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# **Diversity, inclusion and the question of mathematics teacher education**

## **– How do student teachers reflect a potential-related view?**

Timo Dixel<sup>1</sup>, Ralf Benölken<sup>2</sup> and Marcel Veber<sup>3</sup>

<sup>1</sup>University of Münster, Germany; [t.dixel@wwu.de](mailto:t.dixel@wwu.de)

<sup>2</sup>University of Wuppertal, Germany; [benoelken@uni-wuppertal.de](mailto:benoelken@uni-wuppertal.de)

<sup>3</sup>University of Osnabrück, Germany; [marcel.veber@uni-osnabrueck.de](mailto:marcel.veber@uni-osnabrueck.de)

*Diversity raises different questions such as how an adequate education of student teachers can be organized in this context. Against the background of a potential-related view, this paper outlines an exemplary concept of an interdisciplinary seminar and an evaluation study about possible impacts reflected by student teachers as barriers in inclusive mathematics teaching. Qualitative data were generated by learning maps in a pre-post-design and analyzed by a reconstructive pedagogic-iconological interpretation. The results indicate that the foundation of the seminar leads to a more complex reflection of student teachers' individual educational paths.*

*Keywords: Diversity, inclusive mathematics education, teacher education.*

### **Introduction**

According to Ainscow (2007), inclusion is seen “as a reform that supports and welcomes diversity amongst all learners” (p. 3). Its aim is to analyze barriers to participation and learning experienced by students within school systems. In some countries, inclusive education is seen as teaching children with disabilities within general education, traditionally by special educators. Slee and Allan (2001), who express their skepticism about inclusion as co-location of pupils, criticized this understanding earlier. There is a similar discourse in Germany: Hinz (2013) states that inclusion moved from ignorance to being unrecognizable, reminding us that inclusion had been ignored by educational science and politics, and now the scientific discourse shifts its attention from inclusion to de-segregation: Instead of focusing on barriers, the individual problems of pupils with special needs and their location in regular schools are discussed. This causes consequences for teacher education: Mathematics teacher education for inclusion is often realized by implementing elements of special education (Werner, 2017), or inclusive mathematics education is reduced to the question of how pupils with special needs learn and what can be done to compensate for their deficits (Krause, 2017). Three problems can be found in this approach: Empirical research showed that marking pupils with special needs is highly influenced by socio-economic status or migration, leading to negative consequences for further schooling and to the potential danger of stigmatization (Sturm, 2016). Secondly, a focus on categories might neglect other children who do not belong in a predetermined category and, therefore, become marginalized (Messiou, 2017). Finally, concentrating on pupils' individual deficits ignores the role of the social and political environment in mathematics education and individualizes failure (Veber & Fischer, 2016). An alternative approach and the framework of this paper is given by viewing inclusion not limited to deficits or categories like gender or social class, but by perceiving individuals' differences as an advantage. We will outline that addressing pupils' differences in this sense of diversity, which we call

potential-related, understanding inclusion as a concept welcoming diversity, and a focus on barriers to participation are suitable frames for mathematics teachers' education (Benölken, Berlinger, & Veber, 2018). In this paper, we address the learning and reflection of student teachers in the context of inclusive mathematics education. Therefore, we do not only describe our attempts on inclusive teacher education but focus on the students attending these courses. The following questions will be investigated: *How can a seminar for student teachers be conceptualized into inclusive mathematics education from a potential-related perspective? How do student teachers reflect on barriers in inclusive mathematics teaching before and after taking part in the seminar?* First, brief overviews of the theoretical frameworks will be given. On these bases, the seminar concept will be outlined. Finally, the design and results of an exploratory study analyzing learning-maps in a pre-post-comparison by applying methods of pedagogic-iconological image interpretation will be subsumed and discussed.

