Developing mathematical reasoning by using questions in a multilingual mathematics classroom

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In this paper, students' questions while working in small groups on mathematical problem-solving tasks are investigated. In order to improve students' reasoning and communication abilities in mathematics, an intervention study was designed in a multilingual upper secondary mathematics classroom in Sweden. In their discussions students used Swedish, which was their second language and also the language of instruction. The changes in students' ways of using questions across the three cycles of the intervention were analysed. The results showed how students over the cycles changed their ways of framing questions from looking for the correct answer towards clarifying other students' meaning in order to understand each other's reasoning. The implication from the study is that it is important to promote interactions between students rather than focusing on students' need to develop their second language competencies.

Deficit perspectives on multilingual students seem to be pervasive, not only in society, but also in research (Gutiérrez, 2008; Langer-Osuna et al., 2016; Setati, 2001). More often than not, the idea that students lack mastery of the language of instruction imposes ideas about their reduced ability to participate in mathematics learning (Langer-Osuna et al., 2016; Norén, 2010). In my research, I challenge these ideas of deficiency by investigating how careful consideration and design of pedagogical strategies can support students to access central activities of mathematical learning. These activities, which focus on building forms of participating, can provide opportunities for students' interactions in which doubt about their use of the language of instruction is bridged and surpassed. In this particular paper, strategies for supporting students to pose questions are examined.

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In Sweden, many mathematics lessons in upper secondary school start with a summary of new mathematical idea by the teacher, followed by individual work in textbooks (Skolinspektionen, 2010). However, this is contrary to research which suggests that it is crucial for mathematics students, regardless of linguistic background to explain, reason and justify (Brandt & Schütte, 2010). Hansson (2011) showed that multilingual students, especially those from low socioeconomic backgrounds, often did not get the support they needed to actively participate during mathematics lessons. Hansson (2011) claimed that multilingual students need classrooms in which there are opportunities for conversations, social activities and challenges. Especially for students in multilingual classrooms, it is important that they actively use language to develop reasoning and communication abilities in mathematics (Domingues, 2011; van Eerde, Hajer & Prenger, 2008;).

Much research has been conducted on how teachers use questions to help students' learning in mathematics (Drageset, 2014; Milani, 2012; Sahin & Kulm, 2008). However, to learn mathematics, students themselves also need to be active and ask mathematical questions (Alrø & Skovsmose, 2004; Fuentes, 2009). When students have their questions answered, they are helped in their learning process (Esmonde, 2009). Student interaction gives students opportunities to "check, refine and elaborate" on what they know (Mercer, 1995, p. 10). In order for students to learn mathematics together, it seems important that they indicate when they do not follow other students' reasoning, for instance by asking their peers questions (Alrø & Skovsmose, 2004). This is not simple and sometimes students need time to prepare for interaction. Ding, Li, Piccolo and Kulm (2007) showed that giving students individual thinking-time before group discussions, could help them think about the mathematical content for the discussion. However, preparation is not only about talking, but also about listening. Otten, Herbel-Eisenmann and Steele (2011) stated that when all participants are actively listening, "opportunities for productive learning within mathematical discussions are increased" (p. 4). Otten et al. (2011) claimed that students need to ask clarifying questions about the ideas being shared, but also place the ideas into dialogue with their own ideas and experiences. This supports the students to collaboratively develop ideas.

Consequently, in this paper, my aim is to identify how multilingual students work with mathematical questions to develop their mathematical reasoning. In order to analyse the changes, two theoretical frameworks are used.

Theoretical frameworks

The analysis of the students' conversations was done using the inquiry co-operation model by Alrø and Skovsmose (2004) and Fuentes' (2009) framework for analysing student communication. In both these frameworks, mathematical questions are essential.

Alrø and Skovsmose's (2004) inquiry co-operation model (IC-model) was originally developed to study teacher-student conversations in a landscape of investigation, which is an open setting in which students "formulate questions and plan different routes of investigation" (Alrø & Skovsmose, 2004, p. 49). The eight different dialogic acts of communication are summarised from the descriptions provided by Alrø and Skovsmose (2004, p. 101–109):

1 *Getting-in-contact* is about students listening to each other "in a relation of mutual respect, responsibility and confidence".

2 *Locating* is about finding out new things through inquiring questions while "examining possibilities and trying things out".

3 *Identifying* is about trying to "crystallise mathematical ideas, meaning being able to identify a mathematical principle or algorithm".

