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Appropriation: The role of progressing and focusing actions

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In a lesson in a challenging 5th grade classroom environment, we observed interactions between a teacher and a student that displayed characteristics of an appropriation process. We analysed the conversations focusing on the teacher's contributions that build on the student's ideas using a framework to identify redirecting, progressing, and focusing actions. A pattern emerged from the analysis: focusing actions dominate initially with a later shift to progressing actions. The implications of this pattern, and also how the teacher introduced the progressing actions, are discussed with regard to the fostering of the student's appropriation process.

Keywords: Appropriation, classroom observation, conversation analysis.

Introduction

The way teachers and students interact with each other in the social context of the mathematics classroom is of central importance to student learning (Franke et al., 2007). In every classroom, no matter how challenging such a demand might be, there needs to be room for students to engage in sense making and productive struggle (Schoenfeld, 2019). Maintaining this room creates a dilemma for the teacher: How to help without “robbing the student of initiative” (Schoenfeld, 2019, p. 367)? Drageset (2014) provides a framework for analysing teacher responses but points out that “in order to understand classroom communication, it is necessary to study both a single [teacher] question...and the larger picture” (p. 288). To this end, this paper studies all the interactions between a 5th grade mathematics teacher (Joe) and one of his students (Mira) during a lesson where they engage in sense making. With the intention of setting the scene, we start by providing a short narration from the beginning of the lesson:

While most students have found their seats, some keep walking around. It is not quiet: Some throw rubbers in the air – there are constant movements of arms and legs. In this tumult, Joe starts the lesson by asking his students to write down different calculations that give 36 as an answer. Then he begins a whole class conversation, trying to tune them in on the connection between multiplication and division. During this 10-minute whole class conversation, Mira leaves her desk five times. One of her many ‘errands’ is changing a bin liner, causing her to leave her desk for three minutes.

Despite this start, the lesson ended with Mira presenting a detailed solution to a fairly complicated division on the blackboard. By viewing Joe and Mira's interactions through the lens of Drageset (2014), we search to understand a teacher's role in how a student can *appropriate mathematics*.

Theoretical framework

When studying how a student appropriates aspects of division and its close connection to multiplication, we draw on the work of Moschkovich (2004). As most research on different forms of appropriation, Moschkovich (2004) takes the work of both Newman et al. (1989), Rogoff (1990) and Radford (2001) as her point of departure, and uses it as a foundation when elaborating on the notion

of appropriation. Appropriation is a central Neo-Vygotskian concept that has been used to describe how learning in students is mediated by interaction with others and how students learn through the teaching and guidance of a teacher (Newman et al., 1989). It involves joint productive activity, a shared focus of attention, and shared meaning (Rogoff, 1990). Additionally, Newman et al. (1989) focused on the situation of an expert helping a novice, where the expert provided alternative interpretations of the novice's actions. Grounded in these rudimentary insights, Moschkovich (2004) set forward two aspects of appropriation: what the learners appropriate, and how learners actively transform what they appropriate (pp. 49–50). This involves “taking what someone else produces during joint activity for one's own use in subsequent productive activity while using new meanings for words, new perspective, and new goals and action” (Moschkovich, 2004, p. 51).

By drawing particularly on Newman et al. (1989) who used appropriation to describe in detail how interaction with an adult can affect cognitive change in children, we focus on the teacher's role in an appropriation process where both aspects set forward by Moschkovich (2004) are under investigation. That is, we seek to see the teacher's role in what Mira appropriates, and in how she actively transforms what she appropriates. Drageset (2014) reminds us that “an appropriation process often includes actions that in isolation can be labelled as funnelling, teacher-dominated communication, or IRE [where the teacher does the main work], but as part of the appropriation process these actions might be both beneficial and necessary” (p. 288). While acknowledging the many possible theoretical lenses that can shed light on classroom communication (such as wait time (Ingram & Elliott, 2016); funnelling (Wood, 1998); and revoicing (O'Connor & Michaels, 1993)), we turn to Drageset (2014) who states that, in so doing, there is a need to consider both single questions and the larger picture, such as an appropriation process. In this quest, it is necessary to take utterances, dialogue and sequences of dialogues into consideration.

