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RECONSTRUCTIONS OF "POSSIBILITIES" FOR LEARNING WITH RESPECT TO PARTICIPATION IN CLASSROOM INTERACTION¹

Abstract:

This paper is a contribution to an interactional theory of learning and teaching in mathematics classrooms. Differences in the structure of participation in classroom interaction and the possibilities for learning of the participating children are shown. The special purpose is to describe the responsibility and autonomy of children in classroom interaction.

Concerning the interpretative classroom research, two videotaped and transcribed classroom activities are presented. The responsibility and influence of the persons involved in the interaction are worked out by the analyses of the speakers' status. GOFFMAN's (1981) *decomposition model* of the speaker and the hearer is used as theoretical background. Finally, the speakers' roles in the two whole-class interactions are compared with respect to the learning possibilities for the children involved in the interaction.

Theoretical perspective

In the current discussion about learning mathematics, it is widely accepted that learning and teaching cannot be described by the model of transmitting knowledge. Going back to Piaget's theory of cognitive development, the learner as creator of his/her cognitive schemes is a central idea in the comprehension of mathematical learning. In the radical constructivism, von Glasersfeld rejects the possibility to access to the so-called "reality" and he asserts the self-construction of reality (including the self-organization of mathematical understanding) beyond the "reality". There is no normative obligation for the constructing person, but the individually constructed reality "is 'good enough' for allowing effective action by the person" (STEFFE & KIEREN 1994, p.722).

This orientation of the constructed realities to effective actions indicates that the constructivistic point of view from (cognitive) psychology is only one side of the development of the individual. Learning processes mainly occur in social interaction and cannot be separated from them. So, for describing individual learning processes, it is adequate to supplement the cognitive point of view by the interactionistic perspective from sociology. The individual constitution of meaning (as an aspect of learning processes) is strongly related to the participants' collective constitution of meaning in the interaction.

"[...] the individuals' reasoning and sense-making processes cannot be separated from their participation in the interactive constitution of taken-as-shared mathematical meanings." (YACKEL & COBB 1996, p. 460)

Following the idea of combining cognitive constructivism and social interactionism as outlined by COBB & BAUERSFELD (1995), the following approach focuses on the relevance of social interaction processes for the individual learning process. The way in which a student participates in a classroom lesson initiates and constrains her/his individual learning process. Focusing the sociological aspects of learning, not only the taken-as-shared meanings, but also the emerging interaction forms are constituted interactively:

"The manner in which the interaction occurs is seen as emerging from the individual's interpretation of their own and other's action and from mutual orienting that occurs between the members of the class." (WOOD 1996, p. 86/87)

¹ This paper is a part of research project "Reconstruction of formats of collective argumentation" which is realized at the Free University of Berlin and supported by German Research Foundation (DFG).

Summarizing, in the interaction processes meaning taken-as-shared emerges and the forms of interaction (including the possibilities to participate for each) as well, both by processes of negotiation.

Argumentation in negotiation processes

Argumentation is of special importance for the process of negotiated meaning. In these processes several participants contribute to the generation of an argumentation. This form of collective argumentation (MILLER 1986) is not aligned to logical argumentation but on rhetorical forms of argumentation (KRUMMHEUER 1995, 1997). In an analytical argumentation – like a mathematical proof - the validity of a conclusion is deduced from the basic premises using deductive inferences. In contrast to that, the participants of a classroom interaction try to present their actions as valid and convincing, which can be described as substantial argumentation (TOULMIN 1969). Following the ideas of symbolic interactionism, the classroom interaction is seen as an event beyond the sum of the participants' individual contributions (BLUMER 1973). So, collective argumentation is more than the collection of the individual contributions to the argumentation:

- The individually uttered arguments are reflecting the dynamic of the interaction process.
- No single participant could produce all "foundations" or "reasoning" in the emerged connecting and combining of statements.

