

Sámi concepts of *pattern* in the mathematics curriculum

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Norway's new mathematics curriculum took effect in 2020. The word mønster (English: "pattern") appears 13 times in the curriculum text. This paper aims at providing insight into how the curriculum's term "pattern" can be translated into North Sámi in a way that supports a mathematics teaching rooted in local Sámi culture and language. Five Sámi words for patterns are analysed to highlight different meanings. The analysis reveals that minsttar is the word most frequently used in direct translations. A possible explanation for this is that the meaning of the word minsttar has evolved to cover more aspects of the meaning of "pattern". Context plays an important role in determining which Sámi word to choose; some words are for instance related to visual patterns and one is related to Sámi handicraft. The choices depend on what kind of pattern is examined. Because of language differences, it is important to translate "pattern" with great care.

Keywords: Pattern, translation, Indigenous, curriculum, language.

Introduction

In this paper, we identify challenges related to translating one central word in the mathematics curriculum from Norwegian to Sámi. According to Norway's Sámi²¹ act (Ministry of Local Government and Modernisation, 1989), Sámi and Norwegian languages are equal. This means that Norway's mathematics curriculum (Ministry of Education and Research [KD], 2019) will be translated into Sámi languages²². The translation must be made so that it supports Sámi teachers' choice of relevant cultural contexts for their teaching. Language and culture differences make translations of terminology complicated, not just in the field of mathematics education. Cole (2009) discusses challenges related to translations of Vygotsky's word *obuchenie* (teaching, learning, education, et cetera) from Russian to English; the English translations do not fully capture the meaning of the original word. According to Barton et al. (1998), Māori has more words than English for *large*; all of these can be used for numbers, but only some of them refer to size. Omitting nuances like this in translations from English to Māori might contribute to language deprivation. Fyhn et al. (2011) explain how the meaning of the Sámi term *bealli* is richer term than just *half*; it describes both the ratio 2:1 and the ratio 1:2. A direct translation of *bealli* to Norwegian (or English) might cause unclarity or be misleading. It is even more problematic to translate "half" into Sámi languages, because there is a risk that "half as much" is translated into "twice as much". Sámi students had to face that obstacle at the 2018 national test in mathematics (Fyhn & Hætta, 2019). Fyhn and Hansen

²¹ The Sámi are an Indigenous people of the Arctic. They inhabit Northern Scandinavia and the Kola Peninsula of Russia.

²² November 2021: The curriculum is not translated.

(2019) revealed that when translating the mathematics curriculum's word "pattern" from Norwegian to Sámi, one must consider at least the three words *minsttar*, *hearva* and *girji*.

Bishop (1990) points out that the language and logic of the Indo-European language group have developed layers of abstract terms within the hierarchical classification matrix, but this has not happened in all language groups. As a result, there are different logics and different ways of relating phenomena around the world. Sámi languages belong to the Finno-Ugric language group (Duolljá & Gaski, 2020), while Norwegian (like English) is a Germanic (and Indo-European) language. Sámi languages do not generalise by using overarching terms the same way Germanic languages do (Fyhn et al., 2018). Our paper provides examples of how one central term in mathematics is embedded differently in one Indigenous language than it is in Germanic languages like Norwegian and English.

Why we focus on *pattern*

Fyhn and Hansen (2019) studied mathematics teaching in a mixed Grades 1–2 class in a Sámi school. They focused on students' work with repeating linear patterns, which according to Threlfall (1999/2005) is the first step towards number patterns and algebra. The teacher and the students consistently use the Sámi word *hearva* for patterns (*mønster* in Norwegian²³), while the mathematics curriculum (KD, 2013) consequently translates "pattern" into *minsttar*. A linguistics professor supports the teacher's choice of word. Our study is rooted in Fyhn and Hansen's (2019) findings by highlighting challenges that may arise when translating the mathematics curriculum's term "pattern" into Sámi²⁴. According to Zazkis and Liljedahl (2002), patterns are the heart and soul of mathematics. Devlin (1998) claims that mathematics is the science of patterns; it is a way of looking at the world. The Organisation for Economic Co-operation and Development (OECD, 1999) was in agreement with Devlin when they claimed that "[m]athematics is the language that describes patterns, both patterns in nature and patterns invented by the human mind. To be mathematically literate, students must recognise these patterns and see their variety, regularity and interconnections" (p. 48).

The word "pattern" appears on 13 different occasions in the new mathematics curriculum (KD, 2019). In this paper we investigate possible translations of these 13 appearances of "pattern" into Sámi. Our aim is to contribute to the wider discussions of how to translate mathematics curriculum texts to Indigenous languages. To avoid misunderstandings, it is of importance to Sámi mathematics education that the mathematics curriculum is translated with great care. The research question is: How can "pattern" (*mønster*) in the mathematics curriculum be translated from Norwegian to Sámi?

