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# The underlying beliefs in Pirkko's narrative about implementing collaborative learning in mathematics - 'my job is to give individual instruction'

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## ABSTRACT

Many teachers resist adopting collaborative learning despite its proven benefits. Beliefs play a role in this resistance, but exactly how they do so has yet to be understood. This narrative study provides a comprehensive analysis of one resisting teacher's ambivalent perceptions and underlying beliefs about implementing a collaborative approach to learning mathematics in a Finnish seventh-grade class. Our results reveal how the seemingly noble goal of guiding students individually and associated beliefs may inhibit teachers from adopting collaborative learning even after successfully implementing it.

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Collaborative learning (CL) has been shown to influence positively affective, social and motivational dimensions of learning, as well as enhance cognition and meta-cognition (Kyndt et al. 2013; van Leeuwen and Janssen 2019). However, successfully implementing CL is challenging (Sharan 2010), as it requires the development of productive group dynamics in various ways (Johnson and Johnson 2009). Teachers have resisted adopting CL due to reasons such as fear of losing control in class, insufficient time to cover curriculum, preparation for external exams and organisational challenges (Gillies and Boyle 2010; Hämäläinen and Vähäsantanen 2011).

Although some knowledge about teachers' reasons for resisting collaborative approaches exists (e.g. Gillies and Boyle 2010), little is known about how teachers' perceptions constrain their attempts to adopt CL (Keiler 2018). While some researchers have noted that teachers who perceive themselves as deliverers of content resist adopting collaborative practices (e.g. Keiler 2018), it is not known at a detailed level what exactly happens when teachers' beliefs are misaligned with the approach they are trying to adopt. It is also unknown to what extent the actual reasons for teachers' resistance and failures to implement CL are related to their beliefs, competence or external constraints. Filling these knowledge gaps would have important implications in teacher professional development.

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Accordingly, the aim of this study is to provide a detailed analysis of one resisting teacher's ambivalent perceptions in adopting a collaborative approach to learning mathematics in a Finnish seventh-grade class. By analysing shifts in this teacher's perceptions of effective instruction, we aim to identify beliefs underpinning those perceptions and their effect on the teacher's willingness to implement CL and her success in doing so. The research questions are:

- (1) How do a teacher's perceptions of effective instruction change while implementing CL?
- (2) What do shifts in perceptions tell us about underlying beliefs and their effect on teachers' willingness to implement CL?

## Theoretical background

### *Collaborative learning and teachers' willingness to implement it*

We refer to CL as 'instructional arrangements that involve two or more students working together on a shared learning goal' (van Leeuwen and Janssen 2019, 73). CL emphasises questioning, elaboration of explanations, argumentation, formulation of new ideas and generally productive interaction between students (Johnson and Johnson 2009). CL in the context of this study will be described further in the methods section. Meta-analyses (such as Kyndt et al. 2013) show that collaborative learning environments enhance students' learning more than environments with less peer-interaction. However, implementing CL is challenging because it requires a constant refining of instructional strategies (Sharan 2010). Johnson and Johnson (2009) describe many requirements for successful CL, showing that it is not effortless to implement.

Previous research has also identified a variety of possible obstacles for successful CL, including a lack social skills required for productive collaboration, free-riding, the difficulty of coordinating work between low- and high-status students and even friendship (Le, Janssen, and Wubbels 2018). Teachers are thus reluctant to transfer responsibility and authority to students (Buchs et al. 2017). They also struggle with preparational challenges such as designing appropriate group tasks, composing groups, managing time (Gillies and Boyle 2010), and assessing, monitoring and facilitating productive collaboration (Hämäläinen and Vähäsantanen 2011). Accordingly, teachers often feel incompetent when it comes to implementing CL successfully (see, for example, Gillies and Boyle 2010). Teachers often perceive that external constraints such as curriculum, external exams and pressure from others (teachers, parents or students) reduce their freedom (Buchs et al. 2017). Cultural contexts also strongly affect teaching habits (Hiebert, Stigler, and Manaster 1999). The difficulty of changing culturally customary teaching habits may prevent adopting collaboration-based instruction, and new habits are often abandoned soon after successful implementation (Sharan 2010).

The compatibility of teachers' existing beliefs plays an important role in teachers' success and willingness to implement CL (Brody 1998). It has been found that teachers who have a transmission orientation to learning – and teachers who acknowledge CL methods as valuable in achieving social but not academic skills have been found to be reluctant to use CL (Keiler 2018; Le, Janssen, and Wubbels 2018). These teachers justify

their resistance in various ways. They are often unwilling to set goals for collaboration because they believe that their students are already struggling with cognitive goals and do not have the resources for additional goals (Le, Janssen, and Wubbels 2018). One case is portrayed by Keiler (2018) in a study where she explored how implementing collaborative pedagogies affected 13 teachers' identities. In that study, only one teacher, Hillary, failed to adopt the student-centred approach. She was proud of her experience in 'old school' teaching. She had students successfully 'sit in rows' and focused on guiding students individually. Hillary was sceptical about students teaching each other, but she was pleased with the benefits of productive group work. However, she preferred holding on to her content expert role rather than a team management one.

