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BELIEFS VS. PATTERNS OF PARTICIPATION – TOWARDS COHERENCE IN UNDERSTANDING THE ROLE THE TEACHER

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The three main lines of research on teachers are the ones concerned with beliefs, knowledge and identity. The two first are generally based on acquisitionism, the last is more participationist. This leads to some incoherence. I introduce an ongoing study that aims to develop a coherent approach, using a patterns-of-participation framework, which was initially developed in relation to beliefs. It is a multiple case study that views instruction as the simultaneous engagement in multiple, possibly conflicting social practices. The data presented are about Anna, a novice, lower secondary teacher. The interpretations of the practices that unfold in her classroom suggest that there is some potential in the patterns-of-participation perspective.

The main contribution of teacher-related belief research has been to point to the limitations of the cognitive and purely mathematical emphases that used to dominate mathematics education. Since the 1980s it has insisted on the role of meta-issues such as teachers’ conceptions of mathematics and its teaching and learning for classroom practice (Leder et al., 2002; Lloyd, 2005; Maasz & Schlöglmann, 2009; Schoenfeld, 1992; Skott, 2001; Speer, 2005; Thompson, 1984). In this sense it supplements research on teachers’ mathematical knowledge, which is primarily concerned with the specifics of teachers’ content preparation (Ball et al., 2008; Davis & Simmt, 2006; Ma, 1999), and the more recent interest in teachers’ professional identities (Brown & McNamara, 2005; Hogden & Askew, 2007; Sfard & Prusak, 2005).

There are, then, three main lines of research that focus on mathematics teachers, i.e. the ones related to beliefs, knowledge and identity. Besides these lines of inquiry to some extent share a methodical interest in qualitative studies of mathematics classrooms, as it is increasingly agreed that understandings of (i) teachers’ beliefs of mathematics and its teaching and learning, (ii) the relevant aspects of their mathematical proficiency, and (iii) their tales of themselves as professionals must, at least in part, be based on interpretations of their contributions to classroom practice. Besides, studies of teachers’ knowledge and beliefs share an inspiration from acquisitionist views of learning and knowing. Knowledge and beliefs, then, are generally understood as relatively stable objectifications of engagement in (social) practices (cf. Sfard, 2008). These object-like entities are viewed as the properties of the individual in question and expected to take on a life of their own and have significant impact on practice (Skott, 2010).

In spite of these similarities there is a somewhat surprising disconnect between research on teachers’ beliefs, knowledge, and identity that is counterproductive to the
development of coherent understandings of the teachers’ role for classroom practice and for student learning. First, research on identity tends to adopt a participationist stance that is at least partly in contrast to research conducted in the other two fields. It maintains a processual emphasis, for instance in line with Holland et al. (1998), Wenger (1998), or Sfard & Prusak (2005). Identity, then, is generally viewed as fluid and always in the making, as tales of being and becoming as they relate to simultaneous engagement in multiple, social practices. In this sense it is used as a less contextually and temporally stable construct than knowledge and beliefs. Second, there is little connection between current understandings of mathematical knowledge for teaching and the role of teachers’ beliefs in instruction in spite of the acquisitionist and somewhat individualistic underpinnings of both lines of research.

Research on mathematics teachers, then, is conducted in three relatively distinct domains. This paper presents an ongoing study that intends to develop more coherent understandings of the teacher’s role for learning and life in mathematics classrooms. It does so by using a patterns-of-participation framework that was initially developed in an attempt to overcome the notorious conceptual and methodological problems in belief research (cf. Skott, 2009), while maintaining an interest in the meta-issues that constitute the field of beliefs. The patterns-of-participation framework challenges mainstream belief research by questioning the very notion of beliefs and its acquisitionist underpinnings (Skott, 2010). It has subsequently been used for empirical purposes as an alternative to regarding classroom practices as a result of an enactment of objectified mental constructs, i.e. beliefs, on the part of the teacher (Skott et al., 2011). In line with other more social approaches to research in mathematics education, this alternative insists on the emergent and processual character of classroom practices. It relies, then, to a greater extent than mainstream belief research on participationism as a metaphor for human functioning.

