Initializing phase of lesson study: communication a special didactic tool in mathematics

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Abstract

Purpose – This study examined participating teachers' expressions about teaching and learning when implementing lesson study (LS) about communication as a special didactic tool in mathematics; it also investigated their experience with LS. The initializing phase was characterized by letting the teachers become familiar with LS as a model for their professional development (PD). It also provided an opportunity for the participants to acquire common understanding of their starting point.

Design/methodology/approach – An adapted version of LS was used as a model for teachers' PD. The methods for data collection were a semi-structured interview and discussions with the teachers. From a teaching team in school year 1, two class teachers participated. The data obtained were qualitative and subjected to a thematic analysis. The teachers participated together in the different discussions during the study. All the discussions were audio-recorded.

Findings – During the discussions, the teachers raised some critical points: how to gain students' attention during lesson reviews; how to make follow-ups of the students' understanding of lesson content; how to plan and factors that could have been changed in education that could assist in all students' progress.

Originality/value – Both the initializing phase and the concept of special didactics have not received full attention in research. This study highlights the importance of capturing the teachers' attained competence toward understanding what is needed for future competence concerning communication as a special didactic tool in mathematics.

Keywords Communication, Initializing phase, Lesson study, Mathematics, Special didactic, Special needs

Paper type Research paper

Introduction

This study examines the results related to teaching and learning during the initializing phase of lesson study (LS) about communication as a special didactic tool in mathematics. The focus is on the initializing phase and if (and in what way) teachers' expressions change during that phase. The study involved two class teachers in school year 1 from a school located in a small town in southern Sweden.

In Japan, LS is a familiar, well-established model used for professional development (PD) in schools (Stigler and Hiebert, 2016). When implementing LS in other contexts at different levels (Fujii, 2016; Lewis, 2016), a deep understanding of its true nature may be difficult to attain (Fernandez *et al.*, 2003; Fujii, 2016; Stigler and Hiebert, 2016). This in turn may affect the

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possibility of creating a sustainable development. One solution could be to use the initial phase to let participants become familiar with the LS model by experiencing its different phases (Hart and Carriere, 2011). Another recommendation is involving a leader with knowledge of LS (Hart and Carriere, 2011; Perry and Lewis, 2009). During the initializing phase, the leader has the opportunity to capture the teachers' attained competence toward determining what is needed for future competence (Säljö, 2000). The initializing phase could be crucial for teachers' motivation and readiness to participate. However, little research has examined the initializing phase (Stigler and Hiebert, 2016).

On the basis of results from international assessments by the Program for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) there has been ongoing discussion about the role of mathematics in Swedish schools. The performance of Swedish students has decreased over recent years (Henrekson and Jävervall, 2016). Even though recent assessments indicate improvement in results, the results are still lower than in 1995 (Skolverket, 2016). One competence related to mathematics as assessed in the PISA is communication (Sollerman and Winnberg, 2019).

Difficulties in communicating mathematics have been cited as a reason for problems with the subject (Skovhus, 2017). To give all students the opportunity to reach a required knowledge level, teachers need competence about how to use communication in mathematics teaching. Skovhus (2017) discussed how communication can be used as a special didactic tool. According to Kroesbergen and Van Luit (2003), students with difficulties in mathematics can be found in almost every classroom. To make mathematics accessible for all students demands a professional competence, including subject competence, didactic competence and relational competence (Roos, 2019).

In addition, teachers express a high level of need to learn more about methods to teach students with special needs (OECD, 2014, 2019; Skolverket, 2019). From a Swedish perspective this point relates to a statement in the Swedish curriculum, whereby "all who work in school have the responsibility to be observant of and support pupils in need of extra adaptation or special support" (Skolverket, 2018, p. 12). This policy should be implemented in mainstream classrooms (Sverige, 2018).

