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# Diverse epistemic participation profiles in socially established explaining practices

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*Same classroom, same learning opportunity? Although learning to explain takes place while participating in the classroom microculture's practices of explaining, this interactionist conceptualization must be widened in order to account for students' diversity. For analysing not only quantitative, but also qualitative differences between students' participation in explaining practices, we present the construct 'epistemic participation profile' and illustrate how it allows to account for the diversity within a classroom.*

**Keywords:** Explaining practices, interaction, epistemic participation profiles.

## DIVERSITY IN PARTICIPATION IN CLASSROOM PRACTICES

Many researchers with social, socio-cultural or socio-constructivist perspectives describe mathematics learning as an increasing participation in interactively constituted classroom practices. We join this view by adopting an interactionist perspective and account for students' learning processes in explaining practices of classroom microcultures (Prediger & Erath, 2014). These practices are regulated by shared sociomathematical and social norms (Cobb, Stephan, McClain, & Gravemeijer, 2001). Whereas early interactionist approaches assumed the class to be a coherent body in which the mentioned aspects can be "taken-as-shared" by all members (cf. critique in Cobb et al., 2001), later approaches acknowledged diversity among students: students usually participate in diverse ways, and the individual participation shapes the individual learning opportunities which are preconditions for learning achievement (Greeno & Gresalfi, 2008). Learning was then described as increasing from the "legitimate peripheral participation" (Lave & Wenger, 1991) to more acknowledged central participation, hence lim-

ited participation was seen as an intermediate state. However, many (especially underprivileged) students seem to stay in a peripheral position (DIME, 2007). In order to deepen this idea of *diverse individual learning opportunities depending on students' ways of participation*, these ways must be described *quantitatively*, but also with respect to their *quality*. Greeno and Gresalfi (2008) give hints for this qualification by describing conceptual practices as crucial for mathematics learning in contrast to purely procedural ones. We present a framework for qualifying students' diverse profiles of participation as one key to understand the reproduction of inequality in classroom interaction where all students have the same formal and curricular learning opportunities (DIME, 2007). This paper deals with *three research questions* from which the first one had to be solved by developing an analysing tool: (Q1) How can we distinguish between students' diverse ways of participating in classroom explaining practices with respect to the epistemic processes of knowledge construction? (Q2) Are there patterns of ways of participating which allow speaking about a consistent participation profile? (Q3) How does students' participation develop over half a year?

We address two points relevant to the TWG as raised by Morgan (2013): First, bilingual learners in mathematics and second, the question what linguistic competences and knowledge are required for participation in mathematical practices.

## EXPLAINING PRACTICES IN MATHEMATICS CLASSROOMS

Our case study is embedded in our large research project INTERPASS in which we investigate whole class interactions with joint explaining activities and different research questions. For investigating the mathematical core of explanations and their func-

tions in the process of knowledge constitution, we combine the interactionist perspective on explaining with an epistemic perspective. In the *epistemic perspective*, explaining is defined as aiming at building and connecting knowledge in a systematic, structured way by linking an *explanandum* (the issue that needs to be explained) to an *explanans* (by which the issue is explained). This distinction structured the tool developed for analysing contributions with respect to their epistemic character, the so-called epistemic matrix (Prediger & Erath, 2014), which led to observe the phenomenon presented below.

In the rows of the epistemic matrix (in Figure 1), contributions to a joint explaining activity are distinguished with respect to the *explanandum*. For this, we refine the conceptual/procedural distinction (raised as relevant for participation profiles by Greeno & Gresalfi, 2008) into *seven logical levels*: The four conceptual levels comprise concepts (categories such as maximum), semiotic representations (e.g., a diagram itself), mathematical models (addressing relations between reality and mathematical objects/statements), and propositions (mathematical patterns, statements, or theorems); the three procedural levels comprise procedures (e.g. a general way of drawing a diagram), conventional rules (e.g., “frequencies always on vertical axis”), and concrete solutions (e.g., individual solutions of a mathematical task). In the columns of the epistemic matrix, the *explanans* is distinguished in *six epistemic modes*: ||labelling & naming|| is the only mode that can be addressed by a single word (e.g., “maximum”). The mode ||explicit formulation|| includes definitions and theorems and is a linguistically elaborate way to treat an *explanandum*, it is usually also epistemically more elaborate than the mode ||exemplification|| which addresses examples and counterexamples. The mode ||mean-

