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Collaboration in inclusive mathematics settings from the point of view of German primary school and special education teachers

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Inclusive mathematics settings need beneficial environments for all students by using differentiated instruction with joint whole-class experiences and individual support. To cope with these requirements, the collaboration of regular school and special education teachers is essential. However, research is needed on how multi-professional teams' collaboration in inclusive mathematics education can be fruitfully implemented. But before considering such an implementation, the current status must be clarified, which is aimed in the qualitative study presented in this paper. The focus is on the current subject-specific roles and tasks of the teachers working in inclusive mathematics settings at primary schools.

Keywords: Collaboration, team teaching, inclusive education, special education.

Collaboration in inclusive mathematics settings

For a long time, students with learning difficulties and disabilities were taught in German special schools, and special education teachers mainly taught at these schools, such as in other countries (cf. Evans, 2004; Scherer et al., 2020). Since the UN Convention on the Rights of Persons with Disabilities was accepted in Germany in 2009 (see UN, 2006), children with special education needs can attend regular schools (cf. Prediger & Buró, 2021; Neumann & Lütje-Klose, 2021). So German special education teachers are also needed in inclusive settings at regular schools (cf. Neumann & Lütje-Klose, 2021).

In mathematics, such inclusive settings need the creation of beneficial environments for all students (cf. Booth & Ainscow, 2011) by using differentiated instruction with joint whole-class experiences on the one hand and individual support for learners on the other hand, especially for students with special needs (cf. Lawrence-Brown, 2004). This results in requirements for teachers, which Prediger and Buró (2021) structure into five requirement situations for inclusive mathematics teaching:

- “Identify potential demands and notice students’ abilities,
- Differentiate learning goals with respect to identified ability,
- Compensate limited abilities by scaffolding,
- Enhance a targeted learning goal with respect to the ability,
- Orchestrate joint learning with addressing the ability“ (p. 6).

These requirement situations (jobs) are typical, often complex demands in inclusive settings teachers must cope with by using recurrent patterns (practices) which are characterized, among other things, by pedagogical tools (ibid.). Responsible for taking over these jobs in inclusive settings at regular schools are regular school teachers, but since the UN Convention, also special education teachers. These teachers differ in terms of their professional, didactic, pedagogical, and methodological knowledge as well as their beliefs due to the German tradition of segregated teacher training and

differentiated educational tracks for primary level, middle level, academic level, and special education (cf. Knigge & Kollosche, 2019). In addition to the fact that the subject of mathematics can be studied to varying degrees (as a full or basic subject), regular school teachers learn more subject didactic and scientific content, while special education teachers also focus on special needs, so less time is available for the subject (cf. Geisen, 2021). In addition, many teachers also teach mathematics out-of-field. These differences can make it difficult for regular school and special education teachers to work together in regular schools.

However, empirical studies make it clear that high-quality collaboration between teachers positively impacts the quality of teaching and the learning performance of learners (cf. Lee & Smith, 1996). Hence, subject-specific collaboration is condition for successful inclusive mathematics education (e. g. Neumann & Lütje-Klose, 2021; Ritter et al., 2018; Hoppey & McLeskey, 2014; Salisbury & McGregor, 2002). The question of how collaboration in multi-professional teams consisting of regular school and special education teachers in mathematics at regular schools can be fruitfully implemented must, therefore, be a central question of inclusive mathematics education. German research to date is primarily related to collaboration processes in general (e. g. Neumann & Lütje-Klose, 2021). However, research questions arise from a didactic perspective, such as which attitudes towards collaboration in inclusive mathematics settings exist, how collaboration occurs in inclusive mathematics lessons, or which subject-specific roles and tasks there are. This article gives insight into a qualitative study that pursues these questions.

Collaboration between challenges and conditions for success

In connection with collaboration in inclusive settings, teachers are confronted with various interdisciplinary challenges (e. g. Geisen, 2021). However, these challenges conflict with the conditions for successful collaboration concerning a four-level model for analyzing and implementing cooperative relationships (cf. Lütje-Klose & Urban, 2014). These four subject-independent levels are connected inseparably (ibid.):

- The individual level concerns professional competences and beliefs.
- The factual level refers to the design of cooperation in and outside the classroom and clarifying roles and tasks.
- The institutional level refers to the structural anchoring of cooperation in school.
- The interactional level describes the design of the relationship between the participants regarding forms and structures of communication.

Since this paper will focus on the factual level, this level will be described in more detail.

At the factual level, the aim is to clarify how exactly cooperation in a team should be designed and how the different tasks are distributed (cf. Trapp & Ehlscheid, 2018). Essential questions to be asked are, therefore (ibid.):

- What are the tasks inside and outside the classroom?
- How can joint teaching be designed?
- How can roles in an inclusive, collaborative school setting be defined?

So a common assumption of responsibility (cf. Cook & Friend, 1993) and a transparent distribution of roles and tasks for the contexts of teaching and counseling (ibid.; see also Neumann & Lütje-Klose, 2021; Friend et al., 2010) are essential prerequisites for collaboration.

