Convergences and influences of discourses in an online professional development course for mathematics teachers

EVA-LENA ERIXON

Despite the ever-increasing number of online professional development (OPD) courses, few studies have examined online education for mathematics teachers. This article reports on a case study of discourses in an OPD course for mathematics teachers concerning the convergence and influence of discourses in course seminar discussions and in mathematics teaching in school when course participants are given the task of translating their insights into actual teaching, with a focus on the participants' discussions of their own and one another's video-recorded lessons. The analysis shows that there is a convergence of discourses in the seminars and in the school context related to a focus on concepts and everyday life connections. However, the study also suggests that there is a risk of students remaining outside in an "everyday discourse", in which knowledge of mathematics might be useful, but mathematics is discussed in imprecise and simplified terms.

Professional development is a critical consideration when it comes to mathematics teachers enhancing their knowledge of and ability to teach a subject (Borko, 2004; Hodges & Cady, 2013; Niss, 2007). This has been highlighted in transnational and national arenas (Erixon & Wahlström, 2016). It is a challenge to provide teachers in remote areas with small schools with professional development courses through face-to-face activities, and online professional development is consi-dered a solution to this problem (Hodges & Cady, 2013; Russell, Carey, Kleiman & Venable, 2009). Although online communication has become increasingly common in in-service teacher education (Goos & Geiger, 2012), very little research has explored online education for mathematics teachers (Borba & Llinares, 2012). Since the introduction of online professional development (OPD), questions have been raised regarding its influence

Eva-Lena Erixon
Dalarna University

Erixon, E.-L. (2017). Convergences and influences of discourses in an online professional development course for mathematics teachers. *Nordic Studies in Mathematics Education*, 22 (1), 85–100.

on teaching practice (Dash, Kramer, O'Dwyer, Masters & Russell, 2012; Russell et al., 2009).

This study contributes to responding to the debate surrounding OPD for mathematics teachers by exploring emergent discourses in these two arenas and the possible overlap of discursive meaning.

The research question is as follows: What characterises the discourses that emerge in the teaching of mathematics in the classroom and in the subsequent seminar discussions in an OPD course for mathematics teachers? The point of departure for the research question is a case study of an OPD course for mathematics teachers.

The first section of the article explores the notion of discourse, while the second section outlines the study's methodological considerations. The results are presented in the third section, and the analysis results are discussed in the fourth and final section.

The notion of Discourse

The term "discourse" refers primarily to talk, communication and language in use (e.g. Fairclough, 2010; Imm & Stylianou, 2012; Riesbeck, 2008; Ryve, 2011). Discourse also "denote[s] any specific instance of communicating, whether diachronic or synchronic, whether with others or with oneself, whether predominantly verbal or with the help of any other symbolic system" (Sfard, 2001, p. 28; Sfard & Kieran, 2001, p. 47). Gee (2014) distinguishes between discourse and Discourse and argues that discourse is a subset of Discourse. First, discourse concerns how sentences connect and relate to one another, or, in other words, the sequence of sentences. Second, discourse is the use of language in specific contexts (Gee, 2014). Combinations of saying/writing-doing-being-valuing-believing are referred to as Discourse. A Discourse can be seen as a way of being in the world and can include forms of life that integrate words, values, gestures, etc. (Gee, 1989). A discourse community can be defined as a "community of all those capable of participating in a given discourse" (Sfard, 2008, pp. 91, 297). Drawing mainly on Wittgenstein and Vygotsky, Sfard (2008, p. 79) employs a participatory understanding of discourses and the concept of practice as the unit for analysis in terms of "patterned collective doings". Consequently, she perceives thinking as a human capacity originating and developed from these patterned collective activities. Communication becomes possible through historically established customs; that is, communication is dependent on how a "community *got into a habit* of reacting to certain actions with certain types of re-actions" (Sfard, 2008, p. 88). According to Sfard (2008), this habit of communicative action complies with Gee's (1989) Discourse. Discourse is, thus, defined as a type of communication that can "draw some individuals together while excluding some others" (Sfard, 2008, p. 91). Using the term "commognition", Sfard stresses that communicating and thinking are two sides of the same coin. Thus, by exploring emerging discourses as dynamic, time-dependent entities that preserve their specific identities through continuous change, one can gain insight into the development and increasing complexities in discourses.