### **Theoretical framework: A brief overview**

*Inclusive* education demands a positioning in the understanding of 'inclusive'. While most of German mathematics education research regards the concept in the sense of special education, an alternative approach is a potential-related view. Benölken, Berlinger and Veber (2018) identified three axioms of inclusion: (1) The rejection of labels such as 'disabled' or 'dyscalculia' for pedagogical actions is an inherent part of inclusive approaches. It means that differences are produced in contexts and not determined in a static way. Most pedagogical categories emphasize negative aspects and, therefore, reduce people to one dimension of their individuality. Vice versa, a potential-related view focuses on the resources of learners. (2) The traditional German school-system is based on homogeneity, assuming pupils learn better if they visit schools for their specific needs. For example, the *Gymnasium* for supposedly 'intelligent' children or the *Förderschule* for 'disabled' children. Inherent is the assumption that heterogeneity poses an obstacle for successful learning. In contrast, a potential-related view demands to accept and to appreciate differences, which is represented in the term *diversity*. (3) Inclusion has a political approach. It is based on human rights, and it demands for changes in society (Slee & Allan, 2001). The research status on inclusion in German mathematics education is characterized by proposals for inclusive lessons (Häsel-Weide & Nührenbörger, 2017), often using the concept of natural differentiation. There are few concepts that include other aspects such as co-teaching, diagnostics and beliefs (Käpnick, 2016). There tends to be a lack of a theoretical discussion about the principles of inclusive mathematics education. Often, the needs of pupils with difficulties in learning mathematics are discussed to design learning environments; the role of mathematics education itself as a producer of inequality is hereby neglected. The international research on inequality and exclusion has given useful suggestions on reflecting discriminating structures and the influence of mathematics education and its teachers (e.g., Bishop, Tan, & Barkatsas, 2015). Consequently, we think that it is not sufficient to add special needs courses to mathematics teacher education. We suggest *reflexive inclusion* as a promising theoretical construct (Budde & Hummrich, 2013). Reflexive inclusion means both to perceive differences when it is needed and to make discrimination visible, but at the same time a rejection of implicit norms and institutional categorization. In this understanding, reflexive inclusion is an interdisciplinary task of mathematics education, special education and

pedagogy. In contrast to other concepts, it is not reduced to the dimension of disability, but framed intersectionally, that is, several dimensions of diversity act in combination. This understanding meets our axioms and provides the theoretical background of a potential-related view. Thus, it is relevant for student teachers to learn that differences need to be deconstructed when possible, and to recognize discrimination. Furthermore, specific knowledge about pedagogical diagnostics and categories of social inequality such as disability, gender, milieu and such is necessary. Therefore, it is of interest to scrutinize seminar designs, and to explore the development of student teachers' reflection, knowledge or perhaps beliefs on, for example, ex- and including factors.

## **Survey of a seminar conception**

We will outline an exemplary teaching concept (for further details see Benölken, Berlinger, & Veber, 2018). It has proven itself in implementations at the Universities of Münster, Osnabrück, Halle and Kassel as well as at the Pedagogical University Tyrol. It aims at students who have already acquired their first subject-didactic and subject-scientific knowledge. Thus, it requires a level of ambition that enables students to expand and network knowledge already acquired with a focus on the organization of inclusive mathematics lessons. Against the background of interdisciplinary networks, the aim of the seminar is to enable students to plan, reflect and analyze inclusive mathematics lessons. The overarching questions of the seminar sessions can be identified as follows: Which influencing factors must be considered in the design of inclusive mathematics lessons? How can concrete mathematics didactic implementations be identified, and, conversely, do they meet the requirements of inclusive education? The seminar concept approaches these questions with a potential-related understanding of inclusive education. Consequently, various facets that are discussed in the relevant literature concerning the realization of lessons for all children without exclusion are taken into account: Attitudes and experiences, professional competencies in relation to various diversity facets (including facets relevant to special education), diagnostic and methodical spectra, educational framework conditions, social relationships as well as cooperative forms of teaching. In summary, the complex of all presented aspects mirrors a holistic approach to student teachers' education, and they explore single facets of the complex as well as interrelated patterns by research-based learning, that is, by raising relevant questions, developing corresponding concepts and sometimes examining them in greater depth in bachelor and master theses. The organization of the seminar combines usual demands of higher education didactic such as different methods and both traditional and digital media, multifaceted combinations of theoretical contents and authentic practical examples. Additionally, there are supplements of expert lectures (often as 'best practice' information), school visits and workshops, in which student teachers can network and deepen their knowledge. A recurring highlight are discussions about both potentials and possibilities of implementing developed ideas, concepts and findings in inclusive mathematics teaching. In each case it is scrutinized whether work products meet both mathematics educational and inclusive pedagogical postulates of organizing teaching-learning processes.

