PATTERNS OF PARTICIPATION – A FRAMEWORK FOR UNDERSTANDING THE ROLE OF THE TEACHER FOR CLASSROOM PRACTICE

Dorte Moeskær Larsen, University College Capital, Denmark

Camilla Hellsten Østergaard, University College Metropol, Denmark

Jeppe Skott, the Linnaeus University, Sweden & Aarhus University, Denmark

Research on teachers' knowledge and beliefs has grown big in recent years. The larger parts of these fields are built on acquisitionist interpretations of human functioning. We explore the potentials of a participationist framework for understanding the role of the teacher for emerging classroom practices. The framework is built on social practice theory and symbolic interactionism and adopts a processual approach to understanding the role of the teacher. We use the framework in a qualitative study of two teachers with different prior experiences. The study suggests that the framework has some potential and sheds light on the dynamic relationships between the teacher's engagement in the practices of the mathematics classroom and other, personally significant, past and present ones.

Key words: mathematics teachers, patterns of participation, classroom research.

Research on and with mathematics teachers has grown over the last decades. Among others, it has addressed the questions of how to reconceptualise the mathematical knowledge teachers need in instruction (Ball et al. 2008; Davis and Simmt 2006; Ma 1999; Rowland and Ruthven 2011; Rowland et al. 2009) and of the relationships between their conceptualisations of mathematics and its teaching and learning on the one hand and the classroom practices on the other (Leder et al. 2002; Maasz and Schlöglmann 2009; Rösken et al. 2011). This research on teachers' knowledge and beliefs generally interpret human functioning in acquisitionist terms. Knowledge and beliefs are considered entities that reside within the individual. They may be challenged socially, but such challenges are considered a result of an experiential encounter between the individual and an external reality.

This conceptualisation of the individual is somewhat at odds with other current attempts to interpret human functioning in more social terms and view learning and learning to teach as shifting modes of participation in socially established practices. For the purposes of the present paper we adopt a perspective more in line with this latter perspective as we use what we have called a patterns-of-participation framework to understand how the teacher contributes to the practices that emerge in mathematics classrooms (Skott forthcoming; Skott et al. 2011).

THE PATTERNS-OF-PARTICIPATION FRAMEWORK

Patterns-of-participation research (PoP) draws on social practice theory (Holland et al. 1998; Holland and Lave 2009; Lave 1996; Lave and Wenger 1991; Wenger 1998) and symbolic interactionism (Blumer 1969, 1980; Mead 1934) to develop processual and dynamic interpretations of the role of the teacher for classroom practice. The argument is that the locally social emerges as individuals view themselves from the outside and in the parlance of symbolic interactionism take on the attitudes of individual and generalised others. In interaction one interprets others' actions and actual and envisaged reactions to one's own conduct symbolically and adjusts one's actions accordingly. This does not necessarily imply becoming in line with one's immediate interlocutors' expectations. Rather it may involve reintroducing the perspective of for instance other individuals, a group of people who are significant for the context as seen by the person in question (e.g. a team of collaborating teachers), and what Holland and her colleagues (1998) call figured worlds (i.e. imagined as-if worlds such academia, games of Dungeons and Dragons and Alcoholics Anonymous; - or a reform discourse in mathematics education).

In Wenger's terms a community of practice is characterised by mutual engagement, a joint enterprise, and a shared repertoire; to participate in a practice is to engage in the negotiation of its meaning. When a teacher works with a team of colleagues to develop mathematics education or to find ways of addressing more generic educational problems she may be said to participate in a community of practice in Wenger's sense. However, the notions characterising a community of practice need to be stretched if they are to account for the relationship between a teacher and for instance the figured world of the reform in mathematics education. In spite of that we use 'participation' also to account for the latter situation. It is in this case a matter of negotiating meaning and positioning oneself in an internalised discourse about the teaching and learning of mathematics.