4 *Advocating* is about "stating what you think and at the same time being willing to examine your understandings and pre-understandings" and "a trying out of suggestions for proving".

5 *Thinking aloud* is about "expressing one's thoughts, ideas and feelings during the process of inquiry".

6 *Reformulating* is about "repeating what has just been said".

7 *Challenging* is about attempting to "push things in a new direction or to question already gained knowledge or fixed perspectives".

8 *Evaluating* is about "correction of mistakes, negative critique, constructive critique, advice, unconditional support, praise or new examination".

Alrø and Skovsmose (2004) claimed that the IC-model characterises qualities in communication that are important for students' learning and they connected all of the eight dialogic acts to mathematical questions. For instance, *getting-in-contact* can be related to students' use of tag questions to ensure that other students follow the mathematical reasoning. *Locating* and *identifying* can be related to ”what-if questions” to try out different perspectives and ”why questions” to understand the mathematics. These questions can lead to new questions about mathematical strategies, for instance ”can we solve it like this?”, which is a part of *advocating*. *Reformulating* can be connected to questions starting with ”do you mean …” followed by students' rewordings of what was already said, and *challenging* can happen when students question each other's thoughts and strategies.

The IC-model (Alrø & Skovsmose, 2004) was built to study teacher-student conversations and has been used in other research for this purpose, such as Drageset (2014) and Milani (2012). However, students can also have mathematical discussions when working together in small groups. Another framework for analysing how students work with questions is Fuentes' (2009) framework for analysing student communication. In this framework, Fuentes classified student conversations with help of eight question/comment-response pairs (QCR-pairs) (table 1).

Table 1. *Fuentes' (2009) framework for analysing student communication (p.27)*

Question/Comment	Response
1. A asks B to show work	1. B shows own work
2. A asks B to explain work	2. B explains own work
3. A criticises B's work	3. B justifies own work
4. A rejects B's justification	4. B reconstructs own work
5. A asks B to evaluate work	5. B evaluates A's work
6. A suggests a strategy to the group	6. The group tries the strategy
7. A asks B a content question	7. B answers A's question
8. A asks B a clarification question	8. B answers A's question

Fuentes (2009) used the framework both for analysing and for promoting student-to-student discourse in a design-based cyclic study in which students worked together with mathematical problem solving. Fuentes (2013) identified three factors that could affect student interaction negatively: lack of communication between all students in a group, poor communication patterns, and norms that impede students' learning.

Neither of the two frameworks were originally used for multilingual students. However, Alrø and Skovsmose (2004) claimed that the IC-model could be relevant in other classrooms than just the monolingual one they studied and Stentoft (2004) used it for analysing discussions in a multilingual setting. In Fuentes' (2009) study, one of the students had

English as second language, and Fuentes found it important to encourage students to ask her questions.

In this intervention study, the student-to-student interaction was examined using both frameworks. The frameworks were considered as complementing each other (Sjöblom, 2015). For instance, *challenging* was often connected to QCR-pair 3, *advocating* could contain suggestions about how to solve a task, which also is done in QCR-pair 6, and *evaluating* could be connected to QCR-pair 5. When students asked questions connected to QCR-pairs 7 or 8, this could be *getting-in-contact*, *locating* or *identifying*. All parts of the transcripts were coded using both frameworks, in order to find out what dialogic acts students used, what kind of questions they asked, if and how the questions were answered.

A classroom with many different languages

The students in the study were in their first year of the Social science program in upper secondary school. This programme provided students with an opportunity to go to university to study social science courses and required students to complete compulsory mathematics subjects, as well as other subjects. The students did not have Swedish as their first language and at least nine different languages were spoken in the class. I designed and implemented an intervention with the focus on improving students' reasoning and communication abilities in mathematics. The students had opportunities to use other languages, but since Swedish was the language of instruction as well as the common language for all students, they rarely chose to use their other languages. In interviews, the students stated that Swedish was the language that they had used for learning mathematics almost all of their school career, and therefore saw Swedish as their language for learning mathematics (Sjöblom, 2015).

Nevertheless, I was aware that having Swedish as a second language meant that these students may have had more need for developing an awareness of how language could be used in student-to-student interactions about mathematics. Van Eerde, Hajer and Prenger (2008) claimed that second language learners "need to actively use and produce new linguistic elements" (p. 34) and van Eerde and Hajer (2009) claimed that "learning mathematics and second language appropriation cannot be separated" (p. 270). Therefore, one aim of the intervention study (Sjöblom, 2015) was to help students to develop how they interacted during mathematics lessons, with extra focus on how mathematical questions could support their learning.

