

# OBJECTS AS PARTICIPANTS IN CLASSROOM INTERACTION

Marei Fetzer

IDM, J. W. Goethe-University, Frankfurt/M., Germany

*In this article an object-integrating approach to interaction in the mathematics classroom is proposed. Accordingly, not only human beings, but also non-human objects are considered as participants in the course of action. Symbolic interactionism and Actor-Network-Theory both serve as a theoretical basis for the development of the object-integrating approach to classroom interaction outlined in this article.*

*Keywords: objects, classroom interaction, Symbolic interactionism, ANT, analysis*

## INTRODUCTION

Research on teaching and learning processes in the mathematics classroom focuses on different aspects. Mathematical language, or communication in a broader sense, are possible points of interest. In this article I take an interactionistic perspective on processes of teaching and learning. I investigate classroom interaction as it is developed by its participants. My current interest is on the role of objects in such interactional processes. How do they affect the proceeding of interactional learning processes in primary education? My concern is the development of an object-integrating approach to interaction in the mathematics classroom.

## OBJECTS AND CLASSROOM INTERACTION

The ‘discovery’ of the mere existence of objects in the mathematics classroom is rather innocuous. Besides, the observation that objects have an influence on interaction in mathematics primary education is not new either. Moreover, systematic implementation of objects such as books, paper and pencil, blackboards, calculators, cubes or dice in teaching and learning activities is a commonly shared practice. It gains wide acceptance amongst researchers as well as amongst primary teachers. Undoubtedly, objects play a role in the course of mathematical teaching and learning. But how can one describe the objects’ role in the course of classroom interaction theoretically? Interactionistic perspectives on primary mathematics education traditionally focus on students and teachers (see e.g. Mehan, 1979; Cobb & Bauersfeld, 1995). These persons are the actors developing the interactional process. However, no special attention is paid to non-human objects, and no interactionistic thought is given to them. Thus, there remains uncertainty concerning things and their role within the interactional development. Subsequently I am going to outline a theoretical approach to interaction in which objects have “agency” (Latour 2005, p. 63) as well. Proposing this object-integrating approach to classroom interaction, I draw on the framework of symbolic interactionism (Blumer, 1986) and on Latour’s Actor-Network-Theory (ANT) (Latour, 2005). Referring to ANT I go beyond the more common idea of interpreting objects as tools or instruments in human’s hands.

Nor do I concentrate on mediated thinking or objectification (Radford 2006). Instead, I accept objects as participants in classroom interaction. Thus, Latour's theory serves as an impetus for a radical change in studying mathematical learning processes. While the suggested object-integrating approach is not yet a fully developed theory, I suggest it as a thought-provoking impulse.

### **Symbolic Interactionism**

Blumer (1986) gives an outline of the nature of symbolic interactionism, calling in three premises. The first premise is that "human beings act toward things on the basis of the meanings the things have for them." (ibid., p. 2). Here, Blumer's use of the term 'thing' differs fundamentally from the understanding of 'things' throughout the rest of this article. It is as broad and overarching as possible. Blumer defines: "Such things include everything that the human being may note in his world – physical objects [...], other human beings [...], institutions [...], guiding ideals [...], activities of others [...] and such situations as an individual encounters in his daily life." (ibid., p. 2). In contrast, I apply the everyday-term 'thing' with regard to ANT in a much closer form. I use it as a colloquial and sensitizing version of the term 'object', taken as short for non-human physical object.

The second premise refers to the source of meaning. Meaning is not intrinsic to the thing. Nor is it a psychical accretion like a sensation, memory, or feeling brought into play in connection with perceiving the thing. Instead, "symbolic interactionism sees meaning as arising in the process of interaction between people. The meaning of a thing for a person grows out of the ways in which other persons act toward the person with regard to the thing." (ibid., p. 4). Thus, the meaning of things is formed in the context of social interaction. It is seen as a social product.

The meaning of a thing is derived by the person from the interactional process. But meaning is not an already established application to a thing. It is nothing that has to be arisen from the thing itself. In contrast, the use of meaning by the actor occurs through a process of interpretation. And this leads to the third fundamental premise put forward by Blumer: "The meanings are handled in, and modified through, an interpretative process." (ibid., p.5). Thus, interpretation becomes a matter of handling meanings. It is considered as a formative process in which meanings are used and revised as instruments for the guidance and formation of action.

