

BELIEF RESEARCH AND THE ACTUAL AND VIRTUAL COMMUNITIES OF A NOVICE TEACHER'S PRACTICE

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So far, few attempts have been made to develop socially oriented understandings of the relationship between teacher beliefs and classroom practices. Two such attempts are outlined and a third presented, which is based on an empirical study of a novice teacher. This study suggests understanding the belief-practice relationship from the perspective of the multiple actual and virtual communities of a teacher's practice.

Research in mathematics education has recently moved towards a greater focus on the social contexts of the teaching-learning processes (Lerman 2001; Bishop, 2001). This *social turn* in mathematics education (Lerman, 2001) is apparent for instance from the increasing emphasis on the communicative and interactive aspects of learning and from the inclusion of situated perspectives on knowing.

There are, however, fields in which the social emphases are still conspicuously absent. One of them is research on the relationship between teachers' beliefs and the classroom practices. Belief enactment, then, is still considered a highly individual endeavour, and beliefs are often considered an explanatory principle in relation to the classroom interactions (cf. Skott, in press). More specifically, if - from an observer's perspective - there is apparent compatibility between the beliefs espoused in research interviews and the classroom practices, there is little more to explain. If no such compatibility is found, an argument for the lack of impact is made, for instance using highly individualistic and condemning explanations of teacher inconsistency, or capitalising on the methodological and conceptual problems of beliefs, deeming the classroom practices dependent on beliefs residing at other levels of consciousness, than those espoused in research interviews or questionnaires. In this understanding, beliefs are seen as a main determinant and the teacher as the sole agent of the mathematics classroom. It is indeed *the teacher's* practice.

One socially oriented reaction to this is Hoyles' (1992) and Lerman's (2001) claim that beliefs are contextualised. Drawing on the work of Lave and Wenger (1991), Hoyles introduces the notion of *situated beliefs*. In this understanding, situations are co-producers of beliefs, and mismatch between beliefs espoused outside the classroom and the practices within it is only to be expected. Slightly modifying this argument, Lerman claims that although there may be 'family resemblance' between the views of school mathematics expressed in research interviews and those held in the mathematics classroom, they are qualitatively different entities (2001, p. 36). Another socially oriented reaction to the individual emphasis in the larger part of belief research, is to adopt an interactionistic perspective. Skott (2001) points to the classroom interactions as a source of changes in the objects and motives of the teacher's activity. When the intention of facilitating mathematical learning is submerged other motives of the teacher's activity (managing the classroom, building students' self confidence, taking their family backgrounds into consideration, etc.),

there may not be compatibility between the teacher's explicit priorities and his/her contributions to the classroom interactions. However, this is neither to be seen as teacher inconsistency (as traditional belief research claims), nor as belief change within the situation at hand (as Hoyles suggests). It is to be perceived as a situation in which the teacher becomes involved in activities not immediately related to mathematics teaching: (s)he is 'playing another game than that of teaching mathematics' (ibid. p. 24).

This paper is based on the premise that the extremely individual perspective often adopted in research on the belief-practice relationship is too limited, and that a *social turn* is needed also in this field. However, the above attempts to include a social perspective appear to need an elaboration. Hoyles' use of the notion of situatedness does not indicate specific ways in which different situations structure beliefs, and the notion seems to be conceived merely in terms of time and setting. Consequently, it becomes an explanatory principle for otherwise inexplicable differences between beliefs and classroom practices, ironically somewhat in the same sense as teacher beliefs have become an explanatory principle in more traditional belief research. Skott, on the other hand, includes activity as a constituting element of situatedness, but does not account for how the objects of the teacher's activity relates to contexts broader than the immediate interaction. More specifically, it is beyond the approach taken how for instance a set of dominant educational priorities in a certain school is brought to the classroom by the pupils and the teacher, and how they become part of the set of mutual expectations that frame the interactions.

The intention of this paper is to suggest an approach to research on belief-practice relationships that takes it seriously that a social perspective on teachers' beliefs is needed, while maintaining that beliefs are significant. I shall refer to a study initially framed within traditional belief research to make the point.

THE STUDY

The study described in this section aimed to contribute to an understanding of the relationship between novice teachers' beliefs and the classroom practices. Larry, a 29-year-old teacher from Copenhagen, was one of 4 teachers for primary and lower secondary school (1-10) selected for the study upon their graduation from college.

Larry had responded to a questionnaire sent to those Danish student teachers in their fourth and final year of pre-service education, who specialised in mathematics. The questionnaire included open and closed items on the students' views of teaching-learning processes in mathematics and their priorities of different aspects of mathematics as a school subject. Also, it asked questions about the students' own educational experiences with mathematics, their reasons for specialising in it at college, and their confidence as beginning mathematics teachers.