Autonomy in learning processes

The different accomplishment of participation patterns is related to different possibilities of a child to contribute to the classroom interaction. Describing aspects of the learning processes as an increasing responsibility and autonomy of children while participating in collective argumentation, a special question is, how the children are involved in the constitution of collective argumentations.

One theoretical approach to the increasing autonomy is the description of the ontogenetical development by MILLER (1986). Following him, in the beginning learning is bound to heteronomous interaction with asymmetric cognitive competencies by the participants (e.g. parents and child). The asymmetry of the cognitive competence turns to more balance between the participants, later on. In those reciprocal environments (like peer-groups), the learning process is still bound to interaction in a narrow sense. Based on knowledge, which is acquired in such former ways of interaction, it is possible for the individual to "learn" autonomously in later situations. In elementary classroom interaction, though, the heteronomous and reciprocal forms are dominating the learning processes.

For learning by participating in social interaction it seems to be appropriate to refer to BRUNER's (1983) concept of participation in formats, which contains the idea of an increasing responsibility and autonomy for the children, too. He describes for language acquisition "formats" as

"... standardized, initially microcosmic interaction pattern between an adult and an infant that contains demarcated roles that eventually become reversible." (p. 120)

The participation in such formats including the change of roles forms the learning process. As an adaptation of BRUNER's idea to mathematical education, KRUMMHEUER (1992) describes stable structures of collective argumentation in the mathematical classroom

interaction as argumentation formats. The persons involved (in collective argumentation) generate a participation model in which the learning process takes place.

Participation in multi-party-interaction

The mutual attention which is typical in dyads like mother-child interaction (for the language acquisition) cannot be assumed for classroom interaction with 20-30 children and one or two teachers. So, the concept of learning by participating in formats has to be modified with respect to the peculiarity of multi-party-interactions.

An useful approach to multi-party-interactions is given by GOFFMAN (1981).² He demands in his general criticism of the dyadic model for conversation:

- the dissolution of the speaker-hearer dyad, and furthermore
- the decomposition of the everyday terms speaker and hearer:

"It takes global folk categories (like speaker and hearer) for granted instead of decomposing them into smaller, analytically coherent elements." (p. 129)

For the aspects of reception, he describes the different relations between the participants in a gathering as *participation framework* :

"The point of all this, of course, is that an utterance does not carve up the world beyond the speaker into precisely two parts, recipients and non-recipients, but rather opens up an array of structurally differentiated possibilities, establishing the participation framework in which the speaker will be guiding his delivery." (p. 137)

For the aspects of speaking he comments

"Plainly, reciting a fully memorized text or reading aloud from a prepared script allows us to animate words we had no hand in formulating, and express opinions, beliefs, and sentiments we do not hold." (p. 145)

He invents the term *production format*³. The application of the production format to the classroom interaction will be illustrated by the interaction examples. But first, the methodological basis is outlined.

Methodological remarks

The aim of the project is to elaborate the comprehension of collective processes of argumentation (MILLER 1986) in elementary mathematics classroom interaction. In particular

- the (re)accomplishment of formats of argumentation in interactional processes (KRUMMHEUER 1992, 1995),
- the autonomy and authenticity of the arguing persons (BRANDT 1997) and
- the kind of reception of (and in) such processes.

² see SAHLSTRÖM (1997) for a detailed examination of the relevant literature

³ see BRANDT (1997) and BRANDT & KRUMMHEUER (1998) for production formats in classroom interaction

The empirical basis of our research are videotaped lessons. We have observed two classes, for two weeks each: a first grade class (21 children, average age 7 years) and a multi-age class of first through third graders (27 children, 6-10 years old). In this paper both examples are lessons of the first grade class. The analyses were done from transcribed episodes, which were selected by the research purpose and methodological considerations. Following BOHNSACK (1993) we call our methodology "reconstructive", which includes two aspects of reconstruction. First we reconstruct the learning situations by

- interaction analysis
- argumentation analysis and
- participation analysis.

The analysis of participation forms is used to work out the roles or functions of single participants in the interaction process. The interpretation is based on the reaction of the other participants - so it is not done from an individualistic point of view, but in an ethnomethodological and interactionistic manner.