A discourse is ("counts as") mathematical if it deals with mathematical words, such as words related to numbers, operations on numbers, quantities and geometric shapes (Sfard, 2007; Sfard, 2008; Ben-Yehuda, Lavy, Linchevski & Sfard, 2005). A mathematical discourse has a number of characteristic features, such as special keywords (e.g. "function"), visual mediators (e.g. graphs), routines and narratives (Sfard, 2012). This type of discourse is described as special because it relies on symbolic artefacts, such as graphs, drawings and formulas, and on the meta-rules that govern communication. In a mathematical discourse, meta-rules determine the ways of communicating and are the principles that regulate such activities as defining and proving. These rules are often implied by those taking part in the discourse (Sfard, 2001). Signs are considered to be at the heart of mathematical activity (Duval, 2006), and the use of signs is emphasised in mathematics education research (e.g. Duval, 2006; Evans, Morgan & Tsatsaroni, 2006; Moschkovich, 2002; Radford, Bardini & Sabena, 2007; Sfard, 2008). Students and teachers use signs and artefacts, such as mathematical symbols, words and calculators, to make different things apparent (Radford et al., 2007).

There are a number of different mathematical discourses (e.g. an academic mathematical discourse and a school mathematical discourse), all of which have different meta-rules. A university lecture in mathematics and a mathematics lesson in school differ in many ways (Sfard, 2000). The school mathematical discourse can be compared to an everyday discourse, which occurs when a mathematical problem is presented in an everyday context (Evans et al., 2006) or when "everyday mathematics" refers to mathematical practices in out-of-school activities (Barwell, 2013).

Classroom conversations represent a cross-breeding between everyday discourse and mathematical discourse (Sfard, 2000). Talking and acting in the same way as mathematically competent people means taking part in a mathematical classroom Discourse. However, there is more to participating in a mathematical Discourse than reciting a list of mathematical terms (Moschkovich, 2002).

In this study, discourse is interpreted in accordance with Sfard's (2007) understanding of discourse as different types of including and excluding communication. This understanding of discourse also subscribes to

Gee's (1989) differentiation between discourse and Discourse. According to Sfard (2008), "[d]ifferent collective discourses have always been feeding into one another" (p. 116), and the change caused by another discourse can be either moderate or extensive. When a discourse or concept is moved from one context to another, the different discourse elements and relations are re-selected, re-located and re-understood in partly different ways. The principle of re-contextualisation means that the elements within a discourse are selectively re-focused and related to new combinations of discourses. Through the function of recontextualisation, specific pedagogic discourses are created (Bernstein, 2000; see also Fairclough, 2010).

Methodological Considerations

Focusing on the research question, a case study of an OPD course for mathematics teachers was conducted. The course awards 7.5 credits and is one of four independent, voluntary courses provided by a Swedish university as part of a larger, government-run educational initiative for strengthening teachers' skills in mathematics teaching in order to increase students' achievement. The overall goals of this specific course are to: i) promote peer lesson planning, ii) promote teachers' ability to explore and develop students' learning and iii) strengthen teachers' skills in teaching mathematics. The current OPD course includes four mathematics teachers at the secondary and upper secondary school levels, as well as a university lecturer. The role of the lecturer is to facilitate dialogue, rather than to offer explanations. In this OPD course, the participants are physically separated and talk to each other via a digital web conferencing software service using headsets, but no web camera. Thus, they can hear each other, but not see each other. This represents a qualitative difference between "traditional" and virtual classrooms with respect to face-to-face contact with fellow students (McBrien, Jones & Cheng, 2009). The communication in this digital medium is characterised by the participants waiting until the current speaker has finished his or her remarks. Thus, the conversation attains a monologist character, which affects the discussions because it is unusual to break into a conversation with questions or to ask for clarification (Högberg, 2015). As a consequence of this conversational character, discussions often take new directions after a participant has finished his or her comments, and there is a risk of a lack of reciprocal participation and reflection. Thus, this specific form of "monologist conversation" tends not to deepen reflections (Erixon, 2016).

