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Mathematics teacher educators' critical collegueship

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In this paper, we apply the ideas of Lord (1994) about critical collegueship to understand how mathematics teacher educators (MTEs) can work together to become more critical in their teaching practices. There is relatively little research on MTEs' learning and development from a critical perspective. Our study examines a group of MTEs working together to develop novel teaching and do research about initiating critical discussions. During two meetings, the MTEs discussed their different perspectives after using indices such as the Body Mass Index (BMI) in teaching. Identified examples of Lord's elements were a willingness to seek and try out promising ideas, and being open to share perspectives and ask for arguments. Such collaboration supports reflections for developing teaching and research.

Keywords: Critical collegueship, mathematics teacher educators, reflections.

Introduction and previous research

There are several studies concerning mathematics teachers' knowledge for teaching (e.g. Ball, Thames, & Phelps, 2008; Rowland, Hucksteps, & Thwait, 2005), as well as mathematics education courses designed for mathematics teachers' professional development. Zaslavsky and Leikin (2004) pointed to the lack of research on becoming a MTE and lack of formal training programs. "Mostly, teacher-educators are 'self-made'" (Zaslavsky, 2008, p. 94). Some studies about MTEs focus on the mathematical knowledge for teaching mathematics teachers (Zopf, 2010), and MTEs' practices in providing professional development (Kuzle & Biehler, 2015). In a historical overview, Jaworski (2008), in line with Zaslavsky & Leikin (2004), found that a very small number of studies reflect on the MTE's learning "from engaging in teacher education, through reflecting on their own practice, or through research into the programs they design and lead" (p. 3). Our study is a contribution to narrow this gap by focusing on how MTEs can collaborate to become more critical about their teaching practices.

According to Zaslavsky and Leikin's (2004) model of MTEs' professional development, MTEs learn through learning (facilitated by an experienced MTE) and through teaching (to mathematics teachers), while collaborating with other colleagues of similar or differing expertise. The need for MTEs to reflect, individually and collectively, on different aspects of their own practice and development is pinpointed as important for their learning (e.g. Tzur, 2001; Jaworski, 2008; Zaslavsky & Leikin, 2004; Garcia, Sanchez, & Escudero, 2007). Individual reflections upon the different stages of becoming an MTE include reflections on learning mathematics, learning to teach it, learning to educate mathematics teachers, and learning to mentor educators (Tzur, 2001). In collective reflections between colleagues when preparing and teaching different courses, practices such as sharing experiences, reading and conducting research, and continuous efforts to improve courses (Roth McDuffie, Drake, & Herbel-Eisenmann, 2008), as well as MTEs adopting theoretical perspectives to examine their teaching practices (Garcia et al., 2007), can influence MTEs' development.

Zaslavsky (2008) argued that one of the identified practices, from which MTEs can learn, is the choice and design of tasks and resources by which students can learn specific content or ways of teaching. In our research group, we collaborate on identifying and implementing new teaching ideas that can promote critical mathematical discussions (in line with Skovsmose, 1994) amongst pre-service and in-service teachers. We collectively reflect upon the implementation of these ideas in our own teaching. One idea we aim to investigate in our project is the use of indices as mathematical models for in-service teachers to experience initiating and developing critical discussions about the role of mathematics in society. Indices, such as the BMI, have proved to be fruitful entry points to such discussions (see Kacerja et al., 2017). Reflecting collectively as MTEs upon our own practice can help us learn more about being teacher educators (Roth McDuffie et al., 2008; Zaslavsky & Leikin, 2004).

In the data presented in this paper, we reflect as a group upon our experiences with critical discussions after two colleagues had tried out a task about the BMI with in-service teachers. We investigate how we communicate in the group and how we invite and present ideas and perspectives from a critical collegueship perspective (Lord, 1994). Critical collegueship is a particular type of collegiality and is elaborated on in the next section. The question we pose in this paper is: *What aspects of critical collegueship can mathematics teacher educators' collaboration bring about?* By focusing on the critical collegueship aspects by Lord (1994), we explore how such a collaboration can support our work as MTEs.

Critical collegueship among mathematics teacher educators

Lord (1994) emphasised professional development of teachers and discussed critical collegueship as one kind of collegueship to support teachers' reflections. Colleagues sharing interests and experiences, being open and respectful, willing to try out new ideas and to be critical, are crucial conditions for such a collegueship. The main difference between critical collegueship and other kinds of collective reflections is the support of a "critical stance toward teaching" (p. 192). The critical stance in our study means we do not only share our ideas with colleagues, but we also ask for, and articulate, the assumptions behind these ideas.