Special didactic

The concept of "special didactic" is poorly represented in the research literature as different definitions are evident. Kansanen and Meri (1999) note that special didactics are "problems of teaching in different types of school, to particular age levels of student or to specific domains of content" (p. 16). Degn Mårtensson (2017) relates the special didactic concept to students with special needs; the author defines it as "an ongoing discussion, and hopefully a humble stance of caring and teaching people in special needs, who differ either qualitatively or quantitatively from what is perceived as the general in a culture at a given time" (p. 29). Starcic *et al.* (2016) and Starcic *et al.* (2013) refer to the concept in terms of special needs with a particular focus on mathematics. Their focus is on how special needs can be provided in mainstream classrooms to attain equal inclusion. The authors link a special didactic mode with a teacher's ability to capture students' attained competence and give the students relevant strategies from that point. Bruun (2017) explained special didactics as a combination of "general didactic," "special didactic" and "process didactic" with the emphasis on planning. Process didactic stresses the importance of assessment; it uses results as information toward meeting students' different needs. For students, this presents an opportunity to enhance their skills and attain set goals. Bruun (2017) also discusses a number of attention points that need to be considered, e.g. relational competence, communicative competence and the competence to contribute to the students' self-image.

Aims and research questions

The aim of the present study is to capture participating teachers' expressions of teaching and learning when initializing a LS about communication as a special didactic tool in mathematics and in what way their experiences change. The focus is on teachers' theoretical perspectives: how they teach mathematics content and views about education for students with special educational needs.

Accordingly, four research questions were formulated:

(1) What perspectives on learning were expressed in relation to communication in mathematics during the initializing phase of lesson study?

(2) What did teachers discuss with respect to communication when analyzing teaching during the initializing phase?

(3) Which views can be found about education for students with special educational needs?

(4) If, and in what way did the teachers change their way of understanding, teaching and learning regarding research questions 1–3 during lesson study?

Research review

The initializing phase of lesson study

To achieve sustainable PD, Stigler and Hiebert (2016) emphasized the importance of conducting LS that is not simply conducting a lesson in exactly the right way. When LS is used in a context where it is not a natural part of the teaching culture, Akiba and Wilkinson (2016) described various challenges for teachers that could affect outcomes. Examples here include lack of time for implementation (Yoshida, 2012), possessing the ability to interpret collected data and lack of experience for appropriate development.

To overcome such challenges, some studies have highlighted the advantages of using leaders who are familiar with LS or the subject area (Fernandez *et al.*, 2003; Hart and Carriere, 2011; Perry and Lewis, 2009). Fernandez *et al.* (2003) examined a process with American teachers who were guided by Japanese teachers as leaders and were well familiar with LS. In that study, three perspectives (mentioned as critical lenses) emerged during the analysis: the research lens, the students' lens and the curriculum developer lens. These critical lenses are needed when examining the own practice. How well the American teachers succeeded in adopting those critical lenses depended on their attained competence (Säljö, 2000), as well as on the guiding teachers' ability to deal with that. From a sociocultural perspective, the initial phase can be used to capture the teachers' zone of proximal development (ZPD) (Säljö, 2000). Hart and Carriere (2011) used those three critical lenses as both analytic tools and as scaffoldings when implementing LS as a model for teachers unfamiliar with LS. Those authors found that it takes time to enhance teachers' understanding of LS and to conquer the meaning of the critical lenses when examining the practice. To help teachers develop those critical lenses, Fernandez *et al.* (2003) concluded that the guiding teacher should take a more proactive role.

The above studies raise questions about how to develop the teaching culture, what role an outside guiding teacher should have and the extent to which that teacher should intervene. The initial phase could have a decisive impact (Fernandez *et al.*, 2003; Hart and Carriere, 2011), especially regarding teachers' willingness and motivation. According to de Brabander and Glastra (2018), teachers' motivation in this regard is related to readiness. Motivation and readiness to participate in PD could be influenced by the person who initiates the process. For example, the initiative and decision may arise from the head teacher (Akiba and Wilkinson, 2016) or from the regular teachers (Lewis, 2016).

Communication as a special didactic tool

In the ERIC database, the search terms "special didactic," "communication" and "mathematics" produce only one article in English language research literature. This article presents results from an intervention in preservice education with the theme multimodal design and digital storytelling in mathematics. The starting point is that digital storytelling makes it possible to create meaningful learning "within the contexts of mathematical problem solving and ICT" (Starcic *et al.*, 2016, p. 48). Multimodal design and digital storytelling are described as methods that enable students with special need to enhance their communicative skills in mathematics in the mainstream classroom. Those authors found that both teachers' understanding of multimodal design as a method and knowledge about how to use the related technology are crucial for the outcome when implementing in mathematics education.