As part of the course, the participants are asked to choose a mathematical content, video record a lesson focusing on this content and then to watch their own video recordings and reflect on their lessons. Before the seminars, the participants watch one another's video-recorded lessons and their own video-recorded lessons. Analyses of the teachings are discussed during the subsequent seminars. Consequently, course participants video record one lesson each. They all reflect together on lesson content in the subsequent course seminar and then revise their own lessons in accordance with the seminar discussion. Then, they create new lessons. This procedure is repeated until each course participant video records a total of three lessons. The OPD course also incorporates a number of literature seminars, but these are not included in this study.

The focus of this study is a sequence of three school lessons and three academic seminars. The seminars comprise discussions about and reflections on the lesson content. I follow a teacher through three school lessons and three seminars with her course participants. The pseudonym Julia is used to represent the teacher. In this study, I sought mathematical content at a more advanced level. Julia was chosen because she was teaching upper secondary school. She also gave me permission to use her video-recorded lessons for research purposes. During this OPD course, Julia chose to focus on "functions and derivatives". A discourse analysis was conducted on Julia's three video-recorded lessons and three intermediate seminars, all of which were recorded and attended by the same participants. The seminars and the video recordings were transcribed verbatim. The utterances in the video-recorded lessons and the writings on the whiteboard were also transcribed.

The discourse analysis conducted in this study is based on Gee's (2014) seven building tasks. A study of language-in-use is a study of saying, doing and being and of actual utterances in speech or writing in specific contexts (Gee, 2014). Through saying, doing and being, certain practices belonging to, for example, institutions like schools are enacted. According to Gee (2014), discourse analysis involves formulating hypotheses that must be further investigated, rather than formulating proofs. Gee (2014) stated, "[i]t is clear that all the building tasks are integrally linked to each other and often mutually and simultaneously supported by the same words and phrases" (p. 41). Each task gives rise to a discourse analysis question.

This article is structured in accordance with the seven building tasks, such that four of the tasks form the centre of the analysis results, while the three wider building tasks shape the main features of the final discussion. The results are based on analyses guided by the four building tasks' significances, practices, sign systems and knowledge. The summarising analysis is based on the three building tasks' identities, politics and connections.

The building task of ”significance” is analysed with a discourse analysis question related to how language is used to make certain things significant. The following sentence serves as an example: ”[The lesson] became completely different due to lack of time”. In this quote, the participant stresses ”completely”, rather than just saying that the lesson became different. The building task ”practices” is directed toward how the language is used to get others to recognise what is going on. For example, the quote ”It always looks fun being a teacher in your class” tells us that the participants are engaged in the activity of teaching. The building task ”sign systems and knowledge” is concerned with how the language either privileges or disprivileges specific sign systems (e.g. technical language vs. everyday language, words vs. equations, etc.). The use of specific words (e.g. ”space” instead of ”interval”) illustrates how everyday language is privileged. The building task ”relationships” concerns how the language is used to signal the kind of relationship people have or want to have with other people, as in the following quote: ”It was great to see you in action with the students [...] you have really good relations with the students”. The examined seminars and the school lessons are both part of the same OPD course, with the aim of influencing practice by using theoretical knowledge and practical experience simultaneously to deepen the meanings of the academic discussions during the seminars.

The results of the analysis

When focusing on the four building tasks and their related discourse analysis questions mentioned above, certain discourses emerge from the communication. This section explores the discourses that emerge in Julia's three video-recorded mathematics lessons and in the three academic seminars.