Students had experiences of working together in groups before the study started and the teacher worked with different techniques to support their possibilities for cooperating. During the class, they were always in groups of four. Homework was often given in flipped-classroom format, so that student listened to a description of new mathematical idea at home with the expectation that they would have more time to ask questions and interact at school.

Method: educational design research

The aim of the intervention was to improve students' reasoning and communication abilities in mathematics. Sfard and Kieran (2001) claimed that "the art of communicating has to be taught" (p. 71). Similarly, Fuentes (2009) found that "quality communication will not occur immediately, especially if the students are not accustomed to working in groups" and that "it is something that needs to be cultivated over time" (p. 180). Therefore, in the intervention, a plan was made on how to help students ask mathematical questions, with support of the IC-model (Alrø & Skovsmose, 2004) and Fuentes' (2009) framework. The questions were to help the students engage in the different dialogic acts of the IC-model, and hence support how they communicated with each other and develop their mathematical thinking. By using Fuentes' framework it was possible to analyse what type of questions students asked (and needed to ask) while working with different dialogic acts and in what way and how often the questions were answered.

The intervention study was based on educational design research, which is a cyclic process with the aim of producing both theoretical and practical results (McKenney & Reeves, 2012). In the study, there were three cycles performed during one semester. The intervention used problem solving tasks and included support in the form of having students take on communicative roles, providing question lists and lists of problem solving strategies. These supports were tried out and refined over the three cycles to improve students' possibilities for discussing mathematics in small groups. In each cycle, students were recorded while working with problem solving tasks as well as interviewed afterwards about their attitudes towards working together, asking mathematical questions, etc. The analysis of the interactions and the interviews determined what parts of the intervention needed to be altered in the coming cycle.

The teacher and myself, as the researcher, worked together on the intervention, but the teacher was responsible for the teaching in the classroom. Two groups with 3–4 students were recorded working together and interviewed after each session. In these groups, all students had Swedish as their second language, but different first languages, making it difficult for them to use another language than Swedish.

Changes in questions over the three cycles

The following sections describe what was done to support students' work with the mathematical questions in the different cycles, and how this affected their interactions as well as their perceptions about their interactions. The transcripts in the examples come from different groups and are chosen to illustrate particular points about how students' use of questions changed over time.

The first cycle

In the first cycle, the focus was on making students talk to each other about problem solving tasks, while introducing the support means. One problem solving task given to the students was:

> The Fence
> Marie and Johannes need to paint a fence. If Marie does the painting herself it will take four hours. If Johannes does it, it will only take two hours, since he has a broader brush. They need ten litres of paint for the fence. How long will it take to paint the fence if they cooperate and paint the fence together?

The support means were general in the first cycle. The students were told to follow the structure in an information box on a problem-solving strategy in their textbook (Alfredsson, Bråting, Erixson & Heikne, 2011), see figure 1.

1. Understand the problem
2. Plan for what strategy to use
3. Use the strategy
4. Look back at the problem

Figure 1. *Problem solving strategy, cycle 1*

The students were also given a blank question list, on which they were encouraged to write down questions they used during group work (the same list was used in the two first cycles).

Students were also given communicative roles. These were: a *chairperson* who decided who talked when, a *summariser* who wrote down the conclusions, a *thinker* who was to think aloud and an *accountant* who was to present the group's conclusions on the board. All students also had the role of *questioners*, in that they were to ask each other questions. The teacher explained the support means to the students and gave them written instructions about the communicative roles before the students started working with the tasks.

In the first cycle, the focus of the intervention was on students working with *getting-in-contact*, *locating* and *identifying* in the IC-model (Alrø & Skovsmose, 2004). In later cycles, students were supposed to work with all the acts. However, in the first cycle it was not easy to make students ask each other *locating* or *identifying* questions, and they did not seem interested in *getting-in-contact* with each other or using any of the support means. Some of the students tried to follow their communicative roles, especially the students who were given concrete tasks to carry out. Nevertheless, it seemed that most students were focused on finding the right answer to the task. A lot of questions were asked, but as the students did not listen to each other, the questions were rarely answered (no *getting-in-contact*). Instead students focused on explaining their own thinking and it was a comparison of ideas without sufficient justification. One example of this is shown in transcript 1 (see appendix for Swedish original).

