DEVELOPING INCLUSION IN MATHEMATICS - THE IMPACT OF THE PRINCIPAL

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The overall aim of the present research project is to empirically investigate what inclusion in mathematics education can be and how it is possible to develop inclusive mathematics education, based on special educational needs in mathematics. In this paper, the aim is to present how the impact of the principal affects the development of inclusion in mathematics in a case study. The study has an ethnographic approach, where a large primary School is being studied. The results indicate that the principal's impact on inclusion in mathematics at the realisation arena is relatively weak. In this study, inclusion in mathematics has strong connections with didactical issues.

Keywords: inclusive mathematics education, special education, organisation, principal

INTRODUCTION

Many Swedish students struggle with the mathematics in school. Even though massive efforts have been made from the government to increase students' knowledge in mathematics, there is no improvement according to the latest TIMSS investigation (Mullis, O.Martin, Foy & Arora, 2012). An increasing number of students are in need of special education in mathematics. Some schools are approaching this problem by trying to use inclusion in mathematics as a method to improve all students' knowledge in mathematics. Although inclusion is used, it is unclear what it means in practice. Therefore it is essential to understand what inclusion in mathematics can be, and how it can help students struggling with mathematics. Hence, the overall aim of the present research project is to empirically investigate what inclusion in mathematics education *can be* and how it is possible to develop inclusive mathematics education, based on special educational needs in mathematics (SEM). In this paper the aim is to present the analyses of the impact of the principal in the development of inclusion in mathematics.

The principal has impact on student achievement through responsiveness to students and creating a "climate of psychological safety to learn" (Hattie, 2003, p. 2). The principal can influence the climate and students responsiveness through the pedagogical environment at the school. The principal is thus responsible for organising the pedagogical environment to promote learning. In order to do that, a reorganisation is often made. However it has also been shown that reorganisations in schools does not always improve the practice (Larsson, 1998).

The organisation regarding mathematics education is often discussed with issues like ability grouping in focus (Boaler, 2008; Stigler & Hiebert, 2009; Wallby, Carlsson, & Nyström, 2001). Many Swedish schools use ability grouping in mathematics and the teachers envisions better goal achievements. Nevertheless, research concludes that organisational differentiation does not give the positive impact on students' knowledge development the teachers expect (Boaler, 2008; Persson & Persson, 2011; Slavin, 1990). Educational differentiation and individualisation is a complex issue, which requires more investigation. The present investigation of the notion of inclusion in mathematics education might be one way to illustrate differentiation and individualisation.

In the overall research project inclusion in mathematics education is investigated through observations, group interviews and interviews with both teachers and students. In this paper, the data used to capture the present research question - What impact has the principal in the development of inclusion in mathematics? is interviews with the principal and teachers.

THEORETICAL FOUNDATIONS

The entire research project build on two theoretical perspectives, a participatory perspective using communities of practice (Wenger, 1998) and an inclusive perspective (Asp-Onsjö, 2006). Thus, the study is grounded in a social perspective on learning. The overall principle of this perspective is that learning is considered to be a function of participation (Wenger, 1998). Participation is to be seen as "a process of taking part" (Wenger, 1998, p. 55). Participation is an active process that involves the whole person and combines "doing, talking, thinking, feeling and belonging" (Wenger, 1998, p. 56). It "goes beyond direct engagement in specific activities with specific people" (Wenger, 1998, p. 57). The practice "exists because people are engaged in actions whose meanings they negotiate with one another" (Wenger, 1998, p. 73) and the practice reside in a community of individuals with *mutual engagement.* Members of a community of practice are practitioners who develop a *shared repertoire*, such as experiences, tools, artefacts, stories, concepts etc. The *joint enterprise* keeps the community of practice together. It is a collective process of negotiation by the participants in the process of pursuing it.

From a participatory social perspective inclusion means not only to be present in the classroom physically, it also means to be included in the mathematical practice of the classroom. This form of inclusion has no physical condition, it is imaginary. Asp-Onsjö (2006) speaks of *spatial, social* and *didactical* inclusion. Spatial inclusion basically refers to how much time a student is spending in the same room as his or her classmates. The social dimension of inclusions concerns the way in which students are participating in the social, interactive play with the others. Didactical inclusion refers to the ways in which student's participation relates to a teacher's teaching approach and the way in which the students engage with the teaching material, the explanations and the content that the teachers may supply for supporting

the student's learning.