The next step is the comparison of analyses of different classroom episodes. The selection of episodes in the ongoing research process is guided by this comparison, which causes modifications of our analytical methods and the (re)construction of theoretical elements, as well.⁴ This methodological aspect clarifies the selection of the interaction examples: For the comparative analysis, it is necessary to vary relevant dimensions (STRAUSS & CORBIN 1990).

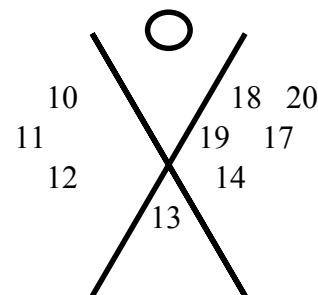
Empirical data and analyses

In this paper, I concentrate on the participation analysis⁵ and on autonomy and authenticity of the arguing persons, specially. A mathematical classroom interaction will be compared with an episode of spelling words in the same class. Both scenes are teacher-centered, so with MILLER's terms, they are heteronomously shaped.

Transcript and description of the mathematical example: Mister X

In the first episode, the class is concerned with a kind of mathematical game, called Mister X: One boy writes a number between 10 and 20 on the blackboard (hidden) and the other children have to guess this number. They have to offer their guesses in form of a term.

In the beginning, one example is given by the teacher: ten / plus / eight \ . is / eighteen.⁶ The children offer the following numbers: 10+10=20, 10+0=10, 10+9=19, 10+1=11, 10+2=12, 10+7=17, 18-4=14 (in this order). The boy at the blackboard collects the offered numbers and writes the bigger ones at the right side, the smaller ones at the left side of "Mister X" (see picture). Then, the solution 13 is mentioned by Aram and fixed at the bottom of Mister X.



⁴ see PEIRCE (1978) and KELLE (1994) for this principle of abduction

⁵ see VOLLMER (1997) (Naujok nowadays) for our way of interaction analysis and KRUMMHEUER (1995) for more details of argumentation analysis

⁶ Citations of our material - especially words or lines of the transcript - are written in smaller letters in the text. Please find the since of transcription at the end of the article.

Now the transcript starts:

- 129 t who has thought that **either** \ *a lot of pupils are putting up their hands* is there
- 130 perhaps a **reason** why you have thought that \ why **could** it only be **thirteen**
- 131 *shows the thirteen at the blackboard* in the end\ . I believe **Aram** was **guessing** a
- 132 little bit / isn't it so Aram / . why could it only be thirteen in the end \
- Jaquelin
- 133 9:25
- 134 Jaquelin because **all** numbers were always in except of thirteen
- 135 t no / **fifteen** for example /
- 136 Jarek and sixteen \
- 137 < t there is another reason \ there is another reason \ David \
- 137.1 < Jarek sixteen \
- 137.2 *some noises in the classroom*
- 138 < David because fourteen was too big
- 138.1 < p1 a b c d
- 138.2 < p2 hey shut up
- 138.3 *some more noises in the classroom*
- 139 t **stop** it \ that's very important now \ start again \
- 139.1 Efreem and hundred
- 140 < David because fourteen was too big because \ *lays down on his table*
- +
- 141 < t *showing the fourteen* yes \ . + and *showing the twelve*
- 142 David the. *speaking faster* twelve was too small \
- 143 t repeat this + Efreem \ Efreem - . repeat this \ David told us something **very**
- 144 **clever** \ you can keep it in your minds \ who can **repeat** what **David** told \
- 145 *silent Petra*
- 146 < Petra because because the fourteen was too big / an and the twelve was too small \
- 147 < t *showing the fourteen* + *showing the twelve*
- 148 t and in between is only a /
- 149 Petra thirteen \

It follows a short description of the episode with some interpretative remarks.⁷

<129-137>: After the solution 13 is fixed at the blackboard, the teacher asks for a reason. She rejects the first proposal and she gets support for her rejection by Jarek's heckling. The teacher asks for **another** reason.