Transcript 1. *Cycle 1, task the Fence: Azad, Carlos, Mohammed, Mustafa, 11:55*

Azad:	Listen, listen, listen, listen, listen. Wait. If he paints the fence himself, it takes four hours. If she, she …
Carlos:	But we say that …
Azad:	If he, for him, it takes two hours.
Mustafa:	Ahaaaaaaa!
Several voices:	It is three.
Carlos:	But if we divide it …
Azad:	No, no. Listen now. If she paints the fence in four hours, then he must paint it in half that time, that is two hours. So if they cooperate, one hour and a half.
Mohammed:	It is three.
Azad:	No.
Mustafa:	It is less than two anyway.
Carlos:	Three hours. Since, if we say that they split it in halves, he takes half of it first, then it takes one hour.

In the transcript, it is not possible to see which student had which role, and no statement is followed by a question, so it was not possible to do any categorisation using Fuentes' framework. As was the case with the other groups, all students reasoned on their own and did not work together with *locating* or *identifying* questions. Instead, the students guessed what the answer to the task was, and then tried to find ways to solve the task that would result in their guessed answer. They did not use any of the suggested problem solving strategies and did not respect the communicative roles. The role of the questioner was not visible in the analysis.

The students did not seem so see the point of asking questions. For example, when Azad and Mohammed were asked how they worked with questions in the first cycle (Interview cycle 1: Azad, Mohammed, 3:42), Azad said "there was no need ... as everyone was active" and Mohammed said "All knew the questions ... we did not need to ask each other questions". In Mohammed's answer, there seem to be a confusion about what a mathematical question is – the first part of his answer seems to be connected to the mathematical problem formulated in the written task, while the other part seems to be connected to questions students ask each other. Asking mathematical questions was not something students stated as contributing to the mathematical discussions and they did not seem to understand how mathematical questions could help them with their problem solving process. The focus on mathematical questions was new to the students. In the second cycle, the teacher was asked to clarify for the students what mathematical questions could be in a mathematical discussion. However, the focus in this clarification was not on language as such, but on making students cooperate and build onto each other's utterances.

The second cycle

In the second cycle, one of the problems focused on interests and loans.

> The Loan
> Marie and Johannes have one loan each. Marie's loan has an interest of 3 % and Johannes's loan has an interest of 6 %. Each month they pay the same amounts on their loans. How much money could they have borrowed?

Changes were made so that there were several possible answers to the tasks, and several ways of reaching a solution, so that students no longer would ask questions focusing only on finding the right answer. Students were also given individual thinking time to prepare questions before the tasks. Most often however, they did not use this time, but instead started the discussions right away.

Also the support means were made more specific. Since the students had questioned the communicative roles in the first cycle, the roles were changed, so that every student had responsibility for one out of four areas: *group work* (making sure everyone participates), *written summary*, *questions* and *oral presentation*. The student responsible for questions was to write down the questions on the blank question list, and use the questions in the extended problem solving strategy, see figure 2.

In the second cycle, the amount of joint *advocating* while discussing different strategies increased. Students not only asked questions, but also

1. Understand the problem	What information is given in the task? What do we need to know and why?
2. Plan for what strategy to use	How can we solve the task? Why do we choose this strategy?
3. Use the strategy	Questions about calculations: What? How? When? Why?
4. Look back at the problem	Is it possible to understand the solution? Are there any more solutions? Is the answer reasonable?

Figure 2. *Problem-solving approach with questions, cycle 2*

listened to some extent to the answers. They often worked in pairs within the groups. One example of joint *advocating* from the second cycle was when Aisha, Carlos and Mariam were discussing how to calculate a three-month period of interest in Swedish kronor (transcript 2). During some short episodes, both before and after this transcript, Aisha and Mariam spoke Arabic to each other, but since Carlos did not understand Arabic, almost all parts of the conversation were in Swedish. The original conversation in transcript 2 were entirely in Swedish (see appendix).

Transcript 2. *Cycle 2, task the Loan: Aisha, Carlos, Mariam, 6:28*

Aisha:	Should we divide it by twelve months? Then we have fifty-five. One month.
Mariam:	Fifty-five what?
Aisha:	Fifty-six kronor a month.
Mariam:	Fifty-six kronor a month? Is it just the interest you calculate?
Carlos:	Why don't you divide by four instead?
Mariam:	Yes, but you can do it like this. That is, we divide the interest by twelve and then you get per month. Then we multiply by three.
Aisha:	What is the difference?
Carlos:	What is the difference? It is faster to divide by four.
Aisha:	Yes, divide by four.
Mariam:	Aha, yes, divide by four, that is three months.