However, interdisciplinary research findings show that the role of regular school teachers and teaching remains the same in inclusive German settings (cf. Arndt & Werning, 2013), and German special education teachers more often hand over their class leadership and take on advisory and diagnostic tasks as well as help and support tasks (cf. Neumann & Lütje-Klose, 2021; Melzer et al., 2015).

The collaboration of regular school and special education teachers is an excellent opportunity for inclusive mathematics teaching, but also challenging. Overcoming these challenges is central to successful collaboration, whereby collaboration in the school context can generally be regarded as successful if both learners and teachers benefit from it (e. g. Lütje-Klose & Urban, 2014).

Collaboration of German teachers in inclusive mathematics education – the current status

Objectives, method, and sample

The collaboration between regular school and special education teachers is an excellent chance for implementing inclusive teaching, whereby there are subject- and school-level-independent challenges and success conditions. In inclusive mathematics education, a central challenge is to design inclusive settings with individual support and joint learning (cf. Lawrence-Brown, 2004). Collaboration between regular school and special education teachers can make coping with these subject-specific challenges easier. From a didactic perspective, research is needed on how multi-professional teams' collaboration in inclusive mathematics education can be didactically fruitfully implemented. However, before considering such an implementation, the current status must be clarified, which is aimed in the study presented in this paper. Therefore, the following questions are considered:

- 1 Which beliefs exist towards collaboration in inclusive mathematics settings?
- 2 How does collaboration occur in inclusive mathematics settings?
- 3 Which subject-specific roles and tasks exist in inclusive mathematics settings?

For this purpose, in the first phase, guided interviews were conducted. At the beginning of the interviews, questions aimed at understanding mathematics, inclusion, and collaboration. Then the focus is gradually shifted to the collaboration of regular school and special education teachers in inclusive mathematics education to determine how teachers collaborate in inclusive mathematics education, what challenges they are confronted with, and what conditions for success they identify. The teachers should report and reflect on collaboration in requirement situations in inclusive mathematics settings. The sample consisted of 15 primary school and special education teachers who teach mathematics inclusively at a primary school. Two of these teachers had studied the subject of mathematics as a full subject, and eight primary school and two special education teachers had received a basic mathematical education at university. Three special education teachers taught mathematics out-of-field (cf. Bosse & Törner, 2013). Table 1 gives an overview of this data.

Table 1: Sample

	Interviewed teachers	Mathematics as a full subject	Mathematics as a basic education	Out-of-field in mathematics education
Primary school teachers	8	2	8	-
Special education teachers	7	-	2	3

The 15 interviews were transcribed and analysed deductively and inductively using qualitative content analysis (cf. Kuckartz, 2019). The main categories result deductively from the theoretical foundations and the interview guide. An excerpt of the category system is shown in connection with the presentation of exemplary results in the following chapter. These results refer to research question 3 concerning the subject-specific roles and tasks on the factual level.

Exemplary results

On the factual level, the teachers address their roles and tasks in inclusive mathematics education. To describe these roles and tasks, it is necessary to classify their reported jobs and practices (cf. Prediger & Buró, 2021), which are also summarized in Figure 1, showing a section of the category system.

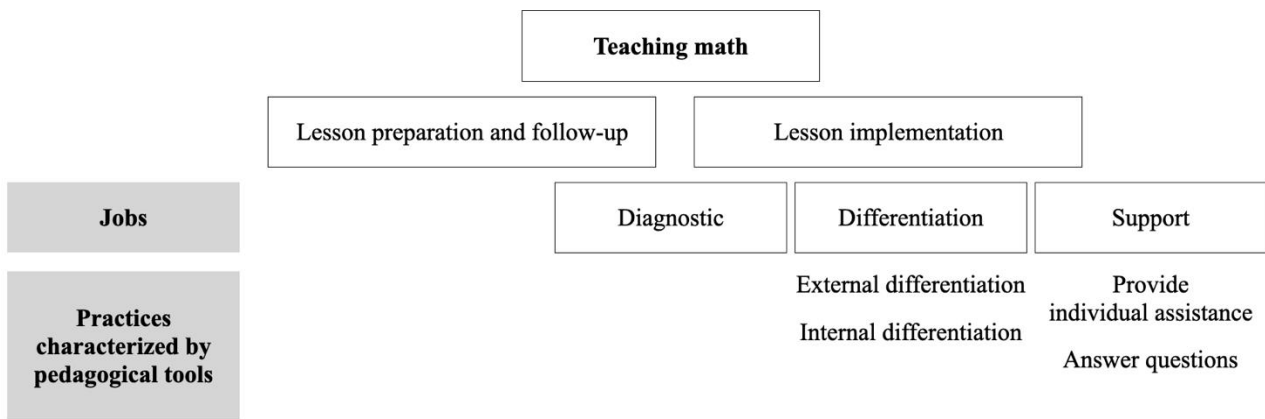


Figure 1: Reported jobs and practices of teachers in inclusive mathematics settings in terms of collaboration (cf. Prediger & Buró, 2021)

In the interviews, the teachers distinguish two phases in teaching math: lesson preparation or follow-up and lesson implementation. According to both phases, they identify diagnostic jobs. In terms of lesson implementation, they also describe diagnostic but also support jobs and jobs concerning differentiation. The teachers also specify different practices to respond to, particularly differentiation and support jobs. They report on using external and internal differentiation and identify providing individual assistance for learners and answering questions from learners regarding support.