Lindhardt (2017) describes mathematics as complex as it consists of different competencies (KOM-arbejdsgruppen [KOM], 2002), one of which is communication. This competence includes communicating in, with and about mathematics, i.e. being able to express oneself and being able to interpret when others communicate in oral, written or visual forms (Niss, 2003). For students with special needs, mathematics teaching often focuses on abilities rather than on competencies, for example, communication (Lindhardt, 2017). Difficulties in communicating mathematics can be a cause for students having problems with that subject (Skovhus, 2017); thus, the teacher's task should be on enhancing opportunities for communication and using language as a support. It could be advantageous to plan and organize activities that give students the opportunity to communicate and reflect. Students may also need support in this area. Understanding concepts, procedures and symbols is of importance (Skovhus, 2017). According to Wu (2018), this approach can begin during the initial years of schooling and continue through education with the goal that elder students can use exact definitions.

Eriksson-Gustavsson and Samuelsson (2007) focused on learning through communication and they analyzed communication regarding basic skills in the subject of Swedish and mathematics in special education. The authors found that opportunities for learning increased when discussions involved several students rather than just the teacher and a single student. With mathematics teaching, Olteanu (2016) investigated the opportunities given to students to communicate. The author emphasized the importance of planning in giving students opportunities to communicate.

The theoretical frame

The present study is positioned within the theory of situated learning (Lave and Wenger, 1991) in which learning is perceived as a process among participants in a community. With situated learning, learning is understood as an essential, inseparable aspect of social practice: the context is important for the process and comprises the individuals concerned, the activity and the social world (Lave and Wenger, 1991, p. 122). Participating individuals have a dual function –as members of the activity and as agents of the activity– thereby providing a link between meaning and action.

In the present study, two teachers participated in LS. They were colleagues and had worked together for many years. As colleagues, they had already participated in a social context in their community. The present author also participated in the study as a researcher. In this case, the researcher may be regarded as a newcomer in the community. A central concept in the theoretical approach to the present study is legitimate peripheral participation (Lave and Wenger, 1991): it describes the relationship between established participants, in a particular context, and newcomers; it describes how the newcomers become regular participants. The manner of talking is crucial to become a legitimate participant in the

community. This means that it is important for the newcomer to learn how to talk in the same manner as the other participants in the community. In addition, the concept of legitimate peripheral participation describes how engagement in a social praxis leads to learning, where learning is the essential component (ibid.).

The method and the design

Description of the case

The present investigation was conducted as a case study (Hartley, 2004; Simons, 2009) in a school located in the southern part of Sweden. From a teaching team in school year 1, two class teachers (mentioned as teacher 1 and teacher 2) participated. The study was performed in the class where teacher 1 is the class teacher. An agreement was made between the teachers that they would retain the same roles during the lessons throughout the study that is teacher 1 as teacher and teacher 2 as observer. The two teachers participated jointly during the study. Both the initiative and the theme of communication as a special didactic tool were derived from the present author. That theme is applicable to all areas of mathematics, so the content was chosen by the teachers themselves to fit in with their regular planning and ongoing work. The mathematical content in this case was the positioning system with the goal to understand the place value.

To enhance teachers' awareness of communication as a special didactic tool in mathematics, LS (Munthe *et al.*, 2016) was used as a PD model. Munthe (2013) described LS as a cyclic process with four phases. Those four phases continue in an iterative manner until development takes place and can be explained (Holmqvist, 2017). The initializing phase of the present study comprised the four phases that characterize a LS cycle (Figure 1) but in an adapted way.

