

# Language diversity in mathematics education in the Nordic countries 2008–2018

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In 2008, the Nordic Studies in Mathematics Education (NOMAD) journal published a thematic issue on *Bringing focus to mathematics education in multicultural and multilingual settings*. It had four articles with contributors from Australia, Sweden, Denmark and New Zealand (Lange, 2008; Norén, 2008; Owens, 2008; Valero et al., 2008). Although mathematics classrooms in the Nordic countries have become even more linguistically diverse since then, further publication on this topic in NOMAD has been sporadic, with occasional articles being published, mostly originating in post-graduate projects in Sweden. Only four articles that highlight linguistic diverse contexts have been published since 2008 (Bagger, 2016; Norén, 2011; Petersson, 2017; Stentoft & Valero, 2009).

Consequently, we considered that it is timely to bring together researchers to map what was currently being done in the Nordic countries. So a conference was held in Bergen in January 2017, funded by the newly-formed, Western Norway University of Applied Science. Nordic researchers working in the field of language diversity were invited to contribute through the Nordic mathematics education network. Almost all of the subsequent presentations at the conference became articles in this thematic double issue, with 11 articles by Nordic researchers, from Finland, Denmark/Greenland, Sweden and Norway, and an overview article by Susanne Prediger (2018) from Dortmund University, Germany, as well as this introductory article.

The aim of the thematic issue is to provide an overview of what was being done and from this to determine what still needed to be done on language diversity in mathematics classrooms and early childhood centres in the Nordic countries. Prediger's article synthesises the articles

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to present a structure for understanding the different aspects of language diversity which are highlighted in this set and what is missing in this work.

One of the changes from the 2008 thematic issue is that we adapted the title to "language diversity in mathematics education". The main reason for moving away from the earlier title which had highlighted "mathematics education in multicultural and multilingual settings" is that we considered "language diversity" as providing a broader interpretation on the relationship between mathematics education and aspects to do with the languages that students and teachers use in classrooms.

In her seminal chapter, Delpit (2003) discussed language diversity in mathematics classrooms by critiquing a book written by Eleanor Orr in which Orr indicated that the learning issues of African American students were situated in their use of a non-standard variety of English. Delpit emphasised the destructive aspect of blaming the students for their failure to learn mathematics on their language and the impact it was likely to have on their views of their families and their culture. In other parts of her chapter, Delpit highlighted how Indigenous students' use of a non-standard form of English was used by their teacher as a treasure to be valued, particularly in relationship to their home contexts, while also recognising that the standard version of the language of instruction had advantages in other circumstances. In telling these stories, Delpit emphasised that language diversity issues go beyond the walls of (mathematics) classrooms and are affected by and affect societal views, including those of researchers, about the languages and dialects considered valuable for teaching and learning. Drawing upon Delpit (2003), our definition of language diversity includes culture as an integral part consisting both of societal values and norms but also cultural practices that can be linked to mathematics learning. Thus in this thematic issue, we include a broad set of articles, some of which focus around interactions to do with the learning of mathematics while others look at societal values and norms.

### Themes within the articles

In determining the kind of research which had been done over the last ten years, we have classified the papers into four themes: Indigenous issues; the influence of societal discourses; teaching and learning; and other participants in multilingual mathematics learning. Although there is some overlap in that two or more themes were evident in a paper, for ease of discussion we have chosen to focus on each paper in a particular sector.

*Indigenous issues*

Papers that provided examples of Indigenous languages and culture were part of the 2008 thematic issue, but the examples were not the focus of the paper. In 2008, Owens included examples about mathematics education for Indigenous people in Australia and also for Sami people in Sweden. Nevertheless, her focus was on six key issues in multiculturalism in education:

- 1 valuing the cultural context,
- 2 maintaining culture in different ways,
- 3 teaching in a cultural context including teaching mathematics,
- 4 having an emphasis on national values and using national languages appropriately,
- 5 developing context-specific strategies for diversity, and
- 6 meeting language differences in different ways.