Analysing interaction in the mathematics classroom on the basis of the framework of symbolic interactionism is a matter of interpretation. It is an interpretative effort to reconstruct, as in the case of my research work, *processes* of meaning making. How is meaning formed and negotiated in the process of interaction? How do actors collectively create mathematical meaning? In order to investigate the process of meaning making, every single *action* is interpreted extensively in the sequence of emergence. The analyst tries to generate as many alternative interpretations as possible. Thus, he or she opens up the range of potential ways of understanding and construing the action. In order to get hold of the process of *inter-acting*, actions are

considered to be related to each other. They are interpreted as turns to previous actions. Analysing turn by turn the process of meaning making can be reconstructed.

### **Actor-Network-Theory (ANT)**

Latour (2005) poses the question who and what participates in the course of action. He criticises the established definition of action: If action is limited a priori to “what ‘intentional’, ‘meaningful’ humans do” (ibid., p. 71), objects have no chance to come into play. Instead, he recommends a broader understanding of action and agency. He defines that “*any thing* that does modify a state of affairs by making a difference is an actor” (ibid., p. 71). In doing so, he equips objects just as well as humans with agency. All actors, human or not, are “*participants* in the course of action” (ibid., p. 71). Thus Latour extends and modifies the list of actors assembled as participants fundamentally. He gives several reasons why ANT accepts objects “as full-blown actor entities” (ibid., p. 69). One is that the social world will “retain a sort of provisional, unstable, and chaotic aspect” if it was made of local face-to-face interaction. However, such temporary and fugacious interactions can become far-reaching and durable. Latour calls the “steely quality” (ibid., p. 68) of things to account for this durability and extension. What is new is, that objects are highlighted as actors that might “authorize, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid, and so on” (ibid., p. 72). Latour does not give privilege; human as well as non-human participants in the course of interaction have agency. Latour refrains from imposing “some spurious asymmetry among human intentional action and a material world of cause relations” (ibid., p. 76). He denies loading things into social ties. Objects do not serve as a “backdrop for human action” (ibid., p. 72). Neither do they determine the interactional process; they are not the causes of action. But he does not propose some sort of equality either (ibid., p. 63; p. 76). Instead, he emphasises the varieties and differences in modes of action (ibid., p. 74ff.).

Doing research on mathematical education from an interactionistic perspective, the merge of ANT and symbolic interactionism might be a fruitful effort. Latour considers objects as actors contributing to the process of interaction in different modes of action. They participate in the process of meaning making, even though they have different options open. Concerning methodology, Latour preaches to “follow the actors” (Latour, 2005, p. 156) and “describe” (ibid., p. 144; p. 149). Blumer emphasizes that non-human objects as well as human activities have no intrinsic meaning. They do not carry an established meaning that has to be revealed. Meanings are formed in the process of interaction. Meaning making, according to Blumer, is a matter of interpretation. Symbolic interactionism serves as a point of reference for interpretative research trying to reconstruct the process of meaning making. Merging symbolic interactionism and Latour’s approach might help to bring the consuetudinary excluded objects into the course of interaction. It might contribute to the development of an object-integrating theory of learning in mathematical

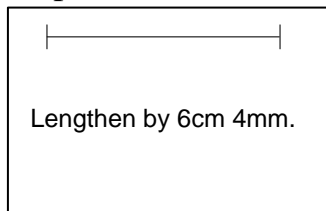
classroom interaction. Latour states with regard to interaction, that “the number and type of ‘actions’ and the span of their ‘inter’ relations has been vastly underestimated. Stretch any given inter-action and, sure enough, it becomes an actor-network” (2005, p. 202). But how do you investigate interactional processes if you consider objects as full-blown actors? How do you deal with the modified list of participants and with the increased modes of action? In the following paragraph, I propose an object-integrating approach on classroom interaction.

## OBJECT-INTEGRATING APPROACH TO CLASSROOM INTERACTION

Empirically grounded development of an object-integrating theory of learning in mathematical classroom interaction includes the development of analytic tools, analysis of numerous scenes, and the comparison of interpretations to various scenes. Below, methodological thoughts are discussed as a basis for analysis of object-related classroom interaction and accordingly as a contribution to the development of an object-integrating theory of learning. To exemplify the methodological points of interest, a short episode taken from a third year German primary class is introduced (first published in Fetzer, 2007).