Based on the analysed data, these reported jobs and practices are assigned to the differently specialized teachers in inclusive mathematics settings. In the following, the term regular school teacher is abbreviated as RST and special education teacher as SET.

Lesson preparation and lesson implementation is taken over mostly by primary school teachers, and special education teachers engage more frequently with individual learners outside the classroom:

RST: It is like this: I plan and implement math lessons, and the special education teacher comes along, takes two or three children into her support room, or stays in the class.

What is reported here is a form of external differentiation as a practice of differentiation jobs. More frequently described is the provision of qualitatively differentiated material by special education teachers:

SET: I try to build up somehow the lessons that they have planned for the children, for the weaker children in the class to provide additional material, or to sit next to them individually and go around, okay where do I notice which child is having problems at the moment, where do I have to start again? Can I use visual aids?

Teachers explicitly mention differentiation jobs in terms of arithmetic content because teaching all students together in arithmetic is more difficult, according to them.

During lesson implementation, a support job taken on by special education teachers with the whole class is answering questions:

SET: I'm there to support mathematics education and to respond to the children individually.

However, this support job more often relates to all learners, not just those with special needs. This changes in higher grades, where their focus is on learners with special needs. They justify this by the fact that the range between learners with and without special needs is increasing in mathematics education. Especially the arithmetic content seems challenging to teach because of large numbers, so they identify a special need for support for special students in higher grades.

Diagnostic jobs are also attributed to special education teachers:

RST: The diagnosis or learning assessment, in particular, is in excellent hands with the special education teachers.

Here, no distinction was made between lesson preparation or follow-up and implementation.

Conclusion

In inclusive mathematics education, a central requirement of regular school and special education teachers is to design inclusive settings with individual support and joint learning (cf. Lawrence-Brown, 2004). The collaborative processes of these teachers are seen as promising for coping with these requirements (cf. Lee & Smith, 1996). Nevertheless, implementing such collaborative processes in inclusive mathematics settings is challenging for teachers. Research is needed on how multi-professional teams' collaboration in inclusive mathematics education can be didactically successfully implemented. However, before considering such an implementation, the current situation needs to be clarified, and this is the purpose of the study presented in this paper. The results presented in the chapter before, which will be reflected in the following against the background of a possible

implementation, refer to research question 3 concerning the subject-specific roles and tasks on the factual level of the 15 conducted and qualitatively analysed interviews.

In inclusive mathematics settings, the role and tasks of the regular school teachers are often retained, while at the same time, the role of the special education teachers changes. While regular school teachers plan and implement mathematics lessons and there is no transfer of skills and joint reflection, special education teachers take over diagnostic, differentiation, and support jobs (cf. Neumann & Lütje-Klose, 2021; Arndt & Werning, 2013). This could result from the fact that diagnostic and support are essential in the university training of special education teachers in Germany. In contrast to expectations due to the orientation of their teacher training at the university, the diagnostic and support jobs taken over by the special education teachers relate not only to learners with special needs but, more often, to all learners with difficulties (cf. Geisen, 2021). However, this changes in higher grades, where special education teachers focus on learners with special needs.

These results must be interpreted cautiously and only provide initial indications due to the small sample. Further evaluations of 24 interviews will follow, of which 14 interviews were conducted with teachers at primary school to expand the small sample and supplement and secure the data evaluated so far. Furthermore, ten secondary school teachers were interviewed to compare primary and secondary education.

Nevertheless, the question arises of how teachers in inclusive mathematics settings can be supported in breaking down current roles and tasks to plan, design, and follow up lessons together. This needs to be considered at the level of teacher education at university, the level of further education and training, and the level of teaching practice. Some thoughts on this are presented below:

As a basis for clarifying roles and tasks, commonalities must be pointed out to find subject-related contact points. For this, it could be helpful to integrate basic special educational skills in all teacher training or implement special education as an in-depth and further training subject for all teaching professions (cf. Scherer, 2022). Besides, it would make sense to have in-depth subject-didactic training for special education teachers (cf. Scherer, 2022). Furthermore, a theoretical focus and a practical integration of collaborative processes in teacher training and further training create awareness and enable own experiences regarding collaboration (cf. Scherer, 2022). Joint courses for primary and special education teachers could be anchored to experience collaboration.

For teachers already in practice, an exchange with other teachers who work collaboratively and can share their experiences could be helpful. A possible framework for this exchange could be implementing a lesson study, a collaborative activity of teachers to explore their practice (cf. Wake & Seleznyov, 2020). Therefore, it could be the next step after evaluating further interviews.

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