Lord (1994, pp. 192–193) identified six characteristics of critical collegueship:

1. Creating and sustaining productive disequilibrium through self-reflection, collegial dialogue, and on-going critique;
2. Embracing fundamental intellectual virtues (e.g. openness to new ideas, willingness to reject weak practices or flimsy reasoning, accepting responsibility for acquiring and using relevant information, willingness to seek out the best ideas, greater reliance on organized and deliberate investigations, assuming collective responsibility for creating a professional record of teachers' research and experimentation);
3. Increasing the capacity for empathetic understanding;
4. Developing and honing the skills and attributes associated with negotiation, improved communication, and the resolution of competing interests;
5. Increasing teachers' comfort with high levels of ambiguity and uncertainty; and
6. Achieving collective generativity.

The characteristics for which a collegueship can be considered critical, according to Lord, have to do with a sense of responsibility for seeking improvement and accepting that the best solution is not yet achieved. It requires participants to be comfortable with uncertainty and to make efforts to develop

and accept new ideas by self-reflection and on-going critique. Differences are seen as driving forces that can facilitate a productive disequilibrium. Our joint interest as MTEs is to learn more about ways of fostering critical discussions in teacher education about the role of mathematics in society. The ideas within critical collegueship support such group reflections. This is the reason why critical collegueship is chosen as a framework for analysing the discussions.

While Lord (1994) defined critical collegueship for groups of teachers reflecting together, Males, Otten, and Herbel-Eisenmann (2010) used Lord's framework to study the collegiality of a group of mathematics teachers and researchers. They identified challenging interactions in which participants asked questions to push for in-depth reflections, and located elements of Lord's intellectual virtues in those interactions. In our paper, we apply critical collegueship within a group of MTEs. We extend critical collegueship as one way of thinking about professional development of MTEs, by reflecting upon our own discussions. In line with Males et al., we focus on the discussions when different perspectives about practice come into play. It is in these situations that it becomes more likely for MTEs to argue for their ideas and invite the colleagues to share their perspectives.

The study, participants, and data analysis

The study focuses on a group of seven teacher educators, including the two authors, collaborating on developing teaching and research. In this paper, we use data from two meetings in which teaching about indices and critical discussions was focused upon. All seven of us took part in the first meeting shortly after TE1¹ and MTE2 had collaborated on a 3-hour workshop on indices for in-service teachers. This was part of a course in Numeracy across the curriculum. The in-service teachers discussed the BMI task for 60 minutes in two groups of six persons. They examined the BMI's mathematical components and formula, its use in society, and the appropriateness of using indices in school teaching. In the next semester, we had a second meeting and continued to discuss ideas for developing our teaching about indices as part of our project. In addition, we discussed a research paper we had written about stimulating critical discussions in mathematics where data from in-service teachers' discussions were analysed (see Kacerja et al., 2017).

The two meetings were audiotaped and transcribed. In line with Lord (1994), we, the authors, investigate discussions when different perspectives in teaching and research come into the fore as driving forces. An example of this is when one MTE argued that we should teach a kind of scheme for dissecting indices, while one of the others thought it was important for in-service teachers to be free to investigate. The first author identified such interactions from both meetings, and both authors examined them from a critical collegueship perspective. We also looked for the use of words such as "yes", "maybe", "but" etc., in order to identify the different characteristics of the critical collegueship. The examples presented in the following are representative for the situations where different perspectives occurred.

¹ TE1 is a teacher educator within social science, while the six others are within mathematics education, thus MTE.

Different perspectives

As previously argued, we identified discussions showing different perspectives on two related topics – the ways to teach critical skills, and the mathematical level in the discussions. We now analyse aspects of critical collegueship in the chosen utterances.

Different perspectives on how to teach critical skills

The first meeting begins with TE1 describing the teaching and his experiences from the workshop. The goal of the lesson was to create an awareness about the importance of being critical to the use and misuse of numbers in society. While TE1 and MTE2 agree upon the goal, differences came to the fore about how to achieve that goal. TE1 then said, “It was actually too little time and too much material” in the teaching session before the group discussions, and continued by saying:

TE1: I wish I had more time, and maybe do something more, dissect an index to really give them a useful example, a template in principle, a recipe, how one can approach an index. How one can take the pieces apart and see what those mean, what the different numbers mean, the different variables in an index.

TE1 explains what he would do differently next time to improve his teaching. He is critical to his planning of “too much material” and shows by this self-reflection a characteristic of critical collegueship. For him, a way to achieve the goal could be to show the teachers an example of how one could criticise an index, by dissecting it and working with its different components to get a sense of the numbers. The use of “maybe” indicates an openness in his reflection. This is strengthened by the wording “I wish”, a choice of words that makes it possible to characterize the whole utterance as a “what if ...?” approach, a focus towards what can be possible to do. A few utterances later, MTE2 presents a different opinion:

MTE2: Yes, and as you said TE1, one can look at this from two sides; how much material should they be presented with beforehand for a discussion like this, and how much should they not [be presented with] ...