The aim of the present paper is to indicate the possible potentials of the patterns-of-participation framework for developing a more coherent approach to research on and with mathematics teachers. The idea, then, is to extend the use of the framework from meta-issues (‘beliefs’) to what is traditionally referred as knowledge and identity. I shall begin by outlining the patterns-of-participation framework as developed in relation and opposition to mainstream belief research. This forms the backdrop of a subsequent analysis of a short classroom episode from an on-going study of Anna, a young teacher at the lower secondary level. The intention is to analyse Anna’s contributions to the interaction as her simultaneous engagement in a range of present and prior social practices, some of which are meta-mathematical, while others are mathematical, and still others relate to her broader tales of herself as a novice teacher.

**PATTERNS-OF-PARTICIPATION**

Students and teachers engage in multiple simultaneous practices in the classroom, some of which relate to the teaching and learning of mathematics and some of which do not. Some of them are discursive in an explicit verbal sense, while others are not;
and some of them are virtual in the sense that they relate to communities that are not physically present in the classroom or at the school (Skott, 2009). For example a teacher may at any instant engage in practices associated with e.g. her colleagues, the school management, the parents, and her pre-service teacher education programme. These activities may function as resources that asymmetrically structure the teacher’s contribution to the practices that unfold in the situation (Lave, 1988).

Mathematics itself is a patterned activity on e.g. numbers, variables, and operations. Meta-mathematical patterns indicate what questions to ask, what answers to expect, and what quality is in relation to a solution or procedure. In the classroom the patterns also designate the relative responsibilities of teachers and students.

The teacher negotiates and contributes to the continuous (re-)generation of classroom practices. She becomes involved in actions as diverse as repeating procedural explanations, solving disciplinary problems, ensuring a student’s position in the classroom community, and taking a child’s problematic home situation into account. In all of this, patterns in the teacher’s prior engagement in social practices are enacted and re-enacted, moulded, fused and sometimes changed beyond recognition as they confront, merge with, transform, substitute, subsume, are absorbed by, exist in parallel with, and further develop those that are related to the more immediate social situation.

From this perspective, teaching is not the enactment of pre-reified knowledge and beliefs. It is a meaning-making activity in which the teacher continuously manoeuvres between different forms of participation in different past and present practices. The research task is to outline the character of these practices, to disentangle the patterns in the teacher’s participation in them, and to understand if and how they influence the learning opportunities that evolve. From the outset it should be made clear that this framework does not do away with individual meaning-making and returns to a behaviourist approach to professional activity. Instead it reformulates what such meaning-making is, by accepting and focusing on the floating character of human interaction and suggesting that meaning is made up of a continuous interpretation and reengagement in value-laden, prior social practices.

THE STUDY

This study is on teachers’ professional development prior to and in the first few years after their graduation. It addresses the question of the relationship between their professional identity and their contributions to mathematics classroom practices, including issues related to what is traditionally described in terms of knowledge and beliefs. The study, however, does not focus on beliefs, knowledge, and identity as distinct, objectified, individual entities with an expected impact on practice. Instead it intends to develop processual interpretations of instructional practice by interpreting classroom interaction as emerging and teachers’ acts and meaning-making activities as participation in meta-mathematical, mathematical, and broader social practices.
Methodology and methods

There are two main methodological challenges in the study. First, we need an approach that views (prospective) teachers’ identity and involvement in educational activity as transformations in modes of participation in classroom practices in view of broader social processes at the institution in question and beyond. Second, an interpretive stance is needed that views institutional practices as well as shifts in the teachers’ engagement in them from the perspective of the teachers in question.

To meet these challenges we use a qualitative approach inspired by grounded theory (GT) (e.g. Charmaz, 2006). We use the methods of GT (e.g. coding schemes, constant comparisons, memo writing) as flexible guidelines for theorising processes of teacher identity and classroom teaching. However, we do so without subscribing to the objectivist connotations sometimes associated with them.