ing & connection|| comprises all semantic aspects of an explanandum and those that bridge to another level or mode, for example pre-existing knowledge (e.g., meanings, arguments, reasons), it can have different epistemic degrees of elaboration. The mode ||purpose|| belongs to a pragmatic approach (e.g., “in diagrams, we see pattern more clearly”). The mode ||evaluation|| often appears in context of evaluating solutions.

In our empirical approach, each (complete or partial) explanation that is demanded and given in a classroom interaction is characterized by the navigation through the addressed *epistemic fields* (=the combination of addressed logical level and epistemic mode). Figure 1 contains an exemplary *navigation pathway* of Episode 1 (signs as ‘#17’ refer to the lines in the transcript, circles stand for the teacher, rectangles for the students). In this navigation pathway, the teacher addresses the fields –concrete solutions / models– ||meaning & connection|| by asking if anybody has a cat at home and knows its weight. Afterwards, he navigates to –models– ||explicit formulation|| by asking for a complete modelling, thus he navigates from children’s concrete experiences to explicit formulations and hence, to consolidated mathematical knowledge.

Whereas two preceding papers investigated by the epistemic matrix the epistemic core of common interactive practices (Prediger & Erath, 2014) and a teachers’ profiles setting different implemented curricula (Erath & Prediger, 2014), this paper applies the analysing tool to specifying diverse students’ epistemic participation profiles. By focusing on the students, we investigate how different individual students contribute on their own ways within an interactively established social practice.

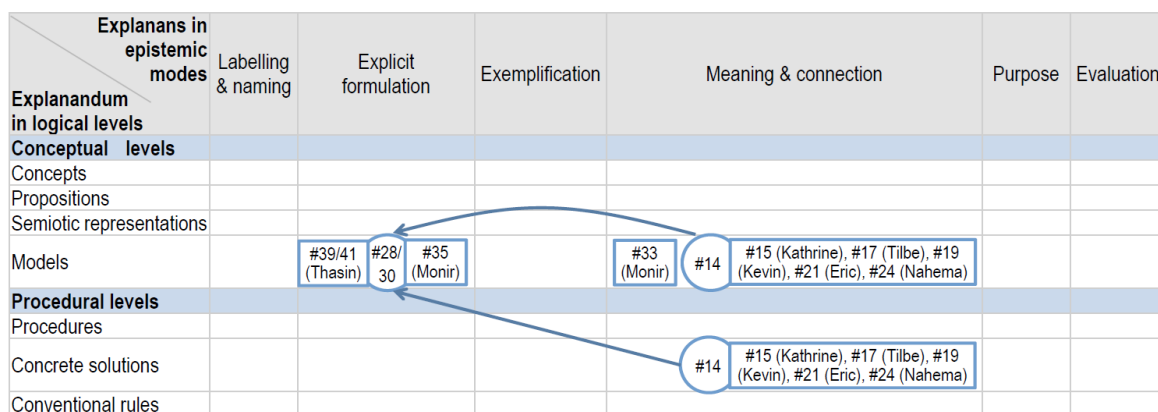


Figure 1: Epistemic matrix for distinguishing explanans and explanandum

We construct a *student's epistemic participation profile* by analysing all her/his contributions in oral classroom explaining practices. The epistemic participation profile is characterized by taking into account (1) the *quantity* of the student's contributions, (2) their *epistemic character*, and (3) their *epistemic potential* for consolidating mathematical knowledge which is determined (3a) by the required level of the epistemic field demanded by the teacher and (3b) by the level of compliance by the individual students. This definition builds upon two assumptions: the epistemic fields play different roles in the collective and individual process of knowledge construction (Vollrath, 2001, pp. 52f), and the individual opportunities to learn also depend on the individual's compliance for contributing to consolidating the knowledge (Greeno & Gresalfi, 2008).

