity again.
   27 Karen: yeah, so you get down to::: standing still ((Laura points
   28        along zero velocity)) [mhm]
   29 Laura:                       [yeah] (.) and then you ((points along
   30        increasing negative velocity)) increase (.) the speed
   31        f::orward=
   32 Karen: =forward
   33 Laura: and then you ((points along decreasing negative velocity))
   34        lower the speed forward, and ((points along the final zero
   35        velocity)) then you get here
   36 Karen: so that it's zero
   37 Laura: m::=
→  38 Karen: =yeah okay >then I understand<

   39 Laura  m::
   40 Karen: shall we give it another try
```

Karen begins the episode by stating that she does not understand and then asks, "how do you see that?" In its sequential context, "that" refers to how Laura has successfully seen the graph in terms of movements in the room, or rather displayed that seeing in her interaction with the teacher. Prefacing the question with "I don't understand" has certain interactional consequences, which potentially could guide a recipient in how to listen and respond to the query. Most importantly, the trouble is located as one of Karen's understanding. Without the "I don't understand," the question could potentially leave the nature and source of the trouble ambiguous. It might, for instance, be interpreted as one of faulty vision—that Karen, because of her position or visual defects, is unable to see the same things as Laura. It could also be interpreted as a problem of the recipient rather the questioner—that there was something problematic with Laura's understanding or vision that the question now called into account.

The question receives an immediate answer prefaced with a "but," and during the rest of the episode, a detailed analysis of the graph is made. Although outside the focus of this study, an analysis of the episode could reveal several important aspects of what it means to "interpret" or "see" a graph in this particular setting. For instance, one could note how the graph is separated into certain sections, transforming the spatiality of the two-dimensional

graph into a highly structured verbal sequence (cf. Nemirovsky, 1996). In the sequential description, moreover, deictic terms like "here" in "here you stand still" (line 7-8) merge visual properties of the graph with movements, or in some cases the absence of movements (line 27 and 36), in the room (cf. Nemirovsky, Tierney and Wright, 1998). In addition, the episode is illuminating with regard to the use of symbiotic gestures (cf. Goodwin, 2003; Lindwall and Lymer, 2008; Nishizaka, 2003); that is, how talk, gesture, and material structure mutually elaborate each other in participants' work of making sense of the lab. One can also note how the interpretation is made instructional through the ways in which Karen addresses places in the graph as especially problematic. For instance, when her analysis reaches the part representing constant velocity—the section from which their problem initially emanated—Karen repeatedly points at the graph, looks at Laura, and stresses that "you keep walking" (line 19). The critical section is thus highlighted in a way that sequentially implicates a confirmation. Being the recipient of the instructive account, Karen eventually starts to fill in with more than continuers (line 15), reformulating and elaborating on Laura's utterances. This is repeated in lines 27, 30, and 36, which makes possible Laura's third-position confirmations of Karen's proposed interpretations (lines 17, 29 and 37).

The hearable lack of any objections to Karen's formulations throughout the episode allows the walkthrough to continue, and finally she states "yeah okay >then I understand<" (line 38). This utterance could be heard as a report on an inner experience—a "click of comprehension" (Brown, 1958; Coulter, 1979) perhaps—but also, and crucially, it is an utterance that begins to close the instructional sequence thereby initiating "another try" (line 40). If one solely focused on the last utterance as a display or formulation of comprehension, it might not be that different from Karen's previous utterances. In the conversation analytical sense mentioned in the introduction (Moerman and Sacks 1971/1988), the previous, "yeah, so you get down" (line 27), "and then you increase" (line 29-30) and "so that it's zero" (line 36),

also work as displays of understanding. Karen's "yeah okay >then I understand<" (line 38) might thus be seen as merely the last in a series of interactional moves that step-by-step display a recognition of what previous turns are saying and doing. While previous reformulations and elaborations could be seen as directed towards interpretations of specific parts of the graph, however, "yeah okay >then I understand<" is less clearly connected to specific details in the talk or the task. As "I don't understand" in the investigated material generally is heard as a request for an instructional sequence—or alternatively as preliminary to a complaint sequence (cf. Excerpt 4.3)—"I understand" or "I get it" often provide a last action before an entry into closings (cf. Jefferson, 1984b). By formulating the achievement of the instructional sequence, it is both coupled back to the preceding instructional work and recognizably a move away from this work (see also Excerpt 4.1 and 4.2). In this case, then, the initial and closing reference to "understand" can be seen as the boundary markers for the instructional activity.

It is important to note that the students, while talking, are involved in doing an educational assignment and that the communication therefore is structured in relation to their lab work. In many settings, silence might "display a failure of speaker transition" (Maynard, 1980:265), whereas students here generally are silent in "doing interpretation," "reading the instructions," "setting up the equipment," and so on (cf. Nevile, 2004:27). And while topic transition in ordinary conversations are often used "as a solution to the problem of producing continuous talk" (ibid.), topic transitions in the investigated lab work are often connected to the assignments—including the students' troubles with instructions and graphs, and the time-constraints put on the activity (cf. Clayman, 1989). As part of the tasks, the students should settle on certain interpretations of what they are seeing. When one or several students display that they see something that another is unable to discern, it is therefore relevant to interrupt the activity by asking for some kind of clarification. In the next episode (Excerpt 1.2), the

students have just started to work with a new assignment by reading the instructions. One of the students then starts to formulate an interpretation of the assignment and how the graph is to be seen.

Excerpt 1.2

```
   1  Frida: okay
   2         (0.9)
   3  Frida: so, up here we have the distance (.)((points along the graph
   4         in the lab instructions)) and then we should write the
   5         velocity
   6         (3.0)
   7  Katja: ri:ght
→  8  Susan: wait, now I didn't get it, what?
   9  Frida: up here ((points along the same graph as previously))
   10 Susan: yeah::
   11 Frida: this one ((Frida continues to explain while Susan provides
   12        uptakes for a number of turns))
```

Through her orientation towards the lab-instruction and the included graph, Frida's initial "okay" (line 1) hearably projects some talk on the assignment—what in this case turns out to be an interpretation of the graph and what to do next. After the 3 seconds of silence, in which all three students examine the instructions and the graphs, Katja, somewhat hesitantly, acknowledges the initial interpretation (line 7). At this point, Susan says, "wait, now I didn't get it, what?" In relation to the question posed in the previous episode (Excerpt 1.1), the elliptical interrogative "what?" that follows the formulation "now I didn't get it" is even more condensed. In its sequential context, however, it is enough to initiate an instructional sequence where Frida further expounds on her interpretation of the graph in a way that Susan eventually acknowledges as sufficient.

This sequence is informative with regards to the step-by-step following of the assignment, and the relation between task and talk. As demonstrated by Jefferson (1984b), the change from one topic to another in a conversation is generally done in a seamless and stepwise manner. It is therefore hard to link topic shifts to specific points in the interaction. However, there are also exceptions—"obvious changes" where "speakers mark that they are

about to change the topic of conversation" (Drew and Holt, 1998:509). One way to do this is through the design of turn-initial components. As noted previously, the communication among the students is closely linked to the lab work and therefore different from many other communicative situations. In the analyzed episode (Excerpt 1.2), as well as in several others in the investigated material, the claim of not understanding has a prefatory component that marks that the speaker is about to disrupt the contiguity of the activity. The "wait" in turn-initial position, like the use of the past tense in "I didn't get it" makes it relevant to ascribe the trouble source to what just has been said and done. In this way, it can be seen as a sign of an incipient rejection of the step-by-step following of the assignment. Other common turn-initial components used in similar ways include "but" and "no"; for instance, "but I don't understand," "no I don't understand," and "no but I don't get it."

As signaled by the prefatory components "no," "but," "well," and "wait," the requests associated with claims of "not getting it" potentially disrupt the flow of the activity in favor of additional explications and explanations. Within a context of limited time and patience, the students being recipients of these requests might therefore choose to reject them. Such rejections, being non-preferred responses, are regularly followed by an account. These accounts, in turn, often turn into complaint sequences addressing the problems of the lab work. The next sequence begins in a similar way to the previous two—in interaction with the teacher, one student's reasoning has been validated as correct. However, when the second student states that she does not get it, the first student rejects this request for assistance.

Excerpt 1.3