## **The study**

The study focuses on the *question* how student teachers reflect on barriers in inclusive mathematics teaching before and after taking part in the seminar. The sample consisted of 124 *participants* (101

f., 23 m.), who were primary and secondary student teachers and took part in the study during the semester in which they attended the seminar. The data originated from implementations of the seminar concept in Münster (between the winter semester 2015/2016 and the summer semester 2017), Osnabrück, and Innsbruck (each in the summer semester 2018). Mostly, the participants were in their first year of undergraduate studies. The study has an explorative character, that is, generalizations were not intended, but existential propositions (Lamnek, 2010). Thus, a qualitative *design* was advisable. As to the *method*, qualitative data were generated by applying learning maps in a pre-post-comparison, which were anonymized by codes to ensure unbiased interpretations. In the maps' header, the student teachers were given the impulse to craft their way between their current status and their future work at schools: "Inclusive education is currently considered as the greatest challenge for teachers. The question arises as to how teachers can structure their specialized instruction in such a way that (really) all children can learn together in order to reach their respective zone of proximal development. This joint learning of all children without exclusion might arise opportunities, challenges, stumbling obstacles and much more. What does this mean to you personally? Which way have you covered or which way will you have to cover in the future? Please lay out your way" (translated from German). All participants designed the maps for the first time, and the maps were created at the beginning of a semester and its end. As to the *analysis*, the pre- and post-maps were compared by a reconstructive pedagogic-iconological image interpretation, following its characteristic steps: (1) Discussion of previous history and selection of key motives, (2) image description and analysis (with regard to the factual, expressive and form-related sense), (3) context analysis, and (4) comparative analysis (Schulze, 2013). The evaluation procedure was piloted in a research workshop with student teachers in the summer semester 2016; afterwards, the analyses were conducted in a research group.