As previously mentioned, the overall study aims at empirically investigate what inclusion in mathematics education can be and how it can be developed using theoretical concepts. The concepts used are *communities of practice* (Wenger, 1998) and *spatial, social* and *didactical inclusion* (Asp-Onsjö, 2006). By following this theoretical structure (Roos, in press) has identified three communities of mathematical practice from a teachers perspective regarding inclusion in mathematics. The first practice is the community of inclusive mathematics that is a community where all three types of inclusion Asp-Onsjö (2006) identify are present. Within this practice teachers sensitivity, acceptance and teaching approaches are central regarding inclusion in mathematics. The second identified community is the community of mathematics classroom, which has didactical inclusion in focus. Here individualisation and teaching approaches are central. The third community identified is the community of special education need in mathematics. Central for this community is terms for teaching and mathematical knowledge within spatial and didactical inclusion. Within social inclusion students' co-decisions is visible.

This paper aims at analysing the impact of the principal using the theoretical concepts, the identified communities of mathematical practice and developed concepts regarding inclusion in mathematics (Roos, in press).

METHOD

In the overall project the notion of inclusion in mathematics is being investigated in a study at a primary school. The notion is here seen as a phenomenon. One way to understand a phenomenon is to use interpersonal methods. These interpersonal methods provide understanding through interpretation (Aspers, 2007). In order to understand the notion of inclusion in mathematics and the development of it, an interpretation of actions and processes at the investigated school is done. To reach and analyse processes and actions the researcher has to integrate with the people involved (Aspers, 2007). In the overall study the integration is made through interviews, discussions and observations. To be able to identify a development of inclusion in mathematics, a longitudinal study has been used. The approach in the study is ethnographic in order to capture a notion and a development. The focus of this paper is the principal's impact on the development of inclusion in mathematics. Hence, a need for understanding the notion and the development of it is present. This understanding is reached through the ethnographic approach, where the interpretation of the interviews and discussions has been used as main data.

Informal and formal interviews, discussions and lessons with the principal, teachers and the remedial teacher at a large primary school were observed and recorded. The school, Oakdale School, is located in a suburb of a medium-sized Swedish town. 7 interviews and 4 discussions has been analysed in this paper and are the basis for results presented in the nest section. The interviews are with the principal (Conrad) and Amanda, Ellie, Anna and Barbara and has been collected during one year.

Amanda, Ellie and Anna are primary teachers working at Oakdale School. They teach mathematics, as well as other subjects, in lower primary school. Barbara is a 61-year old remedial teacher in mathematics primarily working with students in special educational needs in mathematics. Conrad is the principal of the school since one year. He has been a principal at different schools for 8 years. Before that he was a mathematics and science teacher in lower secondary school.

A qualitative, semi structured approach was used (Kvale, 1996) in the individual formal interviews. Here the teachers and principal were invited to elaborate on their view on students in special education needs in mathematics and factors they considered crucial to for students participation in the mathematics in school. In the informal interviews and the discussions the focus was on the education of SEM-students, but the talk was informal and unstructured. The interviews and discussions were recorded and transcribed in full. The analysis was made using coding of the data by labelling the empirical material. This type of coding is the ground for creating new theoretical categories (Aspers, 2007). In the coding of the data, sub codes were identified. Using these sub codes a few major codes arose.

RESULT

The result is presented in two parts. The first part describes the identified communities of mathematical practice at Oakdale School. The second part describes the impact of the principal in the different communities regarding inclusion in mathematics.

Communities of mathematical practice at Oakdale Primary School

Analysing the interviews, five communities of mathematical practice were constructed. Three of these were the same as Roos (in press) identified looking at the teachers' perspective of inclusion in mathematics. The first practice is the *community of inclusive mathematics (CIM).* The principal, Conrad, is a member of this community since he wants the staff at the school to "use the recourses in the class [room]" and he also wants all pedagogues at the school to take responsibility of all their pupils in the class. Amanda is not a member of this community since she is explicit with the fact that she prefers the low achieving students to be excluded from her class "the had nothing to do with the math they were doing here [the classroom] they were not at that level at all". The mutual engagement in this practice is the development of mathematics teaching for students in special education needs. Their shared repertoire is the talk about how to help the students understand mathematics, and their experiences of special education needs in mathematics.

The second practice visible in the data was the *community of mathematics classroom (CMC)*. Conrad is a peripheral member in this practice, with an external perspective. The mutual engagement in these practices is the mathematics learning for all students, that you work according the curriculum. The shared repertoire is the talk

about the mathematics teaching in the classroom, the curriculum and the use of different teaching materials in the classroom.

The third identified practice was the *community of special education needs in mathematics (CSENM)*. This practice is created by the fact that special educational needs in mathematics exist at the school. The mutual engagement is the students in special education needs and their development of mathematical knowledge. The shared repertoire consists of the artefacts involved in the teaching, such as materials, games and tasks. It is also the individual education plans and their content.