Teachers' beliefs about CL and about related challenges (e.g. are challenges solvable, are they minor or major, is CL causing them) may have a notable effect on how these factors actually affect the learning environment. For example, expecting CL to magically solve a problem, such as students' lack of communication, may cause disappointment and resistance towards CL when transforming classroom norms turns out to be slower and trickier than expected (Sharan 2010). Similarly, seeing CL as a collection of teaching methods rather than a holistic approach to learning hinders implementation because successful implementation requires continuous reflection on the part of teachers and students with regard to behaviour, feelings, needs, goals and beliefs (Sharan 2010).

### ***Beliefs and perceptions***

Our interest in teachers' perceptions about effective instruction and CL is grounded in the literature on teachers' beliefs. Philipp (2007) defined beliefs as 'psychologically held understandings, premises, or propositions about the world that are thought to be true' and 'may be held with varying degrees of conviction' (259). Beliefs strongly influence teachers' instructional decisions and behaviour (Cross 2009; Ernest 1989); arguably even more when they are untrue (Pajares 1992). In the present context, we are interested in the role of beliefs in a teacher's resistance and willingness to change.

Our assumptions about beliefs and how they affect individuals' interpretations, intentions and behaviour mirror those of Pajares (1992). Because people are often unable or unwilling to describe their deeper beliefs (Mercier and Sperber 2017), such beliefs must be inferred – in addition to what people say – from what people intend to do and do (Pajares 1992). According to Nisbett and Ross (1980), there is substantial evidence that beliefs persist even when confronted with strong contradicting information. Mercier and Sperber (2017) describe in detail how people do not try to evaluate their beliefs in order to alter or reject inaccurate or unreasonable beliefs. On the contrary, people use their reasoning to make their unconscious beliefs appear rational. The dearer the belief is, or the more connected to other beliefs or shared with people important to us, the more difficult it is to change (Pajares 1992). Thus, awareness of the inconsistencies between individuals' beliefs and desirable changes is central to understanding resistance and willingness to change.

Because deeper beliefs are difficult to access and enduring by nature, we want to make a distinction and use another word to refer to teacher's easily changing opinions, thoughts, and intentions. We use the word perceptions when interpreting what is being conveyed by the teacher's words and gestures on a specific time and place. Perceptions are situation-specific, possibly coloured by the events in the preceding lesson or by the

fact that the teacher is being interviewed by scholars with specific beliefs about learning (e.g. appreciation of CL). Perceptions expressed in the moment may or may not reflect underlying deeper beliefs and must be interpreted carefully. In relation to our definition of beliefs (Philipp 2007), we see perceptions as beliefs that are held with a very slight (or unknown) degree of conviction. We chose to analyse how perceptions change or remain the same over different contexts to access underlying deeper beliefs and to understand how they affected Pirkko's willingness to implement CL.

### ***Relationship between beliefs and practice in the context of learning mathematics***

Domain specific beliefs strongly influence how mathematics is learned (Cross 2009; Ernest 1989; Goldin et al. 2016; Handal 2003). Ernest (1989) highlights beliefs about 1) the nature of mathematics, 2) the role of social context in learning mathematics and 3) the process of learning mathematics. He also describes three stereotypical patterns how mathematics teachers' beliefs can affect their practice: A) Mathematics is facts, rules and skills to be used for a purpose (instrumentalist view). Thus, teachers are instructors who ensure skill mastery by strictly following texts or schemes. Learners should compliantly master required skills. B) Mathematics is a unified body of certain knowledge (platonist view). Thus, teachers are explainers who ensure conceptual understanding by modifying textbook approaches if necessary. Learners should receive the knowledge. C) Mathematics is dynamic human creation, enquiry and revisable (problem solving view). Thus, teachers are facilitators who ensure confident problem posing and solving by enriching problems and activities, even autonomously interpreting the curriculum. Learners should actively construct understanding, explore and even autonomously pursue their own mathematical interests. Similarly to Ernest (1989), also Cross (2009) found that teacher beliefs about the nature of mathematics were highly influential on teachers' pedagogical decisions. Handal (2003) emphasises the inhibitory effect of contradictory beliefs about mathematics in the close environment (parents, exams, colleagues, etc.). A recent review (Goldin et al. 2016) reminds that the relationship between beliefs and practice is complex.

