

Exploring Prospective Teachers' Initial Views on the Teaching and Learning of Mathematics: A Narrative Approach

Exploración de las visiones iniciales del profesorado en formación inicial sobre la enseñanza y el aprendizaje de las matemáticas: un enfoque narrativo

ANDREAS EBBELIND^A AND TRACY HELLIWELL^B

^A Linnaeus University (Sweden), ^B University of Bristol (United Kingdom)

^A andreas.ebbelind@lnu.se, ^B tracy.helliwell@bristol.ac.uk

^A <https://orcid.org/0000-0001-8452-6357>, ^B <https://orcid.org/0000-0002-9681-5540>

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Abstract: Mathematics teacher education research often focuses on ways teacher education can change prospective teachers' views in ways prescribed by teacher educators. In this paper, we explore a different perspective, one that emphasises the importance of understanding the diversity of views that prospective teachers bring to their teacher education programmes, not as a basis of change, but as a platform to build upon. In doing so, we make a case for 'aestheticising' mathematics teacher education research and propose an arts-based approach to analysing and presenting data concerning prospective teachers views on the teaching and learning of mathematics. We exemplify this approach by presenting a fictionalised dialogue between four prospective teachers from Sweden, based on interviews conducted prior to them entering teacher education.

Keywords: Art-Based Approaches; Ethics; Fictionalised Dialogue; Mathematics Teacher Education; Prospective Mathematics Teachers

Resumen: La investigación sobre la formación del profesorado de matemáticas se centra a menudo en la manera en que la formación del profesorado puede cambiar las visiones de los futuros profesores en sentidos prescritos por los formadores de profesores. En este artículo, exploramos una perspectiva diferente, que hace hincapié en la importancia de comprender la diversidad de visiones que los futuros profesores aportan a sus programas de formación del profesorado, no como una base para el cambio, sino como una plataforma sobre la que construir.

Para ello, abogamos por 'estetizar' la investigación sobre la formación del profesorado de matemáticas y proponemos un enfoque basado en las artes para analizar y presentar los datos relativos a las visiones de los futuros profesores sobre la enseñanza y el aprendizaje de las matemáticas. Ejemplificamos este planteamiento presentando un diálogo ficticio entre cuatro futuros profesores suecos basado en entrevistas realizadas antes de que empezaran a formarse.

Palabras clave: Enfoques basados en el arte; Ética; Diálogo ficticio; Formación de profesores de matemáticas; Futuros profesores de matemáticas.

1. MOTIVATION AND BACKGROUND

At MAVI27 in Bremen, we presented findings from an initial phase of a more extensive study focused on ways in which prospective mathematics teachers negotiate meaning from teacher education situations (Ebbelind & Helliwell, 2024). In that paper, we examined the interpersonal aspects of the language used by one mathematics teacher educator in Sweden during a mathematics teacher education lecture for prospective upper-primary school teachers. From this study, we arrived at several important questions about how participating in an initial teacher education situation may contribute to the development of prospective mathematics teachers. In a related study, we applied a further layer of analysis, this time from the perspective of a group of prospective mathematics teachers participating in the same teacher education situation. Through analysing a range of interactions between the various participants (the mathematics teacher educator, the group of prospective teachers, and the researcher), we became aware of the conflicting stories being told (and lived) concerning the effective teaching and learning of mathematics. We noted, that “[w]hen the prospective teachers participate in these teacher education situations, they can experience a form of tension, realising that their view of effective mathematics teaching is not accepted as valid within the teacher education programme” (Ebbelind & Helliwell, 2022, p. 6). Findings from these initial studies have inspired us to further explore the different views on mathematics teaching and learning of those destined to become our future mathematics teachers so that we can consider more carefully how teacher education programmes might be designed with these views in mind. Therefore, in this paper, we explore the views of a group of prospective teachers based on interviews that took place prior to the group entering teacher education. Our aim in doing so is to offer an alternative to a prevailing discourse within mathematics teacher education which characterises prospective primary school teachers from a deficit

perspective, focusing on their perceived lack of subject knowledge (and how to fill that ‘gap’), and their reluctance to adopt new perspectives on the teaching and learning of mathematics, especially in relation to the reform mathematics agenda. We propose to challenge that discourse by giving a voice to those prospective mathematics teachers who offer a different perspective. Ultimately, we aim to explore how teacher education can prioritise making connections with and building on the varied experiences that prospective mathematics teachers bring so they no longer experience what has come to be known as the theory-practice divide.