### Example

In this scene the task is to lengthen a graphically given straight segment by 6cm 4mm (compare fig.). First the children work on the problem on their own. They are asked to put written notes on their problem solving process. Afterwards some children present their approaches on the blackboard. Sonja is the first to explain her proceeding. The teacher requests those students that “can’t follow anymore” to “ask what’s going on”. Sonja selects Sabina as next speaker. She says: “Somehow I don’t get it.” This last utterance will be the focus of investigation.



Person	Aktivität	Activity
Sonja	<i>Steht an der Tafel, schaut zur Lehrerin</i>	<i>Stands at the blackboard, looks towards the teacher</i>
Teacher	Die andern- da sind viele gewesen da kann ich mir vorstellen die komm jetzt schon nicht mehr mit- da müsst ihr auch mal fragen was da los iss- aber wenn die nich meinn sie müssten fragen erklär weiter-	The others- there have been many I can imagine who can't follow anymore- you have to ask what's going on then- but if they don't bother asking keep on explaining-
Sonja Sabina	<i>Schaut in die Klasse Sabina-</i> Ich kapier des irgendwie net-	<i>Looks towards the class Sabina</i> Somehow I don't get it-

First, I will give a ‘traditional’ analysis of the scene focussing on the verbal activities of the human participants. This brief analysis may serve as a basis for the subsequent theoretical and methodological discussion.

An extensional analysis of Sabina’s utterance in the last line of the transcript opens up a wide range of possible ways of understanding. Here only a small selection is

given. By stating “somehow I don’t get it”, Sabina perhaps intends to express that she could not follow Sonja’s explanation. On the one hand this could be a statement referring to herself and her own learning process. On the other hand her utterance could be understood as a statement concerning Sonja’s performance. In the context of the latter interpretation, Sabina would indicate that Sonja’s explanation was not comprehensible. Alternatively one might understand her utterance as an expression of her troubles in solving the given task. If so, her difficulties would not relate to Sonja’s explanation, but to the task itself. Eventually her utterance might be interpreted as a contribution to the classroom interaction in order to demonstrate alertness. In this case, the mathematical substance of her contribution could be minimal.

Who could Sabina possibly refer to? The turn-by-turn analysis basically reveals two alternatives: Sabina’s utterance could be understood either as a turn on Sonja, or alternatively as a turn on the teacher. Following the first interpretation, Sonja addresses Sabina and picks her as the next speaker. Sabina gets active and paraphrases the teacher by translating “can’t follow anymore” into “somehow I don’t get it”. In the context of this interpretation, Sabina would invest hardly any mathematical effort. According to the second understanding, Sonja might just as well get active as a turn on the teacher’s invitation “You have to ask what’s going on”. Again her utterance might be understood as a paraphrasing of the teacher’s “can’t follow anymore” (see above). Following this interpretation, not much mathematical content can be attested to her utterance. An alternative understanding would suggest that Sabina indeed could not follow Sonja’s explanation. She then actually belongs to those who were addressed by the teacher and were invited to get active. Again, Sabina takes the turn offered by the teacher. In the context of this latter understanding the mathematical content attributed to her utterance would be (slightly) increased.

### On actors

According to an object-integrating approach to classroom interaction, not only humans but also objects have agency. This modified understanding of who and what acts in mathematical interaction entails a modified way of transcribing as demonstrated below.

Actor	Aktivität	Activity
Board	$5+6=11$ $4+7=11$ <i>[Tafelanschrieb bleibt während der gesamten Szene unverändert und sichtbar]</i>	$5+6=11$ $4+7=11$ <i>[Notes on the blackboard remain untouched and visible throughout the whole scene]</i>
Sonja	<i>Steht an der Tafel, schaut zur Lehrerin</i>	<i>Stands at the blackboard, looks towards the teacher</i>



Teacher	Die andern- da sind viele gewesen da kann ich mir vorstellen die komm jetzt schon nicht mehr mit- da müsst ihr auch mal fragen was da los iss- aber wenn die nich meinn sie müssten fragen erklär weiter-	The others- there have been many I can imagine who can't follow anymore- you have to ask what's going on then- but if they don't bother asking keep on explaining-
Sonja Sabina	<i>Schaut in die Klasse</i> Sabina- Ich kapier des irgendwie net-	<i>Looks towards the class</i> Sabina- Somehow I don't get it-

The first column indicates the interacting participants. It is captioned with 'actor' because the term 'person' solely refers to human beings and excludes other participants. The second and third columns give the actions in English and in German, differentiating verbal (regular font) and non-verbal actions (*italic font*). In contrast to 'conventional' transcripts, activities of objects are included as well. In the illustrating scene, for example, the notes on the blackboard are highlighted in grey.