```
1  Ann:    that is (.)((points at the relevant part of Betty's lab-
2          report while Betty looks down at the report)) that isn't
3          constant but e:hm increases with constant velocity=
4  Betty:  =mhm:
5          (2.0)
6  Betty:  increases?
7          (0.8)
8  Ann:    yeah it increases the same amount all the time ((points along
9          the constantly increasing velocity))
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   10          (2.6)
→  11 Betty:   I don't get it (.) why is it below zero then?
   12          (0.7)
   13 Ann:     don't know, but we'll analyze that tomorrow
   14 Betty:   'cause there- I:: no:: [no]
   15 Ann:                            [we] just need to finish these so::
→  16          we'll discuss everything tomorrow (.) I don't understand
   17          there's really a lot left
   18 Betty:   yeah it's like always, there's way too many things
```

The episode starts with Ann contrasting a previous interpretation with the one that had been validated as correct. The uptake of this explanation in line 4 and 6 indicates that the contrast still is not salient to Betty, and results in a reformulation of the previous interpretation (line 8-9). After a silence during which she intensively looks at the graph, Betty says, "I don't get it (.) why is it below zero then?" This claim of not getting it, followed by a question about the visual appearance of the graph, is similar to Karen's "I don't understand (.) how do you see that?" in Excerpt 1.1. In both cases, the students' formulated lack of understanding are recognizably preliminary to the specification of a question. In addition, both cases are preceded by a stretch of interaction where the addressed student has made some kind of interpretation deemed to be appropriate by the instructor.

Although it is reasonable to presume that Anna, through her previous interaction with the instructor, is able to provide an answer to Betty's question, she displays an unwillingness to accept Betty's request. This unwillingness can be seen as a pragmatic move to put an end to this particular task. As an account for the rejection, Ann's utterances (line 13 and 15-17) treats Betty's claim of not getting it as a proposal for further work on the task—"getting it" is associated with the activities of "analyzing" (line 13) and "discussing" (line 16), activities that at this time "need" (line 15) to be postponed. By adding, "I don't understand there's <u>really</u> a lot left," Ann positions herself in a similar situation as Betty—as one who does not understand. The sequential implications of this use of "not understanding," however, are very different from the previous. Instead of projecting an answer or instructional sequence, it is

used as preliminary to a complaint sequence in which the lab work activities are criticized. Taking up on this, Betty uses an extreme case formulation, "it's like always," which, in line with the work of Pomerantz (1986), might propose that this problem is in the circumstances of the lab rather than a product of the students' own doings. It is because there are always "way too many things" (line 18) that the problems of "understanding" have to be deferred.

3.2. Students addressing the teacher: Asking questions and requesting help

In the previous section, some instances were presented where students referred to "not getting it" or "not understanding" in requesting help and guidance from other students. Sometimes, the students decide that they are unable to sort things out by themselves and therefore request help from the teacher. In important respects, "I don't get it" or "I don't understand" have similar uses whether it is directed to a teacher or a fellow student: generally, these utterances precede a question and are designed to be heard as pre-requests. Still, there are critical differences—most importantly, the instructors are in one sense more prepared and in another sense less prepared to answer students' questions than are their peers. On the one hand, the instructors act and are treated as having both the knowledge and the obligation to provide an answer. In the investigated material, teachers never answer students by saying "I don't get it" or provide accounts for their not answering by initiating a complaint sequence (as in Excerpt 1.3). In fact, when a teacher, with the words of Vehviläinen (2003:408), is "withholding advice as a way of giving instruction," this is often met with anger and frustration; as in this complaint by a student directed to a teacher "I think that you should get an answer when you ask a question, you don't understand the lab you get more and more frustrated, you have to get an answer to the questions you ask." On the other hand, the instructors are often walking around in the room and the students need to call their attention before requesting help and guidance. This means, among other things, that the instructors do not have access to what students have done before the request—the actions,

interpretations, and problems which eventually led up to their decision to ask for the instructor's attention. As a result, the problems of the students have to be further articulated and discerned—for instance, by contrasting what they do not get with what they actually do get (Excerpt 2.1 and 2.2).

Before the next episode (Excerpt 2.1), the students had placed a propeller-driven cart on a track, using a motion detector connected to a computer to measure the cart's motion and display it in the form of position vs. time, velocity vs. time, and acceleration vs. time graphs (Figure 2). As one of the graphs did not turn out as they had predicted, as "they thought it would," they turn to the instructor.

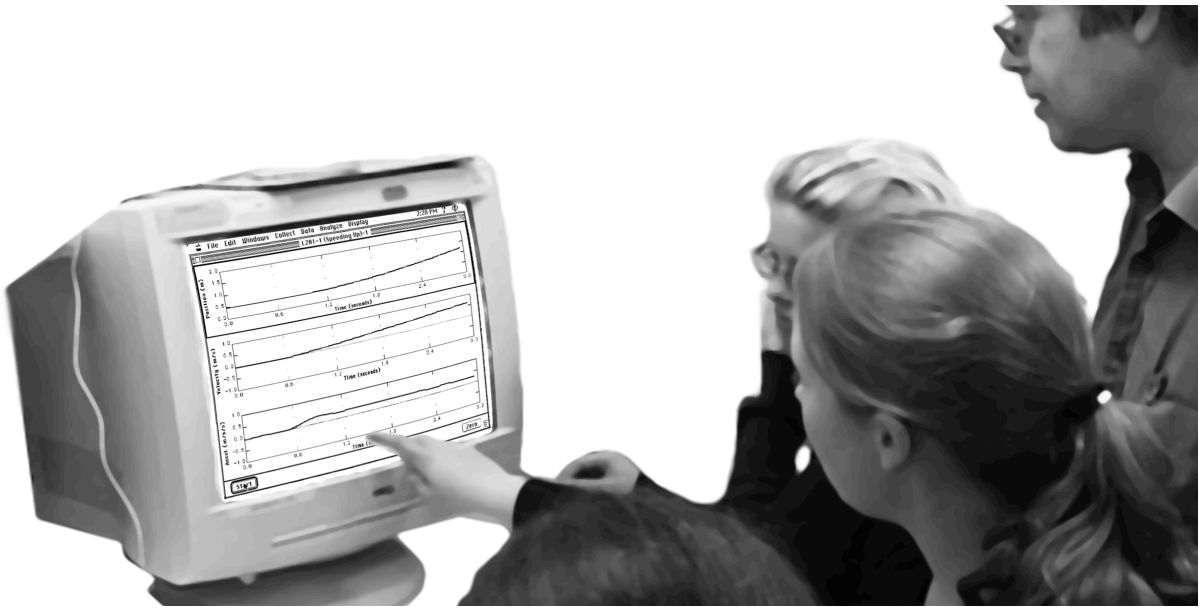

Figure 2

Excerpt 2.1

```
   1  Frida:  we:: need help
   2  Susan:  professor?
   3  JOHN:   yup ((walks towards the group))
→  4  Frida:  we don't [get it]
   5  Susan:           [<professor we] um:: we: we have messed up>
   6  JOHN:   okay [what is the probl-]
   7  Susan:       [<in our] thoughts>
   8  JOHN:   [what's the problem?]
   9  Katja:  [no::eh but]
→ 10  Frida:  we understand ((points at the position vs. time graph)) that
→ 11          one and ((points at the velocity vs. time graph)) that one
```

```
12 Susan: [yeah]
13 Katja: [a::]
14 Frida: but ((points at the acceleration vs. time graph)) this one
15        doesn't get like we thought it would
```

The episode begins with two students calling for the teacher's attention: Frida by explicitly saying "we:: need help" and Susan, in a playful tone of voice, exclaiming "professor?" Responding to their summons, the teacher moves towards the group and says "yes." When the students have the teacher's attention, Frida asserts that they "don't get it" (line 4) and Susan, still in a joking manner, says that they have "messed up" in their "thoughts" (lines 5 and 7). The instructor's questions in line 6 and 8 indicate that the students' descriptions—of not getting it and having messed up in their thoughts—do not identify their problem in a way that makes it possible for him to provide further instruction. Here, one can note a similarity between this episode and that presented in Excerpt 1.1: in both cases students' formulated lack of understanding are recognizably preliminary to something else. In that case, the "I don't understand" was, after a short pause, followed by the question, "how do you see that." In this case, the students' "we don't get it" is followed by the teacher asking, "okay what is the problem." Their claims of not understanding could therefore be characterized as pre-requests (cf. Schegloff, 1990): the claimed lack of understanding needs to be specified by asking a question ("how do you see that"), or, as in this last episode, by pointing out what is and what is not "understood."

In the episodes presented in the previous section (Excerpt 1.1-1.3), the fact that the students had been working on the task together was crucial in responding to the requests: the students formulation of their problem—in relation to the group's shared history and the sequential context—made it possible to start the instructive work on the basis of elliptic questions such as, "how do you see that?" or "now I didn't get it, what?" In this case, however, there is no visible problem in the graphs or the experimental setup and the teacher has no access to what the students have done previously; hence the teacher's question, "what

is the problem," requesting more detailed grounds on which to start the instructive work. As a response to the instructor's questions in lines 6 and 8, Frida points at the position vs. time and velocity vs. time graphs saying, "we understand that one and that one" (lines 10-11). She then expounds on their problem, pointing at the acceleration vs. time graph while saying, "but this one doesn't get like we thought it would" (lines 14-15), thereby using formulations of understanding to establish a contrast—a figure of unexplainable outcomes against a background of what is straightforwardly "understood." Before they produced the three graphs, and in line with the instructions for the assignment, the students had drawn predictions of the three graphs. Since their depicted "thoughts" on the acceleration vs. time graph do not look like the graph produced by means of the technology, they have encountered a visual discrepancy that they "don't get," and for which they now want an explanation. Thereby the students specify their self-ascription of a lack of understanding as being a judgment based on discrepancies between predictions and outcomes. That formulation, in contrast to the pre-sequential indication of not "getting it," is an answerable formulation—it provides the teacher with some concrete materials to address in his instructional work.

In the next episode (Excerpt 2.2), Betty, in a similar way as Frida above, delimits what she "gets" from what she does not "get," but the distinction is made in a way that does not enable the instructor to provide a straight answer. From an 'expert perspective,' it is not even clear whether her question has an answer. Before the episode, the students and the instructor had produced position vs. force, velocity vs. force, and acceleration vs. force graphs (Figure 3) by pushing and pulling a cart coupled to a force sensor back and forth along a motion sensor-equipped track. The assignment was intended to demonstrate the linear relationship between force and acceleration as stated in Newton's second law. At the time of

the episode, Betty tries to figure out the relation between the sign of the force and the placement of the cart: a relation that does not exist in any direct way.

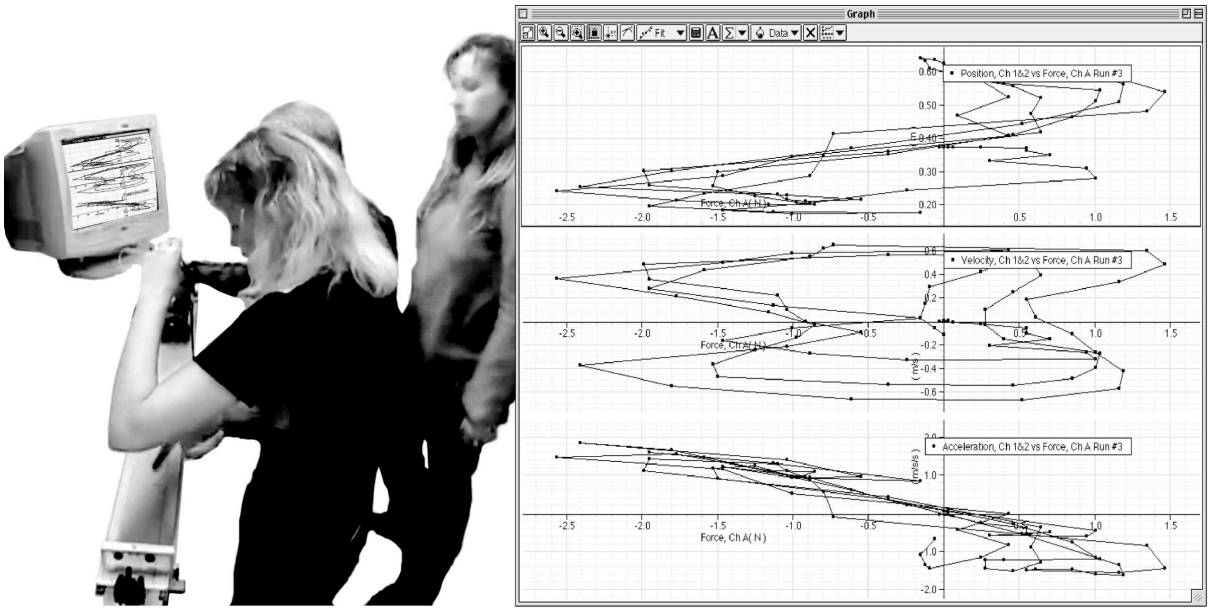

Figure 3

Excerpt 2.2