Leatham (2006) argued that the most effortless and common change in mathematics teachers' beliefs about quality instruction is to reorganise the prioritisation of beliefs. For example, guiding students individually and caring for the students is important (Muller 2001), as is productive collaborative reasoning and autonomy in the small groups (Kyndt et al. 2013), but which should be prioritised under which conditions? Stylianides and Stylianides (2008) provide an interesting case of a skilful and knowledgeable teacher who struggles to hold students accountable for their work due to her strong belief in recognising students' work and giving positive feedback. The teacher states that she appreciates elaborate explanations, but when small groups report their work to the class, she does not insist such explanations and avoids comparing students' work, regardless of the clear differences in quality. Mathematics teachers' beliefs may seem to contradict with their practice (as in the previous case) due to social constraints (e.g. students, parents, peers, superiors, curriculum and assessment), but also due to lack of consciousness of one's own beliefs (Ernest 1989; Goldin et al. 2016; Handal 2003). Ernest (1989) suggests that the following five elements are crucial in how beliefs affect practice: 1) awareness of one's own beliefs, 2) ability to justify one's own beliefs, 3) awareness of viable alternative beliefs, 4) context-sensitivity in choosing pedagogies compatible with specific beliefs

and 5) reflexivity and ability to reconcile conflicting beliefs. In the discussion, we will exemplify how beliefs affect practice in the case of the studied teacher.

## **Narrative data, collection and analysis**

### ***The context of the study***

The data were gathered as part of a larger project that involved collecting different types of data from five classrooms and four teachers. The participating subject teachers implemented eight to twelve lessons of a learning progression called Flexible Equation Solving over a period of three months. The aim of the project was to design a conceptually oriented CL approach to introduce equation solving to seventh-grade students through iterative cycles of implementation, reflection and revision. The project was also intended to identify what kind of support students and teachers need for successful implementation. In the classrooms where data was collected, the observers avoided influencing in any way. Before the lessons, the teacher met one of the teacher educators who gave advice on the implementation but also communicated trust towards teachers' suggested modifications.

The lessons had collaborative goals. Students were expected to collaboratively make sense of a specific mathematical idea (i.e. equivalence). Similarly, the teacher was expected to guide students in engaging in productive conceptual discussions. Teachers were supported in the facilitation of CL by lesson-specific guides, by introducing tools for orchestrating productive mathematical discussions and through discussions with the teacher educators. All materials, including teacher guides, are publicly available through the following link: <https://aoe.fi/#/materiaali/2392>. After each lesson, students briefly assessed the quality of their interaction and reasoning in their three- to five-person heterogeneous groups by answering five questions. For more context on how the learners are collaborating in Pirkko's classroom, see Tuomela and Hähkiöniemi (2018).

### ***Pirkko***

Pirkko was chosen for this study because her attributes matched our aim to reliably capture and understand a subject teacher's perspective to implementing CL. Especially her account was particularly rich, explicit and comprehensive, in line with Patton's (1990) critical case and intensity criteria. When interviewed, she had approximately 10 years of teaching experience, taught in a large rural public school with over 900 students and had approximately 25 students per class. Classes were heterogeneous in terms of maths achievement. Her students had been working together since first grade, but Pirkko had been teaching them for seven months. The participants were new to CL although the Finnish curriculum had been recently updated to emphasise CL. Pirkko contacted us and volunteered for the intervention. She described that her enthusiastic colleague (who could not participate himself due to parental leave) persuaded ('forced') her to sign up. Her motivation was to improve as a teacher.

Pirkko's habit of discussing her thoughts openly and honestly with previously unknown researchers, even when it could have put her in a negative light, also made her especially suitable for this study. For example, she frankly told the

researchers that she would not use any more time to prepare the lessons than she normally did. The most important reason she was chosen for this study, however, is that her authority and straightforward teaching style resembled the attributes of resisting teachers (Keiler 2018; Le, Janssen, and Wubbels 2018) and that she followed through the intervention persistently, regardless of her doubts and slight self-admitted mathematics insecurity. These factors allowed us to access teacher experiences that are currently unexplored and are thus relevant to the research community.

### ***Methodological approach to narrative data***

Narratives can be told by drawing specifically chosen events together in a sequence, directed to a specific outcome (Polkinghorne 1995). Whether they are intended to convince or to create empathy, narratives are often used for legitimation or meaning making, trying to convey a sense of verisimilitude (Bruner and Austin 1986; Lieblich, Tuval-Mashiach, and Zilber 1998; Polkinghorne 1995). The narratives people relate to themselves and others '[freeze] in time what that experience meant in that particular time and space' (Paradis 2019, 65). An event in itself might be difficult to conceptualise or legitimise, but can be imbued with meaning when sequenced in narrative. This methodology is especially suitable for understanding how Pirkko legitimises her reluctance to implement CL.

Our study is underpinned in the narrative paradigm (Spector-Mersel 2010), which focuses on understanding a particular phenomenon centred on a specific case. Here, we focus on Pirkko's specific narrative of her experience of implementing CL activities in her classroom. We consider Pirkko's narrative an embodiment of Polkinghorne's 1995 prosaic discourse, in which natural discourse or speech is considered narrative data. Thus, we consider the way Pirkko aligns a 'succession of happenings' to be important and valuable narrative data (Lieblich, Tuval-Mashiach, and Zilber 1998, 2). Our narrative study is therefore an in-depth exploration of the meaning making Pirkko attributes to her experience in implementing CL in her classroom (Bruner and Austin 1986; Lieblich, Tuval-Mashiach, and Zilber 1998; Polkinghorne 1995).