At the same time, as mathematics teacher education researchers, we are interested in developing innovative ways of doing and communicating research that encourages members of the mathematics teacher education community (ourselves included) to critically reflect on their practices and the design of their teacher education programmes. Consequently, we are drawn to “creative analytical practices” (Richardson & St. Pierre, 2018), where arts-based approaches are combined with more formal analytical methods as a way of saying more about the phenomena of interest than formal analytical methods can do alone. We thus make a case in this paper for the *aestheticising* (Sinclair, 2018) of mathematics teacher education research.

2. BECOMING A MATHEMATICS TEACHER

The experiences that prospective mathematics teachers’ have had of mathematics teaching and learning will strongly influence how they are likely to teach mathematics (Hodgen & Askew, 2007). Forgasz and Leder (2008) go even further suggesting that teacher education has little impact on prospective teachers’ beliefs about mathematics and mathematics teaching and, therefore, has little bearing on the teachers they become. Ebbelind (2020) describes how prospective teachers re-negotiate the content of their teacher education programmes by remaining committed to their prior experiences while teacher educators promote alternative ways of teaching mathematics. Ebbelind adds to the understanding of how discursive patterns frame the prospective teachers’ processes as teachers-to-be. If it is indeed the case that prospective teachers’ own schooling has a more significant impact on their mathematics teaching than that of teacher education, then it is vital we know the relationship between those prior experiences and the experiences gained through participating in teacher education. As mathematics teacher educators ourselves from

different contexts (primary / secondary, Sweden / United Kingdom (UK)) we are compelled to explore this issue, to consider ways in which teacher education can support prospective teachers in seeing more and differently for themselves in relation to mathematics and mathematics teaching.

Despite the vast amount of research that exists on the most effective ways of teaching mathematics, research also continues to report on the absence of change in the way mathematics is taught in schools. The term “reform”, for instance, suggests the need to make changes to current practices for the sake of “improvement”. The very fact that we have continued to use the term reform in relation to the teaching of mathematics, decades since its first use, suggests those changes are not yet being widely observed. For a significant number of years, research on mathematics teacher education has focussed on two main ways of addressing this absence of change in teachers, that is, by either focusing on changing teachers’ knowledge of mathematics, and mathematics teaching and learning or by focussing on changing teachers’ beliefs, or identities in relation to mathematics, and mathematics teaching and learning. For example, in relation to researching prospective teachers’ knowledge for teaching mathematics, Ball et al.’s (2005) *Mathematical Knowledge for Teaching* continues to be heavily utilised as a theoretical framework. More recently, frameworks for prospective teacher noticing (e.g., van Es & Sherin, 2021) and diagnostic competence (e.g., Loibl et al, 2020) are being used as a way of characterising teachers’ competence in relation to recognising and responding to students’ mathematical thinking. In relation to research on prospective teachers’ beliefs, a central focus has been the interplay between beliefs and classroom practices (Ebbelind, 2020), with some research reporting on a close relationship, whilst other research reports on quite the opposite. Over the last 15 years, research on (prospective) mathematics teacher identity has become an increasingly common focus in mathematics education research. It is mainly regarded as an ongoing process related to teacher change (Skott, 2019). In some cases, there seems to be an underlying assumption that there is a “best” way to teach or an “optimal” set of beliefs about mathematics and mathematics teaching and learning, which motivates some researchers to design and test a variety of interventions aimed at supporting prospective teachers to change in certain ways. Much research seems to take place in our endeavour to change prospective teachers in ways we, as a research community, see fit.

On the basis that teachers matter in relation to students' learning of mathematics, as a community, we develop ways to change the prospective mathematics teachers we work with into knowledgeable, interested, and engaged teachers (Sowder, 2007). In doing so, we might "deem certain aspects of what is often – and sometimes condescendingly – called the traditions of school mathematics inappropriate" (Skott, 2004, p. 239). As mathematics teacher educators, we may encourage our prospective teachers to replace one teaching strategy with another, and as a result we try to force them in being autonomous in relation to the reform mathematics movement that "focuses on students' creative engagement in exploratory and problem-solving activities as they develop their understandings of significant mathematical concepts and procedures" (Skott et al., 2018, p. 164). Becoming autonomous in this sense is by no means straightforward, since it requires the prospective teachers to navigate the priorities of the subject as set out in their teacher education programmes whilst at the same time operating within the milieus of their specific school contexts (Skott, 2004). Along with these challenges, every prospective teacher has their own unique history of experiences, which shapes how they view the world of mathematics teaching and learning (Helliwell, 2021). We are not questioning the vision of school mathematics promoted by the reform movement, in fact we are advocates. What we are bringing into question, however, are the ethics of teacher change which we explore in the next section.