MTE2 starts with a “yes” and acknowledges TE1’s point of view. However, she also wants to bring into attention another point of view. There is a dilemma about how much guidance the in-service teachers should get before they start exploring the problem themselves. MTE2 does not comment upon the goal of the lesson, she is only trying to look at an alternative way for achieving it – she creates some disequilibrium. From Lord’s (1994) perspective, disequilibrium provides participants with opportunities to reflect upon other’s ideas and bring their own arguments into the discussion.

MTE2 elaborates afterwards on her argument with a “because” and exemplifies with an episode from the in-service teachers’ group discussions in which one teacher was fascinated about how much she had learned. For MTE2, this is an argument that supports the idea of giving teachers the opportunity to explore the use of mathematics, without necessarily having ready-made schemas, as TE1 suggested. MTE2 argues that the dialogue the in-service teachers had is important for learning to explore, while a recipe “can limit the dialogue and they [the in-service teachers] can become preoccupied with doing it the same way [as the MTE]”. The argument concerns potential negative effects from presenting a recipe; it could hinder the teachers’ explorations and make them adhere too

strictly to the TE's schema. MTE2 provides arguments to support her idea of giving the teachers some space to explore the problem themselves, emphasizing dialogue, wondering and exploration. She presents ideas and counter-arguments, thinks aloud and refers to examples. MTE2 sets some standards for the level of reasoning required for the group discussions to be fruitful, in line with Lord's (1994) emphasis on negotiation and improved communication.

In all of the utterances presented above, as in other cases of disequilibrium in our data, the participants start their utterance by acknowledging the colleague's point of view using phrases like "yes", and "agree", and then introduce an alternative view starting by "because" and supported by examples. Acknowledging colleagues' ideas and arguments relates to Lord's focus on "the capacity for empathetic understanding" (1994, p. 192). By using phrases such as "maybe" and "you can look at it from two sides", TE1 and MTE2 apply some fundamental intellectual virtues in their discussions by opening up for other opinions. They acknowledge the others' views and seek the best ideas by looking at the topic from different points of view. TE1 and MTE2 use classroom examples to support their arguments by using relevant information. This is typical for the participants in both meetings, and in line with previous research (Males et al., 2010). The MTEs explore together how to initiate critical discussions in their teaching without having the answers available. They are, as Lord (1994) put it, coping with uncertainties and ambiguities that TE1 and MTE2 reflect upon.

Different perspectives on the mathematical level in the discussions

Exploring the mathematics of the BMI, and the in-service teachers' mathematical competence to do that, also generated different perspectives. In the first meeting, MTE4 stated that the teachers did not explore in depth the mathematics behind the chosen index. Similarly, TE1 pointed to the lack of mathematical competence as a barrier that hindered the teachers in doing so. He supported his argument by referring to what the teachers expressed during the discussions. This fits with his earlier reflections about how he would organize the teaching differently next time to help teachers overcome this barrier, showing again signs of self-reflection for improving his teaching.

Another disequilibrium occurs in the second meeting, when discussing an article in which we all looked at the competence showed by in-service teachers when working with the BMI task. Similarly to TE1 and MTE4, MTE5 thinks there were "relatively little mathematical discussions". MTE6 asks MTE5 what mathematical discussions are in her opinion. MTE5 answers that she is thinking about discussing mathematical concepts. MTE6 then adds, "Yes ... but there is also a broader understanding of mathematics, of mathematical discussions, to discuss mathematics in use and its role in society". As MTE2 also did earlier, MTE6 accepts MTE5's perspective about what she regards as mathematical discussions with a "yes", but he also introduces his perspective by saying "but there is also". MTE6 presents his view by arguing, in line with a critical mathematics education approach (Skovsmose, 1994), that mathematical competence includes being able to use mathematics and evaluate its use in different contexts. Mathematics goes beyond discussing mathematical concepts; it also involves a broader perspective of its use in society. This is reflected in the goal of the lesson formulated by TE1. MTE6 supports his argument by focusing on competences the teachers showed in their discussions from this extended perspective on mathematics by saying: "They showed many good reflections connected to challenges about indices, and about indices in a school context."

It is possible to identify several fundamental intellectual virtues in this discussion. The MTEs are invited to share ideas and arguments, problems are investigated from different viewpoints, and viewpoints are elaborated upon with several arguments before deciding the next step. In the two meetings, the MTEs clarify their expectations about in-service teachers showing mathematical competence, but also the competence to evaluate and criticize how mathematics is used in society. They search for better ideas to improve the teaching about critical discussions, as Lord (1994) emphasized, as they continue to reflect about the tasks. At the end of the second meeting, when MTE4 wonders if she should ask more targeted mathematics questions in the next teaching session in order to guide the teachers to thoroughly explore mathematics, MTE2 argues:

MTE2: One thing is to go more in depth into the mathematics [of the index], if they are able to do that. But we would also like them to stay there and understand that there is something here that could be necessary for them to understand. They see its meaning ...