### ***Data collection and analysis***

The data for this study were drawn from six unstructured interviews, each lasting between 5 and 15 minutes, conducted immediately after lessons in the classroom where the lessons were held. After the third and eighth lessons of the intervention, the teacher did not have time for an interview. A 45-minute semi-structured interview conducted three weeks after the last lesson of the intervention was also included in the data. In these interviews, Pirkko was asked to freely describe her feelings and thoughts about the preceding lesson and about the whole intervention. Finnish interviews were transcribed directly into English before analysis. Informed consent was signed and all data was stripped of her identifying information to preserve her anonymity. A member of ethics committee of human sciences from the authors' university confirmed that, due to national laws, no ethical approval of the committee is required for this type of study that preserves



anonymity. Pirkko read, commented and validated her narrative in a Zoom meeting with the first author.

Our narrative analysis is based on Bruner and Austin's, 1986 holistic content analysis and related steps (Lieblich, Tuval-Mashiach, and Zilber 1998). This was done by emplotting Pirkko's narrative of the process of implementing CL with her students. First, the two authors of this article individually coded Pirkko's narrative data inductively by reading and re-reading her interviews and labelling statements deemed related to her CL experience. For instance, both researchers coded some of Pirkko's comments, such as *'Somehow, I just feel that if the students get enough repetition, then that also helps to understand the content'* as *Rote Learning*. Second, the authors compared the codes and coded excerpts together and agreed on a way to group them into categories in order to assess what was most important in Pirkko's narrative. For instance, the above comment was included in a category called 'ambitious material and worry for students', because talk about rote learning was often coupled with talk about students becoming confused or too challenged. The categories were then grouped into themes. Third, we emplotted Pirkko's narrative based on the two themes that appeared to be most noteworthy—*Motives for using CL* and *Perceptions of the effect of CL* (especially concern about students' wellbeing and learning) – and organised the combined content chronologically. When significant crises or shifts in perceptions and understandings were expressed, those parts were identified as *turning points*. For instance, when Pirkko said *'I had this panic that ... I won't have time to catch them'* followed by a shift in expectations, this process could be identified as a 'crisis' associated with a turning point. Fourth, in relation to our theoretical frame and our holistic understanding of Pirkko's narrative and experience, we interpreted those turning points and explained our interpretations based on illustrative data segments from her emplotted narrative. Based on his observations and video recordings, the first author checked to what extent Pirkko's behaviour during the lessons were in line with the perceptions she expressed in the interview to gain information about underlying beliefs. Fifth, the first author contacted Pirkko again to share our analysis and interpretation of interview data with her and to confirm that we understood and represented her account accurately (she agreed with both of these points). As a result of our analysis, Pirkko's meaning-making process was outlined and illustrated, which helped us better understand how she perceived this experience and enabled us to answer our research questions.

## Findings: Pirkko's emplotted narrative

Pirkko's emplotted narrative contains two turning points, which reveal shifts in her perceptions. The changes and consistencies in her perceptions will be interpreted in the discussion section to provide insights into her underlying beliefs.

### Before the intervention

Pirkko's enthusiasm to try CL in her class is clear from the outset:

[CL] is fun. I will enjoy this a lot, if I have the resources to give the students that: 'think about it. Discuss'. [...] It is clearly something that is my thing. [...] With interest I'm awaiting what's



going to happen. [...] Maybe ... [CL] would raise the weaker [students] also from there, so that it would promote equity to both directions. Because with the books, supporting both the weak ones and the strong ones is challenging.

Pirkko hesitates 'if she has the resources', meaning determination to change her habits and time to prepare the lessons, now that she has material that supports CL. She hopes to improve the effectiveness of her teaching with CL and differentiate more effectively, especially for the weaker students. However, the way she describes how good teaching is straightforward and should aim for procedural fluency seems misaligned with the nature of CL:

In mathematics you just need a lot of paper and a bunch of pencils. [...] But you really want to give good quality teaching. And that the teaching wouldn't go so diverse and confusing.

Smiling confidently, Pirkko describes her authority and how she uses it to maintain order.

They are under strict order with me. They concentrate, and they are quiet. [...] I really do have strong authority, so I don't have to say many times 'be quiet'. I don't know if it's authority or if the students respect me or what.

Indeed, when the first author and co-researchers enter her classroom, they are surprised by how quietly and compliantly students are working without peer talk due to Pirkko's character and non-verbal communication. Her preference of orderly and quiet classroom is clear and the learners seem to respect her, as Pirkko hints in the last sentence. Overall, while Pirkko appears to be excited about implementing CL, her preferred classroom atmosphere appears misaligned with the usual classroom atmosphere found in CL activities.

### ***During the intervention***

Pirkko implements the activities mostly as suggested in the teacher guides, although she sometimes prefers to use a less collaborative approach and decides to omit sharing of students' work.