⁷ The numbers in <> refer to the lines of the transcript.

<138-139>: David suggests another reason, but it is a little bit noisy in the classroom. The teacher emphasizes the importance of David's answer and gets silence for David's answer. David has to repeat his suggestion.

<140-142>: David starts again because fourteen was too big \ *lays down on his table*. The teacher evaluates his answer by showing the fourteen at the blackboard. David seems to be contented, the pitchdropping and his bodily behavior can be seen as signal, that this is all, he wants to say. But the teacher seems to expect more: she shows the twelve and forces David to continue. With her gestures, she takes a "speaking role". David hesitates, but then he adds quickly: the *speaking faster* twelve was too small \. By showing the twelve, the teacher determines his answer. This interaction form described by BAUERSFELD (1978) as a funnel pattern.

<142-145>: The teacher asks more children to repeat David's answer. Here, two functions of "repeating an answer" are recognizable:

- The teacher turns to Efrem and wants to discipline him. From the view of the teacher, Efrem did not care enough for his role as an "active listener". The teacher complains his inappropriate behavior as recipient by demanding him to repeat the answer. But Efrem gets no chance to repeat, and that supports the admonition.
- The importance and cleverness of David's answer can be supported by "repeating his answer". The teacher expects, that Petra will repeat it. The other children get the chance, to catch the answer once again.

<146-149>: Firstly, Petra repeats the answer, which was stated by David and the teacher. But again, the teacher carries on: and in between is only a /. The answer thirteen is expected - and Petra completes the answer correctly.

David, Petra and the teacher are involved in the process of emerging a collective argumentation: They substantiate the assertion "It could be only thirteen" by using the mathematical principle of delimiting the interval.

The production formats of the Episode

David's and Petra's responsibility for their utterances in this collective argumentation will be worked out by participation analysis. This example of a participation analysis illustrates different forms of responsibility.

Following GOFFMAN (1981), we decompose each utterance in three analytical aspects

- gestical / acoustical appearance,
- words / expression and
- idea / motive.

Each utterance contains all aspects. We base our description of the speaking person on her or his responsibility for one, two or all of these aspects (LEVINSON 1988; BRANDT 1997, BRANDT & KRUMMHEUER 1998). In the case of a speaker talking with restricted responsibility, there is a silent participant, who is responsible for the missing aspects:

speaking person

	appearance	words	motive	example ⁸
<i>creator</i>	+	+	+	David <138>
<i>borrower</i>	+	-	+	teacher <141>
<i>assistant</i>	+	+	-	David <142>
<i>reciter</i>	+	-	-	Petra <146>
<i>spokesman</i>	+	-	-	Petra <149>
<i>authorship</i>				

non speaking person with responsibility

	words	motive	example
<i>moulder</i> (of the teacher <141>)	+	-	David <138>
<i>initiator</i> (of David <142>)	-	+	teacher <5-7>
<i>author</i> (of Petra <149>)	+	+	teacher <148>
<i>authorship</i>			

The analytical aspects *words / expression* and *idea / motive* of the utterances are combined in the analytical term *authorship*. The terms *reciter* and *spokesman* are not distinguished in lack of responsibility for the authorship, but in the frequency of the acoustical realization.

The responsibility of the speaking persons

David's utterance in <138> is influenced by the classroom interaction, but he can be seen as creator of his utterance. Obviously, he is responsible for the gestical and acoustical appearance and the words (suitable to the question in <137>). The argument fourteen was too big <138> is sufficient for him and is taken as idea of the utterance (perhaps he follows the strategy of "reducing the number by one").

In <140-142> the responsibility for the acoustical and gestical components of the utterance splits up into David's and the teacher's. At first, the gesture of the teacher is subordinated and she takes David's motive. Then, David stops his explanation and the teacher takes over the guidance with her gesture: She determines the motive. So, she takes the answer of David and combines it with her own idea. As acoustical source, David puts it in the final form. In <142>, David is a speaking person without responsibility for the whole authorship. Expressing the second part of delimiting the interval, he is an assistant for the motive of the teacher.