During the seminars in the online course, three different discourses can be distinguished. i) First, there was a *mathematics teaching discourse*, concerning the teaching of the mathematical content, characterised by discussions about the use of mathematical concepts, the use of natural language, everyday life connections and drawing attention to ”mistakes”. Goals of mathematics education and the problem-solving process are also part of this discourse; however, these are less prominent. ii) Second, there was a *general teaching discourse*, characterised by discussions about standards of education and pupils as both groups and individuals. The main concern at the individual level was being able to help pupils who had failed to achieve goals. At the group level, the concern was how to treat pupils in mathematic discussions (e.g. how to listen to everybody and not just those who are active). Issues discussed included, for example, how to plan for and carry out teaching, pupils' own responsibility for their learning and classroom discipline. iii) Third, and finally, there was a *social discourse*, characterised by participants' efforts to create a feeling of belonging to the group and to get to know one another.

When Julia was enacting her teaching, two discourses could be distinguished. I have chosen to identify and describe these as follows. i) There was a cross-breeding between *everyday discourse* and *mathematical discourse* as a result of the classroom conversation (Sfard, 2000). In this article, this discourse will be referred to as the cross-breeding discourse, and it focused on the use of several occasionally synonymous mathematical concepts and connections to everyday life, such that mathematical expressions were interpreted in everyday words and tasks were embedded in everyday contexts. One aspect of these everyday connections involved occasionally using everyday words instead of mathematical concepts. Julia also corrected ”mistakes” identified during the academic seminars. ii) There was a *social discourse* focused on sensitivity to students, which was related to everyday life connections through connections between tasks and private lives.

The *mathematics teaching discourse* emerged from the course participants' reflections during the academic seminars. This discourse was characterised by mathematical concepts, ”mistakes” and everyday life connections. The focus was to support the richness of the mathematical concepts used in the lessons, with the goal of giving feedback on mathematical content and a need to highlight ”mistakes”. The discussion focused on mathematical concepts, and the use of concepts was emphasised and considered to be ”extremely significant and important”. However, despite doubt concerning whether or not students understood all the concepts, the participants still appreciated the use of a variety of ”words” and concepts during the lessons. As the following quote illustrates, the participants also thought that using concepts in ways that related to everyday life was advantageous:

> I think that you use good words and concepts. You are clear. You include the concepts that I think are difficult in a good way. You want to describe the function in more everyday language, which I think is great.

A *cross-breeding discourse* was evident in the classroom conversations in the mathematics lessons. This discourse was characterised by an emphasis on the use of mathematical concepts. During the three analysed lessons, Julia used several mathematical concepts that are occasionally synonymous. These included words like ”function”, ”coordinate system”, ”coordinates”, ”expression”, ”interval”, ”rate of change”, ”difference quotient", "instantaneous change", "slope", "derivative", "space", "less than" and "equal to". A function is a central mathematical concept that was not defined in the lesson but which is exemplified as $f(x)$, where x is the time in seconds and $f(x)$ is the distance in metres that a car has moved.

In the lessons, Julia introduced a function $f(x)$, where x is the age of a person in years and $f(x)$ is how tall the person is in centimetres. The teacher asks the students how old they are if the slope is equal to zero and growth has stopped. In this excerpt from one of Julia's lessons, concepts like rate of change, instantaneous velocity and slope are used simultaneously and synonymously:

Julia: We are after a specific year, and then the question is how old you are when the rate of change, velocity or slope equals zero. How does this affect the function? The rate of change this year is zero. It's about when a person stops growing.

The concept of interval can be described as follows: $0 < x < 2$ is said to be an interval, and $x < 0$ and $x > 2$ is considered a "split interval". A student asked whether the "split interval" could be written as $0 > x > 2$. Julia commented on this as follows:

Julia: x is greater than zero, but, sorry, x is less than zero and greater than two. I would prefer the first [pointed to $x < 0$ and $x > 2$].

The *mathematics teaching discourse* that emerged in the academic seminars is also characterised by "mistakes" made in teaching in the video-recorded lessons. The course participants recognised some "mistakes" made during the school lessons, but they were careful in terms of how they expressed them; instead, they often said that the content was unclear. In one of the seminars, Julia's use of the terms "interval" and "split interval" were commented on. During the lesson, a discussion between Julia and a student concerning whether $x < 0$ and $x > 2$ could be written as $0 > x > 2$ occurred. Julia's response that she preferred $x < 0$ and $x > 2$ was vague. This lack of precision was discussed in the seminar, where it also became clear that it could not be written as an interval. The students also noted that Julia simplified some of the concepts. For example, when explaining turning points, Julia said that turning points are maximum points and minimum points whose derivatives are equal to zero. The participants noted that this was only partly true, since the derivative is also equal to zero at the terrace point.