I thought immediately that I will not have the students run there [to the blackboard] and back because it makes everything ... more confusing. ... we would never have made it in time that way. [...] I have tried [displaying students' work with the class before this intervention] and I know that it doesn't work for me. It irritates me that it is so time consuming.

Pirkko perceives multiple students sharing their ideas in the blackboard, or otherwise visually, as too time consuming and chaotic, as 'not working'. This is a recurring theme throughout the interviews. She seems to be uncomfortable with transferring control to the students and she seems to save time for something that will later in the narrative turn out to be individual guidance. Before an especially collaborative lesson (see Tuomela 2016 for details), Pirkko becomes perplexed:

Yesterday when I was reading this lesson plan [...] I was thinking ... 'oh, hell, this won't work out at all, we will not survive this ...'

By not 'surviving' Pirkko means that the CL approach will not only be ineffective due to its complexity but also harm the students' learning. The result of this collaborative task is

unpredictable and Pirkko seems anxious about losing control. Suddenly she appears to be in a crisis. A shift in perceptions is observable, marking the first turning point in her narrative:

It is so important for me that no one drops off the cart. I just can't stand it ... Like I had this panic that ... I won't have time to catch them. That is the real concern. ... When someone drops ... it is so, so difficult to teach further. [...] What I'm afraid of is students becoming mentally jammed and becoming like this [imitates an upset student with arms crossed]. ... With this teaching I will have eight students next autumn when percentages start who understand nothing about anything.

Abundance and strength of descriptions like 'dropping off the cart', 'having no time to catch them', 'mentally jammed' and 'understanding nothing about anything' show how Pirkko experiences an impasse, fearing that the students will become permanently resistant to further learning. Her initial excited tone about differentiating in her heterogenic class through CL changes to a more anxious, but resilient one:

Having worked for 10 years, I can say [that this won't work!] If I can't get them to learn the basics ... Oh well, but it's ok ... We will go through this. And once this [intervention] is over I will take the eight [weak students] and we will go through the basics together so I can lead them through the comprehensive school syllabus without failing.

The CL tasks in the intervention required less pen and pencil work and more discussion. Thus, Pirkko's routine (observed by the researchers in the class) of helping weaker students individually to write down at least something is not possible anymore and she appears to fear that the students might not learn the basic calculations without enough practice. Pirkko's initial hopes in the effectiveness of CL shift, marking a turning point in her narrative. Her fear of her students failing and becoming reluctant take precedence over her will to pursue CL activities as first intended. Nevertheless, she is determined to get her students back on track, even if she has to do it in remedial instruction after the intervention.

Pirkko's measure of effective instruction seems to rely heavily on her students passing their exams. For example the following excerpt shows, how worrying about exams affect her pedagogic decisions and arguably how she sees her role as a teacher. Within this crisis and to prevent failures, Pirkko reverts to ways she knows to be efficient. These familiar habits include individual student guidance, rote learning (calculational routines) and detailed teacher explanation.

So many moving parts! [...] It is just a fact that in every group there is someone who is weak, and I saw that this one girl was out as a snowman [falling behind]. She scored six and a half on an exam. So I decided immediately to go and advise her. [...] I hope the rest of [the students] will advise each other.

Here, Pirkko shows that individual interaction with struggling students is prioritised over peer collaboration in learning. She appears to think that the struggling students will benefit most from individual direct teaching and she 'hopes' that the rest of the students might cope just by collaborating with one another. The emphasis on teacher 'advising' is a sign of transmissive beliefs about learning mathematics, while constructivist approach 'advising each other' is perceived less valuable.

When you are not so mathematically talented . . . It's just that I know that with this [CL] they will not pass the exam. But if just the same would be repeated [drill]. . . They won't understand anything, but they can recall it. They can pass.

Pirkko appears to have little confidence in the abilities of the 'not so mathematically talented' – and for them, she would rather teach in ways that have proven efficient for her – i.e. for students to pass their exams. This includes profound and detailed explanation of the material. The contrast is clear from how she perceived in the beginning that the weaker ones would benefit from CL.

I saw that [the students] didn't understand at all, so I must go through [the lessons] very precisely. . . . I know the level of the students—they need to hear it at least twice in a detailed manner. [. . .] Kind of . . . a trial and error method. Every repetition twice and then that repeated 3 times and they might remember half of it. [. . .] And I have an obligation to give remedial instruction . . . in this situation . . . and I know that we need a lot of remedial instruction to get the students through. . . . Otherwise we will get a lot of fails . . .

Pirkko predicts that her students will not pass normal calculation-oriented exams with this kind of CL approach. She emphasises her obligation to meet students individually, even outside of class time, to prevent them from failing their exams. Undoubtedly, students may struggle in any learning activity, but using CL Pirkko claims that the collective challenge is more than the students can handle. She also insists that if she did not help her students or explain things individually, she would not be teaching well and would 'not be doing her job'.

