

Student teachers' visions of good mathematics teaching and its (dis)connection to practice

OLA HELENIUS & HANNA PALMÉR

In this paper, three Swedish studies focusing on student teachers in transition from university to teacher practice are analyzed with respect to similarities and differences in how the teacher students describe the mathematics teaching they want to do as well as how they relate to teaching they already see carried out. Despite the different theoretical and methodological orientations in the examined studies, we find commonalities. One commonality is how the student teachers align with reform ideas when they talk about preferred mathematics teaching. Another commonality is how teaching observed in school based teacher education is typically described in negative terms since it does not conform to these reform ideas. We discuss this divide as a potentially negative effect of trying to use teacher education as a reform instrument.

Teacher education has a complicated relationship to school and to the teaching profession. On one hand, novice teachers or student teachers could naturally be seen as an apprentice in school practice who should "internalize and reproduce the norms that are characteristic for mathematics classes" (Jaworski & Gellert 2003, p. 847). On the other hand teacher education is often considered instrumental for school development and, at times, for school reform, which in Jaworski and Gellert's words is phrased as novice teacher's enactment of new or modified patterns of interaction.

A particular example of reform messages in mathematics education are the ideas popularized by the National Council of Teachers of Mathematics around 25 years ago (NCTM, 1989). This reform called for "a seismic shift away from a view of mathematics as the accumulation of rules and formulae which are drilled and practiced to one where mathematics is a sense-making activity and learners are actively engaged in their lessons" (Prescott & Cavanagh, 2008, p. 1). This reform message was influential in Sweden too where the national curriculum implemented 1994, LpO 94, was based on such ideas. In fact some of the influential scholars involved in NCTM's work, were also involved in the work leading up to the 1994 national curriculum in Sweden (Emanuelsson,

Ola Helenius, University of Gothenburg
Hanna Palmér, Linnaeus University

Johansson & Lingefjärd 1992; Swedish National Agency for Education, 1994). However, as Kazemi and Loeff-Franke (2004) notes, "[A] large body of literature has demonstrated that supporting teachers to meet the ambitious and complex visions of mathematics reform is difficult" (p.203). In line with these findings, in a relatively large scale qualitative study, it was shown that the 1994 national curriculum had not had much influence on the teaching, as far as some of the central tenets related to the reform movement go. Complementing the classroom research with teacher interviews and a psychological construct, the researchers' conclusion was that teachers had in general not understood the meaning of the reform message, probably due to a superficial interpretation of it (Boesen et al., 2014). Such superficial changes are characterized by a change in how one talks about the teaching and learning, but no corresponding change in ones beliefs or in the teaching practice (Ball, 1990; Charalambous & Philippou, 2010; Gregoire 2003).

One reason for the difficulty for teachers to meet the visions of the reform might be a mismatch between the visionary ideas about a new style of teaching and concrete descriptions of how to carry out such teaching (Kazemi & Loeff-Franke, 2004). As noted by Skott (2004), recommendations within the reform sometimes degenerate into caricatures of what not to do (for example, not using whole class interaction or routine tasks) instead of focusing on what to do. This is in stark contrast to recommendations from research on teacher change, which for the last decade has emphasized the important connection between reflecting on new concepts or ideas and enacting those concepts with ones students (Clarke & Hollingsworth, 2002; Cordingly, Bell, Thomason & Firth, 2005; Grossman & McDonald, 2008).

In the light of this, it is interesting to ask in what sense the practice of teacher education affects students' views as far as reform ideas goes, and in what sense the teacher student are prepared to carry out these reform ideas in practical teaching. Adler writes

Across the world, preservice and inservice mathematics teacher education programmes are preparing teachers to work with and promote reform in the practice of school mathematics. Although emphases will differ across the range of educational contexts, common threads are identifiable.

(Adler 2000 p.205)

It is reasonable to assume that this occurs in Sweden too and that student teachers (at least superficially) adapt reform oriented ideas. But given the result shared above, (Boesen et al., 2014) it is perhaps also reasonable to assume that student teachers meet few examples of reform oriented teaching in their school based teacher education. Building on this, we will in this paper focus on the following two questions:

Q1. *Visions*: How do Swedish student teachers talk about teaching they would prefer to do? In particular, do they (at least superficially) align with the reform ideas?