```
→ 1   Betty:  I still don't get why it becomes minus >you know. does the<
  2           force get minus just 'cause it happens to go over
  3           [here?] ((points at the track))
  4   JOHN:   [yeah but] look at (.) where it says plus and ((points at the
  5           force sensor)) [minus]
→ 6   Betty:                [yeah] but I get that ((points at the force
  7           sensor)) but why::? ewh- what kind of force makes it a minus
  8           force?
  9   JOHN:   it's that it pulls ((pulls the cart)) here now right (.) if
  10          you, if I were to hold this still here and pull I would show-
  11          I would get a reading on,
```

As in previous episodes, the claim of not getting it precedes the formulation of a question. By adding that she "still" does not get it, Betty indicates that the issue has been brought up but not come to a close. Betty then specifies her problem by pointing at the track (see Figure 3) while asking why "does the force get minus just 'cause it happens to go over here?" In this way, she links the graphical representation of negative force with a certain position of the cart. The instructor's overlapping "yeah but" marks his response as countering

Betty's formulated problem. Since the sign concerns the direction of the force applied, and not certain positions on the track, the instructor shifts the focus to the force sensor that marks negative force in one direction and positive in another (lines 4-5). By interrupting the teacher (line 6), Betty shows that this was not the answer asked for, and she then reformulates the question, "what kind of force makes it a minus force?" As there is no particular force that "makes it a minus force," the instructor, yet again, tries to direct Betty's attention towards the relation between the force sensor, the movement of the cart, and the graphical representation. In the interaction between Betty and John, there is thus an interesting tension between the student's claim of "getting that" and what a teacher might hear in such a claim. Rather than accepting it at face value, the instructor acts on it as a display that shows that she has not complied with his request, and which therefore could be used—alongside any other actions that show the student's grasp of the subject matter—as grounds for further instructional moves.

The next episode (Excerpt 2.3) takes place shortly after the previous. In the turns immediately preceding the episode, the teacher has pointed out that they have now created the right set of graphs (as represented in Figure 3) and that previous problems in producing the graphs were due to a cord lying on the track hindering the movement of the cart. This episode shows how formulations of "not understanding" are sometimes used in conjunction with other types of problem formulations.

Excerpt 2.3

```
   1  Betty: so that is right?=
   2  Ann:   =but=
   3  Betty: =that looks [good you mean?] ((points at screen))
   4  Ann:               [yes but sure] but that doesn't look good, we
→  5          can't read off, we don't understand that diagram [at all.]
   6  Betty:                                                  [no:::h]
   7          (0.6)
   8  Ann:   how are we supposed to use that [in a lab report?]
```

```
9  Betty:                                  [nuh huh huh huh] huh ((leans
10         forward, pointing at acceleration vs. force graph))
```

Although the teacher had contrasted the graphs they have now produced with previous faulty ones, the students still distrust the correctness of them, which leads to a series of reformulations of their problems. The first question, "so that is right?" places the graph on a binary scale, being either right or wrong. The second question, which is explicitly directed at the instructor, is stated as a judgment of whether the graph "looks good." Ann, forestalling the teacher's presumed answer, then states that, "sure it doesn't look good." Next, and in the same turn, the troubles with the appearances of the graphs are reformulated: first, as originating from their inability to "read off" and then in their not understanding "that diagram at all." Finally, Anna places it in relation to their having to produce a lab report (line 8), while Betty leans in to point and laugh at some aspect of the graph.

On the one hand, the many reformulations, albeit ambiguously, display the nature of the students' problems: that they do not know what the graphs should look like, whether the graphs in fact are supposed to look otherwise, how the graphs should be interpreted, and what to do with them. As the students do not know what to do, the problems do not take a definite form, and they are therefore unable to know where the instructional work that they ask for should start. On the other hand, the formulations also show what they do know: that they are supposed to see a something, that this something is supposed to be recognizable, that the lab report they are about to write makes their decisions and formulated interpretations accountable, that the instructor knows the answer, and that they may ask him for help and guidance. Based on this knowledge, the students note the lack of visible grounds for answering the question as a "negative event" (Schegloff, 1988:120-123), one that is accountably missing in relation to what is normally the case. There is a subtle but interesting change in voice in the episode, by which that accountability is shifted between the students,

the graphs, and the teacher. While the students in the beginning are asking about the graph, they also, and with an increasing emphasis, question this lack of "understanding," to some extent making the teacher accountable for their inability to "understand that diagram at all" (lines 5), and being unable to use it in a lab report (line 8). On the basis of these formulations, the teacher engages in a focused instruction as to the proper way of seeing these graphs (in Lindwall and Lymer, 2008, we provide a detailed analysis of this work).

3.3. Students asking other students if they understand

The two previous sections dealt with sequences in which students reported that they themselves did not understand, often positioned as pre-sequences to more specific formulations of problems. In contrast, this section exhibits some episodes where students ask other students if they have understood the relevant issues. When posed to another lab group (Excerpt 3.1 and 3.2), the question is often taken as a request for help, either by the recipients trying to provide the guidance needed (Excerpt 3.1), or—if the other group answers in the negative—as an opportunity to dwell on the problems with the assignments (Excerpt 3.2). When posed to a student in the same lab group, the question is commonly used to check that the other student 'follows,' thereby being employed as a resource in the orientation towards the task as a joint concern. Such moves can for instance be made relevant when one student is not as involved as the others are (Excerpt 3.3), or after a turn that is met by a noticeable pause.

In the following episode (Excerpt 3.1), the students use a simulation called *Graphs & Tracks* to arrange a symbolized track and some initial conditions in such a way that the motion of a ball corresponds to a predefined graph (see Figure 4). Sara, who is part of another group, addresses Karen and Laura, asking if they understand "how it is done" (line 1).

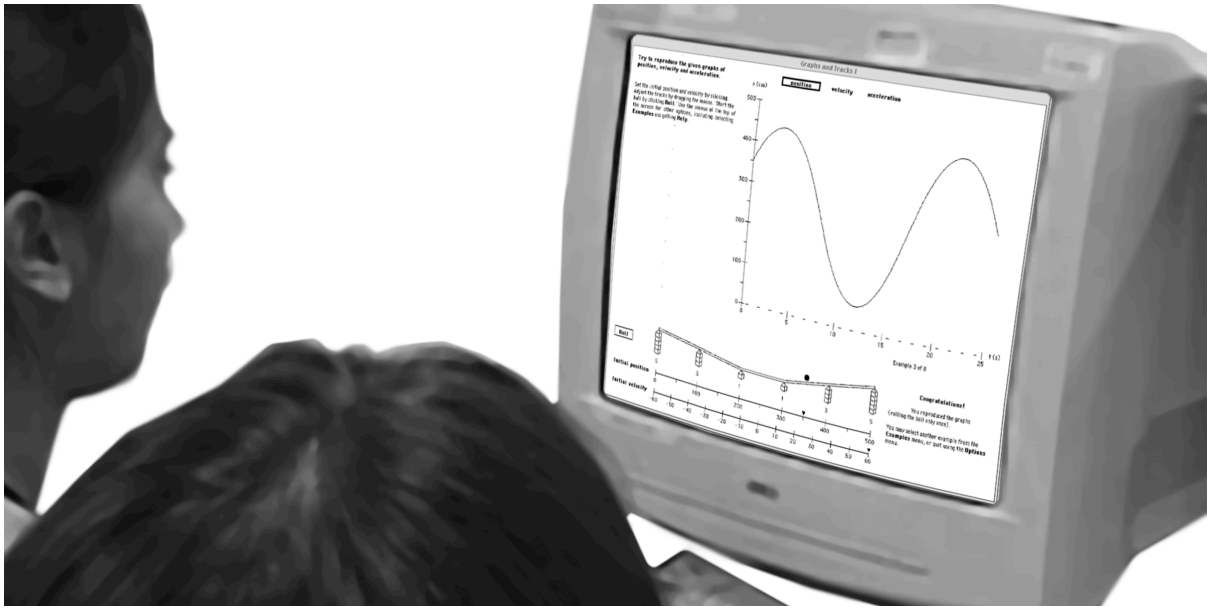

Figure 4

Excerpt 3.1