Viewing a dialogue as a joint construction “made possible by the reciprocally and mutually coordinated actions and interactions by different actors” (Linell, 1998, p. 86), Drageset (2014) focuses on the value that is hidden in the details in teachers' comments and questions. He proposes a framework consisting of 13 categories of teacher comments that are grouped into redirecting, progressing, and focusing actions (the detailed categories are given in Table 1 below). These categories summarise how communication can contribute to students progressing towards a conclusion, “or to redirect the students into alternative approaches focusing on the mathematical content” (Drageset, 2014, p. 281).

Drageset (2014) proposes several ways of using his framework, one of which is to study how combinations of his categories occur and if there are patterns that can have “explanatory power beyond the study of single comments, for example by studying how a teacher uses different actions or categories as part of an appropriation process when the students have to learn something new” (p. 303). Solomon et al. (2021) used Drageset's framework to analyse an appropriation processes in the case of whole class discussions and found that, in addition to focusing actions, “the teacher is forced to intervene with a series of ... progressing actions in order to progress the lesson” (p. 186), and “although teachers keep the intellectual authority in such actions, their strong focus on the students as originators of the appropriated contributions appears to provide the means by which they ...leave

students with the responsibility of solving the problem” (p. 187). This paper builds on Solomon et al.’s (2021) approach, but in the case of a one-to-one interaction.

Table 1: Redirecting, progressing, and focusing actions (Drageset, 2014)

<p>1. Redirecting actions</p> <ul style="list-style-type: none"> a Put aside b Advising a new strategy c Correcting questions 	<p>2. Progressing Actions</p> <ul style="list-style-type: none"> a Demonstration b Simplification c Closed progress details d Open progress initiatives 	<p>3. Focusing actions</p> <ul style="list-style-type: none"> a Requests for student input <ul style="list-style-type: none"> i Enlighten details ii Justification iii Apply to similar problems iv Request assessment from other students <ul style="list-style-type: none"> b Pointing out <ul style="list-style-type: none"> i Recap ii Notice
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As both researchers and teacher educators, we are drawn to the transformation of Mira’s practice during this lesson and wonder what it was about her interactions with Joe that fostered Mira’s process in this case. Hence, we use Drageset’s (2014) framework to analyse the nature of different sequences of conversations. Assuming that there is an appropriation process that has happened, we ask the following research question:

How do redirecting, progressing, and focusing actions facilitate the appropriation process in a one-to-one interaction between a teacher and a student?

Methodology

As part of a larger research project on inclusive mathematics teaching in Norway, a series of observations of 5th grade mathematics classes (ages 10–11) in an inner-city school were conducted. There were three parallel classes of between 23 and 27 students. The school had a diverse student population with many students who had Norwegian as a second language. The classrooms were organized with rows of paired desks, facilitating students working in pairs with their assigned learning partners. All classes were video recorded using a fixed camera at the back of the classroom. A wireless microphone recorded the teacher’s voice and voices of nearby students.

The video allowed us to identify a possible appropriation process in the interactions between Joe and Mira, and additionally the way in which Joe acts in the classroom. These interactions appeared to change over the course of the lesson, and Mira seemed to be gradually more engaged in the mathematics. We chose therefore to analyse the dialogue in the interactions to see what they revealed about the teacher’s role in the emerging mathematical processes. This was performed in a three-step process. We first transcribed all of their conversation in the original language (Norwegian) and watched the video paying careful attention to their movements and interactions. Then, we coded the transcriptions using the 13 categories from Drageset (2014) framework, which we operationalised in close connection with the understanding put forward by Drageset (2014) (see Table 1). Each of the authors coded the transcripts, the codes were discussed until agreement was reached, and associated discussions were noted as these gave us a deeper understanding of the material. The dialogues were

translated to plausible English, making sure that the intended meaning was kept. We used the transcription conventions given in Table 2 to indicate the rhythm and intonation of the original. Finally, we conducted a holistic reading of the data in order to capture their changing actions and the development of the conversations and interactions.