The classroom conversation involved correcting some "mistakes" that appeared to result from misconceptions and simplifications of the mathematical concepts being used. For example, Julia recognised that misunderstandings about intervals had arisen from the previous lesson. She therefore gave the following example to clarify for the students what she meant by ”greater than” and ”greater than or equal to”:

$$-2 \leq x \leq 2 \qquad -2 < x < 2$$

Julia: That sign means greater than or equal to, whereas this means greater than minus 2, so if it is written like this, then minus 2 cannot be in the interval, but only the numbers that are greater than minus 2. And vice versa: here, the number 2 is in the interval, while the 2 is here, it's only up to two. Do you see the difference between the two?

Maximum point and minimum point were discussed when the students were asked to draw the graph of a function. According to Julia, extreme values can be found by differentiating the function when the derivative is equal to zero. The concepts of maximum point and minimum point were also described as turning points:

Julia: It turns here; this is a turning point, from being negative to being positive; here it turns from positive to negative, from negative to positive etc. It's a turning point, so therefore it's really interesting, depending on which function it has or regardless of function, it is interesting just when the derivative is equal to zero because that's where something happens.

The everyday life connections that the participants considered to be important also characterized the *mathematics teaching discourse*. The participants supported Julia's use of everyday words and the use of tasks related to everyday life. They also thought that it was really good that Julia talked about mathematical concepts using a combination of everyday language, real-life examples and mathematical expressions. However, the participants also expressed concerns about simplifying the mathematics in order to make everyday connections:

> Sometimes, using amusing examples from everyday life, such as at what age you stop growing, can be risky. [...] The majority of functions are not just increasing or just decreasing, and besides, a person can grow one year and not the next.

Various suggestions about mathematics tasks related to everyday life were highlighted. Tasks and examples that ”affect” students are often considered to make mathematics more concrete, which, in turn, leads to a ”deeper understanding”. Common examples, such as bacterial cultures, are not relevant because they do not affect the students.

In classroom conversation, the everyday life connections were focused on an interpretation of mathematical expressions in everyday words and the use of tasks embedded in an everyday context. This was visible through the connections the teacher repeatedly made to everyday life.

Everyday connections were also related to the use of natural language, which became evident when Julia used everyday words, rather than mathematical concepts, especially with regard to operations like divide, multiply and equal to (e.g. ”One times three minus one becomes two”). That is, everyday connections occurred frequently in class, and they took diffe-rent forms. The everyday connections concerned how to ”translate” and interpret mathematical expressions into everyday language, as illustrated in the following examples:

Julia: What does this expression mean? [points to the whiteboard] $f(12) = 150$, f of 12 is equal to 150. How would you translate this into everyday Swedish?

[...]

Julia: What about this [points to $f'(15) = 12$], f prime 15 is equal to 12? How might this be expressed in everyday language? When he is 15 years old, he's grown 12 cm per year.

Connections to everyday life were also visible in everyday-related tasks, such as in the function $f(x)$, where x is the age of a person in years and $f(x)$ represents how tall a person is in cm. In this context, the teacher and students worked together with a number of tasks. For example:

Julia: $f(x) = 170$. How old is a person when he/she is 170 cm tall?

[...]

Julia: How would you say $f(15) - f(13) = 21$? What has happened from the time he was 13 up until he became 15 years old? The difference from when he was 13 years old until he was 15 years old is that he has risen 21 cm above sea level.

The teaching was varied in that new tasks with the same mathematical content were provided, but set in different everyday contexts. The above task illustrates how a person's height varies with age. Another example illustrates how the value of shares varies over a period of time. Julia also compared the everyday contexts in the different tasks and explained how the formulas no longer expressed how tall a person is, but, rather the value change in shares.