Q2. *Practice*: How do Swedish student teachers talk about mathematics teaching they have seen or experienced, particularly in school based parts of teacher education?

The reason to investigate these questions is not primarily to understand in what sense student teachers become prepared to teach in line with reform ideas. Answering such a question would require different types of studies than this one. Rather, the combination of the two questions above puts a focus on the relation between teacher education and practice. Using novice teachers as implementers of new ideas is in line with considering teacher education as an instrument for school development. However, a strong divide between novice and experienced teachers would go against the idea of novice teachers and teacher students as apprentices.

No large-scale study has looked at these two questions in Sweden. However, there exist three different small-scale studies that, while working with different theories, methods and aims, all ask questions related to student teachers visions, goals and relation to school practice. In this paper, we make a secondary analysis of these studies to shed light on our two questions above.

Methodological concerns

The studies used in this paper are three Swedish theses of student teachers; Bjerneby Häll (2003), Persson (2009) and Palmér (2013).¹

Bjerneby Häll studied ten respondents educated to become upper primary and lower secondary school mathematics teachers. The respondents were followed from the beginning of their teacher education and eight years forward with focus on how they formulated arguments for mathematics teaching in school. The empirical material was gathered through texts written by the respondents and through interviews.

Persson studied how 16 lower primary school teachers talked about mathematics teaching and how this talk changed throughout mathematics teacher education. The empirical material was gathered through interviews. Persson then continued to study how this talk changed after the respondents graduated and started to work as teachers.

Palmér studied the professional identity development of seven novice primary school mathematics teachers their first two years as novice teachers. The study began with interviews just before the students were to graduate from teacher education.

These three studies were selected since they are the published Swedish theses focused on the two questions raised in this paper. It is important to note that we are not trying to investigate knowledge, beliefs or change of teaching practice, only the results presented in the three studies. In the three theses there are several quotes from student teachers which have guided our analysis. However, based on space limitations only a few quotes will be re-produced in this paper. To answer the two questions we do not use any particular frameworks, constructs or theoretical perspectives. We claim this is in order, but below discuss some possible concerns with this method.

Interpretation of the reform

As explained above, LpO 94 constitutes a new national curriculum implemented in 1994, strongly connected to the type of reform mathematics teaching ideas that are commonly associated to the NTCM standards (Boesen et al., 2014). The three studies relate in different ways to the reform and the reform ideas. Palmér explicitly mentions much of the same literature that is referred to in the present paper. Bjerneby Häll, refers to principal ideas of LpO94 (Swedish National Agency of Education, 1994) and especially focuses on using concrete materials (laborative mathematics) and variation in teaching, in most cases referring to not only using the text book. Persson does not write explicitly about reform in her thesis but about the "official style of thought" as expressed in steering documents in teacher education and primary school, which means that she implicitly refers to LpO 94. Based on these differences we cannot be particularly sure what aspects of the reform the student teachers relate to – if any. However, this is not a problem since our questions do not regard the process of teacher education and/or mathematics teaching but in what sense student teachers' talk about teaching (possibly superficially) align with the reform ideas.

Aggregation of results

The three studies have quite different theoretical perspectives. Bjerneby Häll relies on von Wright's practical reason and logic of events (1983) while Persson uses several perspectives, like for example Fleck's theory of thought styles (1935/1997). Palmér builds on Lave and Wenger's construct community of practice. In all three cases though, the theories are used to explain the participants reasoning or actions, not to structure the analysis of data in the first case. Since we pick up our data from the three studies on a more basic level, before the level of theoretically grounded explanations or argumentation, we draw the conclusion that it is possible to aggregate this data.

Results

It is eight years from the publication of the first to the last of these three studies, but it is 15 years between the first and last data collection. While the three

studies focus on the transition from student teacher to teacher from different theoretical perspective, they all put significant emphasis on how student teachers throughout their university studies, change, adapt or construct their ideas about what constitutes good or favorable mathematics teaching. In all three studies it is also discussed how the student teachers related their personal ideas on mathematics teaching to teaching they have experienced before or are experiencing in the school based parts of their education (practice).