In presenting our analysis, we have referred to the numbering of the categories given in Table 1. The three dialogues between Mira and the teacher appear in the analysis in chronological order.

Table 2: Summary of transcription conventions adapted from Jefferson (2004)

(1)	Numbers in brackets represent elapsed time measured in seconds
(.)	Brief pause of less than a second
=	No pause.
↑word	Noticeable rise in pitch
[word]	Overlapping talk.
wo:rd	Colons indicate a stretched sound
((description))	Indicates the transcriber's description

Findings

We continue Joe and Mira's story where we left off in the introduction. At the end of the initial whole class conversation, the students were assigned a new task – to discuss in pairs the connection between multiplication and division. Joe went straight to Mira's pair:

- Joe: How are timesing and dividing related? ((Interruption from another student. Joe turns back to Mira)) [How]
- Mira: [Times]ing and dividing (.) Timesing and dividing are just about the same, it's just that when you times, then you sort of add (.) but instead of adding (.) you are to (9)
- Joe: What do you think? ((addressed to Mira's learning partner who looks down and then up again but does not speak)) (19) If you look at these ((points at the blackboard)) calculations, how do you think they connect?=It says 36 divided by 9 (.) is 4, (.) because 4 times 9 (.) equals 36.
- Mira: It is because it's backwards=
- Joe: =Yes, it's backwards. (.) Is it possible that it's the opposite, is that another way to look at it?=
Mira: =Yes (.)
Joe: So the opposite of timesing is dividing and the other way around? (1) So can we use (.) ((looks at the blackboard)) timesing to (.) calculate dividing ↑perhaps?
Mira: ↑↑Maybe= ((sounds satisfied, not doubtful))
Joe: =↑Maybe? (.) If you know that 4 times 9 is 36, (.) can you turn it around? (.) Then 36 (.) ((He looks at the blackboard, and then back at Mira)) divided by 9 must be 4?
Mira: Yes ((she sounds very satisfied and nods eagerly))
Joe: ↑Yes. (.) If you know how to times, then you actually know how to divide, maybe?
hm: Good ((Joe leaves))

When Joe is asking for input from Mira we identify his actions as enlighten details (3.a.i) or justification (3.a.ii), while Joe makes details explicit to Mira with recap (3.b.i) and notice (3.b.ii) actions. A possible interpretation of Joe's two turns where he introduces the term "opposite" is as a progressing action either in category (2c) or (2d). Drageset (2014) describes these progressing actions as a way of "moving the process forward" (p. 294) either with closed or open questions. We argue

that the purpose is rather that of highlighting and clarifying the connection so that it may be used later. Indeed, Drageset (2014) expands on to the description of the category *notice* (3.b.ii) by adding that “[t]he teacher often slightly changes the statement or adds new information to make the point clearer... to support the students by pointing out... important aspects to notice which they should understand or use in the future” (p. 297).

Two minutes after Joe left Mira a new whole class discussion took place. During this discussion Joe asked if Mira could repeat what she said during their conversation:

Mira: 36 divided by 9 is 4. So if you do it (.) backwards, first you take 4 divided by (.) 4 times 9 is 36, so, it is just the opposite!

We note that Mira has adopted Joe’s academic language using the word “opposite”. Joe highlights this to the whole class by writing “The opposite of multiplication is division” on the blackboard at the end of the discussion. Then a new task was given: 264 divided by 4.

After four minutes working on the task, Mira left her chair and interrupted Joe (who was speaking with other students) asking “Does 200 divided by 4 equal 50?” He confirmed and continued his ongoing conversation. Mira listened for a while before she started doing dance moves. A few seconds later, Joe followed Mira back to her desk, where she immediately started to explain her thinking:

Mira: 100 divided by 2 is 50=

Joe: =Yes=

Mira: =100 divided by 4 is 25=no 100 divided by 4 is not 25, is it? (1)

Joe: Yes, (.) because 25 times 4 is 100.=

Mira: =And then, 200 divided by 2 is 100 and then I thought, then it has to be like, since 100 divided by 4 is 25, 25 plus 25 is 50. So if 200 divided by 4 (.) then 200 divided by 4 needs to be 50.