As teachers engage in immediate classroom interaction they draw on a range of other past and present practices and figured worlds, some of which relate to mathematics and its teaching and learning, while others do not. The task for PoP may then be rephrased as an attempt to disentangle the multiple practices and figured worlds in which the teacher participates during classroom interaction as well as their transformations and mutual relationships.

In this paper we use PoP to analyse the practices that evolve in two different classrooms at two different primary and lower secondary schools in Denmark. The two teachers are Susanne, working at Southern Heights, and Astrid, working at Eastgate. The question we address is what the patterns are in Susanne's and Astrid's participation in their mathematics classrooms?

THE STUDY OF SUSANNE AND ASTRID

The study of Susanne and Astrid is part of a larger study involving four other practising and prospective teachers. The study spans almost two years.

Susanne is 36 years old when she graduates as a teacher of mathematics from a city college in Denmark. She began teaching at Southern Heights four years prior to that without a degree in education, but she enjoyed teaching and after two years at the school she decided to enrol in a 2-year college programme for second-career, prospective teachers, specialising in mathematics. Formally, the course in mathematics deals not only with the subject itself, but is an integrated course in mathematics and mathematics education.

Astrid has taught for 18 years. During her pre-service education she studied most of the subjects in elementary school, but she specialized in music and physical education. After 9 years of teaching at different schools she gets a position at Eastgate, and begins to teach mathematics. At that time, all mathematics teachers at Eastgate, including Astrid, become involved in a teacher development programme involving four days of lectures and workshops and individual supervision by the teacher educator. Astrid enrols in a similar programme again 8 years later. By then she is also a mentor for prospective teachers in their practicum, she teaches at in-service programmes for other teachers, and she has repeatedly been invited to lecture at college on teaching methods in mathematics.

METHODS

The PoP framework invites analyses of the processual and dynamic character of teachers' participation in classroom interaction. Consequently we need a methodology that views instruction as continuous transformations of teachers' participation in classroom practice in view of broader social practices and figured worlds at the school in question and beyond. Also, we need an interpretive stance that views these practices as well as shifts in the teachers' engagement in them from the perspective of the teachers themselves.

Consequently we use a qualitative approach inspired by grounded theory (Charmaz 2006). We have previously used GT without the objectivist connotations associated with it, and we by no means consider ourselves free from theoretical prerequisites in the present study. However, we still use the coding schemes, constant comparisons, and memo writing of GT as flexible guidelines for theorising classroom processes. They have proved helpful not least as it is not apparent at the outset what and how practices and figured worlds are significant for the teacher in question. The openness of the analytical procedures in GT allows us to address these questions empirically.

The data on Susanne include observations of 12 lessons, six from before her graduation and six from five months after, as well as three semi-structured interviews (Kvale 1996) conducted before and after the observations.

The main data on Astrid are observations of four lessons and two 2-hour semi-structured interviews. Supplementary data include observation notes from her mentoring of three prospective teachers and group interviews with the prospective teachers on their experiences from the practicum. For our present purposes these are used as a supplementary perspective on Astrid's tales of herself as a professional. .

Classroom observations and interviews were video and audio-recorded, respectively, using Transana. The recordings were transcribed in full, and the data were coded moving back and forth between the transcripts and the recordings. The initial and focused codings resulted in 23 tentative categories (e.g. *curriculum*, *epistemological reflections*, *teaching college, teamwork,* and *helping students develop mathematical understanding*). The data were re-coded and memos were written while the categories were conceptualized in two steps, leading to a set of theoretical concepts, including *knowledge of mathematical teaching*, *the reform* and, *life story*, *participation in practices*, and wrote memos.

SUSANNE AT SOUTHERN HEIGHTS

In the interviews and observations Susanne engages in three significant practices and figured worlds beyond the one of the classroom. We describe these as *the tradition*, *the reform*, and *handling students*.