What annoys me is that. . . I think that my mission is to go and ask each student 'how's it going?', and now I don't have time for that. . . . Even if they say only one word to me, I have taken each student into consideration. [. . .] On the other hand, the students will gain from each other [. . .] but . . . maybe there's that if the teacher goes telling them to help one another then they will ask 'what are you [teacher] doing here? Isn't it your job to be teaching us?' I would never want to give the students . . . the opportunity to say that. [. . .] Because that's what's going to happen sooner or later if I go telling the students to 'ask your fellow student [for help]'.

Pirkko perceives her educational and personal role as a good teacher to be instructing the students herself and contacting each student individually every lesson. She seems to dread the idea of instructing students to help one another and collaborate because it would be tantamount to be asking someone else to do her work. Her fear of not fulfilling her perceived role conflicts with the student-centred CL goals. Allocating her time mostly to individual guidance gives her fewer opportunities to observe and facilitate CL.

Despite her doubts, Pirkko tries to pursue the goals of the intervention. For example, she arranges for four students with different correct solutions to compare their work, although she would prefer to use the time differently.

I knew it was something you [researchers] are after so I did it intentionally. [. . .] I don't know if I would have spent so much time on that normally. . . . And then the youngsters were so glad about it! [They said] 'Hey! Look at this! I have done this like this and it is—yes!' [. . .] and . . . one boy there, Saku . . . he . . . is enjoying his group . . . He has been kind of distant and withdrawn and hasn't been very motivated, [but] now he can't laze around.

As she perseveres, Pirkko and her students gain some positive experiences like this with CL, although it shows that she prefers individual guidance, rote learning and detailed

teacher explanation. After the intervention, a test was administered to Pirkko's students and to her colleague's students who did not use CL. Pirkko graded the post-intervention tests, compared results with her colleague and returned to her normal classes without observers for three weeks before the post-intervention interview.

### **After the intervention**

It seems that Pirkko fully realised the benefits of CL only after the intervention. Having considered the test results, Pirkko conveys overall positive feelings towards the intervention. Nevertheless, she still has some ambivalent thoughts about continuing to use CL.

What is for me personally highly important is to know that I have taken every single student into consideration. That is something that I have taken as my personal goal: I will say to each of them something once per lesson. Everyone receives that eye contact from me. Everyone is noticed. That's something that I wasn't able to do. [with this type of collaborative work]

While the intervention required Pirkko to instruct students to collaborate together, she expresses discomfort in this new role because she was not able to interact with every (single) student individually every lesson. Nevertheless, she describes her surprise at how well her students perform in the tests, which makes her reaction ambivalent. She notes that her biggest fear did not materialise, leading to the second turning point of her narrative.

What I ... was afraid of [didn't happen]. The good students were good and the not-so-good remained not-so-good. What I thought was great to see was that those seventh graders were capable of learning; the weak ones also were able to learn more at their own level. They stayed at their own level, but they actually did learn more than in ordinary instruction. [...] I did the scoring in same manner as [Milla's comparison group, who were] actually a whole lot better—actually insanely better, that group. Well, it happened that their grades [were lower]. [...] But my group really performed better, which was kind of great to notice! [...] And ... I knew that the good ones can, but [it surprised me] that the bad ones can learn [even more advanced material] as well, at their own level! [...] So that ... was so great to see, that they didn't have the flop that I was ... so ... afraid of. Well, of course we got ... poor grades too, but now those students are ... kind of at a stronger level.

Pirkko observes that her students, even the weaker ones, did not 'fall off the cart' but exceeded her expectations and outperformed the other 'stronger group' in the test. Thus, a turning point can be noticed here in Pirkko's perception of collaborative learning – from thinking that it would never work, to it actually working i.e. seeing students perform well in the tests. She appears to conquer some of her fears and to recognise some of the benefits of the demanding collaborative approach. Realising the effectiveness of the intervention despite all of the challenges experienced outlines a shift in her perceptions and denotes the second turning point of her narrative. She mentions that she is now confident in the knowledge the students acquired through CL and that it will carry them through higher grades, following the book and beyond.

When I tested their skills with our own course book and material, I thought that ... I have nothing to worry about, next autumn or next year. They really can do those things that according to our book they should be able to do. And ... they know much more. So that is really great.

One of the most positive sentiments expressed by Pirkko regarding CL is that it benefits the students in multiple ways, more than traditional teaching, which she previously considered efficient instruction.

I think that my [usual] teaching reduces creativity, which is of course irritating [...] With [CL] they do learn [creativity and problem solving] ... Most of the students got more out of [CL]. Skills and knowledge ... and, in my opinion, that feeling of success, ... which maybe carries you the furthest. All the skills they can learn if they just want to. That good feeling, that is something that in the end they took home from this. [...] Students learned to learn. Some considered it really difficult ... and some liked it. [...] They really did learn actually to work together.

CL appears to be a solution for Pirkko's frustration with some of her own teaching, which she perceives as impeding students' creative thinking. Moreover, she seems to be convinced that CL was better for students, as she explains that students not only learned more skills and knowledge but that they became more independent and had a sustained feeling of success.