Nevertheless, the teacher presents David as responsible for his answer: David told us something **very clever** \ you can keep it in yours minds \ who can **repeat** what **David** told \ <142-144>. So, the teacher expects the other children to interpret David as a creator, while in the analysis his assistant role is worked out.

In <147> Petra repeats the words uttered by David in <140-142>. She is a speaking person without authorship. We describe her as a reciter.

The missing authorship is considered in her utterance thirteen <149>, again. But her utterance can be distinguished by the frequency of the acoustical realization. She manages the first acoustical realization of thirteen in interrelation with the delimited interval, so we call her a spokesman. This production format is typical for the end of interaction patterns, which BAUERSFELD (1978) describes as funnel pattern.

⁸ The examples will be explained in the following section.

Non speaking persons with responsibility

Every utterance contains all analytical aspects. So, for a speaking person with missing responsibility in the authorship, there must be a non speaking person, who is responsible for these aspects of responsibility..

Following David's words, the teacher shows the fourteen <141>, but she puts David's utterance in her motive of interval delimiting by showing the twelve later on. David can be seen as the moulder of the fourteen. Now, David takes the teacher's motive, but expresses it in his own words <142>. So, the teacher is responsible for the motive in his utterance but not for the words. She is the initiator of the utterance.

Petra utters her contributions to the collective argumentation without responsibility in both aspects of the authorship. In <146>, she recites David. David expresses the motive of the teacher. Looking at David and the teacher as a "unit" for the whole sequence <138-142>, they are the "author" of Petra's utterance. In more detail, David is author for the first part of Petra's utterance because the fourteen was too big /. But the twelve was too small\, the authorship is split up between David and the teacher. David formulates the teacher's motive in <142>, so he is the moulder of this part, while the teacher can be seen as the initiator. That interpretation is independent of the view of David or Petra or the other participants. And, as mentioned above, in <143-144> the teacher attempts to present David as an author.

The supplement thirteen <149> goes back completely to the teacher. She is the author, although she has not uttered the word thirteen yet.

Second example: Introduction of 'B'

In the second interaction example, a variation of "repeating" can be investigated. In this course, the letter b is introduced in the classroom. The lesson starts with some exercises for the script and the writing activities. Then the teacher invites the children to offer words with a "B". She collects several of these words on the blackboard. For the whole sequence of collecting words with one or more "B's", the interaction pattern "Initiation-Reply-Evaluation" emerges (MEHAN 1979). The following parts of the whole transcript concentrate on the idea of constructing new words by changing an old one:

- 83 t um Polly
- 84 Polly bau e b b ball -
- 85 t ball \ very good *writes the word on the blackboard*
- (...)
- 87 t Wayne \
- 88 Wayne basketball \
- 89 t where **is** the b \
- 90 Wayne at the front and in the middle \ um . yes .
- 91 p yes at the front and in the middle \
- (Wayne?)
- 92 t at the front *writing the word* a very nice word \ so long +
- (...)

- 107 Wayne **aah - football** \ *Jarek is looking to Wayne and puts his hand up*
 (...)

146 t a n d Jarek\
 147 Jarek football \
 148 t where **is** the b
 149 < p foot . ball \
 150 < Jarek in the middle \
 151 t yes- *writing*
 (...)

252 t Jarek \
 253 Jarek american football \ (*pronounced in english*)
 254 t football \ well . that's english already
 (...)

268 t ok
 269 Marina um handball
 270 t yes

Polly offers the word ball and the teacher evaluates the answer positively by writing the word on the blackboard. Now, Wayne offers basketball <88>. He has to back up his word by identifying the positions of the B's, but then the word is evaluated in the common way. He is the creator: He chooses a word, and he introduces the motive "constructing a new word by taking an old one". It is not clear, if he is aware of this motive, but it is working in such way in the interaction.