Q1. The student teachers' teaching visions

In the study by Bjerneby Häll, the teaching visions of five of the ten student teachers are exemplified by means of quotations. When the author summarizes, the views expressed by the student teachers become quite homogeneous. It is claimed that the teacher students have changed their views on mathematics teaching to a view in line with Lpo94. In summary the respondents express that they during teacher education have discovered that mathematics teaching can be laboratory, that the learning of mathematics will improve by communication and that mathematics problems can be solved in different ways. The respondents are critical of direct teaching; instead they stress a creative and exploratory approach in mathematics teaching. They say that they will use a text book when teaching mathematics but emphasize the importance of having a varied teaching approach not just teaching in line with the text book. Varied teaching is motivated as increasing the interest and motivation of the students to learn mathematics. The respondents also emphasize the importance of fun, understanding, self-esteem and laboratory elements in the lessons. Furthermore the mathematics teaching ought to be connected to everyday life. Only one exception from this is mentioned "[...] one informant (Ingrid) tells she does not remember anything from the courses in mathematics education" (p. 136).

Persson's study is divided in two parts where we here focus on how the student teachers in her study talk about mathematics and mathematics teaching before and after taking courses in mathematics education within teacher education. Before taking courses in mathematics education almost all of the sixteen respondents tell about memories of a mathematics teaching characterized by exercises in the text book. They have experienced this kind of teaching very differently where some liked it and others did not. After taking courses in mathematics education the respondents instead talk about their previously experienced mathematics teaching using words as *traditional* and *tradition* implying something negative. Before taking courses in mathematics education the student teachers talk more about the mathematical content than they do after taking courses. After the courses they talk about *how* the mathematics teaching is to be conducted and they say that they now understand that it is possible to teach mathematics differently than how they were taught as students. Persson's results are univocal regardless of following the students as a collective or the individual change of each student. The student teachers express having received

a changed understanding of the aim with mathematics teaching through teacher education. "You have been talking about it a lot. We have discussed it and yes, you hear it in every lecture and you read it in every book. You almost become a little brainwashed I actually think" (p. 84). The preferred mathematics teaching is described as joyful, creative, and it should help the students to link the concrete to the abstract. It should involve practical problem solving and real-life situations.

Palmér's results are presented in both a chronological and a thematic way. In the chronological presentation four of the seven respondents are described individually while the thematic part is based on all seven respondents. Together these two parts present a joint picture of the seven respondents. Quotations from all respondents can be found in the thesis and it is clear, based on both quotations and author summaries that the student teachers have changed how they talk about mathematics teaching. The respondents use the words *traditional* and *old-fashioned* when they talk about less good mathematics teaching. Further, they consistently compare good and less good mathematics teaching with each other and often describe good mathematics teaching as "teaching that doesn't ..." followed by an example of less good mathematics teaching. The respondents express that they want to teach mathematics "differently". They say that they probably will use a textbook when teaching mathematics but emphasize the importance of having a varied teaching approach not just teaching in line with the textbook. Instead they talk about mathematics teaching that is reality based, creative, varied with for example laboratory elements and focused on processes. The students are to work a lot in groups, communicating, working with mathematics problems that can be solved in different ways. The respondents also emphasize the importance of students having fun and getting a good self-esteem. On one occasion, one of the respondents says that she does not agree with "everything" but, apart from that, the respondents are very concurrent in their talk about the mathematics teaching they prefer.

In summary, aggregating over all three studies we draw the conclusion that all respondents, with the possible exception of just one, express a vision of mathematics teaching in line with the reform ideas.

Q2. Students thoughts on observed teaching

Turning to the question on how student teachers relate to mathematics teaching they have seen or experienced, particularly in school based parts of teacher education, the picture is again homogeneous. In Bjerneby Häll, nine out of ten student teachers say that the teaching they see in school based parts of teacher education differs little from the teaching they themselves experienced as students in school. While several have positive personal experience from their time as students, it is obvious that the changes in their ideas about

mathematics teaching make them evaluate such teaching differently now. Bjerneby-Häll summarizes that the teacher students

dissociate from the way of using the text book that they experienced as students or student teachers [...] their mathematics lessons should not be as many of them experienced during school based teacher education, not only, "take out the book and start to work". (p. 155)

For five students there are explicit negative remarks about the school based parts of teacher education.

