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What you teach is what you get? Exploring the meanings realised by prospective mathematics teachers during a teacher education programme

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The role of the teacher education programme in preparing mathematics teachers to teach mathematics is an under-researched area within mathematics education. In this paper, we analyse four components of empirical material, each captured from a teacher education programme based in Sweden. Using a methodological approach informed by enactivism and Systemic Functional Linguistics, we build on previous analysis of the language-in-use of one mathematics teacher educator to situate a further layer of analysis, this time, from the perspective of a prospective mathematics teacher. Our findings suggest the prospective teacher in this study, who had positive experiences of mathematics at school, learns to align linguistically with the mathematics teacher educator's contrasting views of mathematics teaching and learning, and in doing so, creates herself a safe space.

Keywords: Mathematics teacher education programmes; mathematics teacher educator language; prospective mathematics teachers; enactivism; Systemic Functional Linguistics.

Background and context of the study

This paper sets out to illustrate a problem related to mathematics teacher education, as part of a more extensive study, to understand how prospective mathematics teachers negotiate meaning from the language of mathematics teacher educators during teacher education situations (Ebbelind, 2020). We set out to address the relationship between interactions during teacher education situations and the kinds of meaning realised by the prospective mathematics teachers. Previously our focus has been on developing a methodology for studying the language-in-use of the mathematics teacher educator (see, Ebbelind & Helliwell, 2021), whereas in this paper, we foreground the prospective mathematics teacher. Specifically, we turn our attention to how one prospective teacher, Lisa, discursively assembles language-in-use when taking part in her teacher education programme. Our research question is: *What meaning does a prospective teacher realise from language-in-use during her initial teacher education?*

The empirical material used for this paper consists of four components, each captured during a teacher education situation in Sweden. The first component is a transcript from a mathematics teacher education lecture, the second is a transcript from a seminar where a group of prospective teachers worked on a task set during the lecture, the third is a transcript from an interview with one of those prospective teachers, Lisa, and the fourth is a set of extended field notes (Delamont, 2008) that were taken based on Lisa's reflections on the lecture. Lisa is in her early 20s and began teacher education directly after finishing school. She described herself as an extremely competitive athlete playing soccer (football) at a high national level. Much of her terminology can be interpreted as related to

sports and management. During Lisa's teacher education programme, she studied 30 ECTS credits (one full semester) in mathematics education. Lisa perceived herself as a "good" mathematician when re-engaging in her past school mathematical experiences at upper secondary school (aged 17-19 years). After her education she will work as a teacher in an upper primary school (aged 10-12 years). The context in Swedish mathematics teacher education is the reform mathematics movement that "promotes a vision of school mathematics that focuses on students' creative engagement in exploratory and problem-solving activities as they develop their understandings of significant mathematical concepts and procedures" (Skott, Mosvold & Sakonidis, 2018, p. 164). In Sweden, prospective teachers at primary level (aged 7-12 years) educate to become generalists, as opposed to subject specialists. As a consequence, primary teachers in Sweden will teach a range of different subjects as well as mathematics and their level of education in each of the school subjects is usually modest. In Sweden (Ebbelind, 2020), and other western countries (Stoehr, 2015), the professional background of a primary teacher is linked less to the teaching of specific subjects than to the profession as a whole. The subject of mathematics itself becomes subordinated for these prospective teachers, and social development becomes the primary aim of schooling. As a result, prospective teachers create a "safe space" for themselves and their future students (Gellert, 2000).

The role of teacher education programmes for prospective mathematics teachers

The role of teacher education programmes in the educational system is increasingly discussed and problematised. There is an underlying assumption in the research field of mathematics education that teachers matter in relation to students' learning. To become a mathematics teacher at primary level concerns a shift from viewing oneself as a learner of mathematics in school to a perspective of oneself as a mathematics teacher who teaches others to learn mathematics. Being enrolled in a teacher education programme has been shown to change the relationship one has to mathematics teaching and learning (Hošpesová, Carrillo & Santos, 2018).