The *social discourse* in the academic seminars was characterised by sensitivity to fellow students. The course participants praised each other's teaching and were careful not to be critical. They also discussed Julia's sensitivity to the students in terms of her openness, encouragement and wonderful relationship with students, illustrated by the following quote:

> I think it was great to see you in action with your students. You are so open and make real contact with the students.

The participants gently noted that misunderstandings occasionally arose and that some concepts were either improperly or too simply used. However, the course participants were careful not to appear too critical and also complimented Julia on her success in creating such a positive classroom climate.

In Julia's mathematics lessons, thus, a *social discourse* emerged that was characterised by sensitivity to the students. Julia adapted her teaching to her students through her selection of mathematical tasks, examples and mathematical content. In one of the tasks associated with everyday life, she began with her own experience and expected the students to solve the task in a similar way. She drew a curve that described her moods over a day, such as what she feels like when she gets up in the morning, when she teaches different groups of students in school and when her children have gone to bed in the evening and she is free. The students were then encouraged to "draw the function that describes your daily moods". The y-axis indicates "how happy you are and the x-axis indicates the time". Julia introduced the task as follows: "In task 4, I want you to describe your own day or your own moods during the course of any one day". The social discourse was related to everyday life connections through the connections between the tasks and the teacher's and students' private lives.

The *general teaching discourse* emerged in the course participants' reflections during the seminars. This discourse was characterised by discussions about the standards of education, including how to help students who fail to achieve goals, how to plan for and carry out teaching and discipline in the classroom. Compared to the mathematics teaching discourse, this discourse differed in that teaching was discussed outside of its relation to mathematical content. Thus, in comparison to the mathematics teaching discourse, the general teaching discourse was limited in extent.

Concluding discussion

Drawing on Gee's (2014) building task of "connections" concerning how certain things are made relevant or connected to other things, there is a convergence between the mathematics teaching discourse in the seminars and the cross-breeding discourse in the school context through the focus on everyday life connections and concepts. In the seminars, everyday life connections were discussed and considered important for the students' understandings of mathematics and its applications. At the same time, some concerns that these connections may oversimplify mathematics were also raised. The cross-breeding discourse in the school lesson arena was characterised by an interpretation of mathematical concepts that was achieved by associating mathematics with everyday words and situations and by formulating mathematical tasks embedded in an everyday context. The teacher in the school lesson arena emphasised the everyday connection in various ways, including two primary ways. First, she ”translated” mathematical expressions into everyday language. These translations could be viewed as part of a contextual discourse dealing with problems concerning words instead of really addressing problems' mathematical elements (Setati, 2005). Second, in her other primary approach to using everyday connections from the analysis of the cross-breeding discourse in the school lesson arena, Julia related mathematical tasks to the students' and/or her own everyday life (Evans et al., 2006). In sum, the conversation in the classroom reflects the cross-breeding between an everyday discourse and a mathematical discourse in accordance with Sfard's (2000) coining of the term.

Julia was supported by the course participants in the use of mathematical concepts, indicating a convergence of discourses between the seminars and the teaching practice. With reference to Gee's (2014) building task of ”politics” concerning the social goods that are at stake when we speak in a way that implies something is ”adequate” or ”good” (or the opposite) (p. 34), this convergence of discourses can be viewed as a way to communicate that aims to create mathematics knowledge as a ”social good” to be made available to all school students. However, this combination of mathematical concepts mirrored through everyday connections could also lead to ”misunderstandings”, which could also occur during the video-recorded lessons. Consequently, the participants in the seminars were concerned that the everyday connections were simplifying the mathematical content. The seminar participants also questioned whether the students really understood all the different mathematical concepts being used during the three studied lessons. Based on the analysis in this study, it is relevant to question whether the introduction of various mathematical concepts over a short period of time really helps students get involved in a mathematical discourse involving mathematical terms, using a mathematical vocabulary (Sfard, 2007, 2008; Ben-Yehuda et al., 2005). Moreover, being able to recite several mathematical terms at a superficial level does not, in itself, allow someone to act, know or talk like a mathematically competent person; that is, it does not *per se* make someone a member of a mathematical Discourse (Moschkovich, 2002).