The forth practice is the *community of mathematics at Oakdale School (CMO).* This practice was not visible from the teacher perspective (Roos, in press). Here Conrad is a core member and the teachers are engaged in the practice, since they teach mathematics at the school. Conrad has done a reorganization in order to increase goal achievement and use competencies at the school the best possible way. He points out that "we shall do the same things […], we shall know what we are doing" referring to the mathematical content of geometry and basic arithmetic. The subject meetings every third week are a part of the community. All teachers in mathematics at Oakdale School are members of this community. They participate at different levels in the practice. The mutual engagement is the development of mathematics teaching at Oakdale School. The shared repertoire is the talk about the mathematics teaching overall, the curriculum and "pedagogical concerns" [in mathematics at the school] (Conrad).

The fifth identified practice is the *community of student health (CSH).* This practice impact the teaching of the SEM-students, since the members of this practice are involved in the decisions about who should receive special education at Oakdale School. The core members of this community are the remedial teachers and the principal. Other members are the school nurse and the school psychologist. The mutual engagement in this community is students in special needs, educational, social and physical needs. The shared repertoire is the "case management" (Conrad), a circle with four steps. It is a "pedagogical mapping rending in a individual education plan, then an evaluation of the program, actions and follow-up." (Conrad). The teachers at the school are peripheral participants of this practice. They influence, and are influenced of it since they address cases to this group and take part in the writing of the individual education plans.

It is thus five visible communities of mathematical practice at Oakdale School looking at the principals' influence: *community of inclusive mathematics (CIM)*, *community of mathematics classroom (CMC), community of special education needs in mathematics (CSENM), Community of Mathematics at Oakdale School (CMO) and Students health at Oakdale School (CSH).* All these five practices overlaps and influence each other, but there are differences of participants, mutual engagement and shared repertories in these practices that influence the development of inclusion in mathematics at Oakdale School.

The impact of the principal regarding inclusion in mathematics

As earlier mentioned, several sub codes regarding the principal's impact of inclusion in mathematics were found in the data. These were grouped into major codes and have been categorized into the five identified communities of mathematical practice at Oakdale School. The three aspects of inclusion have also been considered in the categorisation.

Community of inclusive mathematics

In this community the focus is how to get students in special educational needs involved in the mathematics taught in the classrooms. The spatial inclusion is in focus. Conrad is determined to change the prior excising school culture of excluding SEM-students from the classrooms. He emphasises that the person responsible for the SEM-students is not the remedial teacher; it is the *responsibility* of the regular math teacher. Barbara (the remedial teacher in mathematics) feels responsible for the SEM-students, and is eager to find *flexible solutions* in the collaboration with the mathematics teacher. Here the didactical inclusion becomes visible addressing that the "students shall feel that it is the same stuff they work with" [both inside and outside the classroom] (Barbara). Ellie says "if everyone thought a little more inclusive and did not exclude all the time, it would be easier for everyone in the school". This indicates that Conrad's determination to change the excluding culture at the school has not had an impact in the organisation yet. Barbara has a hard time finding flexible solutions in the organisation, "it falls a little because we have three from the other class." Both Conrad and Barbara talks about creating *courses*; this in order to give the students "an intensive period"(Barbara) and then return to the regular mathematics teaching in the classroom to be included both spatial and didactical. Even Ellie highlights this when she stresses, "it is good to have a session a week [with the remedial teacher] and be raised, it gives synergies in the classroom".

Communities of mathematics classroom

In these communities the *competence* in the classroom is an issue. The teachers and Conrad seems to equate mathematics within a teaching degree with competence. Conrad is struggling to get as much mathematical competence in every classroom as possible. Doing that is in line with the teacher certificate that was introduced in Sweden 2012. Ellie stresses the importance of having an education in mathematics, in order to help all students in the classroom. Amanda feels that it is "hard to explain" in mathematics "in that I do not have all these different ways to explain that [..] a math teacher has" In this community it is also an issue to get *time* for all the students in the class. Both Barbara and Ellie points out that the math teachers spend a lot of time with the SEM-students in the classroom and it is at the expense of the other students. The issues competence and time is within the didactic inclusion, how to reach all the students.

Community of special education needs in mathematics

In this community, as well as in CIM, *courses* are discussed. "We solve it [special education in mathematics] in a good way because we have courses" Conrad points out and Barbara says, "We believe in that [courses]". Even Ellie raises courses in connection to student needs; She [a SEM-student] needs this course". Though courses mostly occur in grades five and six, and Barbara would like to use it in all grades. Conrad talks about "rubbings" in connection to courses, while Barbara and Ellie stress the understanding and to feel competent attending the small group. Anna expresses a desire to have more cooperation with the remedial teacher. This is something that Barbara addresses often. She wants "to plan together [with the math teachers] and think about what to do, how to help; how we use each other in the best way." Though it is hard to get this time. Barbara says, "you can steel a moment" in the morning drinking coffee, which indicates that it is hard to find time and space for *didactical discussions and planning.* Both courses and didactical discussions and planning are within didactical inclusion.