Some researchers regard becoming a primary school teacher through teacher education as problematic because of the relationship prospective teachers have regarding their own past school-related experience, even concluding that teacher education has little impact on prospective teachers' beliefs, with a limited chance of affecting their future teaching (Ebbelind, 2020). Prospective teachers past experiences will affect the way they become teachers. Those prospective teachers who struggled with mathematics at school continue to struggle during their teacher education programmes, whilst the prospective teachers who enjoyed mathematics in school continue to do so (Player-Koro, 2011). The political agenda, as well as some research into teachers' knowledge and beliefs, have both established a deficit model of prospective mathematics teachers (Askew, 2008). Much attention has been given to what prospective teachers do *not* know (based on what they *need* to know) and how to improve their knowledge by incorporating more mathematical content within teacher education programmes. However, as Hemmi and Ryve (2015) explain, this deficit story needs to be used gently by the research community, otherwise the therapeutic aspect of teacher education becomes too extensive (Hannula, 2002). The deficit story, and the therapeutic aspect of teacher education, are considered a part of Swedish teacher education (Hemmi & Ryve, 2015; Player-Koro, 2011). Gaining insights into the experiences of prospective primary school teachers in relation to their development during teacher education programmes is a gap that this study seeks to address.

Methodology: A recursive inquiry

The community of mathematics teacher educators are a diverse group of individuals who come from a variety of professional backgrounds and contexts. The authors of this paper are both university-based mathematics teacher educators and researchers in mathematics education. Andreas is a university mathematics teacher educator from Sweden where he teaches prospective pre-school (aged 1-6 years) and prospective primary (aged 7-12 years) school mathematics teachers. Before moving to teach at university, Andreas taught mathematics in pre-school class (age 6 years) and lower primary school (aged 7-9 years) for ten years. His research background links in different ways to social practice theory and symbolic interaction. Tracy is a university mathematics teacher educator from the UK where she teaches prospective mathematics teachers on a one-year postgraduate course for secondary (aged 11-18 years) mathematics teachers. Before moving to teach at university, Tracy taught mathematics in secondary schools for thirteen years. Her research background links to the perspective used in this study, enactivism, which she has used in researching mathematics teacher and mathematics teacher educator learning. As researchers from different contexts (Sweden/UK, Primary/Secondary) each familiar with different theoretical perspectives and analytical tools, we see value in combining our different perspectives and research approaches to enrich our understanding of particular phenomena of interest. In combining our different methodological approaches, we aim to disrupt the potential interdependency of theory and research findings that are often associated with the use of single perspectives, particularly in relation to sociologically related research within mathematics education (Gellert, 2008).

For an inquiry to be recursive, it involves an iterative process of data collection and analysis, where for example, the initial analysis of data feeds into subsequent analyses in an ongoing process. In this recursive inquiry, we utilise our multiple perspectives through looking at the same empirical data but through different lenses, making multiple revisitations of the data. We use our previous analysis of the language-in-use of one mathematics teacher educator (Ebbelind & Helliwell, 2021) to situate a further layer of analysis, this time, from the perspective of a prospective mathematics teacher. We include our own reflections on the process of analysis alongside any observations and findings that emerge as a result of the analysis, which we share with one another in an ongoing dialogue, which then feeds into the next stage of analysis. Specifically, we have combined enactivist research principles with systematic functional linguistics (SFL). We see enactivism as an overarching methodological framework within which SFL provides a complementary analytical tool.

Enactivism as a research methodology

Reid (1996) sets out two features of enactivist research, derived from key principles of enactivism (Maturana & Varela, 1992; Varela, Thompson & Rosch, 1991), that are “the importance of working from and with multiple perspectives, and the creation of models and theories which are good-enough for, not definitively of” (p. 207). From an enactivist perspective, any model or theory used to describe and explain a phenomenon cannot be definitively of some external truth. This does not mean that models and theories are of no use, rather, models and theories are accepted as being good-enough descriptions and explanations for the phenomenon under study rather than mirrors of reality. As researchers engaged in research, we bring with us our own ways of seeing the world, determined by

our history of interactions and experiences. Thus, utilising multiple perspectives is one way of expanding what is possible to grasp during the research process. As researchers we bring with us our “theories, beliefs, and biases” (Reid, 1996, p. 206) so we seek multiple perspectives and frameworks as a way of seeing more than is possible to see from any single perspective.

Previously we have developed a detailed description of our research methodology for analysing the language-in-use of a mathematics teacher educator. This research methodology was developed by extending the enactivist informed “methodology for studying talk” described by Coles (2015, p. 235) through utilising SFL as a systematic tool for identifying patterns in the transcript of the mathematics teacher education lecture. In the next section we summarise our findings from this analysis (see Ebbelind & Helliwell, 2021) where our focus was on the interpersonal aspects of the mathematics teacher educator’s language-in-use such as voice, tense, polarity, and modality (or certainty) during an early mathematics teacher education lecture for a group of prospective primary teachers in Sweden (the transcript of this lecture providing the first component of empirical material used in this study). Having established our reading of the mathematics teacher education lecture from analysing the language of the teacher educator, we then move on to explore the perspective of one prospective teacher, Lisa, in relation to the same lecture and the mathematics teacher education programme more generally.