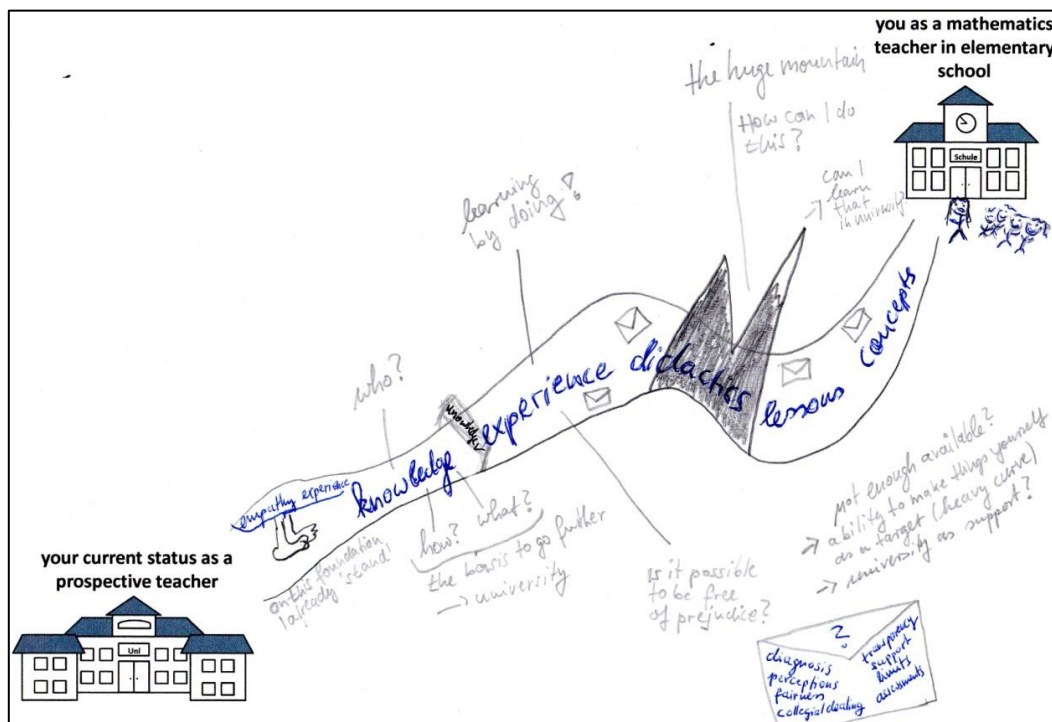


Figure 1: Example of a pre-map

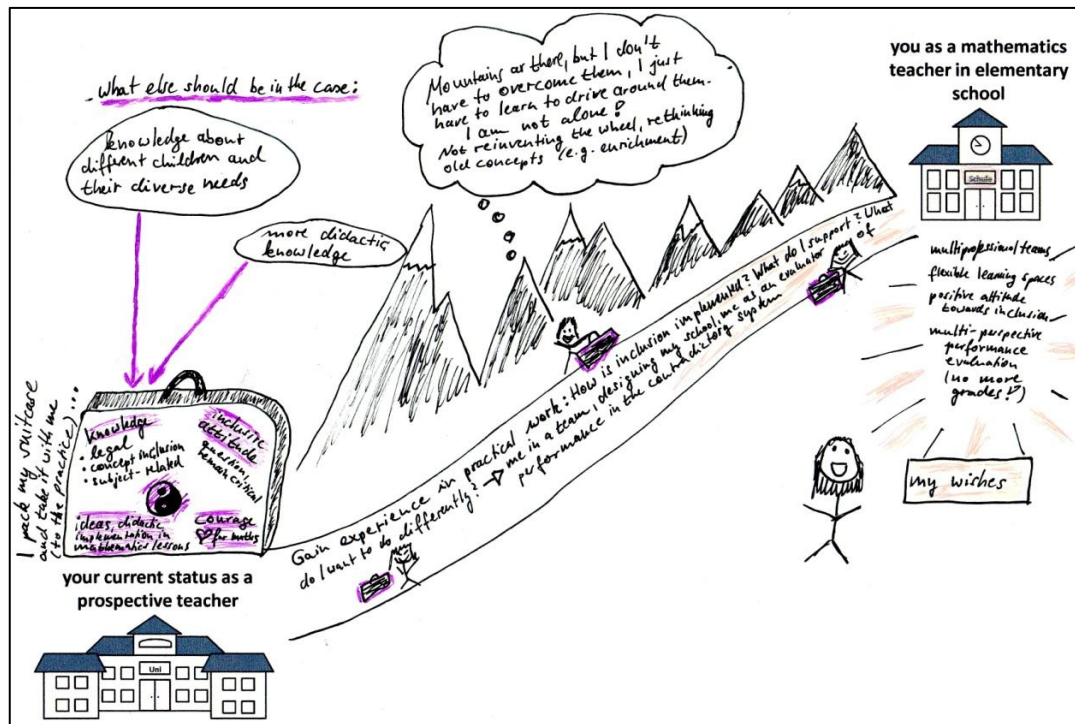


Figure 2: Corresponding post-map to Figure 1

## Results

As to the map's *previous history*, the reflections' interpretations must be seen in the context of the seminar, which attempts to combine school requirements in dealing with diversity and university teaching. For example, led by theory, the student teachers develop concrete task formats in the seminar, which provides one of the topics in the context of methodical spectra. This framing implies that the student teachers receive a view of school practice from the university perspective between the pre- and post-drawings, which produces impacts on the post-maps' design. Additionally, the seminar's evaluation was conducted in a mixed-method design, where the maps provide one constituent. Regarding *key motives* and their *description*, main types were drawing both (1) paths (or a systems of paths), and (2) obstacles. Subsequently, we focus on spotlights of the reconstructions of one example shown by the Figures 1 and 2, which reflect typical features (the figures show facsimiles with translations from German; the original data can be requested from us).

As to the factual sense of the pre-map (Figure 1), the most important symbols are a path and a mountain. With regard to the sense of form, the path begins and ends relatively narrow, and it winds directly before the finish. The mountain is on the path. Additionally, some persons at the end of the path smile and stretch their arms into the air. As to the sense of expression, another noteworthy detail is that the remarks are often written in questions. The expression is rather sober. As to the factual sense of the post-map (Figure 2), the spotlights are basically repeated. Additionally, at the beginning of the path is a large suitcase, which is taken along: Small suitcases are carried by a person walking on the path. With regard to the sense of form, the path is not winding, but it leads straight to the destination without detours. The suitcase is swung back and forth by the person. The mountains stand beside the path in the background. As to the sense of expression, most of the

remarks do not represent questions, but statements. The bigger person smiles and stretches the arms upwards. Colors are used to highlight single aspects.

As to a *context analysis* of the pair of maps, the feet drawn in the pre-map (Figure 1) seem to indicate that the creator of the map reflects that he or she has started the journey to inclusive teaching, but there are several aspects showing ambiguity like the real starting line is not reached yet or the annotations are phrased as questions. The creator still seems to expect to gain experience, knowledge and the like as shown by both the words on the path and the envelopes, especially the big one with the question mark, but his or her bases are “empathy” and “experience” (which is not explained in detail here). With regard to the central symbol ‘mountain’, an ambivalence must be noted: On the one hand, mountains can block the view, can be a hurdle. On the