11 student teachers were selected for interviews out of 115 respondents to the questionnaire. Larry was interviewed immediately after the holidays following his graduation, i.e. within the first week of his teaching career. A semi-structured,

qualitative approach was used (Kvale, 1996) in which he was invited to elaborate on his priorities in relation to school mathematics and to describe significant educational experiences with the subject. Also, he was asked to comment on three sets of written materials: (a) a grade 5 student, Mathias, proudly presenting a false conjecture about the area and perimeter of rectangles; (b) an experienced teacher describing the different roles of investigative activities for high and low ability students; (c) five 12-17 line transcripts from imaginary interviews with teachers presenting different visions of school mathematics. (I shall return to (a) later).

Larry's mathematics classes were videotaped for 2½ weeks six months after his graduation. The videotapes and transcripts were analysed from the perspective of congruence and conflict with the value judgements and educational priorities Larry expressed in the questionnaire and the interview. How, for instance, do the interactions look, when viewed from the perspective of his proclaimed view of student learning? A special focus was on how he organised and orchestrated classroom communication both in whole class and small group settings. In a final interview, Larry was asked to comment on 5 video clips selected as exemplary for the interactions when viewed from this perspective.

Larry at the time of his graduation

Larry was selected for the study because he seemed strongly committed to teaching, and because his views - as presented in the questionnaire and the interview - reflected significant aspects of current reform initiatives in mathematics education (e.g. NCTM, 2000). These views, he claimed, were mainly the outcome of his pre-service education. He described learning as individual knowledge construction especially related to investigative activities with manipulatives, and he saw teaching as facilitating learning in a variety of ways, not merely as explicating concepts and procedures. However, Larry also emphasised more traditional elements of school mathematics, especially student command over basic skills. This led to a perceived conflict between the amounts of time needed for investigations and the pressure to cover the traditional syllabus. Further, he considered these two objectives irreconcilable: at any one time you have to do one *or* the other. These priorities - including the perceived conflict between them - was apparent in his response to the questionnaire, but even more so in the first interview. As a teacher, you have

“to see how your individual students understand - of course you can't *see* that - but you can see how the individual student works and see how they try to move on and see what works for them. [...] Actually, I'd like to allow the students to have more time. Maybe if I can inspire them in different ways, they find out on their own [...], but I also know that we don't always have the time to do that [...] Sometimes you just have to lecture ... all the other stuff isn't possible all the time. [...] maybe 70% of the time they have to work traditionally, and then they may experiment in the last 30%”. (The first interview)

Larry was concerned with how to differentiate his teaching according to the students' ability levels, an issue that was important in his pre-service education. His view of the issue was apparent from his reaction to the transcript on Mathias, cf. the previous

section. In the transcript, Mathias works with three other students to find the area and perimeter of rooms they have measured and to present their findings to the rest of the class. At the end Mathias exclaims with some excitement: 'Wow, look at this, the longer the perimeter, the larger the area!' Larry was informed that as he did not know Mathias and the class, he was expected only to provide an immediate reaction to the situation. He said he would praise Mathias for the observation, but challenge him to find counter examples. Asked if other students would be involved he said:

"No, this is Mathias' observation, so it's OK that he continues with it ... it's also a way to differentiate between the students, because he is ready for it, but maybe the others would find it boring [...] If some of the others see what he is doing and are caught by it, then they can continue working on it, but I wouldn't impose it on them". (The first interview)

In summary, Larry claims that student investigations are required but isolates them from the bulk of his instruction dominated by more traditional tasks. This 'island'-approach is combined with a view of differentiated teaching, which individualises student activity and misses significant opportunities for communal learning.

Larry meeting the school

Larry works at Mellemvang, a conservative private school 30 km from the city. To exemplify the school's traditional educational priorities, he mentions that marks are given from grade 1; standardised tests are used frequently, and the results published within the school, so that marks may be compared between students, classes, and teachers; and students are streamed according to ability in grades 8, 9, and 10. These practices, alien to those of most Danish schools, are the result of decisions made by the management. However, they are endorsed by the parents, who are interested in their children's education, but focussed on traditional values like good behaviour and skill acquisition. At times, their interest does become a trying experience.

Already in the first interview, Larry is worried about the extent to which his own educational priorities would clash with those of the school:

"... somehow it [the management] doesn't fit very well with the ways I think, [...] I have to strike a balance between the expectations of the parents and the school management and the ways I want to work [...]" (The first interview).