Susanne claims that her instructional approach is traditional. She tries to give explicit and precise directions for the students' subsequent individual work by presenting concepts and procedures for them to copy and follow. This is likely to create a calmer and quieter classroom than any alternative she can think of. She refers to her experiences as a student in secondary school as a source of inspiration for this, and also mentions her pre-service teacher education. At odds with the intentions of the teacher education programme, Susanne describes it as dominated by the teacher educator's exposition of proofs for the students to remember and copy. Susanne is not particularly fond of this approach to teacher education. Her criticism, however, is not directed against this way of working in mathematics. Rather, she suggests that prospective teachers should not spend their time studying the subject itself, but need to be "pumped full of great ideas for how to teach" (int. 1).

Susanne knows about the reform discourse from national curricular documents, from textbooks, and from the theoretical part of her college education, even though she does not think of the practices of the teacher education programme as in line with the reform. She refers to the dominant rhetoric of the programme as "college talk" and says that it focuses on student investigations and the use of manipulatives. Also, the students are to work independently, using informal methods before they are introduced to formal mathematics. However, Susanne is highly critical of the reform and associates "college talk" with what she describes as a pedagogy of "cut and paste", "fiddle and touch", and "cubes and gadgets". She finds it hard to see the mathematical potential in this, except for the emphasis on student understanding, "you know that doctrine that they need to understand and not just follow the rules" (int.1). Also, she thinks that in practice it takes too much time for the teacher to prepare lessons according to the reform and the resulting classroom atmosphere is bound to be too noisy. Susanne is aware the curricular documents are influenced by the reform, but she does not worry that her teaching is incompatible with the formal requirements, because she and her students follow a textbook scheme closely, in which "you can even smell the college talk" (int. 1).

Officially Susanne and her colleagues at Southern Heights work in teams, but the mathematics team meets rarely and irregularly, and when it does, they discuss practicalities and organizational issues. Susanne says that the school consists of “a lot of one-man armies, with each teacher running his own race” (int.1). In spite of that they share a concern for how to handle students, who are in some sort of trouble. Susanne is proud that the school “takes incredibly well care of” the students’ individual problems by using different organizational measures” (int. 1). For instance there is a special needs department for students with learning problems and an “observation class” for students, who are violating school norms. Susanne explains that she sometimes sends students off to the observation class, and that she refers some of the weaker ones to the special needs department. In line with this policy of separation, Susanne also separates the students who are not sent off to other departments into more manageable groups. For instance she asks students who are good in mathematics and who behave well to work alone outside the classroom. The remaining students are then a more homogeneous and manageable group.

Multiplication in grade 5

Susanne introduces the first lesson on multiplication in grade 5 by asking the students to suggest a one-digit and a two-digit number. 5 and 55 are suggested and she writes ‘5 × 55’ on the board. When she asks what this means, a girl, Mira, says that you have “Fifty-five five times” or “the reverse”. Susanne continues:

Susanne: Or the reverse, yes, or five fifty-five times. Exactly. Okay, but that means that I can say that now I take those five [points to ‘5’ on the board] five times first, and then afterwards I take them fifty times. That should be the same, right? Then I get fifty-five times altogether. It does not matter if I take fifty-five times at once, or whether I first take one pile and then the other pile and add them up, does it? So, let us do that. We begin by taking five five times [points to ‘5’ and the last ‘5’ in 55]. Five times five.

Dagmar: Twenty-five

Susanne: That is 25. And then this one, this is all the ones, so I write all the ones down here [writes ‘5’ underneath the ‘5 × 55’].

Dagmar: And the twos go down there? [Points to the left of ‘5’ in the result].

Susanne: Well, these are the tens, aren’t they? I add those to the next pile, because now I am to multiply the tens. Right. So in reality this is twenty, even though I have written ‘2’ up here, it is really …?

Dagmar: Twenty.

Susanne: It is really twenty, because it was twenty-five, wasn’t it [says twenty-five slowly, emphasizing both parts of the word]? But we just write ‘2’. Okay? Then I say, well really I say five times fifty, don’t I? I really say five times fifty, but we just do five times five.

Molly: Well, it is 25, but//

Susanne: Yes.

Molly: But isn't it 125? [This may be Molly's suggestion for the result of the whole task].