Joe: =Mm. I agree. And then we have spent 200, and we are left with 64. (.) Ok. Then we know that they all get 50 each (.) and we are left with 64. ((Interruption from one student and then another. Joe encourages them and says he is coming.)) Yes, and next it is 64 divided by 4. (1) Can we make this number any easier?

Mira: Yes, maybe ((Mira sounds positive. Joe leaves to get students back in place.))

During this dialogue, Joe begins with a notice action (3.b.ii) and then makes an open progress initiative (2.d): “Can we make this number any easier?”

Mira worked for a couple of minutes before she started wandering around looking thoughtful counting on her fingers. Suddenly, she jumped, turned around, and ran to Joe while shouting “Joe, I have the answer!”. She continued to shout it six times, and “104. 104. It is 104”. He took her back to her desk:

Mira: Because I divided it by 2, and it is 36= ((referring to her calculation $64 : 2 = 32$))

Joe: =Yes

Mira: And, (.) it is sixty (.) 64=And six (.) 50, 50 pl[us 64]

Joe: [but, look,] you took 62 divided by 2 is 32, and then half of that is?

Mira: Half of tha[t]

Joe: [Then] 64 divided by 4 must be half of this one? ((points at something in Mira’s notebook, presumably 32))

Mira: Yes [Don’t look]

Joe: [What is half] of 32? (.) That was very smart. ((Presumably $64 : 2 = 32$ in Mira’s notebook.)) (.) What is half of 32? (1) What is half of 30?

Mira: Half of 30 is 15.

Joe: Then half of 32 needs to be one more. (.)

Mira: 16

Joe: Yes (.) So (.) So then 64 divided by 4 is 16.
 Mira: Is it $50 + 16$? ((Mira sounds unconvinced, but another student grabs Joe's attention and he leaves to help them.))

Both Mira and Joe mis-spoke in this conversation. Mira said 36 when she meant 32 and Joe said 62 when he meant 64. It is noteworthy that this did not affect the meaning and we will discuss this later.

It seems that Mira had incorrectly calculated $50 + 64 = 104$ as the solution when she invited Joe to her desk (see also the right hand column in Mira's notebook in Figure 1). Hence Joe made a redirecting action which could be interpreted as a correcting question (1.a). However, this turn also has elements of a notice action (3.b.ii), "you took [64] divided by 2 is 32", and a progressing action, "half of that is?" Even though this progressing action is a closed question it could be interpreted as an open progress initiative (2.d). Drageset (2014) points out that "comments in this category...are also aimed at moving the process forward, but without pointing out the direction" (p.294) and, by asking "half of that is", Joe was following up a strategy determined by Mira, not Joe. In any case, and crucially, Joe's response allows Mira to retain at least part of the intellectual responsibility. Joe continues by pointing out both orally and physically, and repeating the question "What is half of 32?" After a short pause, Joe makes a simplification action (2.b) by splitting 32 into $30 + 2$ and taking Mira through step by step.

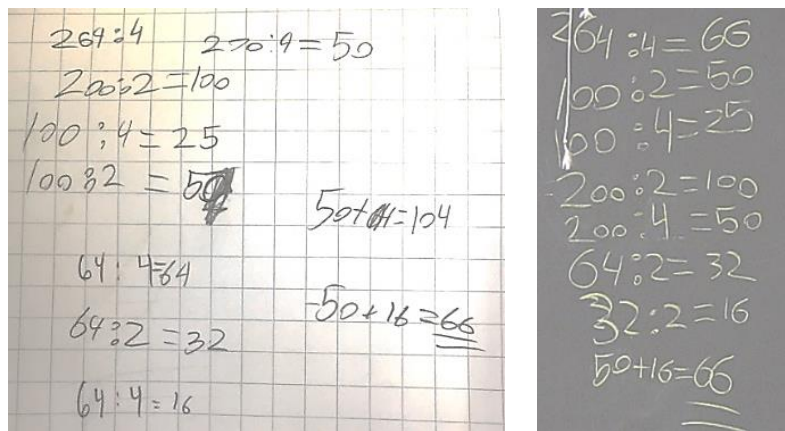


Figure 1: Mira's notebook (left) and her presentation on the blackboard (right)