## METHODOLOGY OF THE STUDY

*Larger data corpus.* In the larger project InterPass video data was gathered in 10 times 12 math and language lessons (each 45–60 min.) in five different grade 5 classes (age 10–11 years). The data corpus also comprises all class materials and written products.

*Sampling for the case study* of this paper. The small comparative case study focuses on 12 math lessons in one higher tracked class (German “Gymnasium”, German as language of instruction) in which we compare three students' participation profiles. The students Nahema, Monir, and Thasin were selected due to their similar social and language background (all boys of 10–11 years, second language German learners, living in an underprivileged urban quarter), but contrasting participation profiles. The video corpus for this case study is formed by all episodes of whole class interactions in which one of the three boys was involved in joint explaining activities.

*Data analysis.* First, the selected video data were transcribed and analysed by means of the epistemic matrix. Second, in order to reconstruct the boys' epistemic participation profiles over time, (1) all contributions above the sentence level of the three boys during classroom interactions of joint explaining were collected, and the *quantity* was determined by counting, (2) their *epistemic character* was operationalized by locating them in the epistemic matrix, and (3) the *epistemic potential* of the contributions (consisting of the required level and the level of students' complying)

was identified by an analysis of teachers' navigation pathway and the criterion how the utterance contributed to consolidating mathematical knowledge in the classroom interaction. (For example, explaining algorithms and describing mathematical ways of acting or connecting procedures and concepts demands a high required linguistic and epistemic level of consolidation, whereas naming result or stating everyday experience without connecting it to mathematics is of lower difficulty.) And third, considering the course of the participation during the 12 lessons allowed analysing their stability. The fact that we conceptualize “participation profile” not as dynamic is justified by the empirical outcome that each of the three students' individual way of participation is quite stable over time.

## THREE STUDENTS' EPISTEMIC PARTICIPATION PROFILES

The participation of the three boys differs in quantity: Monir and Nahema have 8 and 7 contributions above sentence level (i.e. longer than one sentence) to joint explaining activities in whole class interaction within the 12 lessons (and of course many shorter contributions of one to three words not considered here). Thasin shows a more active participation with 12 contributions above sentence level. The relations are similar for the cases in which the boys raise their hand but are not selected to contribute (Monir 15, Nahema 13, Thasin 32). However, this quantitative information cannot account for unequal learning opportunities in active participation. Only the qualitative analysis of transcripts allows to categorize the differences in the epistemic character and to reconstruct their epistemic potential. We illustrate our analysis procedure by two episodes before describing the results of all analysed episodes.

### Episode 1: The meaning of rounded zero in the dot plot

Episode 1 is extracted from a discussion in the class about interpretations for the dot plot in Figure 2, after two students have given opposed interpretations for the 0 kg for cats in Figure 2 (‘nothing written’ versus ‘under ten kilogram, maybe one and a half or two’). The transcript starts when the teacher collects several weights of cats in #14 in order to evaluate the solutions (the translated transcripts use [...] for missing parts, (.) for breaks of increasing length, CAPITALS for emphasized words):