Also, Larry considers his colleagues an obstacle to change. He explains that they used the management as an excuse for not taking any initiatives themselves:

"...several of my colleagues have said, if we've discussed doing things differently: 'Good idea, but you have to remember that at any time you'll be held responsible by the parents and the management, and it's important that you can [...] show that you've been through all that is in the curriculum'." (The first visit to Mellemvang)

Larry is very much aware that he is deemed responsible for the students' learning. At Mellemvang, teaching is a highly individual endeavour:

"It is the individual teacher who makes all the decisions. There is no teamwork. This means that the experiences I am to gain from older colleagues have to be collected in a hurry during the break, while I'm eating my lunch, and doing a whole lot of other stuff

that needs to be taken care of - so obviously: It isn't much. [...] And I miss that a lot. [...] It would be easier if some of my colleagues would ask 'I'm going to try this out, do you want to join in'. I would say yes immediately. But nobody asks" (The first visit to Mellemvang)

It is apparent from the initial interviews that Larry considered himself in opposition to the dominant priorities of the school. He soon developed an 'I-they' relationship, not an 'I-we' relationship, to the colleagues, the management, and the parents.

Larry meeting the classroom

Larry teaches mathematics in grade 5. He calls it 'my little luxury', as there are only 15 students, there are very few disciplinary and social problems, and most of the students do well in mathematics. The only major difficulty is that the school's competitive assessment practices have lead two girls to attach a self-imposed stigma on their mathematical activity, due to their relatively poor performances.

On the day when the class begins on the new chapter on integers, Larry starts off by correcting the students' homework in a fast and insistent manner in a whole class setting. He then introduces the notion of perfect squares by writing ' $2^2 = 2 \cdot 2 = 4$ ' on the board, and asks what 3^2 may mean. A student suggests that the result is 6. Larry, turns it down, saying "Now you have multiplied by 2". He writes ' $3^2 = 3 \cdot 3 = 9$ ', and another student suggests that the two numbers be the same. Larry confirms this and writes the students' homework - a number routine tasks from the textbook - on the board. The students start working on these tasks individually, Larry giving fairly direct instructions to the ones who find it difficult. By the end of the lesson, Larry writes the perfect squares from 1 to 196 on the board and asks for a connection between the numbers. After a few seconds, a boy exclaims: 'Between each number there is an increase of two'. Larry praises him for the observation, and asks, if they think this pattern continues. They claim that it does. Larry agrees and gives an explanation, but one that few students understand. Immediately afterwards, a student interrupts and claims to have found another pattern: 'If you multiply something/two numbers with 5s in the end [as the last digit] the result is always something with a 5'. All of a sudden, other students present other conjectures in a very spontaneous fashion. Larry chooses to close the issue and not pursue the questions any further.

This first lesson on integers is exemplary for the atmosphere in Larry's classroom. First, Larry often dominates whole class discussions in the sense that he uses the textbook to delineate a narrow focus for the students' activity. Second, he is fairly explicit in his support to the students. Third, the students often present conjectures on patterns or relationships, either spontaneously or after being prompted. To sum up, Larry uses fairly traditional modes of interaction with the students in large parts of the lessons, but an atmosphere has evolved that encourages and values student contributions. Larry's response to these contributions is generally to take over the conjecture or observation, both when it concerns a standard result and when this is not the case. The following episode exemplifies the latter situation.

In the next lesson Larry brings in a box of centicubes, i.e. plastic cubes of $1 \times 1 \times 1$ centimetres that may be put together and used for instance when teaching place value. The students are to make squares and cubes out of centicubes in order to relate integer concepts of perfect squares and cubes with their geometric representations. Larry suggests that the students build just a skeleton of a corner and its adjacent sides to illustrate a cube (cf. fig. 1). The students begin and soon this happens:

Kasper: I came to think ... I found that when you make one of these, you don't use 27 centicubes [shows a skeleton of a $9 \times 9 \times 9$ cube].

Larry: Well how many do you use?

Kasper: You only use 25.

Larry: Because//

Kasper: //even though 3×9 is 27 ... because you make like this [takes off two rods of 8 centicubes each]. Now there are 9 centicubes.

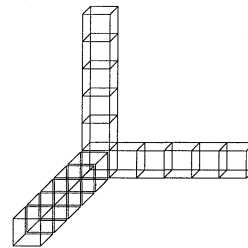


Fig. 1: A $6 \times 6 \times 6$ corner of the type Kasper shows

Larry: Yes.

Kasper: And then these two, they are 8 each [shows the two rods of 8]. And together ... that is 25.

Larry: And that is 25, yes, and that is simply because//

Kasper: [Is trying to remain in control of his proposal] //but Max he thought that the $8 \times 8 \times 8$ -cube would be 24...

Larry: Yes, well that is because this one [picks up Kasper's cube, and points to the centicube in the corner] //

Kasper: //it counts as three.