The language-in-use of a mathematics teacher educator

During the lecture, the mathematics teacher educator, who from this point we refer to as Ian, talks about what it means to know something, for example, “one has an understanding of things when one does not have to remember what one must remember to be able to know”. He positions the prospective teachers as a unit, and ascribes the prospective teachers as all having had negative experiences of mathematics [note: in the transcripts that follow, ... represents a pause, [...] represents some missing text]:

Ian: I think most students here today... who have gone through the whole school system and high school do not feel that way... was mathematics not really something you had to remember ... do this here and it will be alright [...] Students often do not have the skills needed to be able to present their thinking in for example writing ... It is not simply [...] how many doors do you have at home? What you come up with, we will then try to bring into this lecture. You should start thinking ...

There is an assumption, maybe not intentionally, that the prospective teachers have had negative past experiences of mathematics in order to promote the reform agenda. When the teacher educator focuses on current and future practices, we interpret this as relating to the deficit story of prospective teachers.

Ian: Too many students have not understood anything ... We know that from the national board of education reports. If you understand, you do not have to keep such a lot in mind because you know why it is as it is, and you can pick it up and use it, and we want our students to be able to do that in the future.

The level of certainty in Ian’s utterances is low when he speaks in relation to the prospective teachers. For instance, when he talks about the prospective teachers as solving the problem. The level of certainty is also low when Ian addresses the prospective teachers, encouraging the prospective

teachers to synthesise the lecture's content. There are also low levels of certainty relating to mathematics as something for students to master.

In the background, there seems to be a theme of general failure in relation to the past teaching of mathematics. This theme of failure is used to promote another type of teaching by Ian, "We must... you must in the future be able to write yourself mathematically ... we have to give students these tools to pass the national tests." We interpret that Ian is unintentionally positioning all prospective teachers within a deficit story. Even though he promotes another agenda, the reform agenda, the mystification or exclusivity of mathematics is still a part of how the lecture is conveyed. There seems to be a narrative style that can be identified within the transcript of the lecture in that there is a story that unfolds. Throughout this lecture, Ian promotes the idea that there is another story to tell about teaching and learning mathematics than the expected experience of the prospective teachers.

What meaning does the prospective teacher realise?

Following the lecture was a seminar where Ian set tasks for the prospective teachers to complete in their study groups (each study group consisting of a subgroup of the prospective primary teachers). The lecture and seminar were both based around the prospective teachers' past participation in mathematics education, whether that participation was experienced as positive or negative. However, Ian made no reference to any positive experiences during the lecture, and neither did any of the prospective teachers. During the lecture, the majority of the prospective teachers commented on their lack of positive experiences as mathematics students. For prospective teacher Lisa, it became clear that her positive experiences of learning mathematics at school were uncommon. When the different study groups were given a task related to the lecture concerning how their own experiences may have differed from those portrayed during the lecture, Lisa and her peers, Kira and Dina, expressed how the reform-oriented ideas troubled them. This is reflected in the extended field notes from this session:

On the way to the group work, Kira [one of Lisa's study-group members] says that this is different from what she expected, something different from what she had done in school. The prospective teachers in this study group had good experiences of mathematics, they are interested in mathematics and seem to understand the mathematics to a higher extent than many of the others.

During the seminar, members of Lisa's study group indicated that some of their own experiences do not align with those emphasised in the seminar questions introduced by Ian, the teacher educator. Kira contrasts her past in relation to the present teaching during the teacher education programme, "[my past mathematics teachers] did not demonstrate mathematics in that way, with all these words on the board, that is said to be so good." Lisa adds, "but doing mathematics was something that I was good at... I liked the textbook." In relation to the reform-oriented teaching promoted by Ian, Dina concluded that "it was probably only late on in the national test you had to [do problem-solving questions] but otherwise, we were not allowed discussions in our class." The three prospective teachers reacted to Ian's utterances which emphasised the failure of schools, the prospective teachers' "old" mathematics teachers, and the school system more generally, all of which contributed, according to Ian, to the prospective teachers' "dislike" of the subject of mathematics. However, no one within this study group "disliked" mathematics, instead, they enjoyed it. They recall enjoying

being challenged either by the mathematics textbook or the competitive elements or competitive teaching strategies.