- 14 Teacher [...] Does anybody have a cat at HOME, [...] Can you tell how much it WEIGHS, [...]
- 15 Kathrine um (.) I have now um (.) a little KITTEN at home, well it's weighing (.) nearly two KILO;
- 16 Teacher HM\_hm, um (-) TILBE;
- ...
- 21 Eric I have a (.) at my grandma's I have a CAT, I once weighed it, (.) it was very THIN, it think its weight was (-) two KILO, and a (.) bigger tomcat I think even SIX kilo;
- 22 Elif WOW;
- 23 Teacher HM\_hm; NAHEMA;
- 24 Nahema from my friend who is called KEVIN, (.) the ca (.) um the the cat is like THIS, ((shows the size with his hands)) this weighs NINE kilo;
- 25 Elif NINE; ((many students expressing scepticism about cats of nine kilo))
- 32 Teacher MONIR, (.) THASIN, (.) what do YOU think;
- 33 Monir well um (-) the um (.) these (.) SCALES of um how much they weigh, is always only (.) after the TENS (.) so (.) always 10, 10 20 30 40;
- ...
- 35 Monir but the cat weighs UNDER ten; so (-) um (-) the (.) it does not weigh like (-) um; (-) well it has (-) it has no um (-) it two-digit- ((indicates digits in the air with his fingers))
- 36 Teacher HM\_hm; a two-digit NUMBER; or no two-digit WEIGHT;
- 37 Monir YES;
- 38 Teacher HM\_hm, (.) THASIN;
- 39 Thasin If a cat would weigh nine KILO on average, one would round it up on TEN;
- ...
- 42 Teacher BOTH can be correct by the way; (.) THASIN Monir; [...]

Kathrine (#15), Tilbe and Kevin (in unprinted #17 and #19), Eric (#21) and Nahema (#24) are stating their experiences with the weight of cats, hence they are staying in the epistemic fields for which the teacher asked (#14): the epistemic mode ||meaning & connection|| on the logical levels --concrete solution- and --models-. After Eric's six kilos were already commented by 'WOW' (#22), Nahema's suggestion of nine kilo (#24) is rejected by other students Nahema's contribution is linguistically correct, but not concise due to superfluous information.

Having collected these concrete values for cats' weights, the teacher moves back to the mathematical core with the next question (#28/30). As the navigation pathway in Figure 1 shows, he navigates into the epistemic field --models- ||explicit formulation||. He takes on the weight stated by Nahema and calls on Monir and Thasin for giving their suggestions how to model the situation:

- 30 Teacher one WEIGHT symbolizes about ten ki (.) well symbolizes ten kilo; Now, if a cat REGULARLY, right, (.) well if cats would weigh regularly around nine kilo; would one DRAW a weight symbol there, (.) or rather NOT; [...]
- 31 class ((murmuring))

Monir (#33) first refers to the meaning of the weight symbols in the dot plot and hence addresses the epistemic field --models- ||meaning & connection||. Then he shifts the mode to ||explicit formulation|| in #35 by stating that since the weight of a cat has not two digits one would not print a weight symbol (see navigation pathway in Figure 1). Monir is struggling linguistically; the multiple breaks indicate how he is searching for suitable words. In #36, the teacher supports him in closing his utterance by translating Monir's gestures into words. Thasin directly addresses the epistemic field to which the teacher referred in his initiating question and models by using the concept of rounding on tens (#39/41). He uses an if-then-clause which is not trivial for second language learners of this age. The teacher evaluates both utterances (#42) by reformulating them and stating that both ways are plausible and not decidable from the dot plot alone.

All three focus boys, Nahema, Monir and Thasin, participate in the whole class explaining activity for the dot plot with a similar length of utterances (Nahema's being slightly shorter). All three contributions are valued in the interaction since the teacher (who is concerned of including everybody) builds upon them in the further interaction. However, we identify a typical difference between Nahema on the one hand and Monir and Thasin on the other hand: Nahema (as all five students in the beginning) only contributes some

facts from his everyday knowledge. Although the compliance level is very good, the required epistemic mode of ||meaning & connection|| in this case had only a minor epistemic potential, here reduced to being sensitized for plausible weights. The epistemically deeper work on consolidating students' more general mathematical knowledge comes later in the navigation pathway. In this step, Thasin and Monir are involved (by explicitly formulating how to translate the real life situation of 9 kilo into a diagram). This later step in the pathway has a higher required epistemic level. As Monir's compliance level is not ideal in the beginning, he gets a scaffold with more opportunities to develop his thoughts than Nahema. We will show that the distribution of students on different steps of the navigation pathway has persistent pattern, e.g. the epistemic mode of ||explicit formulation|| seems to be addressed only by some of the (non-focus) students whereas others consistently take more peripheral roles. The epistemic matrix allows describing the peripheral parts of a whole class explaining activity with respect to the epistemic potential for knowledge construction and consolidation.