3. ON THE ETHICS OF (PROSPECTIVE) TEACHER CHANGE

As mathematics teacher educators, we are in the business of educating mathematics teachers. It is our role to prepare teachers to teach mathematics in ways that benefit the students that they teach. As Pimm (1993) puts it, however, "mathematics education is a discipline prone to the lure of single solutions" (p. 30). The danger is that a layer of complexity is confounded by an "externally imposed layer of control" (p. 30). As mathematics teacher educators, we are not exempt from these dangers. There is the potential for us to succumb to what Pimm calls our "teacher-educator-lusts" (p. 31). One such lust, "thou shalt change" (p. 31), is the yearning that a teacher educator might possess to change the teachers that they work with:

Their change is not our business; how, when and if they change is surely their concern alone. [...] If I as a teacher educator can only feel successful if the teachers I work with change (and in ways I want them to), I am setting up both myself and the teachers I am working with quite dramatically. I believe it is dangerous to lose sight of how difficult personal change can be - and we should not talk lightly or glibly about it, let alone expect or demand it. (p. 31)

There is the potential for a tension to arise for members of the mathematics teacher education community who wish to promote the most effective and equitable ways of teaching mathematics (in line with the reform agenda) whilst also wanting to support prospective mathematics teachers in becoming the teachers *they* want to become (especially if the image of the teacher they want to become is different to that of the teacher educator). Perhaps, however, there is a *middle-way* where this tension need not arise. Using Skott's (2019) wisdom, we could aim to set up teacher education in a way that re-centres the individual (i.e., the teacher) by not prioritising a pre-defined view of mathematics teaching (or particular practices that promote them) so that prospective teachers can experience a sense of "being, becoming, and belonging" (p. 471) in relation to the teaching profession. It should not be overlooked, according to Skott, that the "social construction of norms and practices are not limited to the classroom but involve broader social settings" (p. 479), hence teacher education could pay more attention to how prospective teachers prior and current experiences shape the way their teaching practices evolve. Ultimately, the desire to change must come from within, not simply from an external source or force. Teachers must want to change for themselves: to feel a need; to imagine a different way of being; and to believe it is possible.

Much of Mason's work (e.g., 2002) has been focussed on supporting teachers in changing their practices. In fact, he states that the *discipline of noticing* provides "a method of working on issues to do with practice, at every level and in any context" (Mason, 2003, p. 281), yet he is careful to make no claims about what is worth changing and warns of the ethical implication associated when an external force (e.g., teacher education) attempts to get teachers to "adopt practices that are deemed valuable or even necessary" (p. 282).

[M]y desire becomes an obstacle, an impediment, as soon as I desire specific practices, specific changes, specific pleasures. I consider it to be ethically sound to wish for others that they have continued opportunities to choose to participate in activities through which they may experience something fresh, some expansion of their current awareness. But I am adamant that at every moment I respect their choice to opt out. (p. 284)

Thus, *as mathematics teacher educators*, we advocate a vision of teacher education that actively and explicitly recognises and builds upon prospective mathematics teachers' existing views and experiences. Concerns of an ethical nature within mathematics teacher education extend beyond our pedagogical practices and the design of our teacher education programmes to the way that we conduct and report on research involving prospective mathematics teachers. As a research community, we take ethical considerations seriously and ensure that research is carried out in accordance with the ethical guidelines set out within our field. Beyond meeting ethical requirements, *as researchers*, we are committed to finding ethically sound ways of expressing, most powerfully, the views of our participating prospective teachers in ways that more formal-analytical approaches alone are not able to do. In doing so our hope is to move those who read our research to critically reflect on their own practices as mathematics teacher educator-researchers. For this reason, we have been inspired by research methods that draw explicitly on the arts.

4. UTILISING ART-BASED APPROACHES

Lincoln and Denzin (2000) claim that qualitative researchers are less concerned about being objective (as may be the case with scientific research) than they are about providing readers “with some powerful propositional, tacit, intuitive, emotional, historical, poetic, and empathic experience of the Other via the texts we write (p. 1058). de Freitas (2007) describes the need to “breach the usual authority of educational research texts and to generate a more critical reading habit on the part of those they aim to reach” (p. 336). This move from thinking about the researcher as the sole owner of the research outcomes, to the reader as “actively construct[ing] possible counter-interpretations” through a process of “reading *otherwise*” (p. 336, emphasis original), has been a particularly powerful idea, helping us to shape our approach to this research. She argues that it is through an approach to narrative research, where the

researcher utilises fictional, literary, or poetic approaches, that readers of research are most likely to engage in the act of reading otherwise.