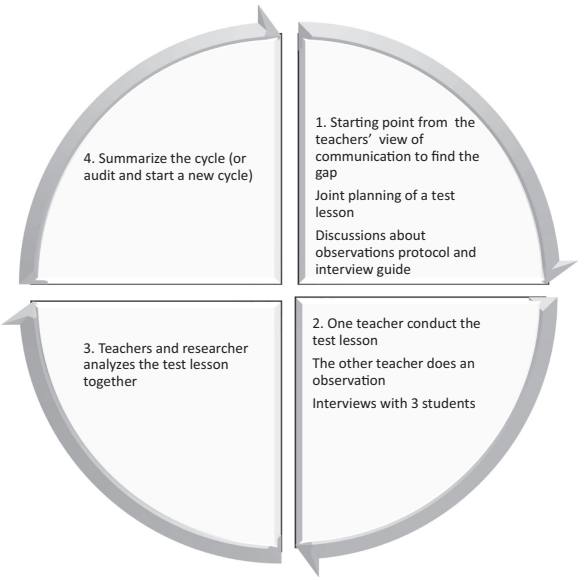

Figure 1.
Characteristics of the lesson study cycle (Munthe, 2013) adapted for the present study

The most marked differences from what is customary could be found during phase 1. The first step was to inform the teachers about the study and LS and then an interview was conducted. Next step for the teachers was to conduct an ordinary lesson which was observed. Further discussions in phase 1 were based on the interview and the observed lesson, without basing the discussions in research. The planned modifications for the test lesson were directed at the teachers; therefore, no special goals for the students were set up. Phase 4 was treated only superficially and was more a discussion of participants' experience of participating. The aim to start in this way was that the teachers should become familiar with LS as a model. It also provided an opportunity for the participants to acquire a common understanding of the teachers' starting point (Fernandez *et al.*, 2003).

This study was a collaboration between teachers and the present author. In the different phases of the study, various methods were used to collect data in accordance with the study's aims and research questions. In the process, parts of the data collected for this study also served as the basis for the teachers' PD.

The research design appears in Table 1, which also presents the manner of data collection. In that table, data collection indicated by italics signifies use only by the teachers in the LS cycle.

The research method

In this study, data were collected using a semi-structured interview (Bryman, 2018) and discussions with the teachers. The teachers participated jointly in the various discussions. All the discussions were audio-recorded. The first meeting (Table 1, phase 1:1) had a twofold purpose. First, it informed the teachers about LS in general and specifically about the plan for the LS in the present study. Second, it involved a semi-structured interview (ibid.) to capture the teachers' starting point regarding communication in mathematics. Through a theme-

Phase	Activity	Participants	Data collection	Analysis units
1:1	Information and semi-structured interview	Teacher 1 Teacher 2 Researcher	Interview	Audio-recorded interview
1:2	An observed lesson was performed	Teacher 1 (teacher) Teacher 2 (observer)	Observation protocol	
1:3	Discussions based on the semi-structured interview and the observed lesson in order to find the gap Planning a test lesson and an interview guide for teachers interview with the students	Teacher 1 Teacher 2 Researcher	Discussion between teachers and researcher	Audio-recorded discussion
2	Implementing and observation of a test lesson Interviews with three students after the test lesson	Teacher 1 (teacher) Teacher 2 (observer and interviewer)	Observation protocol Notes	
3	The analysis of the test lesson	Teacher 1 Teacher 2 Researcher	Discussion between teachers and researcher	Audio-recorded discussion
4	Summarization of the lesson study cycle	Teacher 1 Teacher 2 Researcher	Discussion between teachers and researcher	Audio-recorded discussion

Table 1.
The research design

based semi-structured questionnaire, the interview content was largely determined in advance, but it was possible to ask additional and clarification questions related to the teachers' responses. The interview was audio-recorded.

The starting point for the second meeting (Table 1, phase 1:3) was the teachers' responses to a lesson conducted by teacher 1 and observed by teacher 2. The observation was documented by teacher 2 following an observation protocol (Waldmann *et al.*, 2015). That protocol was given to teacher 2 by the researcher during the first meeting. The purpose of the second meeting was to discuss the first observed lesson. That provided another opportunity to gain an understanding of the teachers' context and starting point. On the basis of the discussion in the second meeting, the joint planning of a test lesson could begin. The discussion was audio-recorded.

After the first two meetings, the researcher listened to the recordings. The third meeting began with additional and clarification questions. After that, the focus was on the test lesson. The teachers provided comments about the test lesson and the observation protocol. In connection with the test lesson, three students were interviewed by teacher 2 . The content of this interview was included in the discussion.