```
→ 1  Sara:   do yo::u understand how it is done?
  2          (0.6)
  3  Karen:  uh:::m
  4          (0.6)
  5  Karen:  he no(h)t rea(h)l(h)ey .hh
  6  Laura:  you have ((waves in the direction of the computer screen)) to
  7          look at those pictures
  8  Sara:   [yea::h]
  9  Laura:  [it says] ((looks down at the instructions)) like this
  10 Sara:   m[::]
  11 Laura:   [how] they look, and then (.) when they come to this point
  12         (0.5) ((Laura looks at Sara))
  13 Sara:   m:=
  14 Laura:  =then you should test (.) an- ch- change ((points at the
  15         tracks as represented in the instructions)) these here (.) to
  16         see what happens (.) then
  17 Sara:   mhm
  18         (1.0)
  19 Sara:   okay
```

Although the interrogative “do you understand how it is done” has the grammatical form of a yes/no question, the interactional function is not just to elicit a yes or a no (cf. Raymond 2003). The utterance is hearably preliminary to something, even though it is ambiguous what this something is—it could be an offer of assistance, a request for help, or,

perhaps, a complaint of some sort (as in Excerpt 1.3). However, as both the syntactical form and the intonation of the utterance indicate a preference for a confirmatory answer, it is reasonable to take it as a pre-request. The fact that the pre-request is posed as a question and not as a pre-sequential indication of lack of understanding followed by a specification of a problem, can be accounted for by the fact that Sara cannot presume that Karen and Laura actually are able to provide the answers sought for. She has not seen what they have done previously as in Excerpt 1.1-1.3; neither can she take it for granted as in Excerpts 2.1-2.3 where the addressee is the teacher.

While Laura does not immediately attend to Sara's question, continuing her orientation to the screen and the tasks, Karen selects herself as recipient. Notwithstanding the ambiguity of the question, answering in the positive might make one accountable for providing a useful display of that self-ascribed understanding. Not being prepared to do just that, Karen hesitatingly and laughingly declines the request. Hearing the hesitation, laughter, and beginning negative answer produced by her lab-partner, Laura starts to describe a procedure of trial and error, where they first "look at those pictures" (line 6-7), then "test" and "change" the condition so as to see "what happens" (line 14-16). Throughout the instructive account, Sara provides minimal continuers. Laura, being neither part of Sara's group (cf. Excerpt 1.1 and 1.2), nor having the position and responsibilities of an instructor (cf. Excerpt 2.2), does not dwell on the uptake of her instructions and settles on continuers and minimal responses. It is up to Karen and Laura to decide if they are able to answer her request: if they "understand how it is done" and up to Sara to decide whether she has "understood" the instruction provided. When the last of Sara's continuers (line 17) does not receive an uptake in the form of continued explanations, which indicates that Laura is finished, Sara hesitantly says, "okay" (line 19) and walks back to her group to try out the task herself.

In the next episode (Excerpt 3.2), the same three students are discussing their "understanding" after Laura and Karen have expressed some confusion and frustration concerning the setup of an experiment. As in the previous episode, another student group asks a question, but here, no one provides the guidance made relevant by the request.

Excerpt 3.2

```
→ 1  Karen: muh .hh I get so sad I don't understand anything hh hu .hh
  2         (2.7)
→ 3  Sara:  do you get it? ((said from the other side of the room))
  4  Karen: noh: ho ho=
  5  Laura: =no how have you got u::m ((looks down at the instructions))
  6         (2.0)
  7  Sara:  wha:t?
  8         (1.8)
→ 9  Laura: aha:: (.) [°I get it°]
→ 10 Karen:           [do you] understand anything?
→ 11 Sara:  ah:: I don't understand what u::m what we
  12        (0.3)
  13 Laura: what we're supposed to do
```

At the beginning of the episode, Karen looks around the room at the same time as she, with a frustrated laughter, says that she gets "so sad" and that she does not "understand anything." Here, not understanding anything is used as an account for Karen's expressed "sadness." Sara, who had just previously expressed similar difficulties in her group, picks up Karen's comment to the room by asking Karen and Laura, "do you get it?" (line 4). Although this might seem as a somewhat strange question to someone who has just emphatically stressed that she does not understand anything, it can be heard as a way of proffering a discussion on the topic made relevant by Karen. Such discussions could be delicate matters,

as they might bring forward asymmetries in knowledge and engagement and therefore connect to matters of face. On the one hand, the students might ask questions that the others find trivial or too complex. On the other hand, they might end up in providing information to someone who already knows or who does not want to know.

To Sara's question "do you get it," Karen replies in the negative with the same kind laughter as previous, whereas Laura—who in the meantime had been focusing on the computer screen—begins to formulate a question "how have you got u::m?" (line 5). The question, which is formulated while she is reading the instructions, is never completed as she finds the answer in her reading (line 9). Therefore, its sense is not fully disclosed, neither to us as analysts, nor to Laura's fellow students. Still, the utterance shows how the initiation of the topic "not understanding" opens up a conversational framework that makes it relevant to address a group on the other side of the room with a question.

While Laura's question was directed towards something in particular, probably a task procedure, Karen asks if the other group "understands anything" (line 10), thereby reformulating Sara's question in terms of her initial "I don't understand anything" (line 1). Laura, who actually stated to herself that she got it, joins this conversation by completing Sara's "I don't understand what" with "what we're supposed to do," something which they expand on for a minute or so. The episode illustrates two recurrent rationales for checking the "understanding" of other groups. On the one hand, asking if another group has understood a specific assignment could be used to initiate an instructional sequence (as in Excerpt 3.1). On the other hand, formulations, such as Karen's "do you understand anything," are also used to initiate discussions on the lab work in general. It is therefore possible for Laura to simultaneously "get it," and agree that they do not understand "what they are supposed to do"; the first utterance is part of *doing* a certain lab assignment, the second is part of *talking about* doing lab assignments in general. There is thus a distinction between uses of

”understand” as applied, on the one hand, to specific contents and procedures, and, on the other hand, to the meaningful trajectory of the lab as a whole.

As noted previously, the interrogatives ”do you understand” and ”do you get it” are hearably preliminary to something. The nature of this something, however, is not to be found in the utterance itself. In the first episode in this section (Excerpt 3.1), ”do you understand” is taken as a request for help and consequently as indicating that the student asking the question in fact does not ”understand.” In the second episode, the student asking the question is met by the counter question ”do you understand anything”—it is not clear whether Sara ”understands” or not, and consequently what her ”do you get it” is preliminary to. In the next episode, ”do you understand” is used preliminary to the offering of guidance. It thus displays another relation in terms of whose understanding is taken for granted and whose is at stake. Before the episode, the students had been instructed to make a prediction of a graph, which corresponds to a movement where they “walk with constant velocity away from the motion detector, stand still for a couple of seconds, and then walk towards the motion detector.” After having drawn a prediction and having produced a graph on the computer screen by walking in the instructed manner, they start to discuss some discrepancies between the predicted graph and the plotted graph, and they realize that standing still results in the graph dropping to the x-axis.

Excerpt 3.3