Who and what participates in the given scene? Sonja, the blackboard, the teacher, and Sabina are actors in the scene. Besides, the children have their own written work at hand. Accordingly, Sonja's and/or Sabina's written approach might just as well enter into account. Working with an object-integrating approach to learning processes casts a different light on the selection of participants. The identification of the actors becomes more difficult for two reasons. Firstly, the fact that objects enter into account does not as a matter of course show in the restricted lines of a transcript. The reason is the time-spreading quality of things. Some-*thing* lying on the table like Sabina's written work or written on the blackboard as in the given example might not be mentioned in the specific scene selected for analysis. Nevertheless, board and written work might become participants within the course of action. Secondly, indicating participants in object-related classroom interaction is not a matter of fact, but a matter of interpretation. Some objects may be appraised as participants in one interpretation, but remain unconnected to the course of interaction in another interpretation. Regarding the interpretation on Sabina's utterance given above neither the board nor Sabina's work get connected to the interaction. However, understandings that take the blackboard as well as Sabina's work as actors can be reconstructed, if an object-integrating approach is applied. As a consequence, the selection of the actors of a given scene can always be no more than a *pre-selection*. Supplementary nominations of participants are likely to become necessary within the process of analysing. Accordingly, the pre-selection of participants should accept a wide range of possible actors. Concerning the example, Sabina's work should be at hand for analysis.

The selection of actors is one crucial point in implementing an object-integrating approach to classroom interaction. Another striking aspect is the matter of sequence and time span of participating. Who and what assembles as participants in the course of action might change very quickly. Especially non-human objects may enter into account one moment and recede into the background an instant later. They appear

associable with one another only momentarily. Analysis of interactional processes focuses on visible actions and the process of interweaving. Consequently, children, teachers or things can become the ‘object’ of analysis just as long as they leave an observable trace. If no trace is produced, no information is offered to the observer. If humans as well as things remain ‘silent’, they are no actors anymore. They remain unaccountable (Latour, 2005, p. 79). The written work on the table is not an actor. But Sabina and her notes might weave together and both become active participants in the interactional process as soon as Sabina picks up her sheet or has a glance on her notes. With Sabina and her written work entering the course of interaction, they may be captured by analysis. Interaction analysis based on the framework of symbolic interactionism takes a micro perspective and proceeds sequentially. Thus, intermittent existence and rapidly changing assembling of participants may be captured appropriately. But in the context of an object-integrating approach, durability and lasting time spans have to be considered as well. The blackboard might show Sonja’s notes for quite a while. Consequently it is a potential actor for a certain length of time. This abiding participating could be indicated in the transcript, for example, by implementing an additional column.