other hand, mountains represent challenges that require effort but offer opportunities in relation to the goal being achieved, and both the ‘path is the goal’ and the ‘goal is the goal’; climbing and reaching the summit can cause a ‘flow’. The latter can justify the previous effort. Mountaineering can also be influenced by different weather conditions and the like, that is, different conditions that require special equipment. Thus, the symbol ‘mountain’ can stand for different chances but also challenges and dangers (on the part of the teachers, but not only there) and this requires a specific preparation. As indicated, in the pre-map, the mountain is drawn on the path, which seems to reflect that the creator can imagine to cope with inclusive teaching at school in principle (which is also indicated by the cheerful group of people at the school), but he or she still perceives barriers that will be difficult and challenging to overcome. This interpretation is confirmed by the fact that a curve is drawn between the mountain and the school. The comparison with the post-map (Figure 2) suggests that the creator now reflects to perceive a direct access to inclusive teaching: The big suitcase seems to indicate that he or she can classify own experiences in a more differentiated way. Experiences and likeness are reflected to be more comprehensive than it was the case in the pre-map. The potential-related perspective can be assumed as an essential impulse for this fundamental change (e.g., “knowledge about different children and their diverse needs”). Questions posed in the pre-map (e.g., “who?”, “how?”, “what?”) turned to concrete intentions and planning steps (as expressed by the phrasings on the path or the “wishes” of the bigger person on the right). Especially, as to the central symbol ‘mountain’, in the pre-post comparison two aspects appear central: the position of the mountains in relation to the path and their number. As to the position of the mountains, it should be noted that, at the beginning, the mountain stands in the way as a hurdle and it makes it necessary to overcome it. Those who want to walk the path cannot avoid overcoming the mountain. In the end, the position of the mountains has shifted significantly, as the path now leads less curvy in front of the mountains: climbing changes from a compulsory to an optional experience. In connection with the altered position, the increasing number of mountains indicates that in the end the ambivalence of mountains is perceived to a much greater and more intensive extent. However, these opportunities and risks no longer appear to be hurdles that cannot be circumvented. Thus, the symbol ‘mountain’ allows exemplary illustrations of a deeper interpretation of the observable changes considering the previous history of the maps: The student teacher experiences a paradoxical situation, since a synchronization of university theory and school practice provokes numerous difficulties (mountain peaks) within the framework of inclusion. However, the mountains are no longer obstacles (i.e., a key motive was reinterpreted). This interpretation is confirmed by the