```
   1  Susan: u::m (.) when she stands still, yeah then it goes ((both
   2         Susan and Frida turns to Katja)) back to zero of course
   3  Frida: yeah ‘cause then I go,
   4  Katja: [right]
   5  Frida: [then I st-] then I don’t have any velo[city]
   6  Susan:                                        [no]
   7         (1.0)
   8  Susan  but oh this is so much fun [hu hi h hi]
→  9  Frida:                           [h hh but] do you understand n-
   10        now:: we measure velocity [not meters] far away
   11 Katja:                          [yeah yeah]
```

The episode begins with Susan noticing that standing still makes the graph go, “back to zero.” Both Katja and Frida respond by confirming this statement: Katja by providing a minimal response (line 4) and Frida by expanding on Susan’s observation (line 5). It is notable, however, that the two responses do not confirm Susan’s observation in the same way. Frida’s utterances (turn 3 and 5), in conjunction with her previous production of the graph, make available her interpretation of the graph in a way that does not occasion Susan to inquire further. In contrast, Katja’s “right” is a weak display of a shared interpretation. That Katja does not join in the laughter following Susan’s comment “this is so much fun” further reinforces her position as not sharing the understandings of Frida and Susan. Acting on this potential asymmetry, Frida asks if Katja “understands” (line 9). Without waiting for an answer, the question is followed by the formulated contrast between the current situation where they measure velocity and the previous one where they measured distance, in her words, “meters far away” (line 10). The contrast is cut short by Katja’s overlapping “yeah yeah,” which, by being an answer to the question “do you understand now,” completes the question-answer pair thereby making further explanations superfluous.

Given the position of her answer, it is possible that Katja did make similar interpretations as Frida and Susan already at the beginning of the episode. It is also possible that Frida’s “we measure velocity” made Katja realize how she should look at the graphs. It is even possible that Katja actually did not follow the other students, but decided to terminate the explanation anyway. Whether she did or did not really understand is not the issue here. This example makes visible yet another situation where explicit uses of ”understand” are occasioned. As the students worked in groups, it would have been possible for just one student to work with the assignment while the others were passive in relation to the task. Although this sometimes was the case, the students usually held the whole group accountable

for shared interpretations of—and similar involvement in—the assignments. As demonstrated by previous excerpts, they continuously asked each other about things that they have not "understood" (Excerpt 1.1-1.3). As this episode illustrates, they also monitored each other's participation and 'understanding' based on displays such as the timing of continuers, the addition of new or reformulated information, and the expressed alignment towards the task. What this episode further illustrates is how claims of understanding, such as Katja's confirmatory answer to the question "do you understand," could be used to mark a preparedness to shift from one task to another. While weak displays might engender questions and further elaborations, a confirmatory answer to the question "do you understand"—although not a display of understanding per se—could hardly be disregarded by peer students.

3.4. References to understanding in closing a task

As have been shown, claims to "not understand" are often used to initiate an instructional sequence. We have also shown how the formulation "now I understand" (Excerpt 1.1), and the answer "yeah yeah" to the question "do you understand" (Excerpt 3.3), are used to close an instructional sequence. In the material, "we get it" or "now we understand" are recurrently used to formulate a task as finished, students as ready to go on with the next assignment, or to go home for the day (Excerpt 4.1 and 4.2). Having "understood," however, is only one of a range of different accounts for finishing a task; having to complete the task in time might be equally, or more, important. Sometimes, issues of *not* "understanding" are brought up in this context. As was shown in a previous section, students sometimes have to postpone resolving any such self-avowed lacks of understanding in order to complete the task in time (Excerpt 1.3). At other times, they express frustration over having completed the task despite that they "don't understand anything" (Excerpt 4.3).

In the following episode, the students are working with the software Graphs & Tracks (Figure 4), in which the evaluation of answers is automated; the computer displays the message “congratulations” when the correct solution is reached. Although the students do not receive a “congratulations” after the run preceding exchange in Excerpt 4.1, they agree that they get it and that they should skip the task by pressing “next” in the menu.

Excerpt 4.1

```
→ 1  Laura: yeah we get it
  2  Karen: shall we go on then?
  3  Laura: yeah hu hh
  4  Karen: otherwise we could sit here until h .hh fi(h)ve
  5  Laura: I just wanna test the next one (.) will just check how it was
  6         (.) yeah but we get that one, we know that,
  7         [we've tested that]
  8  Karen: [we've already] ne:x::t yeah exactly=
  9  Laura: we did that ((turns to Karen, makes a wave-like gesture with
  10        her hand))
  11 Karen: ((laughs))
```

Here, Laura and Karen formulate their “getting it” in a sequence that makes the assignment come to an end. In the beginning of the episode, Laura says, “yeah we get it,” (Sw. ”a vi fattar”) after having gone through a couple of runs with the simulation. Karen takes this as an invitation to a closing, which indicates their being entitled to go on; ending her question with a “then” (line 2), the suggestion is formulated as a consequence of the previous turn. Getting a minimal signal of agreement, “yeah” (line 3), she continues by elaborating on the consequences of lingering with this assignment—their having to stay “until five.” The negotiating and discussing tone of their talk about getting it is interesting in relation to theoretical treatments of understanding: claims to ”understand” or ”get it” as part of decision-making sequences places the practice of formulating understanding squarely within the context of pragmatic considerations of how much time is left, of wanting to go home some time today, and so on, which is something very different from reporting on mental states. As the invitation to the closing have been taken up by Karen, Laura’s lingering

with the assignment requires an account for the delay in the projected closing: it makes relevant her toning down the duration of the delay by the initial ”I just wanna,” and again with ”will just check” (line 5). The invitation, being an invitation and not an actual closing, can always be deferred or delayed (Button, 1987). As both this and the next episode illustrate, however, the act of deferring or delaying are accountable actions and could as such also be met with some resistance.

Before the next episode (Excerpt 4.2), the students have sketched some predictions of the resulting position vs. time, velocity vs. time, and acceleration vs. time graphs for a cart with a fan unit moving towards a motion sensor. After having made the predictions, they started the fan and watched the graphs being produced as the cart moved towards the sensor with constant acceleration (similar to that in Figure 2). At first, the students orient towards the graphs produced as being in line with their predictions. On closer comparison, however, one of the students discovers discrepancies in both the velocity vs. time and the acceleration vs. time graphs.

Excerpt 4.2

```
   1  Katja:  is really happy he ha hh=
→  2  Frida:  =yeah but [then we get that]
   3  Katja:            [yeah look]=
   4  Frida:  woho
   5  Katja:  but this was all hh wro(hh)ng hh h ha he
   6  Frida:  no:::
   7  Katja:  it was the other way around anyhow
   8          (1.0)
   9  Katja:  [cra::p]
   10 Frida:  [>u::m but] it just- u:m it gets the other way around,<
   11 Katja:  but the acceleration was all wrong too really=
```

12 Frida: =no::=

13 Katja: =just the last one there that was right

14 Frida: no

15 Katja: it does not start, (.) u::m okay, roughly then hh he

At the beginning of the episode, Frida says, "yeah but then we get that," indicating, on the basis of her reading of the graphs, that they are ready to move on. Katja, who looks at the predicted graphs, first agrees but then discovers that the velocity vs. time graph is "all wrong" (line 5). When making the prediction about the velocity vs. time graph, the students had discussed the slope of the graph, choosing between two different suggestions. Now, and in hindsight, it turned out to be their other suggestion (line 7) that was correct, which casts doubt on their claim of getting it before (line 2). Again, note the backwards referral to understanding, with lines 5 and 7 countering the claim of understanding made on line 2. The prosodic elements—for instance, the quick pace and slightly formal tone—of Frida's reiteration of Karen's observation (line 10) marks it as a conclusion and a potential formulation to include in the lab report. By ending in a tone of continuation, moreover, it projects further development. Karen initiates her turn with a "but," which indicates that she is not ready to write up the assignment yet, and notes that, "the acceleration was all wrong too really" (line 11). With the words of Button (1987), it constitutes a "move out of closing"; raising this issue might engender additional work, which, in turn, would mean that the closing of the task is delayed. By her "no" (line 12), however, Frida objects to this move and the categorization of the acceleration vs. time graph as "all wrong." After having received a second objection to the proposed discrepancies, Karen hesitantly and with some laughter accepts that the graphs are "roughly" similar (line 15), and the students write down their observations and move on with the assignment. Here, "roughly" becomes a way of reconciling the "wrong" outcome as acceptable.

Throughout the excerpt, issues of correctness—of right and wrong—are closely connected to the participants' use of claims to "understand." As Macbeth (2000:64) notes, this is a generally observable feature of action and interaction in educational settings, where correctness tends to "drive" much of what participants are doing. Indeed, Excerpt 4.2 like Excerpt 1.2 show that correctness is taken as the prima facie grounds for claims to "understand," with the discovery of incorrect answers consistently treated as a source of trouble and as grounds for countering the previous claim. Again, it is important to note that what is countered is not primarily a claim about the character of some mental and individual entity called "understanding," but rather the invitation to closing and moving on that the uses of "we get it" imply. This is further highlighted by the fact that in this kind of group work, "get it" is recurrently preceded by an inclusive "we." As was demonstrated previously (Excerpt 1.1-1.3), requests for additional instruction by peers are commonly preceded by utterances using the first person singular pronoun, e.g., "I don't understand," whereas the pronominal "we" positions the group as the relevant unit in the decision to move on (Excerpt 4.1 and 4.2). In the next case, Anna and Betty have just completed one task and are in the midst of beginning with the next one.

Excerpt 4.3