The sample

To create consistency between research issues and the sample in the field of education, the choice of municipality and school can be described as goal-oriented (Bryman, 2018). In the present study, a school was chosen that had a teaching team in the early school years (years 1–3); the team showed interest in adjusting methods of communication during lessons toward enhancing students' mathematical skills using a special didactic perspective. In addition, they were interested in trying LS as a model for their PD. The head teacher gave permission for the study to take place provided the teachers participated on a voluntary basis since they would not be given any additional time for participation. The school was located in a small town in southern Sweden.

From a teaching team in school year 1, two class teachers participated (teachers 1 and 2). The study took place during the second semester in school year 1. The study was performed in one class with 24 students. A total of 16 students obtained permission from their parents to participate. Among 16 students, teachers 1 and 2 selected three students for a shorter interview performed by teacher 2 in connection with the test lesson.

The model for analysis

The data obtained in this study were qualitative and analyzed thematically (Bryman, 2018). A thematic analysis was conducted to identify, analyze, organize, describe and report themes found in the material (Braun and Clarke, 2006). In the thematic analysis, the data from the different discussions were combined. That enabled an in-depth analysis of each individual theme (Simons, 2009). To become a legitimate participant in a community, the manner of talking is important (Lave and Wenger, 1991). Therefore, the way of speaking was a focus in the analysis.

The analysis

The unit of analysis consisted of three audio-recorded meetings (an interview and two discussions) between the researcher and participating teachers. Each of the meetings lasted about one hour:

(1) There was an audio-recorded initial presentation and a semi-structured interview regarding the teachers' perspectives about communication in mathematics.

(2) There was an audio-recorded meeting with the teachers after one general lesson in mathematics was taught. One of the teachers (teacher 1) taught, while the other (teacher 2) observed the lesson. That lesson was analyzed and formed as the basis for planning the test lesson.

(3) There was an audio-recorded meeting with the teachers after the test lesson. Teacher 1 was taught and teacher 2 observed. The test lesson was discussed and analyzed.

The analysis followed the six-phase method described by Braun and Clarke (2006, 2012). Phase 1 consisted of data familiarization. This phase began after the second meeting and involved the researcher listening to the audio recording. It provided an opportunity for the researcher to ask additional and clarification questions at the next meeting. This allowed the researcher to understand the teachers' context toward becoming a legitimate participant in the community (Lave and Wenger, 1991). Additional and clarification questions made it possible for the researcher to acquire a deeper understanding rather than just drawing on the researcher's own conclusions based on the teachers' descriptions. When all the data were collected, the researcher listened again to the audio recordings to confirm that all the data had been assessed. The audio-recorded meetings were then transcribed verbatim.

In phase 2, the transcripts were read and reread several times to capture the content. The transcripts were then transferred to a spreadsheet and generating the initial codes began. In phases 3–5, the codes were combined to produce various themes; the themes were then defined and named. Phases 3–5 focused on the research questions: what theoretical perspectives the teachers expressed, how the teachers described their mathematical teaching and the expressions about education for students with special educational needs. Finally, the analysis examined if and how the teachers had changed their way of understanding teaching and learning from a theoretical perspective regarding mathematics teaching and students in need of special education. In phase 6, a report was produced.

Ethical issues

With ethical issues, this study relied on a good research practice (Vetenskapsrådet, 2011). The head teacher was informed orally about the study and provided permission for it to take place. The teachers involved were informed both orally and via an information letter. The parents of the students' were informed through an information letter distributed by the teachers. A written consent to participate was obtained both from the teachers and the parents. The written information has provided information about the purpose of the study, that the material will only be used for research purposes, that all material will be kept unapproachable to unauthorized, that the participation is voluntarily and they have right to withdraw from the study at any time during the study and confidentiality.

During this study, the researcher had access to all the data. The recordings and transcripts were stored on an encrypted external hard disk. After the results are published, the material will be stored according to the rules of Malmö University.

Results

In this section, an analysis of the results is presented in line with research questions 1–3. Subsequently, a final analysis of research question 4 is presented.