### Episode 2: Multiplication of decimal numbers

Episode 2 took place half a year later in the same class. At the beginning of a lesson, the teacher initiates a recapitulation of the last lesson one week ago. After the girl Tasnim (#10) does not succeed in reporting properly, she calls on Monir to support her.

- 1 Teacher [...] I would like to know from you, [...] WHAT did we do an eternity ago,
- ...
- 10 Tasnim well (.) well three KIDS (.) I believe, were, have (-) on the blackboard (-) well have calculated TASKS? [...] Oh, I can't EXPLAIN it [...]
- ...
- 20 Monir [...] so (.) we calculated with (.) DECIMAL numbers, (.) calculated DIVIDING, (.) so um we have (.) at the moment (.) the TOPIC so to speak; (-) um DIVISION and multiplication, (-) with DECIMAL numbers, (-) and we did um (-) um CALCULATIONS, um when to INSERT um the (.) point when dividing (.) um at the result; for EXAMPLE- (.) if you (.) HAVE a number with point, like (-) um ((2.5 sec break)) twelve (-) po- um (.) twelve point ((1.5 sec break)) seventy-EIGHT, (.) then um you mus- (.) and you have to divide it by

(-) um FOUR, (-) um (.) then (.) um (.) it is that are THREE; ((1.9 sec break)) um three times four equals TWELVE, (.) then you are calculating twelve MINUS twelve; that equals ZERO; (.) and then you are immediately with the POINT, (-) and um (-) you have this three (-) written DOWN at the result, (-) then you must insert the POINT immediately next to it; because you are (.) NEXT to, (.) um well because you are UNDER the point; with the NUMBER;

- 21 Teacher HM hm;
- 22 Monir you immediately have to put a POINT into (.) the result;
- ...
- 25 Teacher THAT was already a bit more DETAILED; right, [...]

After some stumbling, Monir (#20) names the mathematical topic 'division and multiplication of decimal numbers' (i.e. complies the demanded field of -procedures- ||labelling & naming||), a task of low required level. He immediately continues with a shift to the epistemic mode ||exemplification|| with a potential for later ||explicit formulation|| and explains by an example how the division algorithm works (even though some facts are missing, the idea becomes clear). The teacher evaluates this extensive contribution positively.

Later in the same lesson, after working on tasks in individual seatwork, the second part of Episode 2 starts after discussing the calculation of  $19.8 \cdot 0.708 = 14.0184$ . Thasin mentions his confusion because his rough estimation  $19 \cdot 0 = 0$  does not fit to the result. The class helps him by offering the handier estimation  $20 \cdot 1 = 20$ . Afterwards the teacher shortly repeats how to put the decimal point at the right place in the result. But Thasin is still troubled and after a classmate points the teacher's attention to Thasin's confusion the conversation starts with him stating what seems strange to him:

- 2 Thasin um (.) because (.) now if you (.) um (.) MULTIPLY a number, apart from ZERO, (-) the number gets BIGGER (-) ((silently)) actually; fourteen is SMALLER than the nineteen;
- 3 Sina oh yes;

- 4 Teacher yes (.) to REVEAL that once more; (-) THASIN says; MAN, usually, multiplication means I make something BIGGER [...] EXCELLENTLY seen Thasin; (--) take on (-) one two people who should search an EXPLANATION for that;

Thasin (#2) states his problem by connecting the result of the task to his conceptual understanding of multiplication as an operation that always increases the original numbers. He connects several logical levels in the epistemic mode ||meaning & connection||, namely --concrete solutions / procedures / concepts-. The teacher marks this observation as important by reformulating and positively evaluating it. Several students are asked for an explanation in order to help.