Susanne: No, because you need to add those two [points to the number carried]. Twenty-five and two?

Molly: Twenty-seven.

Susanne: Then it is twenty-seven. In reality it is two hundred and seventy, because it is five times fifty, this is what I says isn't it? But we did already put the ones down there, so we just write 27 [writes '27' in front of the '5' in the results line]. […]

Michael: I don't understand this.

Susanne: No, but then I try to explain it once more. [Repeats the explanation].

The introduction and the subsequent whole class examples to multiplication last more than half an hour.

Interpreting the above classroom episode, we consider Susanne's contributions to the classroom practices a result of the meaning she makes of the interactions that unfold. Doing so, Susanne draws on practices described previously.

In the lesson Susanne presents a multiplication algorithm. She emphasizes value of the digits several times, but in the process talks for instance about "the twos" instead of two tens. Several of the students suggest different results, and others complain that they do not understand. Susanne responds by going over the calculations again, but does so without explaining the value of each digit and without explaining the underlying mathematical reasoning.

Apparently Susanne attempts to introduce the procedure of the multiplication algorithm as well promote student understanding of how it works. In relation to *the tradition* and *the reform* as outlined previously, it seems as if the element of 'understanding' in *the reform* is inserted into a *traditional* instructional approach dominated by procedural competence. In the process it is transformed from being an outcome of the students' own mental activity (in *the* reform) to being transmitted by careful exposition.

Apart from sporadic attempts to supplement *the tradition* with an element of understanding there is a sharp discontinuity between Susanne's re-engagement in *the tradition* of school mathematics and *the reform* discourse. The two practices, then, do not merge to any great extent. Susanne at times inserts an element of understanding in isolated pockets of *the tradition*, possibly changing the meaning of understanding in the reform on the way. And she takes the organizational measures at the school further when asking students to go elsewhere to work, so as to have manageable group to teach according to *the tradition*, apparently changing the intention of supporting students with problems into handling problematic students in the process. But in general *the tradition* appears to be an almost monolithic structure and other practices function primarily by suggesting ways of handling issues at the outskirts of the main practice.

ASTRID AT EASTGATE

Astrid engages in two significant practices and figured worlds beyond the one of the classroom. We describe these as *the reform experiences* and *supporting students*.

Astrid's tales of her professional self at Eastgate has come to include her position as a mathematics teacher. This is primarily due to her participation in the two reform-oriented teacher development programmes. They were influential, not least "because we talked about teaching" and the need to understand the students thinking: "We got into mathematical thinking, and we have done this many times ever since" (int. 1). This includes an increased emphasis on student communication and the requirement that they explain not only their results, but also their solution methods.

Astrid's comment above refers to the spirit of collaboration between the mathematics teachers at Eastgate, "the Eastgate spirit" (int. 1). Astrid is enthusiastic about collegial collaboration, both when they jointly plan lessons and instructional sequences and when they discuss episodes from different teachers' classrooms.

One of the things Astrid has contributed to the collaboration with her colleagues is her collection of good teaching experiences. Following from the teacher development programme she has collected experiences with emphasising students' work with mathematical problem solving and other processes as well as some illustrating the role of task contexts for students' reactions to mathematics. These experiences have been discussed among the colleagues, and Astrid is still keen to use problem solving with the students.

Eastgate prioritises equity issues, not least as they relate to students with special needs. On the homepage it says that the school builds on the children's diverse abilities, in class as well as on the playground. Astrid agrees with the intention of including and supporting all children and says that she makes an effort to make instructional objectives for the children individually. In spite of her support, she suggests that the school's priorities come at the price of sometimes reducing the emphasis and level of the subject matter taught at Eastgate.

Multiplication in grade 5

Reintroducing multiplication in grade 5, Astrid asks the students to solve single-digit multiplications tasks. Subsequently the students are to draw rectangles of different sizes and find ways of determining the number of unit squares in each.