facts that the path is drawn continuously and no longer winding. Furthermore, there are different impressions reflecting a higher level of confidence like the swinging of the small suitcases, the use of colors (e.g., the ‘sun’ on the right) or the big person, whom one may assume to be the creator him- or herself. The synthesis of his or her size and his or her cheerful expression might be interpreted as a symbol of prospective knowledge and experience, that is, he or she can now well imagine coping with diversity at school and experiences him- or herself better equipped for the journey (e.g., by the suitcases).

Based on these typical examples, a *comparative analysis* of all pre- and post-maps suggests that both the paths of student teachers and their experience of walking on the paths, thus, the reflections of barriers in inclusive mathematics teaching, changed to more confident characteristics. In sum, these changes can be described by three reflexively connected levels: key motives, lines of development, and their antitheses or contrasts. For example, the symbol ‘mountains’ clearly shows that the student teachers change their image of inclusive mathematics teaching in the course of the seminar. On the one hand, it becomes more differentiated and extensive, since in their opinion it is no longer sufficient to simply overcome a hurdle and the goal is already in front of their eyes. It rather seems that inclusion in mathematics teaching offers numerous challenges. These offer opportunities, but also dangers for teachers. The given pre-post-map-example represents a main type of all pairs of maps, the ‘expectant expert’. A feature of this type is that knowledge about inclusion increases and the person develops confidence in inclusive teaching. Another type shows similar characteristics, but in a lower level of contrast, which we named the ‘optimistic novice’. In both cases, we reconstructed an increase of knowledge and reflection, so we assumed deeper understanding of – or at least insight in – the possibilities and challenges of inclusive education. Finally, the type ‘interested layman’ was reconstructed showing much lower levels of confidence’s increase (forming the subtypes ‘positively stagnating’ and ‘no process’), but it was rarely found.

## Discussion

The results indicate that participating in a seminar which takes a potential-related perspective on inclusive education and which considers the idea of research-based learning as well as intertwining theory and practice in a university context contributes sustainably to student teachers’ reflections of removing barriers in inclusive mathematics teaching. Thus, beyond the context of mathematics education, the results suggest the hypothesis that the seminar’s foundation provides an appropriate approach to student teachers’ education in the field of diversity, which is, for example, reflected by the main type ‘expectant expert’. Of course, the study’s character is explorative and it has obvious limitations, for example, the reconstructions were conducted within a group of researchers, but it remains uncertain if a consensus view is the right one (Lamnek, 2010). The interpretations reported in this article focus on the most important spotlights, especially regarding the characterization of the previous history of the images’ geneses, the connection between motives emerging from the previous history and the central symbols applied in the maps’ drawings, or the introduction of different types. As to the sample, all data collected between 2015 and 2018 were included in the analyses in order to get both various and sustainable impressions, although single conceptual improvements were conducted during this period because of feedbacks from the single evaluations. However, the basic principle of a potential-related perspective always remained the same.



Subsequent research might focus on a deeper clarification of the evaluation of the seminar's theoretical framework in the context of both mathematics education and education in different subjects. Another step could be adapting contents of the seminar to different types of learners we found in the comparative analysis.

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