In this example of joint *advocating*, Aisha seemed to begin asking herself a question about how to calculate the interest (QCR-pair 6). Mariam helped her by asking clarifying questions (QCR-pair 8), and then Carlos challenged the thinking (QCR-pair 3) and suggested another strategy (QCR-pair 6). Asking questions required the students to listen to each other and build on to what they heard, and the questions were responded to, which differed from the conversations in cycle 1 in which students mostly reasoned individually. The questions seemed to help the group to find a way to solve the problem, as they asked them when they did not understand. However, there were no questions directed to the teacher about the support means or about the language used in the problem or in the support means. The students seemed to understand what they were supposed to do, but were challenged by the mathematics.

When summarizing the responses to the problems, the teacher included a whole-class discussion about mathematical questions, where students were to talk about the questions they had asked each other, during their explanations on the board. However, it appeared that the purpose of the question list was still not clear to all students. In the second cycle, when Nour was asked about the thoughts behind the question list, she said: ”No idea, maybe learn about problem solving” (Interview cycle2: Amal, Mohammed, Nour, 7:33).

In the second cycle, the students' reactions to the questions varied, which was seen from the analysis using Fuentes' (2009) framework if the questions/comments were followed by responses. When students recognized that questions came from the question list, sometimes they told the person asking them to be quiet, or just ignored them. At other times, they answered them and then the questions and answers contributed positively to the mathematical discussions.

The third cycle

In the third cycle, students worked with one task, the Pattern, that was constructed as an interdisciplinary task between the teachers in Mathematics and Digital art. It started with an assignment of taking a photograph and making a visual mathematical pattern out of the picture. In the mathematics class, the students were to describe three different patterns algebraically and find a formula describing the n:th figure. The three patterns (chosen by the teacher) were the same for all students, since some of the students did not do the photo assignment. The complexity increased across the three subtasks and the patterns were possible to interpret in different ways with more than one correct answer.

The communicative roles were the same as they had been in the second cycle, but in the third cycle, the problem solving strategies and the question list were combined, see figure 3. In addition, the student responsible for questions in the group work had to mark which questions they used. Students were prepared for the third cycle in that they tried out the combined list and the teacher had a meta-discussion with the students of how and why to use it.

1. Understand the problem	What information is given in the task? What do we know? What are we to answer in the task? What do we need to find out?
2. Plan for what strategy to use	How can we solve the task? In what way is this task similar to other tasks we have solved? Why do we choose to solve the task like this? Are there more ways to solve the task? What do we need to calculate? How can we structure our solution?
3. Use the strategy	When working with the problem it is good to ask questions starting with: Why are we doing this? What happens if…? How do we calculate this? What is…? In what order do we do this? How are you thinking…? What do you mean by…? How do we know that…? When do we…? What formulas?
4. Look back at the problem	Have we answered the question? Is the answer reasonable? Are there any more solutions? Can we solve the task in another way? Can we check if we have thought correctly? Is it possible to understand the solution?

Figure 3. *Combined problem-solving support list and question list, cycle 3*

In the third cycle, students were no longer so focused on simply finding the correct answer, instead they asked each other questions and tried to understand the other students' reasoning. In the transcript 3, the students discussed one of the formulas for a pattern:

Transcript 3. *Cycle 3, task the Pattern: Amal, Azad, Mohammed, Nour, 34:15*

Amal: Yes, and this? $2n^2$?

Nour: Yes

Amal: Why did you write that?

Nour: Because 1 * 1 is 1, 2 * 2 is 4, 3 * 3 is 9, 4 * 4 is 16. It will be 16–

Amal: And does it work on all [numbers]? How do we know that?

In the transcript, students again worked with joint advocating. Amal asked Nour about her work (QCR-pair 2). Nour recognized that Amal wanted to ask her a question by answering ”yes”, and then waiting for Amal to continue the question. Nour explained the suggested formula (QCR-pair 2). However, Amal was not satisfied, and at the last sentence she was *challenging* Amal's formula (QCR-pair 5), and asked new questions (connected to the question list) that helped the group to continue the mathematical discussion.