He is aware of this motive in <107>: aah football. He uses the motive again, but it is not his turn at the moment. His neighbor - Jarek - follows his utterance attentively and puts his hand up. In <147>, Jarek offers the word football to the teacher and it is evaluated. Jarek is the reciter of Wayne, who is the author of the "construction" football.

The next time it is Jarek again, who applies this idea of constructing new words with a 'b': american football \ <253>. That is a new word, so Jarek is responsible for the expression of the motive: He is an assitant and Wayne is the initiator. Offering hum handball <269>, Marina is another assistant and Wayne is the initiator, once more. Based on the transcription, it is not possible to decide about the authorship from Marina's point of view. But for the analysis of participation forms, that aspect is not relevant. Even if Marina did not care about the answers of Wayne and/or Jarek, Wayne appears as the initiator of her utterance in the process of the interaction.

Comparison and concluding remarks

The two episodes will be compared with respect to the autonomy of the speaking children. The authorship of the utterance is taken as indicator:

- 1) In the first example, the funneling of the argumentation pattern pushes back the children's responsibility of the authorship. The children cannot participate in the collective argumentation autonomously.
- 2) In contrast to this restraining in the other example, it seems possible to describe Jarek's participation as an increasing autonomy. In his first utterance, he is a reciter of Wayne. It would be possible for him to reject the responsibility in any case of criticism by the teacher. So, with the reciter's role, he takes a status seemingly easy and secure. It was possible for him to repeat Wayne's suggestion, because Wayne did not utter the word in "the right moment" - without permission of the teacher. But in the ongoing lesson, Jarek must invest more creativity and originality. He took the motive of Wayne and expressed it with his own "word" american football.

As mentioned above, both episodes are heteronomously shaped. Looking at the assistants of the episodes (David in the first example; Jarek and Marina in the second lesson) and the respective initiators, this description is specified:

- 1) In the first episode, the teacher tries to hide her role as initiator by presenting David as author. For the participants, this interaction seems to be more reciprocal, while it is worked out as heteronomous in the analysis.
- 2) However, in the second example, the teacher-centered interaction pattern "Initiation-Reply-Evaluation" emerges constantly and no exchange between the children is considered in the interaction. Analyzing the speaker status of the children, Wayne appeared as initiator for Jarek and Marina. So, the heteronomous teacher-pupil-interaction partly shifts to a more reciprocal peer-group interaction.

The motive of delimiting the interval is constantly in the teacher's responsibility. So, it can be seen as her "learning goal" of this interaction, but conceivably this goal is not caught by the participating children. By participating more autonomously like Jarek and Marina, the subject matter changes. Perhaps, they do not care about the sound "b", which the teacher wanted them to "learn". But conceivably they learn something about morphology and apart from this a strategy for participating successfully in classroom interaction in general: "Don't change too much by constructing new answers!"⁹ Nevertheless, by orientating their contributions to the concrete interaction, the "shifted learning subject" is still related to the "teacher's intended subject" in some broader sense: They have to grasp the components, which are allowed to change.

Finally, some remarks on the learning possibilities for the children involved in the interaction: Petra chooses (and is expected to choose) a restricted way of uttering and that provides her the opportunity to take part in a collective argumentation. But it is assumed, that this way of participation produces a reproduction of formalism in very particular circumstances. By participating more autonomously, Wayne has to grasp the crucial components of the format. That offers perhaps a chance to use it for own purposes in other situations - or for contributing to accomplish new formats in later collective argumentations.

⁹ This strategie is applicable in mathematical lessons, as well, e.g.: constructing new terms to a given solution by reducing and increasing the summands reciprocally.

Transcription

... ..: <i>break (longer break (more points)</i>	/: <i>pitchraising</i>
bold: <i>stressed spoken words</i>	\: <i>pitchdropping</i>
b r o a d l y: <i>lengthened words</i>	-: <i>floating pitch</i>
italic: (<i>facial</i>) <i>expression, gestures, action</i>	;: <i>breathing space</i>
+: <i>end of the last expression, gestures, action</i>	< in front of the names: <i>marks simultaneity</i>

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