The research participants are selected purposefully. One selection criterion is their commitment to current reform discourse; another is their mathematical and pedagogical self-confidence. If possible these criteria are supplemented with whether the schools have clear educational and/or school mathematical priorities. Between them the criteria are to ensure that the cases are critical (Flyvbjerg, 2006), and may bring to the fore aspects of conflict and congruence between the participants and the dominant practices at their schools. In turn this may allow interpretations and analytic generalisations about teachers’ identity and their role for classroom practice.

The study is a multiple case study of app. 15 prospective and practising teachers at levels ranging from elementary to upper secondary school in Denmark and Sweden. The data reported in the following concern Anna, who teaches lower secondary mathematics at Northgate Primary and Lower Secondary School in Denmark.

At present the data on Anna include a questionnaire used to select participants in the study; three interviews, including one using stimulated recall; observations of eight lessons organised as four sessions of 90 minutes and of one team meeting between Anna and her three closest colleagues; analysis of students’ work and of Anna’s interpretations of it and of a few supplementary teaching-learning materials that she develops herself. The interviews and classroom observations are audio and video recorded, respectively, and transcribed. The data from the team meeting is a text that was written immediately after the meeting on the basis of comprehensive observation notes. This is so, as Anna’s colleagues are opposed to recording team meetings, because they discuss confidential issues in relation to named students at the meetings, and they are worried about a possible breach of confidentiality. Also, they are explicit that they would be less relaxed at the meetings, if they were recorded.

Anna was interviewed immediately after the holiday following her graduation and again 9 months later, i.e. towards the end of her second term as a full-time teacher. The interviews were semi-structured (Kvale, 1996) and invited Anna to reflect on good and bad experiences with mathematics and its teaching and learning. For
instance she was asked to elaborate on the roles of the teacher in specific episodes when instruction went well and to exemplify the qualities – and lack thereof – of her teacher education programme. The second interview focused on Anna’s experiences with mathematics teaching at Northgate and on her relationships with the school, her colleagues and the students. The third interview was conducted after two weeks of classroom observations in Anna’s third term of full-time teaching.

THE CASE OF ANNA AT NORTHGATE

Anna is 25 years old when she finishes her teacher education programme at a city college in Denmark. She has studied mathematics as one of four school subjects.

18 months before her graduation Anna gets a part-time position at Northgate Primary and Lower Secondary School. The school is located in a well-to-do area, few miles from the city centre. Anna teaches 6-8 lessons of physics a week in her first year at Northgate and 15-20 lessons, incl. mathematics in grade 8, in the following six months. Upon graduation she accepts the offer of a full-time position at the school.

In the first interview soon after her graduation, Anna considers it important, that she has taught before, and she is confident that she can manage the challenges of the profession better than most of peers. She does not think of her teaching as a site for the application of educational theory from college. Rather, she has used her teaching experience to prioritise and inform her interpretations of the theoretical contents of her pre-service education:

> I have been able to use really a lot of it [the experience], not only in relation to the school subjects [as taught at the college], but also in educational studies. You know, I have been able to take something with me [from the school to the college] every week. (Int. 1).

Anna always wanted to be a teacher, and mathematics was always her favourite subject. This is still the case, and she explicitly considers herself a mathematics teacher. She emphasises that a teacher needs to be mathematically creative in order to view the subject from the students’ point of view and unobtrusively guide them so that they “develop their own ways of seeing things” (int. 1). However, she is also explicit that “the good mathematics teacher needs to be able to do and know so much more than mathematics” (int. 1). Especially, she emphasises the need for a trusting relationship with the students and that even though she is fond of mathematics, she hopes to become important for them as a role model and a person not only as a teacher of mathematics (int. 1).