- 6 Tilbe so (.) um (.) I GUESS so; (-) because it is zero point seven (.) HUNDRED; and if you (.) MULTIPLY the seven hundred times nineteen - so approximately MULTIPLY times twenty, then (.) it becomes FOURTEEN;

...

- 15 Larissa ((walks to the blackboard)) so HERE there are; (-) here there are only three NUMBERS; ((points to 0.708)) and here suddenly FOUR ((points to 14.0184))
- 16 Teacher (--) this makes the NUMBER; (-) thereby thus AFTER the point (.) after the point bigger, (.) and in FRONT of smaller; right, (-) does anybody have ANOTHER explanation [...] (--) Thasin, you yourSELF

Tilbe (#6) addresses the epistemic field --concrete solutions- ||meaning & connection||, here by estimated calculation. Larissa (#15) describes an observation without offering an explanation. The teacher (#16) asks for further different explanations which can be interpreted as implicit mismatch for both. Thasin wants to explain himself:

- 19 Thasin (-) so- ((2.6 sec break, walks to blackboard)) ZERO times nineteen equals zero; (-) but we do have a POINT here, (-) and that makes the zero BIGGER; (.) and AFTER it there is also something written; ((2.0 sec break)) and (-) ZERO is always that it gets smaller, (-) and because it's not times ONE, (.) but LESS; ((1.3 sec break)) it is SMALLER than nineteen; (-)
- 20 Tom I didn't understand anything;

- 21 Teacher try it AGAIN; (-) but one MOMENT; (.) before Thasin (.) starts the EXPLANATION again, (-) I'm putting THIS here; ((changes  $20 \cdot 1 = 20$  to  $19 \cdot 1 = 19$  at the blackboard)) maybe you can use THIS Thasin;
- 22 Thasin Okay; (-) NINETEEN times zero (-) equals zero; (-) and NINETEEN, (.) nineteen times ONE equals nineteen; ((1.2 sec break)) and here we got (.) zero point seven hundred and eight ; (-) this is LOCATED (.) um- (-) it's not times ONE, but also not times ZERO; (.) that's why it must be located between the NINETEEN and the zero; (-) it's SMALLER than nineteen, but bigger than ZERO; (.) that's kind of ABOUT,
- 23 Tom I UNDERSTAND;
- 24 Teacher YES;

Thasin (#19 and #22) needs two trials to formulate his explanation so that others understand him. The teacher supports him by giving useful referent calculations on the backboard. Thasin takes on this help and explains by connecting logical levels: If  $19 \cdot 0 = 0$  and  $19 \cdot 1 = 19$  and  $0 < 0.708 < 1$ , then  $0 < \text{result} < 19$ . This explanation is marked as understandable by the peers (#23) and positively evaluated by the teacher.

Again, both students, Thasin and Monir, contribute with epistemic potential to the interactive process of mathematical knowledge consolidation. However, we see differences: Whereas Monir stays on the procedural level, Thasin even initiates the connection of the learnt procedure with the prior conceptual knowledge and connects different levels.

### Three students' epistemic participation profiles

As Table 1 shows, Episodes 1 and 2 are prototypic for the three students' epistemic profiles that could be reconstructed from the complete material, lessons 1.1 to 1.8 from the beginning of year 5, and from lessons 2.1 to 2.4 six months later (the last number in '1.2.4' indicates a running number for the students' contribution above sentence level). Within the limits of taking only 12 lessons over six months, Table 1 allows first answers to Q3: Students' epistemic participation profiles show certain stability over the time of half a year, visible tendencies in the first episodes can be detected as a persistent pattern.