Teachers' views of theoretical perspectives

The teachers emphasized communication as a basis and a prerequisite for learning to take place. They stated that learning takes place when people meet and communicate. It is important that students be given the opportunity to express their thoughts in words together

with other people that leads to personal progress. For the teachers, communication is the reason for having schools. In mathematics, communication means naming concepts and talking a mathematical language.

> to use concepts, to talk mathematical language. [The students] say "Now we have single numbers, tens, and hundreds." That is how they talk to one another. "How many tens did you have?" They use concepts in that way. And each time they do so, they get better and better. (teacher 1, hereafter T1)

Ways of working that promote communication in mathematics include visualization, working with practical materials, playing games and using cards and dice. For teachers however, this approach requires that the number of students be limited.

The teachers stated that parents often had a different view of what mathematics was and how to promote students' progress. For parents in general, working with textbooks is central; students are influenced by their parents in that regard. For teachers, however, working with textbooks means working individually and quietly. For teachers, that may prevent communication and hinder students' learning.

Teachers' views of teaching

During the first semester in school year 1 (the semester before the study began), mathematics education was built on the teachers' theoretical view about communication in mathematics; working with practical materials, games and the focus is on the students themselves. They did not use any textbooks. The focus was on basic mathematics and what that meant for students toward their further progress. After a national assessment in mathematics, which was completed at the end of the first semester, the students showed lower results than expected. The teachers blamed themselves for the students' poor results as they felt they had not done enough to follow up and use this information to guide their students' progress. Following students' development through assessments is an essential aspect of special didactic. Results from assessments provide the opportunity to meet students' different needs (Bruun, 2017). Instead of developing their teaching toward special didactic, the significant adjustment for teaching was to start using textbooks in mathematics.

Since teacher 2 focused on mathematics in her teacher training, so they jointly decided that she would have overall responsibility for planning mathematic lessons of the two classes. That planning was based on various factors, e.g. the curriculum and results of the external assessment. However, both teachers mainly followed the planning provided by textbook materials. The planning was described by teacher 1 as being on a more general level about what to do and what to say:

> So, she [teacher 2] tells me what to say and what to do. (T1)

Teachers 1 and 2 did not always discuss their intentions with the lesson plans or what they would like the students to learn. The planning did not consist of how to do follow-ups or how to summarize the lessons. Based on the teachers' description of their planning, the didactic questions what and how is included. At the same time, the questions why and for what purpose seems to be excluded. Thus, in the teachers' way of planning, central parts from special didactics (Bruun, 2017) are missing.

Teachers 1 and 2 expressed that they did not take communication into consideration when planning their lessons. Instead, they believed that communication came automatically through the way they usually taught:

> I consider communication as it arises automatically. I do not think "Now we shall consider how to use communication during the lessons." You think how the students can work with communication and whether they can do something together, such as games. They often play math games and card games and play with dice. Then, talking comes automatically. (T1)

The planning did not include the teachers' way of communicating with students; how to ask questions, how to explain or how instructions should be given and factors that are important when using communication as a special didactic tool in mathematics (Skovhus, 2017).

The lessons usually followed the same structure. A lesson began with the teacher holding a lesson review by visualizing a topic and discussing it with the students in groups. Reviews were often characterized by question and answer sessions, in which the teacher would ask questions and students would answer in a one-way form of communication. Even if the intention with this one-way communication was to let one student at a time answer, it usually ended up in a kind of group discussion among the students. In such group discussions, the teacher unwittingly gave the responsibility to the students to communicate and produce a negotiated answer. After the first observed lesson the observer (teacher 2) described this unconscious, unplanned discussion as positive because many students participated actively. The weakness was described as a lack of control over which students participated and some students avoiding participation. It was also described as lack of control over what concepts the students used; thus, the teacher could not follow up on the discussion other than providing the answer to a problem.

Even when students were supposed to work on their own during the first observed lesson, they took the opportunity to talk to one another. According to teacher 2, the students' conversations were positive because they seemed to talk about their ongoing work and they used relevant concepts:

> Yes, but I sat and listened to you [teacher 1] during your lesson yesterday, and they [the students] talked a lot more than you may have realized. (T2)

The illustrated example could be ground for a further discussion about how communication could be used as a special didactic tool.