Anna describes mathematics as “a multi-facetted subject” (int. 2). She is concerned with connections within the subject, but in particular with the ones between mathematics and the students’ everyday lives. She refers to her own education both in lower and upper secondary school to make the point. In the latter she had a teacher “who was really good at jumping out of the book and let us do projects and things” and who “made mathematics part of everyday life”, for example by having the students measure the school buildings and compound in trigonometry (int. 1).
Anna distances herself from an overemphasis on basic skills, and calls for a strong process orientation, for instance using the term of “landscapes of investigation” from her mathematics education course at college. Also drawing on that course she emphasises students’ mathematical communication, even when the students’ find it difficult. It allows the teacher some access to the students’ thinking, and more importantly it is vital to the students’ understanding and remembering:

They simply find it so difficult to put it into words. […] ‘Then you just do like this’. Yes, but why? […] I think that the communication part is so important, ’cause if they don’t know […] why they can change between percentages and fractions the way they do, if they don’t know why, I don’t think they remember in six months. (Int. 3)

Anna also uses student communication to differentiate her teaching. If she just uses the textbook “some [students] rush right through […]; others get stuck in exercise 1” (int. 1). Students communicate differently, and Anna accepts that their “words may not be the final truth […] But if there is a meaning in it for them […] I think there is a certain quality in it” (int. 3). This also implies that Anna accepts leaving part of the responsibility for the quality of the students’ explanations to themselves. She wants the students to be able to do mathematics “without the teacher checking it” (int. 3).

Anna at Northgate

Anna enjoys Northgate, not least as the teachers are organised in teams, who teach (almost) all subjects to a year group. In the first year after her graduation Anna is in a team of four, who teach grade 9, the last year of lower secondary school. Now, in Anna’s second year, the same team teaches grade 7, Anna teaching mathematics in all three classes.

Anna’s team meets approximately every three weeks. They discuss issues related to individual students and social problems in the year group. They also plan for instance PTA-meetings, the school’s sports day, and changes in the time table. They do not, however, jointly plan instruction or teach together. Anna, for instance, is trusted by her colleagues in the team with all responsibilities related to mathematics in the year group. The other side to this is that in practice she is very much on her own. She once asked an older colleague for suggestions, and she sometimes shares ideas with another novice “in the corridor” (int.2). These two teachers are not in Anna’s team.

Anna does not consider the lack of cooperation about instruction a problem: “in mathematics I have been happy to paddle my own canoe” (int. 2). Her self-confidence is backed by good relationships with the students and frequent praise from the parents (int. 3). Also, she has a sense that the practices she wants to promote are not widely shared among the mathematics teachers at Northgate. For instance, it is evident to her that the students never spent time discussing mathematics before she came. For them “words do not belong in mathematics; that is only numbers” (int. 3).

Anna, then, is satisfied with her professional isolation as it relates to her teaching of mathematics. In contrast, she highly appreciates her collaboration with and assistance
from her team, especially from her older colleague, Ian. She does not discuss instructional planning or classroom teaching with him, but she tries to “maybe copy a little of what [he] does” as it relates to other aspects of the profession, including how to prepare for meetings with the parents, how to keep your teaching-learning materials organized for the next time you need them, and how to maintain a high level of commitment to the job. Especially, Ian has “this way of being with the students” that Anna admires, and that she finds helpful for her own attempts to build a trusting and confident relationship with them (int. 2).

Anna in 7A

7A is a class of 8 girls and 13 boys. Anna is very fond of the class and vice versa. Some students have social and domestic problems, but not so to such an extent that Anna finds it difficult to cope. According to Anna the students’ mathematical performance varies a lot. Some of them can work independently to a great extent, while others are very weak. Catherine, for one, has so many learning problems that “it is really a question of whether she should be here at all” (int. 3).

In the middle of Anna’s first term with 7A, the class works with fractions, decimals, and percentages. They have worked on these concepts before, but the emphasis is now on the connections between them and how to transform one into another.

Introducing the topic, Anna asks the students what they did before on fractions, decimals and percentages. They agree to have discussed where the concepts are used in everyday life, and the students mention some examples of that. No other previous work is mentioned. Next Anna asks the students about the proportion of girls in the class, and this is used to exemplify the transitions between the three concepts.

After that the students begin to work on a set of textbook tasks. In some cases they are expected to make conversions between fractions, percentages and decimals themselves, while in others the book presents a conversion. In all cases, it is the task for the students to explain why or why not a certain conversion is correct, using oral and written language as well as drawings. Introducing these tasks Anna says:

And the most important of it all here is that you say the words, that you also talk [about this] in pairs. The more you talk mathematics, the better you get at […] putting it into words, how you do the calculations.