Similarly, Valero et al. (2008) provided examples from a Māori immersion school to illustrate aspects of a model in which school mathematical discourse is situated in a learning landscape. However, they focused on how school mathematical discourse was linked to the learning landscape which includes student's identity, their foreground, teachers' friends' and parents' perspectives, mathematical content, tools and resources, public discourses and classroom interaction. Mathematics education was presented as a complex network where language is part of the discourse, and as something which is understood in a context. They argued that language can be presented as a problem by teachers and researchers who emphasise the minority students' lack of competence in the language of instruction, but that it can also be seen as a cultural artefact which is developed in response to cultural demands. In the Māori school, language was viewed as a treasure which needed to be re-vitalised and from this perspective all challenges connected to using it as the language of instruction had to be overcome as a joint response from the school community.

In the 2018 thematic issue, Indigenous perspectives are raised in three papers. Two articles focus on the use of Indigenous languages in mathematics education and the translation of Western concepts into these languages. In the article about developing the Greenland language for teaching mathematics, three ways of producing new terms were found to have been used most frequently and these were based on the everyday use of the Greenland language (Hjelmborg & Fleischer, 2018). Hjelmborg

and Fleischer end the article with a discussion about how even when the Greenland language has the possibility for discussing mathematical ideas, some teachers who are fluent in this language may still choose Danish, the colonists' language, to teach mathematics. This indicates that research is needed on how attitudes about the language of instruction are formed. The paper by Fyhn et al. (2018) about Sami translation of Alan Bishop's (1988) six universal mathematical activities also discusses how Sami terms were chosen and so can be seen as an extension of the Greenland paper in that it documents the process as it occurred, rather than trying to identify the process after the event. In this case, Norwegian as the common language between the researchers and the Sami involved in the translation was used to make sense of Bishop's (1988) ideas written in English. The difficulties of doing literal translations involving three languages, English, Norwegian and Sami, indicates how cultural understandings about mathematics education are linked to language.

The third paper in the 2018 thematic issue is concerned with the revitalisation of Kven, a recognised minority language of Norway, which is described as endangered (Huru, Räisänen & Simensen, 2018). In this paper, a framework for designing authentic historical tasks which can be used in immersion situations is proposed. The main argument of the article is that mathematical practices can provide opportunities for authentic immersion situations that support both the learning of mathematics but also Kven. The role of Elders in planning and implementing the tasks is reinforced.

There are clear differences between the 2008 and the 2018 articles in that in the earlier articles examples from Indigenous communities were used to discuss wider points while the 2018 articles place Indigenous issues in the centre of discussions of language and mathematics education. These articles also can be seen as examples of super-diversity, as discussed by Barwell (2016), as they focus on how meaning is communicated, rather than the fluency needed in a specific language to discuss mathematics.

### *Influence of societal discourses*

In the 2008 thematic issue, Lange (2008) and Valero et al. (2008) use the concept of discourse in their research to discuss how people come to believe that certain aspects of learning situations are more important than other aspects. In Lange's (2008) research, the teacher's assumption of how adults in immigrant family spoke with their children – they spoke at, not to – featured in the teacher's explanation for why the bilingual students lacked skills in the academic language needed for mathematics

learning at school. The paper raised the issue of how white, middle-class culture is often taken for granted in research, which can hinder teachers, families and children from valuing the support immigrant students have, especially if it seems different to how support is provided by the majority culture. Lange (2008) argued that "reconstructing discourses about immigrants and homework is the responsibility of governments, politicians, school authorities, and the public and not the sole responsibility of individual teachers" (p. 64).

Also in a later article, Norén (2011) highlighted how discourses promoting multilingualism and social relations contributed to the formation of student identities as engaged mathematics learners which "is a broader perspective than pre-defined identities construed from view points where deficit discourses are applied to minority students" (p. 108). Norén's emphasis in this article was about how teachers do not have to accept the ventriloquizing of deficit discourses, but they can change their expectations and practices to better meet the needs of their students.