Astrid: If it was me, and I felt like a little (.), whew: I'm not good to keep track of too many numbers, so I might say, well, I just take such a little piece here [draw a small rectangle – 11 multiply 13]… we must remember two things;

it is possible to make it into a multiplication task, and it is smart to multiply by 10.

Peter: Okay.

Astrid: Just think about it. Now, if you think, "ah, this is okay, I would like to do something more difficult", then you could for example say, "Well, I'd like to have” [draw a large square on the board – 24 multiply 32, Astrid whistles].

Olga: Frederik can do that one.

Astrid: Frederik can solve this one. You know, I think there are many of you who can solve this one.

Olga: Mostly Frederik

Jens: 100 times 100

Astrid: Okay. Now I want to go crazy, I want to try this. And so you can try to split it or count it – you can do whatever you want. The only thing is, NB, NB, NB [writes “!!” on the board], keep in mind what we have learned. You can make multiplication tasks and we have learned something like - it is very easy to multiply by 10.

Simon: I have an idea. If you find, what is here – you just count 1, 2, 3, and find it here, and multiplies them [referring to the length and width of the rectangle] – that is what you have to do.

Astrid: [holds out her arms in a gesture of approval of Simon’s suggestion]. That is a way to do it. There are many ways to solve it. But before I hear any more pieces of good advice, I would like you all to try.

After the introduction, the students work individually for 20 minutes. They are to set tasks for themselves, and Astrid walks around among the students, asking questions like: “"How can you work this out?”, “Why do you do it like this?”, “If you do like this, how can you show it in the rectangle?” and “You have to write it down, so you can remember what you did”. Later the students show and discuss their different methods for finding the size of the rectangles.

The lesson aims to support the students’ understanding of the idea of multi-digit multiplication and to work towards proficiency in carrying out a procedure. Some of the students’ individual suggestions are shared at the end, but it is not apparent if this is to form the basis for a common approach. At the end of the lesson Astrid tells the students, that she has written a letter to their parents. The letter states a mathematical aim: The students must know the multiplication table up to ten; “the trick” of multiplying by 10; that a multiplication task can be written as an addition; and how to multiply one-digit numbers by two-digit numbers.

Astrid seems to draw on different prior practices in the episode above. She draws rectangles of different sizes on the board, and the students are to find the number of unit squares in each. Working individually the students are later to decide themselves how big a rectangle they want to work with as well as how they want to find the size. It is an open task that may be solved at many different levels. In that sense Astrid draws on the school's approach to inclusion. Discussing the task with the students in a whole class setting afterwards Astrid also focuses on getting all students to talk about their individual approaches. Astrid does not reject or openly approve of the various solutions, in effect avoiding prioritising any of them.

Astrid uses the rectangles, to support student understanding. She draws on her practical experiences with the reform in the teacher development programme and her collaboration with her colleagues. This seems evident from her emphasis on the students setting their own tasks and the lack of emphasis on a standard procedure, leading to an element of investigation. Also, as the students work, Astrid wants them to discuss mathematics and her focus is on the students reasoning.

There is one practice, however, that is conspicuously absent in this, the one of mathematics in a more traditional sense. Although there is a close connection between the drawing and an understanding of multi-digit multiplication and the related algorithms, it is not obvious if the students understand the mathematical point or if they simply are "counting squares". One can speculate if they understand that this is a possible road towards a general procedure for multi-digit multiplication.

CONCLUSION

The above two analyses are attempts to understand how teachers' participation in different present and prior practices relate differently to the ones that develop in the classroom. They are an alternative to interpreting teachers' contributions to classroom practice in terms of their knowledge and beliefs. In the case of Susanne at Southern Heights one practice is dominant while other and more reform-orientated practices are less obvious. In the case of Astrid at Eastgate several practices form a more equal pattern. Susanne's and Astrid's conditions are similar, but the participatory patterns differ. Doing away with the acquisitionist connotations of other lines of research, the patterns of participation framework has some promise for a better understanding of the dynamical nature of classroom interaction.

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