In the final interviews, the students claimed that the combined problem-solving and question list was easier to work with. Nour compared it to the previous versions, claiming "Better. Because you did not know what to ask before, or what you had asked. When you look at the questions, they help" (Interview cycle 3: Amal and Nour, 7:08).

Changes in use of and attitudes on questions over the cycles

In the third cycle, it was evident in the transcripts and in the interviews, that students tried to understand each other's reasoning by asking each other questions. There seemed to be several reasons contributing to this change. Firstly, the support means seemed to contribute to students paying more attention to asking questions in the third cycle, although they did not always choose to use them. Secondly, the focus on mathematical questions in whole-class discussions and interviews, could have improved students' attitudes towards asking questions as a way to learn mathematics. And thirdly, in the third cycle, students knew each other well and had been given time to prepare and get acquainted with the question list before the interaction started.

An increased use in the third cycle of the question "How/what do you mean?" [Hur menar du?] seemed to suggest that students wanted to understand how the other students were thinking. This question seemed especially important for the *advocating* process. In the final interview, Amal claimed there was a change in how students asked questions, saying "I think that before, when someone suggested a solution, everyone was quiet, but now we ask, how did you think and so" (Interview, cycle3, Amal and Nour, 8:20). Over the cycles, the episodes of *advocating* in the transcripts became longer, and it was more common for all students to become engaged in joint advocating. The students however did not have a completely positive attitude towards the question list. Some of them claimed that there were too many questions, and one of students did not see the point of questions across the three cycles, claiming she was just crossing them off the list.

Another difference, found when looking into the interview material, was changes in students' attitudes on questions or working with questions. Azad, who did not see the point of using questions in the first cycle, claimed after the third cycle, "I think, how should we do it and what way should we do it, so I have started to ask in a mathematical way" (Final interview, Amal, Azad, Mohammed, 6:55). This statement is in alignment with the claim by Otten et al. (2011), that asking clarifying questions creates a dialogue with students' own ideas and experiences.

Some of the students claimed that they changed from asking the teacher questions, to asking each other questions. For example, Mariam said, "I can ask them instead of asking the teacher. It is not always that you can to ask the teacher about everything" (Final interview: Aisha, Carlos, Mariam, 36:01). In making this point, Mariam situated her peers as a resource, and someone to ask when she did not understand. Her questions helped the group in the learning process and the students got a chance to "check, refine and elaborate" on what they knew (Mercer, 1995, p.10).

Conclusion

Active communication is important for multilingual students to learn mathematics (Brandt & Schütte, 2010; Domingues, 2011; van Eerde, Hajer & Prenger, 2008). The results of this study indicated that the students had the capability to use Swedish, which was their second language, to develop their understandings of mathematical problem solving tasks. The analysis showed how the focus on increasing the depth in the conversations and dialogue around students' posing questions allowed for deeper ways of engaging where "lacks in words" or the fact that the students were learning the language of instruction was not the focus.

Group work was new to many of the students. In the final interviews, the students stated that in lower secondary school they mainly worked individually in textbooks during mathematics lessons. Therefore, it is not surprising that the students needed support on how to justify their ideas through asking more demanding questions and understanding what mathematical questions could be. However, in this intervention students did not always take up the support that was offered to them. For instance, I had integrated the ideas by Ding et al. (2007) about extra thinking-time before the group discussions started as part of the intervention. However, the students chose not to use it. Also, mathematical questions as such, seemed not to make sense to the majority of the students until the third cycle, after I had discussed mathematical questions extensively in the interviews, and the teacher had held meta-discussions during whole class discussions.

The intervention was about improving how students used Swedish, which was their common language in mathematical discussions, to develop their reasoning and communication abilities in mathematics. To do this, it was important to recognise the importance of the social climate in the groups. Before the intervention started, it was expected that the multilingual classroom would require methods that supported students both mathematically and linguistically (van Eerde, Hajer & Prenger, 2008; van Eerde & Hajer, 2009). However, in the first cycle, the communication patterns were poor partly because the students focused too much on the correct answers and did not ask or answer questions.