With reference to the seventh of Gee's (2014) building tasks concerning the use of language to build an identity, the language used enacted an ”identity” of students who are not really invited to a mathematical Discourse. The students, thus, risked remaining outside in an ”everyday discourse”, where knowledge in mathematics might be useful, but where mathematics is discussed in imprecise and simplified terms. During the

OPD course analysed in this study, the seminar discussions and the school teachings were both characterised by linking mathematics to everyday life; this suggests that this way of teaching is taken for granted. Given the results of this study, it is reasonable to question whether the students and the teacher are members of the same Discourse community: that is, whether they share the same language and whether they are familiar with the rules and norms of that language (Sfard, 2008).

The academic arena influences the school lesson arena when it comes to ”mistakes” during lessons. Such ”mistakes” include both the simplification of mathematical concepts and the incorrect use of concepts. During the course seminars, the participants pointed to and discussed these ”mistakes” in Julia's teaching. Then, in the following lesson, Julia would correct them.

The social discourse was part of both arenas, though it was expressed in different ways. In the school context, this discourse was characterised by Julia's sensitivity to her students, and in the academic context, the social discourse was characterised by students' sensitivity to fellow students. In the seminars, there was also a general teaching discourse characterised by discussions about the standards of education and pupils as both groups and individuals.

A final reflection on the seemingly uncritical focus on mathematical concepts and everyday references in the OPD course, which also likely influenced the content in the school lessons in this study, is that the participants in the OPD course did not seem to have been offered enough opportunities to reflect on how or whether emphasising the simultaneous introduction of several, sometimes synonymous, mathematical concepts or making references to everyday situations really deepened the students' understandings of the mathematical content or enabled them to participate in a mathematical Discourse. One critical factor in deepening reflections is allowing time to reflect on what the other participants have said (Malmberg, 2006). Thus, insufficient time for reflection is a possible explanation for the lack deeper seminar reflections. Another possible explanation may be the mode of oral conversation represented in this particular OPD course. The material conditions of talking and listening, without being able to see the other members of the conversation, contribute to a "monologist conversation" (Högberg, 2015), in which participants must wait for their turn on a list of speakers, without no opportunity to break into the discussion. According to Erixon (2016), each next speaker often continues by introducing a new message to the discussion, leading the discussion in a different direction, rather than dwelling on a specific issue for deepened reflection.

References

Barwell, R. (2013). The academic and the everyday in mathematicians' talk: the case of the hyper-bagel. *Language and Education*, 27 (3), 207–222.

Ben-Yehuda, M., Lavy, I., Linchevski, L. & Sfard, A. (2005). Doing wrong with words: what bars students' access to arithmetical discourses. *Journal of Research in Mathematics Education*, 36 (3), 176–247.

Bernstein, B. (2000). *Pedagogy, symbolic control and identity: theory, research, critique*. Lanham: Rowman & Littlefield Publishers.

Borba, M. C. & Llinares, S. (2012). Online mathematics teacher education: overview of an emergent field of research. *ZDM*, 44 (6), 697–704.

Borko, H. (2004). Professional development and teacher learning: mapping the terrain. *Educational Researcher*, 33 (8), 3–15.

Dash, S., Kramer, R. M. de, O'Dwyer, L. M., Masters, J. & Russell, M. (2012). Impact of online professional development on teacher quality and student achievement in fifth grade mathematics. *Journal of Research on Technology in Education*, 45 (1), 1–26.

Duval, R. (2006). A cognitive analysis of problems of comprehension in a learning of mathematics. *Educational Studies in Mathematics*, 61 (1/2), 103–131.

Erixon, E.-L. (2016). Learning activities and discourses in mathematics teachers' synchronous oral communication online. *Research in Mathematics Education*, 18 (3), 267–282. doi:10.1080/14794802.2016.1190667

Erixon, E.-L. & Wahlström, N. (2016). In-service training programmes for mathematics teachers nested in transnational policy discourses. *European Journal of Teacher Education*, 39 (1), 94–109.