Larry: It belongs to - take good care now - it belongs to this side, to this side, and to this one [Larry takes over and continues his explanation].

In this episode, Kasper presents his observation that fewer cubes are needed than expected. Larry praises him for it, but takes over the conjecture, preventing Kasper to remain in control. Commenting on the episode in the interview, Larry explained that he wanted to give other students access to Kasper's observation, but that few of them did understand. He did not consider this a problem and referred to need to differentiate his teaching. Also he did not pursue the observation any further, because he was uncertain where it would take him, and because

"there are certain things we have to cover in the course of the year, and that's why we spend a lot of time doing textbook tasks. We also have to do stuff like this, but it is obvious that I have to limit it and consider, how much they are to do of one and the other. Obviously I could return to this later, but I am not sure I'd do it. I don't think I would."
(The final interview)

The above episodes from Larry's classroom significantly resemble his school mathematical priorities as espoused in the initial interviews and in the questionnaire. The atmosphere invites student conjectures, which may be pursued by the originator, but never by the whole class, cf. Larry's concern for differentiation. In most cases,

Larry takes over the students' observations and conjectures and closes the investigative opportunities without involving the students. This latter characteristic of his classroom is a result of his initial intention of ensuring enough time for more traditional activities, but is fuelled by the pressure he is under at Mellemvang to ensure that the students perform well in next test.

DISCUSSION AND CONCLUSIONS

As mentioned earlier, two attempts have been made to describe belief-practice relationships socially. One emphasises how the energising element of the teacher's activity emerges from the interactions with specific groups of students and directs her further contributions to the discourse; the other uses situatedness - in terms of time and setting - as an explanatory principle for discrepancies between beliefs and practice. The study of Larry suggests combining these attempts by using the notion of communities of practice (Wenger 1998).

Wenger claims that developing a practice requires

“the formation of a community whose members can engage with one another and thus acknowledge each other as participants. As a consequence, practice entails the negotiation of ways of being a person in that context. [...] In this sense, the formation of a community of practice is also the negotiation of identities ” (1998, p. 149).

From this perspective, there is no *community of teaching practice* at Mellemvang. The teachers' do not jointly relate to the same children, do not discuss ways of handling classrooms in general, do not to challenge the educational priorities of the management, and do not participate in joint efforts to develop or make different use of teaching-learning materials. In short, they do not mutually engage in practices related to facilitating student learning. However, this delineation of the teachers' engagement signifies important aspects of a *community of teachers' practice*, albeit in negative terms. Other aspects of this practice are how to behave in the staff room, how to prepare for the school festival, how to put a request to the management or how to prepare for the next PTA-meeting. These negatively and positively defined fields of practice are those in which the teachers 'acknowledge each other as participants', in which they jointly engage, and which constitute their identities at Mellemvang. At times Larry struggles hard to become part of this community.

However, the community of teachers' practice is not a source of Larry's identity as a facilitator of learning. Repeatedly, he referred to his experiences with mathematics and mathematics teaching and learning at college, both when he was satisfied with his own teaching and when he was not. In spite of the physical and temporal distance between Larry's pre-service education and his teaching activity, the former does constitute a context for the formation of his identity as pertaining to the latter, not only while he was still at college, but also at the beginning of his teaching career. In other terms, when Larry's classroom activity is primarily directed at facilitating learning his participatory framework, the social aspect of his professional identity, is linked to his pre-service education. Specifically, what matters most for the ways in

which he invites student contributions, for his use of manipulatives to support their learning and for the ways he deals with problems of student differentiation, is his participation in the educational discourse of his pre-service training. Upon his graduation, then, Larry is related to the virtual and probably fading community of teaching practice established and defined in the course of his pre-service education, the main source of his beliefs.

The moral of this story concerns how the role of teachers' beliefs in relation to practice may be conceived. The need for a contextualisation of beliefs, i.e. for a *social turn* in research on belief-practice relationships, neither requires one to refrain from dealing with beliefs as a set of relatively stable school mathematical priorities, nor does it force one to rely on vague descriptions of a 'family resemblance' between beliefs and practice. I suggest - in line with Lave and Wenger (1992, p. 32 ff.) - to include activity as a constituting element of situatedness, and to acknowledge the simultaneous existence of multiple, possibly conflicting, actual and virtual communities of a teacher's practice. Each of these may play a role when different objects of the teachers' activity emerge in the course of the classroom interaction. From this perspective, the focus of classroom research on teachers' beliefs is not to state congruence or conflict between beliefs and practice, but to disentangle the ways in which - from the teachers' perspective - the multiple communities interact and frame the emergence of different objects of his or her activity.

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