## Discussion

### *Shifts in Pirkko's perceptions*

Answering the first research question, multiple changes in Pirkko's perceptions about CL are evident in her narrative. The first turning point is her shift from seeing CL as potentially good (e.g. in differentiating) to seeing it as confusing, dangerous and inefficient. We interpret that this shift is a result of her seeing the students challenged more than she is used to. When she predicts that the collaborative approach will cause her students to perform worse in their exams, she shifts from confidence, interest and hope to fear, ambivalence and persistence.

The second turning point occurs after the intervention: Pirkko is thoroughly surprised that her students learn as much as they do in such a short time, which seems to cause relief and satisfaction. We interpret that the good exam results combined with her observation that the students learn in a deeper and long-lasting way convince her of the effectiveness of CL. This shift in perceptions becomes possible because she persistently and successfully implements collaborative activities, even though she would prefer using the time otherwise and despite her fear that she is not doing her job (of teaching mathematics) when she focuses on students' interaction.

We can observe the ambivalence in Pirkko's perceptions and how she begins to confront her own beliefs. Initially, Pirkko perceives effective teaching as helping students pass exams and preventing them 'falling off the cart' (i.e. helping students to understand at least the minimum requirement to be able to understand next topic). We cannot affirm whether Pirkko's initial perceptions of rote learning, control and straightforward instruction changed. However, the absence of these topics in the post-intervention interview and the way she talks instead about deeper understanding, creativity, learning to learn, students' feelings of success and improved interactions among one another, indicate that the experience prompted her to think about other ways to measure the quality of instruction than exam results and how stressed students appear. She seems to be taking a step from preventing bad

outcomes (e.g. bad exam results and student stress) to facilitating desirable outcomes (e.g. deeper mathematical understanding, productive student collaboration, creativity, motivation, learning skills and responsibility). Thus, we presume that she begins to question her underlying beliefs about her role as a mathematics teacher and to acknowledge the problem solving view of mathematics (Ernest 1989), but at the same time external factors inhibit this belief change process as Handal (2003) found often happening.

The most important finding of this study is that individual guidance appears to remain the dominant component of quality instruction for Pirkko, which encapsulates the answer to the second research question. Indeed, regardless of shifts in her perceptions, she seems to hold the belief that individual contact between teacher and students is more important than facilitating collaboration. Thus, her will to adopt collaborative approaches is dependent on the extent to which it prevents her from guiding students individually. Because teacher-student relationships are important for learning (e.g. Muller 2001), it has a rational basis to resist CL when one sees it affecting teacher-student relationships negatively. She also sees the importance of student-student relationships and facilitating collaboration (in alignment with e.g. Johnson and Johnson 2009; Sharan 2010), and is thus faced with difficult decisions. We interpret that she perceives facilitation of student collaboration as misaligned with her primary goal, because she emphasises frequently and strongly her disappointment of not having enough time to meet students individually. Because this is so important to her, she seems to conclude that CL, despite all its other benefits, must be revised to allow more time for individual contact. After the intervention, Pirkko is left with an interesting inner conflict: disappointment in her previous instructional habits creates a basis for professional growth, but her deeply rooted personal goal to guide students individually and related beliefs may prevent her making permanent changes to her teaching practices.

Pirkko resembles resisting teachers described in previous studies. Teachers who see collaborative approaches as a means of developing social and learning skills but not as means of teaching mathematics directly tend to resist or struggle in implementing such approaches (Le, Janssen, and Wubbels 2018). Pirkko resembles these teachers (such as Hillary in Keiler 2018), whose strong focus on delivering content knowledge (to ensure students continue passing their exams) prevents them from concentrating on facilitating productive collaboration. Our study contributes to filling the gap outlined by Keiler (2018), who emphasises the importance of in-depth studies of individual teachers in the process of reconciling conflicting beliefs.

### ***Behind the unwillingness to implement collaborative learning***

The relevance of this study lies in the following points. Firstly, detailed study of Pirkko's experiences and orientations enabled us to recognise how important she believed individual guidance to be, which could easily have been missed in a less detailed study. Secondly, the detailed narrative approach enabled us to identify more accurately the reasons for shifts in her perceptions and to pinpoint the temporality of the shifts. Thirdly, we provide a glimpse into the ambivalence of the perceptions teachers may have about teaching and learning in authentic classrooms, which must be carefully considered when planning studies that do not assess individual teachers in such depth.

It appears that the reasons Pirkko resisted CL differed from the reasons reported by previous studies. Some previous studies found that the main obstacle to adopting CL was a lack of sufficient skills to support collaboration (Gillies and Boyle 2010; Hämäläinen and Vähäsantanen 2011). Teachers who objected to CL also discussed students lacking the necessary skills, a lack of time, insufficient preparation for exams and loss of control (e.g. Le, Janssen, and Wubbels 2018). Pirkko's initial objections to CL – such as her fears that she would not be doing her job and that she would damage her relationships with her students, and her worry that the collaborative approach is too challenging for the students – resonate well with previous findings. However, our study revealed a more persistent underlying reason for her resistance. For Pirkko, the decisive reason appears to be the misalignment of her personal goal of interacting with each student and her related instructional habits. This indicates that she holds a deeply rooted belief about the primordial importance of individual student-teacher interaction for learning, which she justifies by the importance of caring for the weaker students. Indeed, Muller (2001) found that at-risk students who perceived their teacher to care for them, achieved significantly better.