Community of Mathematics at Oakdale School

The teaching of mathematics on an overall level is discussed in this practice. Conrad points out that "we shall do the same things [in mathematics]" referring to one of the aims with the reorganisation at the school. The main reason for the reorganisation is to get an increased goal achievement. Conrad also underlines cooperation and utilisation of *competences*. To develop the teaching in mathematics (and science) the teachers attends the subject meetings every third week. Conrad and Barbara mention the need for mathematical discussions, but the other teachers don't mention it. Barbara is eager to have more of these didactical discussions in connection to planning lessons; "we turn our heads together" in order to develop the mathematics teaching at Oakdale School. *Didactical discussions and planning* "are learning opportunity [ies] for me too" says Barbara. Even though Conrad and Barbara emphasises didactical discussions and planning the data shows that there are few opportunities available for the teachers and remedial teachers to have it. Both competencies and didactical discussions and planning are within didactical inclusion.

Student health at Oakdale School

The students in special educational need in mathematics are discussed in this community. More specific, what and how to write the individual education plans and how to execute them are important. This is within the spatial inclusion. From this community there has been a proposal to use a specific material identifying students' knowledge in mathematics, although this is not clear for the teachers.

The matrix in Figure 1 presents a summary of the analysis, with major codes of the principal's impact in the different communities regarding inclusion in mathematics.

Community	**Major codes of impact**
Community of inclusive mathematics	*Responsibility*

	Flexible solutions *Courses*
Communities of mathematics classroom	*Competence* *Time*
Community of special education needs in mathematics	*Courses* *Didactical discussions and planning*
Community of Mathematics at Oakdale School	*Competence* *Didactical discussions and planning*
Student health at Oakdale School	*Courses*

Figure 1. The impact of the principal regarding inclusion in mathematics

Even though there are different codes of impact in the different communities of mathematical practice at Oakdale School, one can identify several recurring when investigating the impact of the principal. The most frequent is courses. Even competence and didactical discussions and planning recur in the different communities.

CONCLUSION

The results show that the impact of the principal regarding inclusion in mathematics is different in the different communities of mathematical practice at Oakdale School. The major codes of impact show that there are different factors in the different communities. These factors do not always agree with the teachers' views. In CIM, CSENM and SH courses is in focus, but in CIM it shows that it does not work well in all grades. Regarding the flexible solutions, the organisation is an obstacle especially regarding the spatial inclusion. Here the impact of the principal, on the level of teaching, is weak. There is a need to get didactical discussions and planning of the mathematics in CSENM and CMO. The time every third week does not seem to be enough. This indicates that the intentions with the reorganisation have not begun to show in the teaching of mathematics for SEM-students, or new obstacles have emerged in the new organisation.

Does spatial inclusion in mathematics favour didactical inclusion and the other way around? In the case of Amanda – no, and in the case of Ellie – yes. This suggests that the competence is important to get the didactical inclusion. The reorganisation at Oakdale School controls the competencies, which ought to promote inclusion in mathematics eventually. Even so, the present data shows difficulties to get flexible solutions regarding the teaching of the SEM-students. In this case courses and the schedule prevent adaption of the special education in mathematics according to current needs. Even if there has been a reorganisation the data suggest that there has been no noticeable impact on the development of inclusion in mathematics so far. Like Gadler (2011) concludes in her thesis, there is a discrepancy between the

formulation arena, where the decisions are made, and the realisation arena, where the decisions are executed. In this case the issue is inclusion in mathematics. The results indicate that the principal's impact on inclusion in mathematics at the realisation arena is relatively weak.

Looking into the three different aspects of inclusion in this investigation, it seems that the didactical inclusion is the most frequent. The spatial is often embedded in the didactical, referring to getting access to the mathematics thought in the classroom. The social inclusion is not apparent. In this case, looking at the impact of the principal, inclusion in mathematics has strong connections with didactical issues.

This investigation of the impact of the principal regarding inclusion in mathematics not only identify major codes of impact and concludes that the impact of the principal is relatively weak, it also creates new questions; does the absence of social inclusion have any impact of the development of inclusion in mathematics at Oakdale School? Does the impact of the principal change over time regarding inclusion in mathematics? Will there be an enhancement of inclusion in mathematics eventually, when the utilisation of competences is optimal?

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