```
   1  Anna:   we'll never finish this (.) ((skims through the
   2          instructions)) >but look here<
   3          (2.0) ((Anna shows the instructions to Betty))
   4  Anna:   >there's just this one left and we're done< and we can go
   5          home=
→  6  Betty:  =yeah, I don't understand anything
   7  Anna:   wo::nderful
   8          (1.7) ((Betty puts her papers in order for continuing the
   9          assignment))
→ 10  Betty:  honestly, I don't understand much, I couldn't say that
```

The tone of the initial complaint by Anna quickly changes to one of joy and relief when she realizes that there is just one assignment left, that they will soon be done and can go home (lines 4-5). Betty does not share Anna's excitement. Instead, she reports that she does

not “understand anything” (line 6). As exclamations of not understanding “anything” are very common in our material, the utterances might cause concern if taken as literal reports on the quantity of the students’ understanding. This, however, would miss what utterances such as ”I don’t understand anything” do in these circumstances. Betty’s formulated lack of understanding are general and unspecific in its reference; it is not about a particular graph (cf. Excerpt 1.1) or a conceptual construct such as negative velocity (Excerpt 2.2). By being an extreme case formulation, it is rather designed so as to be heard in a non-literal way (cf. Edwards, 2000). The students have spent several hours in the lab, they will soon have completed the assignments, and still Betty does not “understand anything,” which provide reasonable grounds for a complaint. It is not clear whether Anna’s exclamation in line 7 refers to her previous observation or is an ironic remark referring to Betty’s claim of not understanding anything—perhaps it is both. Putting her papers in order to continue with the final assignment for the day, Betty again comments on her lack of understanding, this time that she ”honestly” does not “understand much” (line 9).

In the light of Excerpts 4.2 and 4.3, Betty’s utterances are interesting, as they are produced to comment on Anna’s suggestions to move on, finish, and go home for the day. While claims to ”get it” in the previous two excerpts were taken as invitations to closings—which in one case was resisted with reference to discovered discrepancies between predictions and outcomes (Excerpt 4.3)—claims of not understanding is here used as a response to an invitation to go on that itself makes no references to understanding. On the one hand, Betty’s claims of not getting it might be seen as declining the invitation to a closing. On the other hand, it is not taken up as such and through its formulation as a general complaint—rather than, for instance, a pre-request (Excerpt 1.1-1.3) or a specific counter-claim (Excerpt 4.2)—it is not clear what other actions it calls for besides an extended complaint sequence. While ”we get it” commonly are used as an account for going on,

Betty's utterances can be seen as a way of displaying a stance towards the going on without "understanding." Edwards and Fasulo (2006) demonstrate some ways in which the phrase "to be honest" are used before a dispreferred answer that provides a subjective report as an account for not giving the requested information. Here, "honestly" is followed by " I don't understand much," which could be seen as an account for the dispreferred action of moving on despite that they "don't understand," alternatively as an account for the dispreferred action of not explicitly complying to move on.

3.5 Teachers' uses of "understand"

This section focuses on the teachers' uses of "understand," which, compared to those of the students, are much less frequent. This is hardly surprising: there are fewer teachers than there are students, and the total amount of talk produced by teachers is less than that of students. Also, however, there seems to be some interesting peculiarities to the ways in which "understand" is used by teachers as compared to students. In the first episode (Excerpt 5.1), an instructor asks the students if they "got understanding from it as well?" In a way, this utterance is similar to the utterance where one student asked another "do you understand n-now:: we measure velocity" (Excerpt 3.3)—as the questions receive positive answers, no further interactional work is done, nor is it accountably missing. At the same time, one could note a central difference between these uses; the instructor is talking about the thing that the lab is to provide, i.e. "understanding," rather than just checking that the students are 'following.' Even though the teachers, like the students, use "understand" to manage the organization of task and talk, the ways in which they do this differ from those of the students. This includes the ways in which the distinction between completing the task and "understanding" is handled. In the final episode of the previous section (Excerpt 4.3), the students ended a task and continued with the next one, despite one student's claim to "not understand anything." In the second episode of this section (Excerpt 5.2), the distinction

between completion and understanding is made relevant for instructional purposes: a teacher tells the student to “try to understand as well.” Asking if students get ”understanding from it as well,” like saying that they should ”understand as well,” can be somewhat problematic when used as instructional strategies. In the final episode (Excerpt 5.3), an alternative line of action is employed by the teacher: he engages in a lengthy discussion with the students, thereby eliciting interactional materials as displays of their grasp of the subject matter, closing the sequence by referring to the subject matter discussed as ”important to understand.”

In the following episode (Excerpt 5.1), the students have completed a number of assignments in the Graphs & Tracks software (see Figure 4), mainly using a sort of trial-and-error strategy, when an instructor approaches the students, checking in on their lab work performance.

Excerpt 5.1

```
   1  Betty: this was actually real fun=
   2  PETER: =it was was it?=
   3  Betty: [yeah]
→  4  PETER: [and] you got understanding from it as well?
   5  Betty: yeah
   6  Anna:  yeah sure=
   7  PETER: =yeah
   8         (0.4)
   9  PETER: that's perfect
```

At the beginning of the episode, Betty exclaims, “this was actually real fun.” One of the instructors, after having received a confirmatory answer to his question, “it was was it?” asks, “you got understanding from it as well” (line 4). Again, he receives confirmatory answers (line 5 and 6). After a short but hearable pause, the instructor concludes, “that’s perfect.” This is one of the only two instances in the data where the Swedish word ”förståelse,” i.e. ”understanding,” features as a noun. In contrast to almost all uses of ”understand” or ”get it,” this utterance does not suggest, make relevant, or invite the closing

of some extended work on the task. No such work is initiated by the student, and no interactional effort is spent to account for this. Asking about the students' achieved "understanding" positions some *thing* as a product of the students' work with the software ("you got understanding *from it* as well")—and it talks about the achieved understanding in general, rather than about the specificities of what they are currently doing or seeing. As noted, this is a deviant case in relation to the general absence of "understanding," as compared to "understand" and "get it." In relation to this, the circumstance of its production is interesting since it clearly connects with the way understanding is commonly used in the educational research literature. To further illustrate this point, consider the second of the two deviant cases; while working on a task, a student calls on the instructor and inquires about the significance of "that understanding test," or in Swedish, "det där förståelsetestet." Here too, the notion of "understanding" is closely associated with the discourses and practices of educational theory. Although two cases is not enough for drawing any strong conclusions, such references to "understanding" seem to occur only in particular circumstances, connected to a theoretically informed discourse about the point or significance of lab work for students' learning and understanding of subject matter content.

The "as well" (line 4) in the end of the teacher's utterance, which highlights the distinction between 'doing' and 'understanding,' recurs in the next episode (Excerpt 5.2, line 3). Before this episode, the students had printed the graphs, and asked the instructor if they should only continue to page 10, after which they put down the instructions, and prepared to go get the printouts. Receiving a positive answer, one of the students formulates the assignment, and their day's work, as finished.

Excerpt 5.2

1. Mia: in that case now we're done=

```
   2. JOHN:   =pardon yeah (.) then the thing is that you are supposed to,
→  3.         (.) try and to understand as well eh
   4. Mia:    but when should we hand this in then?
   5.         (1.4)
   6. JOHN:   well it's not that much of a hurry it's like this that it
   7.         continues (.) but keep eh keep the lab instructions then so
   8.         that you bring them with you next time
```

After having completed the assignment the students were working on, Mia states that they are "done." The instructor responds to this by saying that the students are supposed to "try and understand as well" (line 3), thereby indicating that they actually are not done after all. Similarly to the last episode of the previous section (Excerpt, 4.3)—where the students were "done" without having understood "anything"—the students' orientation towards being "done" here makes relevant the issue of moving on without understanding "as well." As a teacher, John is neither part of the group nor one whose understanding is implicated by the suggestion to move on. This accounts for the design of the utterance; rather than saying "I don't understand" or "you don't understand," he formulates "the thing," which is the point or purpose of the lab activity, as trying to understand. Ending the turn with "as well" (line 3), he further indicates this understanding as coming from some other activity than the completion of the task, and also as something in addition to what these students have done previously.

One could say that the teacher *proffers* a delay of the completion through further work on the task. He presents this as a possible next activity, available for acceptance or rejection (cf. Schegloff, 2007:170). Not accepting this offer, Mia asks John when they are supposed to hand in the report (line 4), thereby holding onto the topic of task completion and indicating John's prompt to "try and understand" as a potentially time-consuming activity. In effect, she rids the suggestion of interactional significance by responding in line with a different rationality, withholding any expansion on the proffered topic. The student's question, which does not pick up on John's suggestion, is followed by a hearable pause. Although partly buying into the rationality of completion, John then tones down the hurry, thereby implicitly

portraying the situation as allowing time for the extra activity of trying to understand (lines 6-8). This comment, however, does not receive any apparent uptake by the students, who get their print-outs, pack their things, and leave the room.

This episode, like the previous, displays some of the interactional difficulties involved in the teachers' work of addressing students' "understanding." Although the "thing is" that the students should "try to understand as well," the issue of what the students should do in addition to what they already have done remains unspecified. Finishing the concrete lab assignments is an all-or-nothing affair—either they are finished, or they are not—while the "understand" part is not straightforwardly assessable and thus open to negotiation. It leaves it up to the students to decide if the are to engage in "understanding as well." Somewhat similarly, when the teacher asks if the students got "understanding from it as well" (Excerpt 5.1), the question leaves it to the students to decide if they are in need of further guidance or not. A negative answer to the question, as the many instances of "I don't get it" investigated in previous sections (Excerpt 1.1-2.3) proves, is possible to use as a starting point for an instructional sequence concerning the problematic issue. A positive answer, however, as the one received in the previous episode (Excerpt 5.1), does not occasion such instructional sequences; but neither does it guarantee that the students, from a teacher's point of view, "have understood as well."

An instructional alternative to the question "did you understand" or the suggestion "you should try to understand as well" is to engage in lengthy "Socratic" dialogues with students, eliciting from them other types of responses than a yes or a no—responses suitable for making judgments concerning the need for further instruction. Before the next sequence (Excerpt 5.3), two students was about to go and print a set of position vs. time, velocity vs. time, and acceleration-time graphs (as represented in Figure 2) for inclusion in the lab report when an instructor approached them asking if they could "describe those graphs?" This

question was then followed by similar queries, such as, “what is this, is it a straight line?” and, “what is the acceleration graph.” Just before the following episode, one of the students’ answers had made it sequentially and instructionally relevant to ask what the students mean by the term “constant.”

Excerpt 5.3