In the 2018 thematic issue, the influence of policy documents, as an expression of social discourses, is seen in two papers Norén and Källberg (2018) and Källberg (2018). In alignment with earlier work in NOMAD on this theme, Källberg (2018) analysed interviews with two students with immigrant backgrounds to explore how different discourses seem to shape their identities as they talk about the mathematics learning opportunities that they had in a previous school and in a new school after a forced transfer. Their identities cross the boundaries between being mathematics learners and also being social beings, needing friends and needing to feel comfortable in the new environment.

In Norén and Källberg (2018), the policy documents themselves are analysed to determine what discourses might enter discussions about mathematics and Swedish language learning. They found two discourses that were in contradiction and perhaps in conflict with each other. The first was one in which newly-arrived students in Sweden were described as having experiences and knowledge that would be useful in their future learning of mathematics. The second discourses focused on the knowledge and experiences, especially their lack of fluency in the Swedish language, which could negatively affect their learning of mathematics.

The 2018 papers, therefore, follow the tradition established in earlier NOMAD papers where students' identities are linked to the prevailing societal discourses. However, analysis of policy documents has been done separately to determining the discourses present in student interviews and operating in classrooms observations. Although Lange (2008) implied a relationship between the recent publication in Denmark of a report and the teacher's observations, there seems to be a need for a study

which tries to investigate more thoroughly how discourses from policy documents enter the public sphere and are then taken up into identity formations.

### *Teaching and learning*

Another theme which appeared in papers from both the 2008 and 2018 thematic issues is that of teaching and learning. It is perhaps surprising that there are in fact so few of these papers in both the 2008 and 2018 sets of articles.

In 2008, Norén (2008) wrote an article on learning mathematics in a bilingual classroom where student's mother tongue was seen as a resource. In this article, she described both the students' and the teachers' perspectives on the teaching. Although from the students' perspective there were advantages in being able to use their mother tongue, Norén (2008) also noted that differences in what constituted "good" mathematics teaching became evident between the bilingual and Swedish-only teachers.

In two articles published between the thematic issues (Stentoft & Valero, 2009; Bagger, 2016), students with multilingual backgrounds were mentioned but were not the main focus. This is in contrast to Petersson's (2017) article in which he used data from Swedish national tests to suggest that that students immigrating in later school years were able to exploit knowledge about certain mathematical topics, such as algebra, from schooling in their home countries and so achieve higher results than students who had immigrated at an earlier age. In this way, he highlighted differences between groups of linguistically-diverse students which produced statistically significant differences in results and highlighted the need for them to be explored. Given that immigrant students as a whole did not do as well as their Swedish-only peers, differences between groups require further investigation to determine what causes the differences when fluency in Swedish is no longer used as an explanatory factor.

In the 2018 double issue, teaching and learning issues are raised in several papers, including a follow-up study by Petersson (2018). In this study, he looked specifically at arithmetic results in national tests and found that newly arrived immigrant students showed more knowledge of arithmetic laws, such as the associative and distributive, as well as the order of operations than students who had been in Sweden longer. His results suggest that further research is needed to determine how students with an immigrant background can be better supported in the early years of school in Sweden so that gaps in their knowledge do not appear.

Ahlholm and Portaankorva-Koivisto (2018) also used test items from PISA to ask three students who had Russian as their first language but

who were learning mathematics in Finnish to talk through their problem solving strategies. Russian and Finnish are morphologically distant. The authors used a tripartite definition of language to describe the specific issues that their informants had while solving the problems. Although differences between the languages did not affect cognitive processing, they did seem to affect the possibilities for the students to explain their results.

In some ways, Sjöblom's (2018) study can be seen as an extension of the work of Ahlholm and Portaankorva-Koivisto (2018) in that it describes a project in which multilingual students were supported to develop mathematical questions to ask each other when solving problems in groups. She found that as students increased the amount and quality of the questions about each other's thinking, they were better able to work together to solve the problems. In this project, students' fluency in one or other language was not in focus but rather how they learnt to communicate together was the focus.