Less than one minute after Joe had left her desk, Mira ran to find him again, repeating "Joe, I have the answer!" She was very eager, shaking her book, jumping, saying, "66, can I show my answer on the blackboard?" Joe agreed. She climbed on a shelf placed under the blackboard and began to write. While she wrote nothing was commented upon by her or Joe (see Figure 1 for her presented solution).

We note that Mira's presentation on the blackboard diverged from her notebook. In particular, she had reorganised the calculations so that they follow a logical progression. Crucially, Mira's presentation of 64 divided by 4 used her strategy of repeated halving, and she did not split 32 into $30+2$. This was now her solution.

Discussion and concluding remarks

Appropriation involves joint productive activity, a shared focus of attention, and shared meanings (Rogoff, 1990). As noted earlier, both Joe and Mira misspoke in the last conversation without it affecting the communication or the dialogical flow. We take this as a sign that they are locked-in to

the mathematical process as a shared focus of attention. In addition, appropriation involves taking what someone else produces during joint activity for one's own in subsequent productive activity (Moschkovich, 2004). After the first conversation, Mira adopts Joe's alternative interpretation (Newman, 1989) by using the word "opposite" in her whole class discussion contribution, and, in the end of the previous section, we saw that Mira had made the solution her own when she presented it at the blackboard. We thus argue that the interactions between Joe and Mira displayed characteristics of an appropriation process where the student is working with mathematical practices. But, what has the analysis uncovered?

An overarching view of the analysis with respect to Drageset's framework (2014) reveals a shift in Joe's responses during the lesson. In the first conversation, Joe used focusing actions exclusively, and these were also present in the other conversations. In the second conversation, there was an open progress initiative. Progressing actions were also present in the third conversation in addition to simplification and a correcting question. This pattern may play a part in the appropriation process. The initial focusing actions may have indicated to Mira that her thinking was valued. Once this was established, progress was encouraged with actions that allow the student to retain intellectual authority (Drageset, 2014), wholly or partially. Finally, there was a simplification sequence. This final sequence taken out of the context of the lesson could be interpreted as a case of funnelling (Wood, 1998). However, Joe's previous careful handling of Mira's intellectual offerings allowed for a shared focus to be retained and a shared meaning to be developed (Rogoff, 1990) as evidenced in Mira's presentation to the class. The pattern is similar to the strategies employed by the teachers in Solomon et al.'s (2021) study of whole class discussions. In the whole class setting, the teachers explicitly emphasised student authorship (Solomon et al., 2021). Joe makes one such move ("that was very smart") in the conversations analysed above, but as we have argued, his choice of actions emphasises student authorship and "help maintain the shift of authority away from the teacher towards at least shared responsibility" (Solomon et al., 2021, p. 187).

Our analysis highlights what we believe to be an important feature of this interaction: The way in which Joe starts with focusing actions, and later introduces progressing actions sparingly. However, it is clear that this is not the whole story. Depending on what we focus on, there will always be nuances that come to the fore and we see potential for fruitful further research. For instance, the wait of nine seconds and then 19 seconds after Mira's first turn is unusually long (Ingram & Elliott, 2016) and especially so in this busy classroom environment. It is possible that these indicate to Mira that her thinking is valued. Similarly, we saw several instances where vocal intonations featured. In the first conversation when the idea of "opposite" is introduced, it is accompanied by a high pitched "maybe" that is then repeated by both parties in the following turns. This may function as a way of softening Joe's imposition of intellectual authority on the conversation. These diverse features have a commonality that is also revealed in the analysis: Through the interactions Joe and Mira co-produce a way of thinking that Mira can eventually inherit.

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