MTE2 acknowledges again the other colleagues' idea of more in-depth exploring of the mathematics. She then continues in line with her earlier ideas about giving the teachers the time and possibility to discover things by themselves, to get the feeling that they need to learn something. She connects this to the meaning the teachers themselves would give to an index, and to the mathematics of the index.

So far, the MTEs have shared their ideas, been open-minded for other arguments and ways of doing, argued for their views, and presented alternative points of view. One could then ask what effect this exchange of ideas has on the MTEs and their collaboration. By the end of the meeting, MTE2 continues with a proposal for further developing the task about critical mathematics and BMI:

MTE2: As you [MTE4] mentioned with proportionality ... Is it possible to design a teaching session where one first goes through the main mathematical ideas of the index? But not specify the index. Then talk [teach] about inverse proportionality without saying that it is the BMI we are talking about ...

MTE2 starts with taking into account MTE4's earlier idea of proportionality. By raising a question, "is it possible to design ...?", MTE2 tries to negotiate with MTE4 and the others to find a teaching approach that takes into consideration many of the colleagues' comments. She proposes one way to organize the session by starting with some teaching about the mathematical concepts of BMI, such as inverse proportionality, but without giving any scheme for how to do it. By so doing, the in-service teachers would be given some mathematical foundation when exploring the mathematics of the formula, as MTE5, TE1, and MTE4 called for. At the same time, MTE2 takes care of her own idea of giving the teachers the freedom to explore by adding "then they [the in-service teachers] could get the BMI formula and see if they connect it [to inverse proportionality]. We haven't tried that". MTE5 agrees with MTE2 by saying "I thought the same ... teaching about proportionality independently of the index". MTE6 also supports MTE2's idea by saying, "start the teaching with some mathematics". Everyone agrees that it is a good idea to try out MTE2's proposal. The negotiation highlights the importance of giving the in-service teachers more support to develop and show mathematical competence, while at the same time giving them freedom to show their competence on reflecting upon the mathematics' use in society. The MTEs have together come to an idea while trying to avoid

the pitfalls expressed earlier by the colleagues, a kind of “collective generativity” (Lord, 1994). The best agreed upon solution in this round of discussions is to teach some mathematics and see if this will help the teachers in their discussion of the index.

Conclusions

In this paper, we have focused on identifying aspects of critical collegueship in mathematics teacher educators’ collaboration on developing teaching about critical discussions. We singled out utterances when colleagues had different perspectives because it is when we disagree that we ask each other for more arguments. This is a vital element of the critical collegueship perspective as it creates conditions for the participants to dig into the assumptions behind their ideas, and thus adopt a critical stance in terms of Lord’s framework. We, MTEs, are also in a position to reflect better upon our own views when challenged to argue and exemplify the teaching, and modify it for better results. In this aspect, our results fit with findings from Males et al. (2010).

During the collaboration to develop our teaching, there were particularly two aspects that generated different perspectives. One aspect is about the way of organizing such teaching and the amount of guidance to give teachers, and the other concerns expectations about the level of mathematics in the teachers’ discussions. We, MTEs, discuss different perspectives and consider them, showing several elements of Lord’s framework, especially fundamental intellectual virtues such as openness to new ideas, respect, and seeking better solutions. We support our points of view with arguments from classroom examples, as MTE2 and TE1 did, and from theoretical ideas influenced by critical mathematics education (see Skovsmose, 1994), as MTE2 and MTE6 did. Examining our practice with theoretical lenses, as with the critical perspective lenses, is a way for us to develop as MTEs (Garcia et al., 2007).

At the end, the agreed solution covers some of the challenges discussed in the two meetings. The engagement brings about some collective generativity. The solution indicates that we, MTEs, value the development of teachers’ mathematical competency, but also the importance of the freedom to develop their critical competence by not giving them too much guidance. In this way, we move forward in developing our understanding of what critical mathematical discussions are and how to support them in our teaching. As Roth McDuffie et al. (2008) pointed out, sharing experiences, looking for improvement in our practice, and doing research together, facilitate such development. It can be concluded that we, MTEs, enrich our own views by listening to our colleagues’ arguments and by trying to make sense of their reasoning, when we collectively reflect upon and analyse our work.

Given the very few possibilities for MTEs to develop their knowledge and skills, and given that collaboration of MTEs about teaching and research is a common practice, it is important to study what and how such collaborations can support the MTEs’ work, as we have done in our study. Lord (1994) discussed critical collegueship as a way to support teachers’ reflections. In this study, the concepts in Lord’s elements of critical collegueship helped us identify and discuss the potential such collaboration has in supporting MTEs’ reflections.

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