In this study, time for reflection and summarizing a lesson was not always included in the planning or implementation of a lesson. Even though both teachers were of the importance of summarizing, they did not always have time for it at the end of a lesson. Sometimes, they had to stop in the middle of dealing with a particular topic because they ran out of time. Both teachers said that they regarded the whole week as a long lesson. They hoped that at the end-of-the-week, they would be able summarize with the students what they had learned during the week. The teachers defended this procedure by saying that it would be boring for the students if they conducted a summary at the end of every lesson. From a special didactic perspective (Bruun, 2017), time for reflections and summarizing lessons could contribute to information necessary for meeting the students' different needs. These factors need to be included in the planning.

Teachers' views of education for students in need of special education

Teachers 1 and 2 expressed that students with special needs required one-to-one teaching. However, it would be impossible for them to implement one-to-one-teaching within the framework of ordinary teaching. The lack of time, having too many students in each class and a broad spread of students' knowledge would make it difficult for them to fulfill their task to meet the need of all students:

> Theoretically, we all know that it is our task to meet the needs of all students, but there are practical difficulties. At the same time as you do something to move forward, you should stop and help students who did not understand it the first time. (T2)

Resource teachers were mentioned as a possible means of giving one-to-one teaching. In that way, students with special needs would have the opportunity to repeat lesson content toward increasing their understanding.

Teachers 1 and 2 expressed that they knew which students they needed to pay particular attention to. The external assessment (completed during the first semester in school year 1) provided both the teachers with information about which students had special needs. During their discussion in this study, it emerged that they did not take that information into consideration when planning the mathematics lesson, neither for the regular planning nor for the test lesson.

Teachers' communicative competence in dealing with students with special needs was stated. This included to be amusing, enthusiastic and having the ability to adjust their pace with the students. Other qualities are being to explain matters in an easy way, using words the students know and varying their explanations. These qualities are especially important during reviews. The teachers seemed to transfer much responsibility to the students when they stated that students who can listen actively during reviews have a great advantage over those who cannot.

Differences in understanding during lesson study

Through engagement in the social praxis (Lave and Wenger, 1991) the teachers' understanding related to key elements in special didactic could be discerned. During the discussions, some critical aspects were raised by the teachers: how to get students' attention during lesson reviews; how to make follow-ups for students' understanding of the content presented during a lesson; how to plan for mathematics lessons and factors that can increase the possibility of making mathematics understandable by all students (Roos, 2019).

When planning the test lesson, the critical aspect of how to implement follow-ups was considered. Instead of beginning the test lesson with a review, the previous lesson would be followed up allowing the students to visualize numbers provided by the teacher in written form through the use of practical materials. During the analysis of the test lesson, teacher 1 expressed that she did not feel comfortable without using an oral review as that would not allow her to use her good qualities, e.g. to adjust the pace according to the students and providing easy and varied explanations. It was clear that teacher 1 had missed an opportunity to use visual communication in her follow-ups; she could have used information from the visual communication as information in dealing with all students as an opportunity to capture the students' attained competence (Starcic *et al.*, 2013, 2016).

Teachers 1 and 2 agreed about the responsibility for planning the lessons and teacher 2 was responsible for planning mathematics. During the LS process, they pointed out that this was problematic –especially with respect to the critical factor of how to do follow-ups. In the discussions, it was clear that planning should start from students' needs and not from textbooks. Because of the way teachers 1 and 2 decided to split-up the planning, it became impossible for teacher 2 to cater to the needs of the other class:

> Yes, how could I know what review she [teacher 1] needs to do with the students in her class? (T2)

They also stated that they were not used to planning or discussing mathematics lessons as thoroughly, as they did during the initializing steps of this LS. In special didactic planning it is emphasized (Bruun, 2017).

During the LS process, teachers 1 and 2 discovered one factor in the teaching that could have been changed to facilitate students' understanding: time. Instead of letting students spend time with the resource teacher outside the classroom, they could have spent more time working with the same moment during the lessons. That could have given all the students –but especially those with special needs– the opportunity to develop their understanding within the context of regular teaching. This factor can be understood as special didactic –in combination with general didactic, process didactic and communicative competence.