```
   1  CLAUS: why? (.) this is not constant it increases ((traces shape of
   2         graph with finger)) (.) what do you mean by constant?
   3  Anna:  it’s it’s um increases ((points at velocity vs. time graph))
   4         eh (.) with ((Claus looks at Anna and nods)) the same (.) eh
   5         speed
   6  CLAUS: rate of change
   7  Anna:  mhm
   8  CLAUS: yes and that’s and that’s ((points at acceleration vs. time
   9         graph)) this this graph (.) this is constant and that's
   10        ((points at the velocity vs. time graph)) the constant change
   11 Anna:  mhm
   12 Betty: °mhm?°
   13 CLAUS: yeah? ((looks at Betty)) (.) and that’s very  [important to
→  14        understand]
   15 Anna:  [and this (.)] and here is where we stopped ((points at the
   16        end of the velocity vs. time graph))
   17 CLAUS: yeah
```

Responding to a potentially problematic utterance by Anna, the instructor points out that, “this is not constant it increases,” and asks, “what do you mean by constant?” (lines 1 and 2) Anna explains that she means that it increases at the same “speed,” which Claus reformulates as an issue of “rate of change.” Anna confirms this (line 7), and Claus then goes on to indicate in the graphs the difference between constant speed and constant rate of change. After having received minimal confirmations from Anna and Betty, he concludes that this is “very important to understand.” This sequence, like many others found in educational settings, effects “a course of talk in which the teacher or educator requires the [students] to articulate ‘what they have done and why’, such that their response can be taken as indicating ‘what has been learnt’” (Hemming, Randall, Marr and Francis, 2000:242). Instructors use various techniques for eliciting responses that can be used as grounds for professional inferences as to whether students are merely doing the tasks in the lab, or

understanding “as well.” Still, those techniques offer no principled remedy for the unavoidable fact that the elicited materials are stretches of talk and action, and nothing more. As such, they seldom afford complete and unambiguous closure. There is often an uncertainty whether the students actually follow what the instructions are saying; hence the highlighting of what is ”very important to understand” (line 13-14). It is not just that the teacher and student are involved in a conversation; there is also a lesson there to be found. On the one hand, the instructional moves by the teacher are designed for these particular students—eliciting responses that can be used as grounds for further instructional work. On the other hand, one can note the lack of personal pronouns in relation to the use of ”understand”—the thing showed and told is something that is generally ”very important to understand.”

4. Discussion

This study has presented a collection of uses of ”understand” in science education, focusing on their positioning and interactional consequences. The initial aim of the study was to investigate topicalizations of ”understanding.” However, it soon became evident that ”understanding” as a *noun* hardly occurred at all, whereas the *verbs* ”understand” and ”get” were frequently used. Another early finding was that almost none of the investigated uses of ”understand” occurred in relation to troubles or breakdowns in the ongoing management of fluent conversational sequencing—a prima facie plausible result—nor did they occur in the fairly common talk about non-lab related topics. Instead, an overwhelming majority of the uses was directed at task procedures, the purpose of the lab, or the subject matter content. The ‘things’ formulated as ”understood” or ”not understood” include the visual appearance of specific graphs (Excerpt 1.1 and 2.3), the relation between direction of movement and sign (Excerpt 2.2), observed agreements or discrepancies between predictions and outcomes (Excerpt 2.1 and 4.1), and the point and sense of the whole lab work experience (Excerpt

3.2). In addition, ”understand” is used in teachers’ formulations of the aim of the activity (Excerpt 5.1) and in highlighting particularly important subject matter content (Excerpt 5.3). As these uses are all intimately tied to the normative, disciplinary, and institutional concerns of the setting, the terms would do—and be directed at—markedly different things when used in other contexts: for instance, in military training programs, “understand what you have done wrong” (Bousfield, 2008:256), congressional hearings, “then it is your understanding that it was Mr. Gray’s understanding” (Molotch and Boden, 1985:278), or health appraisal interviews, ”so from what I’m understanding you play one role at work” (Beach and Dixson, 2001:30).

4.1 Teachers and students

In the collection of uses of ”understand” and ”get it” there are some clear distributional patterns connected to the concerns of the setting. As all of the investigated uses of ”understand” are directed towards lab work, assignments, and subject matter content, there are clear differences between the uses of these terms by students and teachers, respectively. It is never an issue whether teachers ”understand” the lab or the subject matter; understanding these things is handled as a defining characteristic of being a teacher in the setting (cf. Sharrock, 1974). Questions of the type “do you understand,” which are relatively frequent in the material, are only addressed to students, either by teachers or by other students. In the only deviant case, a student explains to the teacher how the group reasoned about a certain task, and then asks, “do you understand?” The ‘object’ is thus not physics per se, but the *students’* interpretation of a graph, which is presented to be assessed as either right or wrong. Uses of “understand” with regards to the subject matter are constrained in this way by different sets of rights and obligations for students and teachers. As has been shown, this does not only hold for the *formulation* of questions. When “I don’t understand” is addressed to a teacher, it has different *interactional implications* from when it is addressed to a fellow

student. In the former case, it will almost without exceptions initiate some kind of assistance (Excerpt 2.1-2.3). In the latter case, there are two possibilities: either the addressee picks up on the request for help and provides an explanation (Excerpt 1.1 and 1.2), or the addressee declines through the use of some sort of account (Excerpt 1.3). Declining, in turn, often continues into a joint complaint sequence in which the object of the complaint is not declination, but the task, the lab, or the educational program.

Another difference between students and teachers concerns the use of personal pronouns. When students use ”understand” and ”get,” the utterances always implicate some particular actor or actors; that is, ”I don’t get it” (Excerpt 1.1-1.3), ”we don’t get it” (Excerpt 2.1 and 2.3), ”do you understand” (Excerpt 3.1-3.3) or ”we get it” (Excerpt 4.1-4.2). The pronoun ”we,” which positions the students as a group, is either used in relation to the decision to move on or in calling the attention of the teacher. The use of first person singular is commonly used to request help, ask a question, and/or discern a problem in the midst of discussing and working with tasks. The plural ”you” (Swedish, ”ni”) is often used in the proffering of discussion on the topic of ”understanding,” while the singular ”you” (Swedish, ”du”) is used when checking that a student within the group follows. Thus, the ”understandings” made relevant through these formulations all ’belong’ to the students. Teachers, on the other hand, are charged with the task, not of understanding, as their understanding is implied, but of facilitating students’ learning. It is in relation to this that we find the only use of ”understanding” proper. The noun occurs in a question as to whether students ”got understanding” (Excerpt 5.2) from a task. In the two other examples of teachers’ uses of ”understand” (Excerpt 5.1 and 5.3), the particle ”to” is used with the infinite of the verb to formulate the point of the lab or the assignment. These are ways of talking informed and motivated by the disciplinary and professional concerns of science education; to recall, the teacher of the investigated course formulated the design of the labs as

attempting to “guide students towards a conceptual and qualitative understanding of physics.” As the vocabulary of understanding is part of members’ ways of formulating the point and projected outcome of lab work, it is perhaps not surprising that uses of ”understand” and ”get it” become such prominent resources in the initiation and closing of activities. If “understanding” is configured as the point of lab work, to “not understand” is an accountably serious matter.

4.2 Openings and closings

As has been demonstrated, claims to understand or not understand are recurrently made in and as the *opening* and *closing* of tasks and interactional sequences: the reading of instructions, the performance of tasks and sub-tasks constituting lab assignments, teacher’s explanations, and so on, are regularly initiated and closed by way of formulations that implicate the vocabulary of understanding. ”I don’t understand” or ”we don’t understand,” for instance, are recurrently used as a pre-requests for assistance, often followed by a specification of a problem (Excerpt 1.1-2.3). ”I understand” or ”I get it,” are often used to terminate the explanations of teachers or fellow students (Excerpt 1.1), and ”we get it” are commonly used in moving into the closing of a task (Excerpt 4.1-4.2). When to initiate or close a task or a sequence is negotiable. If posed to a fellow student, ”I don’t get it” can work to resist an imminent closing of a task (Excerpt 1.3) or invite a temporary break in the step-by-step following of a procedure (Excerpt 1.1 and 1.2); instead of moving on with the tasks at hand, ”I don’t get it” proffers an activity of further assistance. Not complying with such an activity is an accountable act, which implicates additional interactional work; for instance, by referring to there being no time left (Excerpt 1.3). It is not only the refusal to give further assistance that is accountable in this sense. Resisting the invitation to a closing made relevant by ”we get it” is similarly dispreferred and projects additional work to account for the delay (Excerpt 4.1-4.2). In sum, ”understand” and ”get it,” along with their negated forms, are

intimately connected to the temporal management of the flow of work in the lab. To understand implies moving on, closing, or terminating, while not understanding implies halting and prolonging activities underway through suggesting the initiation of additional explanations, assistance or complaints.