As was the case with the previous two themes, there is only minor evidence of changes in how this theme has been tackled in 2018. Petersson's (2018) article in the thematic issue reinforces his earlier results that showed that second language learners of Swedish should not be considered as sharing the same set of experiences and knowledge of mathematics. In both Norén (2008) and Sjöblom (2018) papers, the focus is not on deficiencies in fluency but in how the resources that are present in the classrooms can be utilised and further developed to support the communication of mathematical ideas. Ahlholm and Portaankorva-Koivisto's (2018) paper presents a new theoretical framework for considering language use. Although Valero et al.'s (2008) paper could be considered as describing a theoretical framework, these kinds of papers are not strongly represented in this set of papers.

### *Other participants in multilingual mathematics learning*

Our final theme was not evident in any of the early NOMAD papers to any large degree. In Valero et al. (2008), parents' views are mentioned but they are not the focus of that paper. However in the 2018 thematic issue there are two papers which focus on the views of multilingual parents as well as the mentioning of the need for Elders to be incorporated into the work with Kven by Huru, et al. (2018). The third paper in this set looks at the work of mathematics teacher educators (Eikset & Meaney, 2018). Two of the papers (Lembrér, 2018; Lange & Meaney, 2018) used surveys of parents of young, multilingual children to investigate specific topics. These papers are different to previous studies in NOMAD, which have

focused almost exclusively on multilingual, school students. Lembrér (2018) focussed on the views of Polish parents living in Sweden about mathematics education for young children. On the whole she found that the parents had adopted views in alignment with the Swedish curriculum for preschools, which suggests that opportunities to provide input from their own experiences might have been limited. Lange and Meaney (2018) used an international survey to find out parents' views on multilingual children use of digital games to determine what kinds of information the parents could contribute to the development of playful, mathematical, digital games. One aspect which became clear was how to discuss with parents potential mathematical learning opportunities which were broader than understandings of number and shapes.

As there had not been previous NOMAD papers which investigated the views of parents whose children were multilingual, there had also not been a paper on the role of mathematics teacher educators on how to implement mathematics teacher education that included discussions of language diversity. The paper by Eikset and Meaney (2018) describes the authors' process of reflecting on their own practices and highlighted some of the difficulties of achieving their aims for doing that.

### Concluding remarks

Comparing the articles published in NOMAD 2008–2018, about language diversity in mathematics education, shows an increase in the number of researchers working in this field and the aspects of language diversity that are being investigated. Previously, research into linguistic diversity in mathematics education in the Nordic countries has been dominated by the work done in Sweden and Denmark. In this issue, Finland and Norway are also represented. We consider this important as we need research which is grounded in the different cultures present in the Nordic countries.

In earlier research published in NOMAD, little has been written about *Indigenous perspectives* in mathematics education. The three articles in this double issue, indicate that there is an increasing interest in learning more about how language and culture are connected and how this perspective can enrich mathematics education.

*Influence of societal discourses* have been an important issue from the beginning in 2008, and has been developed further in several of the articles in the last decade. In the future, there is a need for more research in this field, focussing for example on how discourses from policy documents enter the public sphere and are taken up into identity formations.



We identified relatively few papers under the theme *Teaching and learning*. The perspective of how languages can be a resource for learning where fluency is not in focus, rather how students can learn to communicate together in for instance problem solving, we see as an important issue which can inform the teaching in multilingual mathematical classrooms.

The last theme, *Other participants in multilingual mathematics learning*, came from articles only in the double issue. Two focused on parents' views on mathematical education for their multilingual children. The last one focused on two mathematics teacher educators' reflections on the difficulties they met when their aim was to include discussions about language diversity in their teaching. There seems little research, not just in the Nordic countries but also globally, where parents and teacher educators' perspectives in multilingual mathematics learning are in focus. It will, therefore, be exciting to see how these perspectives are followed up in subsequent research projects.

The broadness in the presented papers shows the variety of different aspects in research on language diversity in mathematics education. If we take Owens (2008) six key issues connected to multiculturalism in education seriously, we find there is a need for more research involving all the Nordic countries. The differences in our languages and cultures make it necessary for researchers in all these countries to do locally-focussed research – however, we also have enough in common to learn from each other, and to support each other so that the outcomes when combined provide a rich understanding of issues in this field.

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