Even if teachers 1 and 2 had been colleagues for many years it is clear that they would not have been accustomed to observing each other's lessons. They found the LS experience a

positive one as it provided a basis for discussions and could help them better understand students' needs with respect to further planning.

Conclusions

When introducing LS in a new setting, a deep understanding of its true nature can be hard to attain (Fernandez *et al.*, 2003; Fujii, 2016; Stigler and Hiebert, 2016). One solution could be to use the initial phase to allow participants to become familiar with the LS model by experiencing the different phases (Hart and Carriere, 2011). Another solution could be to involve a leader with knowledge about LS, as well as the subject being taught (Hart and Carriere, 2011; Perry and Lewis, 2009). In addition, teachers' motivation and readiness to participate are important (de Brabander and Glastra, 2018). These factors were the starting point for the present study. This study examined participating teachers' expressions with respect to teaching and learning when initializing LS about communication as a special didactic tool in mathematics. It also analyzed how the teachers' expressions change during the study. The intention was to let the teachers gain experience with the different phases in LS. Even though the teachers gain experience with the four phases of LS, the initial phase in this study was characterized by finding the gap. Generally, finding the gap is included in phase 1 (Munthe, 2013). Discussions are important elements of LS. In this case, the discussions provided for the researcher as a newcomer to become a regular participant in the teachers' already established community (Lave and Wenger, 1991). The discussions also provided an opportunity for the participants to acquire common understanding of the teachers starting point.

The participating teachers' educational ideals about the impact of communication emerged. When they worked according to their ideals, they expressed that communication became a natural part of the mathematics education and they expressed that they did not need to plan for it. At the same time, some critical aspects were raised by the teachers that can be related to this: how to get students' attention during lesson reviews and how to make follow-ups for students' understanding of the content presented during a lesson. From a special didactic perspective in general, and more specific, communication as special didactic tool in mathematics could be a gap. To take communication into consideration when planning mathematics could help the teachers to capture students' attained competence in order to give the students relevant strategies from that point (Bruun, 2017; Starcic *et al.*, 2013, 2016).

The initializing phase in this study forms the basis for the teachers' further progress. From whom the initiative derived could affect the teachers' willingness and motivation to continue their participation. Through the participants engagement in this social praxis (Lave and Wenger, 1991), the teachers have highlighted important issues. Discovering these aspects contributed to their willingness of continuing their participation.

At a leisurely pace, without any real requirements, the teachers had the opportunity to try out the different phases. Not least to plan together and discuss based on shared experiences from the lessons. Despite of many years' cooperation to observe and to be observed was a new experience. Next step could be to use video during observation as a base for further discussions. This could also contribute for the researcher to share the teachers' experience.

To use communication as a special didactic tool, it requires an understanding of special didactic. Special didactic, in turn, put demand on teachers' views about students in special needs. Teachers need to be aware of how their teaching may contribute to inclusion in mainstream education. Planning and the importance of assessment is emphasized in special didactic. Thorough planning (Olteanu, 2016) could help teachers identify students' needs which could help in dealing with students with special needs.

The critical aspects that become visible for the teachers during this initializing phase form the basis for a special didactic perspective. A perspective that may contribute to make

mathematics understandable by all students (Roos, 2019). Based on the theme communication in mathematics, a special didactic perspective could be further utilized.

The results presented in this study is based on a small study with only two teacher from a teaching team from one school. This is a limitation for generalizing and transferring the study to other contexts. One way to broaden the study would have been to involve other teachers from the same team. It would also have been of interest to conduct the study at two or three schools, for the option of comparing results from these schools. Despite the limitations, the results demonstrate one example of how the initializing phase of LS may contribute to the teachers' willingness and readiness for continued participation. Especially, when the initiative and theme are derived from the researcher. In this study, important aspects which form the basis for a special didactic perspective have been illuminated. The aspects that could have been ignored if focus had been mainly and directly on communication.

The lack of time for implementation is mentioned as a challenge for the outcomes (Yoshida, 2012). For a continuation, the teachers need time for participation. Another challenge is the lack of experiences for appropriate development (Akiba and Wilkinson, 2016). This opens the way for the guiding teacher to take a more proactive role (Fernandez *et al.*, 2003).

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