### **On modes of action**

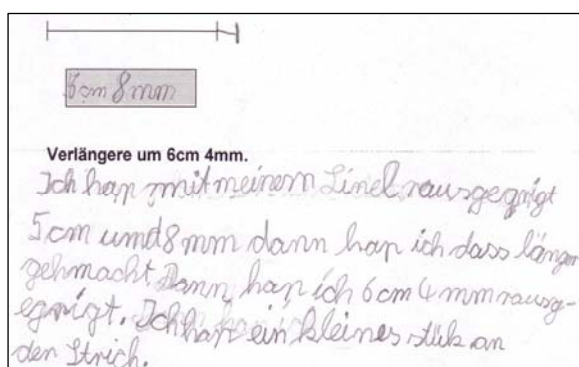
Investigating processes of teaching and learning in mathematics education actions are analysed in their order of emergence (see above). The analyst generates as many sensible interpretations to the given action as possible in order to expand the range of potential understandings. Reconstructing the process of meaning making in the context of ANT widens the spectrum and modes of actions under investigation. Both, human and non-human actions have to be analysed. However, analysing non-human’s actions on the first glance appears to be a bold venture. How can an object’s agency be interpreted? In order to investigate the object’s agency one may firstly explore the object itself ‘nakedly’. What does this object tell the analyst, what does it remind him of? What might it express, suggest, allow, forbid, enable, etc.? This mode of analysis compares to a methodical dodge often applied in analysing human action: the variation of the interactional context. The action is taken out of the given context and conveyed into another. This is an established proceeding in interaction analysis in the theoretical framework of symbolic interactionism. What is new is to implement the variation of the context to objects and their activities. This analytic move raises the analyst’s awareness and sharpens his or her analytic senses when it comes to interpret the object’s actions. This is possible as soon as objects get visibly connected to other participants in the course of action. Once they become associated with one another, their action might be captured by analysis. With Sabina glancing on her notes, the written work becomes a participant in the interaction. It is no longer a sheet of paper on the table, but a tangible link between now and earlier. It is a concrete backing of argumentation or a means of distraction. As an actor, the written work in front of Sabina might demonstrate alertness, or it might assign her to be the current speaker. The assumption that objects have agency, too, widens the range of observable

actions. Consequently, the analysis of the sequentially emerging action must be implemented to human as well as to non-human actors' activities.

Interesting enough an object may well be there unaltered or untouched for a couple of minutes or half an hour. In the selected example this applies for both, the blackboard and for the written work(s). Their 'steely quality' persists, although objects just momentarily enter into account, and become active only from time to time. In the context of the traditional analysis of interaction we are used to focus on actions as momentary affairs producing visible or otherwise perceivable traces only here and now. Objects prompt the analyst to open the perspective. The potentially long lasting effect of an object's activity on classroom interaction has to be considered. The blackboard *is* there. Any participant might refer to the notes any time within the interaction. Thus the notes on the board become participants.

These theoretical thoughts have an impact on the method of analysis in the context of an object-integrating approach to classroom interaction. To illustrate the effects on the analysing procedure, the investigation presented above is adopted and supplemented accordingly. Subsequently, the blackboard and Sabina's work are explored.

On the blackboard there are two number problems. Both are additions, both sums are eleven. Due to a lack of space, again, only a selection of possible interpretations is given. The two lines seem to refer to an arithmetic problem. They might for instance be related to each other by the mathematical strategy of inverse changing of summands. Assuming that Sonja's notes are related to the given task on measuring and calculating lengths, the two sums might be read as operations with numerical values omitting the units (cm and mm). In this case, the two sums could be interpreted as short versions of  $5\text{cm}+6\text{cm}=11\text{cm}$  and  $4\text{mm}+7\text{mm}=11\text{mm}$ . From a mathematician's point of view, this interpretation would give the written sums the touch of side notes. Taking a (weak) student's perspective, these two lines could be seen as the extract or the fundament of the problem: Plain numerical values, assorted by different values. One rather complex calculation with units is reduced to two simple arithmetic problems that can be managed easily. Anyhow, the blackboard displays an arithmetic problem. The geometric element of the graphically given straight segment does not show anymore.



Below the task (Lengthen by 6cm 4mm) Sabina's work says: "I found out with my ruler 5cm and 8mm then I have lengthened that Then I found out 6cm 4mm. I had a little bit to the line." (See fig.). Her work shows a rather geometric approach based on the idea of adding *up to* 6cm 4mm (instead of *lengthen by*). The little figure on the right hand side can be interpreted as the answer to



the given task; it is the missing bit to the requested length. The written text proves this interpretation valuable. The ruler is assigned to be the clue to the solving process. First, it serves to find out the length of the given line. Afterwards, it shows the gap between given and requested length.