Before calling the study groups back to the lecture hall, Ian has brief discussions with each study group. Lisa's study group is the last group that Ian attends. He seems hurried and begins by discussing their negative feelings against the subject without asking them about their experiences:

Ian: It seems that you got into the same thing as all the groups, I think, and that is probably it. Typical, that what you bring with you into this course. Is it possible to change this then? It will be a nice task ahead. Yes, you are to become excellent math teachers.

However, Lisa, Kira and Dina do not challenge Ian during this discussion, instead, they play along and have a tentative conversation with him, aligning with his views. This deviation is brought up in an interview with Lisa one week after the seminar:

Andreas: I attended your seminar when you had a group discussion ... and from what I perceived, you had a pretty good discussion, but then I thought, when [Ian] came, suddenly, he started talking ...

Lisa: About many things that we did not discuss.

Andreas: I was wondering ...

Lisa: It felt a bit strange because it felt like what we had done was very wrong ... at the same time, it felt like we answered the questions ... and he replied ... it did not feel as if things were connected [...] Yes, it was bizarre [laughing]. But at the same time, you understand what he says, but it is not like you have considered ... often when you think back, you remember what was good ... one does not think in this way when you are young ... then, everything was good, and you quickly calculated things in the mathematics textbook, and it was damn good ... great fun and then when he puts it ... so maybe it was not so good ... it was probably a little awakening for us all...

Discussion

The prospective teachers Lisa, Dina, and Kira all expressed their appreciation of mathematics as related to the way it was taught. They each remember the positive feelings that they had when participating in mathematics as students in school. However, Ian's argumentation is somewhat different. He promotes another way of teaching mathematics, together with rejecting the teaching that, for example, Lisa recalls as being positive. There seem to be conflicting stories about effective teaching and learning of mathematics. When 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. Lisa, Kira, and Dina, who enjoyed mathematics at school, re-negotiated the content taught by Ian, perhaps as a way of creating a "safe space" (Gellert, 2000) which allowed them to continue enjoying mathematics in their own ways (Player-Koro, 2011).

The deficit model of prospective teachers (Askew, 2008) seems to guide the story of the lecture, but at the same time, Ian seems to be convincing the prospective teachers that more (and different) subject knowledge is needed as part of teacher education. The complex phenomenon arising is that while expressing mathematics as being difficult, Ian is simultaneously enacting the therapeutic side of teacher education (Hannula, 2002). In other words, one potential challenge for the mathematics teacher educator is to create an environment where prospective teachers, who may be looked upon as

problematic, are convinced that a problem indeed exists (within mathematics teaching and learning), without themselves becoming dejected. The majority of the prospective teachers embrace the ideas presented at the mathematics education course as a revelation, and Lisa, Dina and Kira also embrace the intentions *linguistically*. This means that when they participate in the teacher education setting, they align their language with the language of the teacher educator. However, beyond the formal setting, these prospective teachers express a different view of mathematics teaching and learning, to that being encouraged within the teacher education programme. As mathematics teacher educators ourselves, we ask if we too are affected by the deficit story, and in what ways? An important question in relation to this is how prospective teachers may be constrained in their development by aligning with a performative culture from their past as well as the prevailing deficient story of today's society.

From an enactivist perspective, the way we respond to situations is determined by our history of experiences. The situation itself does not (and cannot) determine how an individual might respond. From this position, a vital aspect of mathematics education programmes is acknowledging and working with the experiences (however varied these experiences may be) of the group of prospective teachers. By foregrounding the experiences of the prospective teachers, we need not abandon the quest to improve mathematics teaching and learning, but the emphasis shifts to supporting the prospective teachers in realising, for themselves, what might be possible in the mathematics classroom, that they have not yet themselves encountered.

We are left with a set of new questions, both as mathematics teacher educators and researchers: How do prospective teachers in teacher education situations prioritise the content taught during mathematics teacher education programmes? Do prospective teachers prioritise the content taught during the teacher education programme, or do they prioritise something other than what seems to be expected from the mathematics teacher educator's point of view? What is essential or relevant from the perspective of prospective teachers' when attending the teacher education programme in general and in mathematics education in particular? How can we foreground the diverse experiences of the prospective teachers whilst supporting them to explore potentially new ways of teaching and learning mathematics? These questions we take with us into the future.

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