They just followed the book straight down, chapter by chapter. My mentor wanted it like that. So I roughly did that in the groups I had. A few times I tried to use some more open tasks in grade 7. So that it wouldn't be so awfully boring. It didn't really turn out much like I wanted. You shouldn't care, really but you feel you should do like the mentor wants. (p. 143)

As mentioned above, the student teachers in Persson's study talk about their previously experienced mathematics teaching using words as *traditional* and *tradition* implying something negative after taking courses in mathematics. They express having met the same kind of teaching as they experienced as students during their school based parts of teacher education. They say that "it [time] has stood still" (p. 87) and none of the respondents express the mathematics teaching they have met during practice as being in line with the mathematics teaching emphasized in teacher education. The student teachers express that there are no connections between teacher education and the mathematics teaching they have met in schools and that this make them uncertain as they think that it will take a lot more from them to teach in the new way. Some of the respondents also talk about the importance of them inspiring, and by that changing, the mathematics teaching of their future colleagues.

The student teachers in Palmér's study find it hard to give good examples from the teaching they have seen or experienced during their school based parts of teacher education. But, when they are asked to give examples of less good mathematics teaching "[t]hen there is many" (p. 101). Often these examples are connected to the text book and teachers being "very controlled by the text book" (p. 101) which, according to the student teachers makes the students "finally think it is boring" (p. 101). "[I have] been at two different schools quite a long time and it feels like many teachers are very controlled by the text book and that is what counts" (p. 99). The respondents' position away from their own experiences of mathematics teaching, even the ones who themselves experienced working in a text book as fun in school.

In summary, aggregating over all three studies we draw the conclusion that the student teachers in all three studies are critical of the teaching they have seen or experienced, both as students and in school based parts of teacher education.

Conclusion and discussion

The three studies together comprise over 30 student teachers, and the homogeneity in relation to our two questions is overwhelming. While we can still not reliably generalize to a larger population of student teachers, the different theoretical perspectives of the studies as well as the difference in time and place if anything strengthen the result.

A relevant observation is that it might not necessarily be because the student teachers know more about reform ideas that they grow skeptical towards the teaching they observe. As shown by Boesen et al. (2014), also the teacher practice tends to, in superficial words, be positive about reform ideas. What we have here, then, are two related practices that share a (possibly) superficial positive appraisal of reform ideas but do not share a practice where such ideas are actually enacted. The lack of practice is visible in the results presented above where the respondents can talk about good mathematics teaching but they have not experienced it, either as students themselves or during their practice periods. Quite the opposite, in the three studies the respondents talk about practice seems to be quite consistent with what Skott (2004) wrote about as caricatures of what not to do.

From a more general point of view, it must be considered problematic when student teachers hold such negative views of teaching in practice. Quantitative studies from the US based on a large scale experiments show experience lead to slightly better student performance (Nye, Konstantopoulos & Hedges, 2004). Other large scale studies in a German setting also indicate a positive effect on teacher knowledge from experience (Bauman et al., 2010). It is hence reasonable to assume that novice teacher have important things to learn from experienced teachers, as also indicated by the apprenticeship perspective in Jaworski and Gellert's model (2009).

Hemmi and Ryve (2015) have shown that the message regarding mathematics teaching in two Swedish teacher education programmes seemed to be quite homogenous. This message included several influences from reform movements. Based on their study they assume that student teachers' conceptions of good mathematics teaching are influenced by the homogenous message. The results presented in this paper indicate that Hemmi and Ryve's assumption is correct. While we do not know anything about the effectiveness of the student teachers in the three reviewed studies, what we can conclude is that the effect of teacher education has been a noticeable skepticism towards experienced teachers.

We end by noting that other studies too have found the relationship between mathematics teacher education in Sweden and teacher practice quite peculiar. Hegender (2009) observed that assessment of student teachers performance in the school based parts of education focused largely on relational, emotional and caring aspects of the profession, rather than mathematical knowledge for teaching. When comparing school based education from the point of view of

university teachers, Ryve, Hemmi and Börjesson (2013) discovered that while Finnish educators saw it as a largely as a laboratory to carry out teaching, Swedish educators discussed it more as an organizational problem.

Together these studies raise some possible problems in the subject matter educational aspects of how teacher education in Sweden relate to experienced teachers and to practice in general. A systematic study of this relation could be a worthwhile future research effort.