We invite the readers of this research to read *otherwise*, to explore the meanings that emerge for them as they read, to find what resonates, and to consider what that might mean for their own practices. Like Clough (2002), we deliberately question the common-sense understanding of what constitutes data and the way research is conducted. Writing narrative research, according to Clough, “is not carried out outside of a need, a community, a context. These are actually the primary ingredients” (p. 8). An educational narrative is expected to engage the reader with a familiar context, to make the familiar strange and the strange familiar.

We exemplify the ideas discussed thus far, by presenting some data as a fictionalised dialogue (Hannula, 2003) between four prospective mathematics teachers (Lisa, Evie, Lina, and Alva (all pseudonyms)). The dialogue is based on individual interviews that were conducted the week before the prospective teachers' first encounter with teacher education. The four teachers all described their “love” of mathematics (in differing ways) and achieved high scores in mathematics at upper secondary school. They are critical cases because their views are underrepresented in the current research literature that tends to focus on the deficit story of prospective teachers (Ebbelind, 2020). The four interviews were conducted in Swedish, transcribed, and translated into English. Each of the authors analysed the interviews separately, by closely reading and annotating the transcriptions before writing interpretive descriptions of each of the teachers' views in relation to mathematics and mathematics teaching and learning. Although the four prospective teachers were interviewed separately before they got to know each other, we decided to present the data from these interviews as a fictionalised dialogue between the four of them. We imagined the group would have had similar conversations over the course of their teacher education programme and so by presenting the data as a dialogue, not only are we presenting the individual views of the teachers, but we are simultaneously communicating the potential influences these teachers may have had on one another throughout their teacher education programme. The fictionalised dialogue was constructed by both authors through a process of aesthetic structuring (Winter, 1988) using extracts from the individual interviews, woven together to bring the conversation to life. In the next section, we present this fictionalised dialogue before discussing what we see as significant in terms of their views of mathematics and mathematics

teaching and learning. As previously alluded to, we invite readers of the dialogue to consider what stands out for them, the purpose of presenting the dialogue is less about coming to objective findings and more about inviting reader to engage with the data for themselves.

5. EXPLORING VIEWS ON TEACHING AND LEARNING MATHEMATICS: A FICTIONALISED DIALOGUE

Imagine that Lisa, Evie, Lina, and Alva are sat together during one of their early mathematics education seminars. The conversation begins when the group are prompted to share their experiences of mathematics and mathematics teaching and learning with one another by the mathematics teacher educator.

Lisa Three words come to mind for me when I think about good mathematics teaching: individual, playful, and competitive. When I was at school we competed for it, and everyone enjoyed the challenge. When we were working from the textbook, the teacher would walk around and support individuals who needed help.

Evie That sounds like my experience of mathematics in fifth and sixth grade. We just did page after page in the textbook and competed to be the first to finish. In retrospect, it was pretty negative. There was no profound understanding, it was more that you were in a hurry to do everything.

Lisa Actually, I loved using textbooks! Bad teaching for me was teaching *without* a textbook. I hated being given worksheets, there was no structure, papers everywhere, and nowhere to put them. Working without a textbook is messy. In the mathematics textbook, everything is in one place and you can see how many pages you have done. I was always ahead of others. I got my first textbook in mathematics at ten years old.

Evie Maths got better for me once I got to upper secondary school, there we got a deeper understanding, and there was no race to be first. I quite enjoyed working individually in mathematics. If lots of students were having difficulty with something, the teacher would take it up with the whole class. I remember the good mathematics teachers would do