Evans, J., Morgan, C. & Tsatsaroni, A. (2006). Discursive positioning and emotion in school mathematics practices. *Educational Studies in Mathematics*, 63 (2), 209–226.

Fairclough, N. (2010). *Critical discourse analysis: the critical study of language*. Harlow: Longman.

Gee, J. P. (1989). Literacy, discourse, and linguistics: introduction. *Journal of Education*, 171 (1), 5–17.

Gee, J. P. (2014). *An introduction to discourse analysis: theory and method*. New York: Routledge.

Goos, M. & Geiger, V. (2012). Connecting social perspectives on mathematics teacher education in online environments. *ZDM*, 44 (6), 705–715.

Hodges, T. E. & Cady, J. (2013). Blended-format professional development and the emergence of communities of practice. *Mathematics Education Research Journal*, 25 (2), 299–316.

Högberg, S. (2015). *Om lärarskapets moraliska dimension: ett perspektiv och en studie av lärarstuderandes nätbaserade seminariesamtal* [On the moral dimension of teaching: a perspective and a study of student teachers' discussions in net-based seminars] (Ph.D. dissertation). Department of Humanities, Education and Social Sciences, Örebro University.

Imm, K. & Stylianou, D. A. (2012). Talking mathematically: an analysis of discourse communities. *The Journal of Mathematical Behavior,* 31 (1), 130–148.
McBrien, J. L., Jones, P. & Cheng, R. (2009). Virtual spaces. Employing a synchronous online classroom to facilitate student engagement in online learning. *The International Review of Research in Open and Distributed Learning*, 10 (3), 1–17.
Moschkovich, J. (2002). A situated and sociocultural perspective on bilingual mathematics learners. *Mathematical Thinking and Learning*, 4 (2-3), 189–212.
Niss, M. (2007). Reflections on the state of and trends in research on mathematics teaching and learning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 1293–1312). Charlotte: Information Age.
Radford, L., Bardini, C. & Sabena, C. (2007). Perceiving the general: the multisemiotic dimension of students' algebraic activity. *Journal for Research in Mathematics Education*, 38 (5), 507–530.
Riesbeck, E. (2008). *På tal om matematik. Matematiken, vardagen och den matematikdidaktiska diskursen* [Speaking of mathematics. Mathematics, every-day life and school mathematics discourse] (Ph.D. dissertation). Department of Behavioural and Sciences Learning, University of Linköping.
Russell, M., Carey, R., Kleiman, G. & Venable, J. D. (2009). Face-to-face and online professional development for mathematics teachers: a comparative study. *Journal of Asynchronous Learning Networks*, 13 (2), 71–87.
Ryve, A. (2011). Discourse research in mathematics education: a critical evaluation of 108 journal articles. *Journal for Research in Mathematics Education*, 42 (2), 167–199.
Sfard, A. (2000). On reform movement and the limits of mathematical discourse. *Mathematical Thinking and Learning*, 2 (3), 157–189.
Sfard, A. (2001). There is more to discourse than meets the ears: looking at thinking as communicating to learn more about mathematical learning. *Educational Studies in Mathematics*, 46 (1/3), 13–57.
Sfard, A. (2007). When the rules of discourse change, but nobody tells you: making sense of mathematics learning from a commognitive standpoint. *The Journal of the Learning Sciences*, 16 (4), 565–613.
Sfard, A. (2008). *Thinking as communicating: human development, the growth of discourses, and mathematizing.* Cambridge University Press.
Sfard A. (Ed.) (2012). Developing mathematical discourse: some insights from communicational research. *International Journal of Educational Research* [Special issue], 51–52.
Sfard, A. & Kieran, C. (2001). Cognition as communication: rethinking learning-by-talking through multi-faceted analysis of students' mathematical interactions. *Mind, Culture, and Activity,* 8 (1), 42–76.

Eva-Lena Erixon

Eva-Lena Erixon works as a lecturer in mathematics education at Dalarna University. She is also a doctoral student at Örebro University with the professional development of mathematics teachers as research interest.

eer@du.se