### **On turns**

In order to reconstruct the process of meaning making in mathematical classroom interaction according to symbolic interactionism, actions are understood as turns on previous actions. As soon as objects are accepted as actors in the ongoing course of interaction, not only the concept of ‘action’ has to be adopted (see above). The concept of ‘turn’ as originally introduced by Sacks (1996) has to be re-thought as well. In his book “Lectures on Conversation” he works on the subject of turn-taking and introduces the adjacency relationship if utterances are related to each other as turns (Vol. II, part 1, p. 41ff.). This utterance-based understanding of ‘turn’ does not meet the demands of interactions. It is not only verbal, but rather all sorts of activities that might be related to each other as turns. The teacher’s utterance might be interpreted as a turn on Sonja’s look at her. Sabina’s “Somehow I don’t get it” might be a turn on the written notes on the blackboard or her working sheet. As a consequence, in the context of an object-integrating approach to classroom interaction, I use the term ‘turn’ in a broader sense: Actions are interpreted as turns, if they are closely related to previous actions. The underlying concept of ‘action’ is closely linked to ANT. It includes different modes of actions carried out either by human beings or by objects. If the concept of action and turn is extended in this way, analysis on the basis of the framework of symbolic interactionism will serve as an appropriate method to reconstruct object-related classroom interaction. Objects and things will be integrated into the course of interaction again. To me, re-thinking the concept of turn is the decisive approach in investigating object-orientated classroom interaction. It is the adopted understanding of turn that helps to trace object’s activities. On the level of turns objects leave observable marks and become visibly connected to one another. Human as well as non-human actors get involved as soon as it comes to think about possible relations between actions as turns.

Analysis on the basis of the adopted concept of turn may work as presented below. Again I refer to the example “Somehow I don’t get it.” In addition to the interpretations suggested above, I now propose an interpretation taking Sabina’s action as a turn on her own written work. Sonja presented her arithmetic proceeding to the task, based on the idea of adding two specific lengths. She did it in a convincing way, and Sabina could follow well. Consequently, she remains silent when the teacher asks those, who got in trouble, to become active. However, looking onto her written work causes confusion. Two different approaches, yet both convincing, show neither conformance nor consensus. The ideas of lengthen *up to* on the one hand and lengthen *by* on the other hand seem incommensurate. The geometrical and the arithmetic approach simply won’t merge. According to this

interpretation, the utterance “Somehow I don’t get it” appears to be a mathematically spoken reasonable statement. The last line of the transcript can be interpreted as a mathematically substantial statement. Its mathematical relevance is closely connected to the two objects, blackboard and written work.

## **ANALYSING OBJECT-RELATED CLASSROOM INTERACTION**

Based on the presented outline of an approach to object-integrating interaction in the mathematic classroom, I will eventually point out some key points concerning the related method of analysis.

The identification of the actors in the scene to be investigated is an interpretative act. Thus, assembling of the list of participants is a pre-selection. In order to leave space for a wide spectrum of alternative interpretations, the list of (potential) participants should not be prematurely limited.

In order to maximize the range of possible interpretations to an observable action, the analytic dodge of variation of the context might be called on. This applies both for human as well as non-human actions.

Actions are related to each other as turns. On the one hand, actions are interpreted as turns on previous human-actors’ actions. On the other hand, actions are explicitly related to non-human actions that may be perceived in distinct ways. How could a certain action be interpreted if it was a turn on an object-participant’s action? Performing such an object-integrating turn-by-turn analysis prevents from accidental neglect or premature exclusion of objects as actors. However, the list of participants might need reassembling or supplementation in the context of this analytic move.

## **REFERENCES**

- Blumer, J. (1986). *Symbolic interactionism: Perspective and Method*. Berkley, Los Angeles: University of California Press.
- Cobb, P. & Bauersfeld, H. (Eds.). (1995). *The emergence of mathematical meaning: Interaction in classroom cultures*. Hillsdale, NJ: Lawrence Erlbaum.
- Fetzer, M. (2007). *Interaktion am Werk. Eine Interaktionstheorie fachlichen Lernens, entwickelt am Beispiel von Schreibanlässen im Mathematikunterricht der Grundschule*. Bad Heilbrunn: Verlag Julius Klinkhardt.
- Latour, B. (2005). *Reassembling the Social. An Introduction to Actor-Network-Theory*. Oxford: University Press.
- Mehan, H. (1979). *Learning lessons*. Cambridge, Mass.: Harvard University Press.
- Radford, L. (2006). *Elements of a Cultural Theory of Objectification*. Revista Latinoamericana de Investigación en Matemática Educativa, Special Issue on Semiotics, Culture and Mathematical Thinking. pp. 103-129.
- Sacks, H. (1996). *Lectures on Conversation*. Cornwall: Blackwell Publishers.