The students begin, but many find it difficult and have questions to ask. Anna walks around from table to table to help them. Soon after she stays 3½ minutes with Debra and Annika, who are trying to explain why $20\% = 0,20 = \frac{1}{5}$. Annika got stuck in her attempt to reduce the fraction of $\frac{20}{100}$. Debra has written “$\frac{20}{100} = \frac{2}{10}$” in her notebook:

Anna: [To Annika] Try to look at what Debra has written.
[Annika looks in Debra’s note book.]
In the episode Annika has problems reducing a fraction. Anna asks her to look for help from Debra. Debra produces a procedural explanation that works for the specific numbers, but Annika realises that the procedure does not work in general. Anna supports her in this, but they do not follow up on Annika’s comment. Anna leaves them, confirming Debra that her procedure is right.

Anna was asked to comment on the episode in the stimulated recall interview:

What immediately comes to mind, which I am sure it didn’t at the instant, is that ‘take away the zero’ [cf. ‘6’][…] there is no explanation […] she explains what she does, but not why she does it. You know, […] this is not a mathematical explanation. (Int. 3).

Anna also commented on her own reaction to Debra. She says that Debra did explain something, but Anna also noticed Debra’s comment that she is not very good at this. It reflects that “Debra generally has the problem that she thinks she is the weakest in mathematics in the whole world, which is not the case at all”.

**DISCUSSION AND CONCLUSIONS**

Anna enjoys taking on the responsibilities that follow from the functioning of her team at Northgate. She does so with confidence in 7A and engages in mathematical discourse, discussing and manipulating the concepts, the symbols and the operations of the subject in whole-class and small group settings. At the same time she re-engages in two distinct educational discourses. One of these relate to mathematics and addresses the issues of a process orientation of school mathematics and the use of the real world problems. This relates to theoretical parts of her mathematics education course at college, and is backed by her own school experiences. The other educational discourse concerns how to develop a trusting relationship with the
students. This is connected to other theoretical aspects of her teacher education programme and to her imitation of Ian’s ways of being with the students. Between them they suggest allowing the students significant degrees of freedom and responsibility, both in relation to their learning of mathematics and beyond.

In the transcript, Anna insists that the students explain a result given in the book. She also tries to convince Debra that she – Debra – is not so weak in mathematics as she thinks herself. This reflects her engagement in the two educational discourses mentioned above. In contrast, she does not engage in a genuinely mathematical discussion with the two students about the relationships between percentages, decimals and fractions or about the functioning of Debra’s procedure, even when Annika questions its applicability. In turn this lack of attention to mathematics per se, leads to missed opportunities for meta-mathematical discussions about what constitutes a good mathematical explanation. In this episode, then, Anna’s participation in mathematical discourse is overruled by a merger of her engagement in a more general educational one and her emphasis on reform issues in mathematics, especially student communication. This is noteworthy as Anna’s comments in the subsequent interview indicate that the lack of mathematical emphasis is neither due to a general lack of command of the relevant mathematical discourse, nor to a general interpretation of Debra’s comment as a satisfactory explanation.

In the terms of patterns-of-participation, Anna is renegotiating what it means to be teacher in her team at Northgate. She takes on the sole responsibility of mathematics in the year group, and doing so she positions herself within the team as well as in relation to the students and the parents. As part of this she participates in emerging classroom practices by re-engaging in theoretical discourses from her teacher education programme, in more immediate forms of social interaction from her own schooling, and in mental negotiations with Ian about ways of relating to the students. In the transcript, these prior practices dominate her contributions to the interaction to the extent that the mathematical potential of the task vanishes.

This is an alternative to interpreting the practices in 7A as a result of Anna’s enactment of pre-reified mathematical knowledge and beliefs. In comparison it does away with the acquisitionist connotations of the latter, and it offers a view of classroom processes as indeed processual. It may be developed into a coherent approach to understanding the role of the teacher for emerging classroom practices.

References


Skott