These problems seemed to be connected to the norms and social environment about mathematical discussions that the students had which did not contribute positively to their learning. In Fuentes' study (2013), a lack of communication between students in a group, poor communication patterns, and norms that impeded students' learning negatively affected student interaction. Knowing about these factors provided clues about where the intervention for this study needed to start. The results of this study do not contest that it is important for multilingual students to develop both their language and their mathematics skills at the same time (van Eerde & Hajer, 2009), but claim that there is a choice of what aspects of the classroom interaction to focus on first. For the intervention in this study, it was decided to flexibly meet the complex situation in the classroom, rather than focussing solely on linguistic competence. This was partly done to avoid the pervasive risk of unintentionally adopting a deficit perspective by mentioning linguistically weakness as linked to particular groups of learners (see for instance Langer-Osuna et al., 2016).

Another reason for why the multilingualism did not came to the fore, could be that the theoretical frameworks, the IC-model (Alrø & Skovsmose, 2004) and Fuentes' (2009) model for analysing student communication were not originally developed for a multilingual setting. Although Alrø and Skovsmose (2004), claimed that the model could be used for different settings, there might be issues that were missed in the analysis, or more QCR-pairs that needed to be added to Fuentes' (2009) model in order to find out how mathematical questions in multilingual classrooms can help students learn mathematics, and therefore more research is needed concerning this area. However, students themselves did not seem concerned about this – talking Swedish during mathematics lessons was the norm and they did not seem to notice when they switched languages. For instance, Amal said ”When we speak Arabic, I don't think we notice that we switch language. We understand both languages. It just happens” (Final interview, part1: Amal, Azad, Mohammed, 25:55). Also Aisha said in the final interview (Final interview: Aisha, Carlos, Mariam, 19:50) that she did not think that it affected the group work that not everyone in the group had Swedish as their first language. Svensson (2014) had similar results, when interviewing a multilingual group of students in lower secondary school. She found that students did not think that better language skills in Swedish would increase their possibilities for learning mathematics.

Halai, Muzaffar and Valero (2016) claimed that "research itself is implicated in the creation of the differentiation of multilingual/multicultural children" and that it "constructs the idea of the 'deficient multilingual child'" (p. 281). In this study, it seemed important not to assume certain strategies because of the linguistic backgrounds of the students, and to actually investigate, using the cyclic nature of educational design research, how questions could be used in this classroom with these particular students. This might contribute to the research on multilingual students, changing so that it focuses on developing effective classroom discussion and student-to-student interaction regardless of what languages students speak.

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Appendix

Transcript 1. *Cycle 1, task the Fence: Azad, Carlos, Mohammed, Mustafa, 11:55*

Azad:	Lyssna, lyssna, lyssna, lyssna, lyssna. Vänta. Om han målar staketet själv tar det fyra timmar. Om hon, hon ...
Carlos:	Men vi säger att ...
Azad:	Om han, för han tar det två timmar.
Mustafa:	Ahaaaaaaa!
Flera röster:	Det blir tre.
Carlos:	Men om vi delar upp det ...
Azad:	Nej, nej. Lyssna nu. Om hon målar staketet på fyra timmar, så måste han måla det på hälften, det blir två timmar. Så om de samarbetar, en och en halv timme.
Mohammed:	Det blir tre.
Azad:	Nej.
Mustafa:	Det blir mindre än två i alla fall.
Carlos:	Tre timmar. För om vi säger att de delar halva, han tar halva först, då tar det en timme.

Transcript 2. *Cycle 2, task the Loan: Aisha, Carlos, Mariam, 6:28*

Aisha:	Ska vi dela den med tolv månader? Då har vi femtiofem. En månad.
Mariam:	Femtiofem vad?
Aisha:	Femtiosex kronor per månad.
Mariam:	Femtiosex kronor per månad? Är det bara ränta du räknar?
Carlos:	Varför delar du inte med fyra istället?
Mariam:	Ja, men man kan göra såhär. Alltså vi delar räntan med tolv sen man får per månad. Sen gångar vi med tre.
Aisha:	Vad är skillnaden?
Carlos:	Vad är skillnaden? Det går snabbare att dela med fyra
Aisha:	Ja, dela med fyra.
Mariam:	Aha, visst dela med fyra, det blir tre månader.

Transcript 3. *Cycle 3, task the Pattern: Amal, Azad, Mohammed, Nour, 34:15*

Amal:	Ja, och det här? $2n^2$?
Nour:	Ja
Amal:	Varför skrev du det?
Nour:	För att 1 * 1 är 1, 2 * 2 är 4, 3 * 3 är 9, 4 * 4 är 16. Det kommer att bli 16.
Amal:	Och funkar det på alla? Hur ser vi det?