- this; they were interested in us as students. They walked around and checked on our understanding, they wanted to help us. We had to explain our thinking to them and others, I liked explaining to others.
- Lina I remember one particularly inspiring teacher. With her personality, skills, and enthusiasm, she was so *on it*. There were specific rules to follow through. Today's teachers have no restrictions, and that is a problem.
- Alva All my teachers must have been the same. I don't really remember them, so I guess their teaching was nothing special. I can see them standing there at the board, talking while I sat working. I really loved solving problems, but there were too few to solve. I think you solve problems logically, and I remember that was fun because it was different to the regular teaching in mathematics. My teachers only seemed to have one strategy, but I had many when I was solving problems. I didn't really enjoy mathematics lessons at school, even though I achieved good grades.
- Lina We sat down more than we moved when I had maths in school. I don't learn well that way. I would probably be even better at maths if I had to move around more. I am that kind of person, but I think there are at least four or five different forms of mathematics learners.
- Lisa But mathematics is so logical that you don't even have to think. You follow the rules, and then everything works. Mathematics is about numbers and how different things are connected and it's included in a lot of today's society, geometry, and everything. It's just logical.
- Lina There is a certain logic with mathematics that I love, it is incredibly simple because it's so logical. You do need thinking space as well though.
- Evie Mathematics for me is a part of society, and everything is connected with money, costs, interest rates, and so on. So, you need to give students the right conditions to understand the context and to understand the context, you must teach them basic arithmetic. Otherwise, they will not understand anything.

- Alva I have no idea what mathematics is, it was not fun the way I was taught. Hopefully, mathematics can be more like my experience of solving problems. My experience of learning mathematics is that you sit there with your book. The teacher stands there and tells you how you do it. You count numbers and not a lot more. In other subjects it is different, the teaching is more varied.
- Evie I think you need to teach differently in other subjects. Somehow, you have to make students understand that everything is connected. Other subjects can be taught as discrete topics, but not mathematics. Mathematics is not based on facts, like in other subjects.
- Lisa I agree that teaching mathematics is very different from teaching other subjects. Mathematics is either easy or difficult for you, while other subjects are something you can learn in different ways. Other subjects are connected. Mathematics is more like a set of rules to learn and helping students to read and understand the textbook. In mathematics, you have to give a lot of time to individuals. In other subjects, lessons can be conducted with the whole class. Mathematics is a more complex subject, there is always something that works or is interesting. It is not something you can learn to understand. You have to have a particular aptitude.
- Lina Like I said, mathematics is not difficult to teach because it is straightforward and logical. You have everything there. You do not have to think about anything. There is nothing to really feel when you do mathematics. If I read a poem, it is my feelings, my experiences that come into play. Mathematics is not about feelings, it's simple and nothing else. There is a certain logic and I like logic and yes, I actually really like it...

The mathematics teacher educator brings the conversations to a close.

6. DISCUSSION

In this section we offer some of the aspects of the conversation that emerged for us through the process of constructing the dialogue. We do not view our ‘findings’ as objective and instead encourage readers to

interpret the conversation for themselves, potentially interpreting the dialogue differently to the way we have done here.

The four prospective teachers referred to a range of positive experiences concerning the subject of mathematics. They all enjoyed different aspects of doing mathematics at school. For Alva, this enjoyment related to the process of problem-solving, which she recognised as something she would have valued more opportunity to engage with. Lisa enjoyed mathematics because of what she saw as its competitive elements. Evie was recognised as somebody who could support others, and she earned recognition for her ability to mathematise. While Lisa and Evie considered themselves as being good at mathematics, Lina enjoyed the subject because of the structured nature of the lessons and Alva during the limited moments when she could engage in higher level thinking. Put simply; they each enjoyed different aspects of the teaching and learning of mathematics. We might consider Alva as most closely aligned in terms of values to those promoted by the reform agenda. However, this is not the same story for Lisa, Evie, and Lina, who enjoyed aspects of mathematics not commonly valued by the mathematics education community.

What then are the implications and what do we learn from our analysis concerning the views of these prospective teachers? We know that each prospective teacher brings with them their own personal history of experiences in relation to the world of mathematics teaching and learning. This range in personal histories will indeed determine the range of views that prospective mathematics teachers bring to teacher education. Some of these views may well not align with those promoted by the reform agenda or by their mathematics teacher educators, and perhaps this is nothing new. But maybe by engaging with the range of different views, by taking each view as legitimate and well-grounded, we might avoid any chance of thinking about prospective teachers as a homogenous group. We cannot expect these individuals to change based on our interventions, especially not in pre-defined ways. We can, however, pay more attention to how prospective teachers' prior and current experiences shape the way their teaching practices evolve, so that they are more likely to experience a sense of "being, becoming, and belonging" (Skott, 2019, p. 471) in relation to the teaching profession. By re-centring these individuals rather than focussing on their (potential lack of) certain knowledge or beliefs, we might understand more about how prospective teachers develop themselves within the different situations and social practices that they find themselves in. We continue to ask ourselves, as two mathematics

teacher educator-researchers, what does mathematics teacher education look like where there is real (as opposed to “forced” (Skott, 2004)) autonomy?

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