Notes

1. Bjerneby Häll and Persson write in Swedish and all translations of citations are made by the authors of this paper.

References

- Adler, J. (2000). Conceptualising resources as a theme for teacher education. *Journal of Mathematics Teacher Education*, 3, 205–224.
- Ball, D. (1990). Reflections and deflections of policy: the case of Carol Turner. *Educational Evaluation and Policy Analysis*, 12 (3), 263–275.
- Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., et al. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom and student progress. *American Educational Research Journal*, 47, 133–180.
- Bjerneby Häll, M. (2006). *Allt har förändrats och allt är sig likt: en longitudinell studie av argument för grundskolans matematikundervisning* (doktorsavhandling). Utbildningsvetenskap, Linköpings Universitet.
- Boesen, J., Helenius, O., Lithner, J., Bergqvist, E., Bergqvist, T., et al. (2014). Developing mathematical competence: from the intended to the enacted curriculum. *Journal of Mathematical Behavior*, 33, 72–87.
- Charalambous, C. & Philippou, G. (2010). Teachers' concerns and efficacy beliefs about implementing a mathematics curriculum reform: integrating two lines of inquiry. *Educational Studies in Mathematics*, 75 (1), 1–21.
- Emanuelsson, G., Johansson, B., & Lingefjärd, T. (1992). *Matematikämnet i skolan i internationell belysning*. Mölndal: Institutionen för ämnesdidaktik.
- Fleck, L. (1935/1997). Uppkomsten och utvecklingen av ett vetenskapligt faktum: inledning till läran om tankestil och tankekollektiv. Stockholm: Brutus Östlings Bokförlag Symposion.
- Graven, M. & Lerman, S. (2003). Book review of Wenger, E. (1998) Communities of practice: learning, meaning and identity. *Journal of Mathematics Teacher Education*, 6 (2), 185–194.
- Gregoire, M. (2003). Is it a challenge or a threat? A dual-process model of teachers' cognition and appraisal processes during conceptual change. *Educational Psychology Review*, 15 (2), 147–179.

- Hegender, H. (2010). The assessment of student teachers' academic and professional knowledge in school-based teacher education. *Scandinavian Journal of Educational Research*, 54, 151–171.
- Hemmi, K. & Ryve, A. (2015). Effective mathematics teaching in Finnish and Swedish teacher education discourses. *Journal of Mathematics Teacher Education*, 18, 501–521.
- Jaworski, B. & Gellert, U. (2003). Educating new mathematics teachers: integrating theory and practice, and the roles of practicing teachers. In A.J. Bishop, M.A. Clements, C. Keitel, J. Kilpatrick & F.K.S. Leung (Eds.), *Second international handbook of mathematics education* (pp. 829–875). London: Kluwer Academic.
- Kazemi, E. & Franke, M. L. (2004). Teacher learning in mathematics: using student work to promote collective inquiry. *Journal of Mathematics Teacher Education*, 7, 203–235.
- National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics*. Reston: NCTM.
- Nye, B., Konstantopoulos, S. & Hedges, L.V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis*, 26 (3), 237–257.
- Palmér, H. (2013). *To become – or not to become – a primary school mathematics teacher. A study of novice teachers' professional identity development* (Linnaeus University Dissertations No 130/2013). Linnaeus University.
- Persson, E. (2009). *Det kommer med tiden. Från lärarstudent till matematiklärare*. Institutionen för didaktik och pedagogiskt arbete, Stockholms Universitet.
- Prescott, A. & Cavanagh, A. (2008). A situated perspective on learning to teach secondary mathematics. In M. Goos, R. Brown & K. Makar (Eds.), *Proceedings of the 31th annual conference of the Mathematics Education Research Group of Australasia* (pp.407–413). Brisbane: MERGA.
- Ryve, A., Hemmi, K. & Börjesson, M. (2013). Discourses about school-based mathematics teacher education in Finland and Sweden. *Scandinavian Journal of Educational Research*, 57, 132–147.
- Skott, J. (2004). The forced autonomy of mathematics teachers. *Educational Studies in Mathematics*, 55 (1), 227–257.
- Swedish National Agency for Education (1994). *Curriculum for the non-compulsory school system, Lpf94*. Stockholm: National Agency for Education.
- Wenger, E. (1998). *Communities of practice. Learning, meaning, and identity*. Cambridge University Press.