There is a substantive amount of work on topic initiation, transition, and termination, which has bearings on these issues (e.g., Button, 1987; Button and Casey, 1985; Drew and Holt, 1998; LeBaron and Jones, 2002; Maynard, 1980; Sacks, 1992; Schegloff and Sacks, 1973). Among other things, it has been found that certain types of expressions display distributional patterns in relation to topic transitions. Drew and Holt (1998) show how figurative expressions, such as "had a good innings" or "come to the end of [one's] tether," are recurrently used in the termination of topics. They note how figurative expressions serve as a conclusion and assessment of the reported events and thereby bring the topic to a close. Claims to "understand" in the closing of sequences of talk in the lab have similar characteristics. In the first episode (Excerpt 1.1), talk on mechanics, graphs, and movements—whose purpose is explaining the relevant way of interpreting a graph—is concluded by the recipient of the explanation stating, "yeah okay then I understand." Before this, the recipient has contributed to the unfolding of the explanation through interstitial reformulations, repetitions, and continuers, in effect co-constructing the activity as an instance of explanation and displayed uptake. In that context, the claim to "understand," does not add to the mechanics-related talk, but brings it to a close. While figurative expressions captures the 'gist' of what has been said previously, formulations of understanding can be said to announce the achievement of the projected *outcome* of the activity: "yeah okay *then* I understand."

Ascertaining understanding in the closing of topics shares another interactional property with figurative expressions: "their use as generic assessments detached from

empirical particulars may give them a certain ‘power’ in summarizing and closing topics – e.g., in contrast to the use of repetitions or other forms of assessment, which are more closely tied to prior empirical details.” (p. 504) By being relatively disengaged from the immediately prior turn, the formulation of understanding can refer back to the whole episode. Thus, while reformulations and minimal responses—tied to ”prior empirical detail”—display that the students are following what was just said, the utterance “yeah okay then I understand” closes the topic by formulating the achievement of the instructional sequence. It is not just the students’ receiving instructions but also teachers who use ”understand” to formulate such achievements; for instance, by ending with ”that is very important to understand” (Excerpt 5.3) or ”you should understand as well” (Excerpt 5.1). One can further note how some uses of “not understanding”—especially when connected to extreme case formulations, such as “not understanding *anything*”—are referring to entire tasks, or even a whole day’s work in the lab. Removing themselves from the details of lab work, such formulations commonly end up as initiating talk *about* lab work—sometimes in the form of elaborated complaint sequences—rather than talk in and as the work with a particular task. Still, most of the uses of ”not understand” or ”not getting it” are directed towards the particulars of the situation; for instance, the “I don’t understand,” followed by “how do you see that,” is the initiation of a sequence of explanation of an interpretation of a specific graph (Excerpt 1.1). Nonetheless, the *utterance* ”I don’t understand”, like the ”I understand” used in the termination of explanation, provides very little empirical detail with regards to the assistance called for. Rather, it can be said to frame the ensuing specification, with the bulk of the work conducted through the interaction that follows.

4.3 Task and talk

When discussing the findings of this study in relation to conversation analytic findings on topic initiations, transitions, and closings, it is important to bear in mind that what

teachers and students are doing is not only or primarily conversation, but educational lab work. The initiation and closing of lab assignments can thus not be equated with the transition from one topic to another in, say, a telephone conversation. Informative parallels can here be drawn to Clayman's (1989) analyses of the "interactional achievement of temporal boundary" in activities that, unlike casual talk, are characterized by clear constraints with regards to their duration. Clayman investigates an activity with fixed temporal boundaries—a live TV interview—and describes the ways in which "an essentially spontaneous interactional encounter is routinely made to end at a prespecified time." (p. 660) Rather than being only topic transitions, the shifts in the content of talk is paced by the work of the setting; the production of a well-timed television show.

In the lab, the temporal boundaries of activities are not fixed, but neither are they understandable only on the level of the talk itself. The unfolding of *topics* analyzable in the talk of the setting is subordinate to the unfolding of the *work* of the lab, and the tasks specified in the lab assignments. As uses of "understand" are observed to be boundary markers, the relevant boundaries are boundaries in the practical accomplishment of the work of doing lab assignments, rather than boundaries purely in the talk. The interactional, or rather *praxeological* milieu in which formulations of understanding are occasioned must thus be understood in relation to the specific activities engaged in. For instance, when a group of students in the end of a task ascertains that they now understand, this is done at the precise moment when they have completed the practical steps of the assignment. In fact, it is the completion of the task that makes taking stand with regards to "understanding" relevant—not mainly by virtue of particular features of prior turns, but rather of the fact that a position has been reached in the pre-structured sequence of activities, where moving on to the next task makes students potentially accountable for having "understood" the previous one. Similarly, claims of understanding in the termination of explanations are occasioned by the trouble

being resolved and, most importantly, by the detailed character of what is being explained. Returning yet again to the first episode (Excerpt 1.1), Laura's explanation is not terminated at just any point, but at the precise moment when the verbal walk-through has reached the right end of the graph and the whole graph thereby has been interpreted. Again, staking out a position with regards to "understanding" at this point is made relevant by the structure of the particular graph that is the topic of the talk.

In connection to this, it is also important to note the educational nature of the lab work. Although the students are accountable for doing all the tasks, the aim of the lab is not just the completion of the tasks. Being an educational activity, the lab is designed for students to learn, and in order to do this, they must in some sense 'understand' what they are doing. As both instructors and students make salient in and through their conduct, it is possible to go on with an assignment without really having understood. The distinction is highlighted when the teacher asks if the students got "understanding from it as well?" (Excerpt 5.1) and when he—in suspecting that this understanding is lacking—tells the students that they should "try to understand as well" (Excerpt 5.2). The distinction is also noted by students; for instance, when they at the end of one assignment complain that they "don't understand anything" (Excerpt 4.3) or when the issue of "getting it" is delayed to the next day (Excerpt 1.3). Doing without understanding is sometimes expressed in terms of pointlessness, "we did that and that and that and it's like pointless." With a phrasing taken from Wittgenstein's opening quotation, the investigated lab work seems to provide the possibility of "knowing how to go on" without "understanding anything." Although it is important to note that our analysis of uses of "understand" is a different project from making statements about the analytic notion of understanding, a few remarks in that direction might be in place. The notion of knowing how to go on captures the prospective nature of understanding—of being able to see what next action is called for at a given point in time. In contrast, the complaint formulated by the

students in the example given above refers to an *achieved* sense or relevance of what has been done, and is thus a retrospective, or summative, orientation to the activities engaged in. As discussed elsewhere (e.g., Amerine and Bilmes, 1988; Lindwall and Lymer, 2008), it is a feature of educational practices such as lab work that understanding in a sense is the hoped for *outcome* of activities; therefore, students need to wait "for something later in order to see what was meant before" (Garfinkel, 1967:41). In other words, the lack of grasp of the subject matter being taught is precisely what prevents a student from seeing "the point" of the actions she is nevertheless able to perform. Orienting towards understanding as an outcome of activities is, as noted by Macbeth (this issue), one of the identifying features of educational research, but also, as we have shown in the analysis, of educational practice.

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Figure Captions

Figure 1. To the left, two students are working on an assignment where they have replicated a graph by walking back and forth in front of a motion detector. Both the predefined graph and the graph produced by the students are shown to the left. To an expert, the graph produced by the student might display two problems: first, they stopped when they should have walked backwards with constant velocity; second, they changed direction instead of slowing down when they walked towards the detector.

Figure 2. Three students and a teacher are looking at three graphs that have been produced by a motion detector measuring the movement of a fan-propelled cart. The constant force produced by the fan results in a graph representing constant positive acceleration (bottom), a velocity with a constant rate of change (middle), and a position vs. time graph showing a parabola (top).

Figure 3. To the left, two students interacting with an instructor (center) who is pointing at the graphs on the computer screen. In front of the three participants, there is a track and a cart, which are connected to the probeware interface via a motion and a force detector. To the right, from top to bottom, there is a position vs. force, velocity vs. force graph and an acceleration vs. force graph. According to Newton's second law, there is a relationship between force and acceleration. Here, the bottommost graph displays this relationship as a somewhat straight line.

Figure 4. Two students are working with a simulation called Graphs & Tracks. In this simulation, the general task is to arrange a track and two initial conditions, position and velocity, in a way that makes the motion of a simulated ball correspond to a predefined graph. Here the students are looking at the position vs. time graph, but they

can also choose to display the corresponding velocity vs. time and acceleration vs. time graphs.

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