Explanans in epistemic modes Explanandum in logical levels	Labelling & naming			Explicit formulation			Exemplification			Meaning & connection			Purpose			Evaluation			
	M	N	T	M	N	T	M	N	T	M	N	T	M	N	T	M	N	T	
<b>Conceptual levels</b>																			
Concepts											<i>1.8.6</i> <i>2.1.10</i>		1.3.3	1.8.7					
Propositions																			
Semiotic representations				<i>1.4.5</i>									1.3.3			<i>1.4.5</i>		1.7.5	
Models				<i>1.6.6</i>		<i>1.6.2</i>					<i>1.6.6</i>	<i>1.6.5</i>	<i>1.6.3</i>						
<b>Procedural levels</b>																			
Procedures				1.1.2 <i>2.4.8</i>	<i>1.1.1</i>	1.5.1	<i>1.1.1</i> <i>1.2.4</i> <i>2.1.7</i> <i>2.4.8</i>		<i>1.6.4</i> <i>1.8.8</i> <i>2.4.12</i>		1.1.2 <i>2.1.9</i>	<i>2.1.10</i> <i>1.2.4</i> <i>2.4.12</i> <i>2.4.8</i>	1.1.2 <i>1.2.4</i> <i>1.4.4</i>			<i>1.1.2</i> <i>1.2.4</i> <i>1.4.5</i>	<i>1.1.2</i> <i>1.2.4</i> <i>1.4.5</i>		
Concrete solutions	1.2.3	<i>2.4.7</i>	2.4.11								<i>1.4.5</i>	1.1.2 <i>1.6.5</i>	<i>2.1.9</i> <i>2.1.10</i> <i>2.4.12</i>	1.1.2 <i>1.2.4</i> <i>1.4.4</i> <i>1.8.6</i>			<i>1.1.2</i> <i>1.2.4</i> <i>1.4.5</i>	<i>1.1.2</i> <i>1.8.6</i>	1.7.5
Conventional rules																			

**Table 1:** Students’ epistemic profiles (Monir in blue, Thasin in violet, Nahema in green, **bold italics** indicate potential for mathematical learning opportunities)

Thasin comparatively often refers to conceptual levels, the mode ||meaning & connection|| and within it the connection across levels. In the second period, he gives conceptual explanations as in Episode 2. As reconstructed for Prediger and Erath (2014), these explaining practices are highly valued in this classroom microculture. The classification of their epistemic potential (Table 1) detected nearly 9 out of 12 contributions as productive for consolidating knowledge since raising meanings is crucial for consolidation.

Monir with limited linguistic resources is specialised on the procedural levels and on the mode ||exemplification|| and the combination of several modes on one logical level. This specialisation allows his contributions to be mostly classified as having epistemic potential for consolidating (mainly procedural) knowledge. Hence, both boys significantly contribute to the individuals’ opportunity to learn mathematics according to the microculture’s sociomathematical norms. Nahema’s seven contributions are mainly procedural and focus on the mode ||purpose|| in which he refers to mostly initial and concrete issues in the teacher’s navigation pathways. This concreteness allows activating deictic means and compensating limited linguistic resources. However, in later steps of the classroom’s navigation pathways when it comes to knowledge consolidation on epistemically higher levels, he usually keeps silent. This does not mean that he does not profit from passive participation, but he does not contribute actively to consolidating knowledge. Instead of the often assumed participation trajectory of increasing participation, Nahema’s participation decreases to one explanation six months later (he raises his hand four times but is not selected to speak). Hence, Nahema’s restricted linguistic re-

sources in the language of instruction limit his active participation and due to the limited epistemic potential, seem to strengthen the inequality of his learning opportunities.

**DISCUSSION AND OUTLOOK**

From our case study for three second language learners with unequal German linguistic resources, we conclude: Students show different ways of participation which can be grasped by means of the epistemic matrix. The location in the fields of the epistemic matrix and within the steps of a navigation pathway makes the unequal individual epistemic potential for consolidating the mathematical knowledge visible.

The developed framework enables us to observe a new phenomenon: The reconstructed patterns show certain stability over time. Rather than talking about naturally increasing participation, we must therefore talk about participation profiles being connected to unequal German resources and learning opportunities within the same class. The relation between the visibly unequal linguistic resources of the three boys and their participation profiles will be the issue for further research since this seems to be one key for understanding the reproduction of inequality in classroom interaction.

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