Difficulty with facilitating collaboration does not seem to be the reason that Pirkko objected to collaborative approaches. Evidently, she has the required skills to facilitate collaboration (e.g. Johnson and Johnson 2009; Sharan 2010) as she saw opportunities for it and successfully facilitated collaboration when she decided to try it. However, this success in favour of CL did not outweigh her need to reserve time to interact with her students individually. Even salient outcomes in the form of desirable student interaction, acquired learning skills, good exam results and observed deeper understanding did not allay her disappointment that she had less time to interact with her students. We interpret that the intervention allowed Pirkko to become more aware of alternative beliefs about learning mathematics (e.g. instrumentalist, platonist, problem solving as suggested by Ernest 1989) and to reflect on the compatibility of different pedagogies, such as individual guidance or comparing student work, to those beliefs. She was able to justify alternative beliefs and pedagogies, and was left in the process of reconciling conflicting beliefs, which is how changes in beliefs cause changes in practice (Cross 2009; Ernest 1989). Similar Even when teachers witness the effectiveness of an approach by experiencing positive outcomes, adopting it permanently may still require them to confront their core beliefs.

This finding enriches and enhances prior research about the importance of teachers' existing beliefs when implementing CL. Pirkko's narrative exemplifies how deeply rooted teachers' resistance to alternative instructional approaches can. Our close focus on one teacher's reality explains in detail how and why existing beliefs play such an important role in willingness to use CL. It is also important to note that previous research has not identified the importance teachers place on individual guidance as a barrier to adopting CL.

### ***Core beliefs as barriers to professional growth***

Based on these results, we conjecture that a crucial, but often invisible reason for teachers' resistance to CL and their inability to adopt collaborative approaches is an incompatible set of personal core beliefs, which could also be unconscious. It has been previously found



that unconscious deeper beliefs are difficult to change (Mercier and Sperber 2017; Nisbett and Ross 1980; Pajares 1992). The supposition that core beliefs prevent adoption of apparently incompatible instructional moves is supported by some previous studies. Stylianides and Stylianides (2008) provided an excellent example of a teacher balancing a demand for better argumentation with the desire to boost students' self-efficacy. They found that the teacher's beliefs about the importance of positive feedback prevented her from teaching argumentation and evaluation. This case from their study and our case about balancing between individual and collaborative guidance are just two examples of competing goals. Arguably, taking turns to focus on what is currently needed in the classroom and vary goals accordingly is more effective than constantly prioritising a single goal. However, this kind of pedagogical flexibility requires the ability to confront one's core beliefs as previous research suggests (Ernest 1989; Goldin et al. 2016).

### ***Implications: identifying cultural barriers and recognising ambivalence in teaching***

Our study focuses specifically on how Pirkko's perceptions evolve during one intervention with ambitious learning goals. It is beyond our scope to predict how she may change even in the near future or to generalise these results to other teachers, although we have made some speculations. Our narrow focus is on what happens, for whom and under which conditions. Therefore, our work is dependent on other similar studies and meta-studies to collect and combine such narrow and deep findings. It is important to note that the social and cultural context of learning may dramatically affect reasons for resisting CL.

Teachers and researchers may be blind to some of the significant features that characterise teaching in their own cultural contexts (Stigler and Hiebert 1999). Is the importance of individual contact in human relationships a culturally determined element of some communities and societies? If close individual contact between teacher and students (and caring for students) is an integral aspect of social interaction in a given cultural context – for example, in many parts of Finland and Sweden – then it is important for teachers and teacher educators to understand the complexity of combining that with CL. How should teachers be supported, given the tension between valuing individual contact and the pressure to adopt CL? What happens if a teacher gives up individual instruction but also fails to facilitate CL appropriately? Future research could explore how CL affects the teacher-student relationship.

Our results imply that it is important for teacher educators and teachers themselves to think about what kind of learning is being inhibited by teachers' core beliefs. Effective instruction can be seen as a balancing act between several important but partly conflicting goals. Continuous inspection of one's own beliefs will enable educators to make informed decisions regarding what to sacrifice (e.g. individual contact time) in order to gain something else (i.e. creativity, students' voices, learning-to-learn, motivation, deeper mathematical understanding). If such informed decisions are not made, requiring a choice between incompatible options may leave teachers in limbo. It is important to be able to shift flexibly between pedagogies and to choose situationally appropriate approaches to teaching and learning (Ernest 1989). We propose that this kind of instructional flexibility could be increased by developing the ability of educators to reflect upon and confront one's own beliefs.

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