Roberts (1998) claims that when translating from English to Indigenous languages, mathematical language should follow the structure of the Indigenous language, to avoid language deprivation. To consider this claim, we firstly provide an overview of Sámi words that can mean *pattern* when translated from Sámi into Norwegian. McMurchy-Pilkington et al. (2013) point to the importance of debating standardisation of terms and the place of dialectical differences in the development of Indigenous mathematics curricula. In many cases, there are significant differences between words from one dialect and words from another within the Sámi languages. Therefore, a first step of the analysis is to examine and compare translations of the curriculum sentences from Norwegian to the

²³ This paper uses the English word "pattern" for the Norwegian *mønster* throughout the text.

²⁴ When we refer to Sámi language in this paper, we mean North Sámi unless something else is explicitly stated.

Kárášjohka/Karasjok (eastern) and Guovdageaidnu/Kautokeino (western) dialects of North Sámi. The second step is to discuss each appearance of Sámi words for *pattern* to a) validate if the translation is in accordance with the meaning of the original sentence in Norwegian, and b) investigate whether more than one word is needed to cover the meaning of "pattern". Standardisation of terms is included in the discussion section.

Sámi culture and language

Fishman et al. (1985) claim that language itself is a part of culture and that every language becomes symbolic to the culture with which it is intimately associated. Furthermore, Indigenous cultures include traditional knowledge about how to use nature and its resources, and how to adapt and transform purchased materials for use in the local community (Sara, 2004). Traditional Sámi livelihoods like hunting, fishing, trapping, and reindeer husbandry are important for sustaining Sámi culture and language. Sámi languages (there are ten in total) reflect the use of nature by reindeer herders, those who pick berries, hunters, and others. Local languages are rich in details about the terrain, nature, and the use of nature. Traditional knowledge is an important part of language preservation. *Duodji* (Sámi handicraft) constitutes a major part of Sámi traditional knowledge; it is handicraft intertwined with Sámi culture, traditions, and language. People who perform *duodji* work with cultural expressions that arise out of the culture's traditional knowledge (Guttorm, 2007). Traditionally, a purpose of *duodji* was to cover a need as well as having a decorative aspect. There are several *duodji* words that can be translated into "pattern" in English. All these words describe specific aspects and properties of the handicraft process and product. The term *minsttar* describes a template, made from for example paper or wood and used when cutting materials for the handicraft. Craftsmen use *minsttar* when cutting materials for different kinds of garments. One traditional Sámi garment is *gákti*. The style or appearance of a *gákti* varies from place to place in Sápmi. The term *málle* or *gáktemálle* is typically used to describe the distinctive style of a *gákti* (Hermansen, 1993), which depends on its origin. This means that you can have a specific *minsttar* for cutting materials for a *gákti*, and the *gákti* can have a *málle* belonging to a particular area or family in Sápmi. In addition, the word *hápmi* refers to how the *gákti* appears on you as an individual.

A similar distinction as between *minsttar* and *málle* is present in Sámi weaving, knitting and braiding terminology. This distinction is between the two words *minsttar* and *hearva*; *minsttar* means a template, while *hearva* means decoration or ornamentation. Hætta (2016) consequently uses *minsttar* for weaving patterns. The woven products then have varying *hearva* and colours depending on their place of origin; they are symbolic and express a meaning. Additionally, Sámi weaving terminology includes the term *girji*. Figure 1 shows an example of a woven band where *girji* is highlighted. *Girji* describes the repeating unit of a woven band. Norwegian weavers use the similar term *rapport*. There are two kinds of visual patterns on gloves; gloves that are patterned all over have *girji*, while gloves with a repeating pattern around the wrist have *hearva* (Nielsen, 1962/1979; Fyhn & Hansen, 2019).



Figure 1. *Girji* on woven band. Photo: Márjá-Liissá Partapuoli

An overview of Sámi words for *pattern*

Dictionaries provide translations of "pattern" from Norwegian to Sámi: i) The Sámi mathematics dictionary (Nystad et al., 2002) translates "pattern" into *minsttar*. ii) The online Sámi dictionary (Giellatekno, 2021) translates "pattern" into *málle* or *minsttar*. These translations do not cover all meanings of "pattern". The other way around: Translations from Sámi to English reveal more words than translations from Norwegian/English into Sámi, as Table 1 shows.

	Giellatekno (2021)	Konrad Nielsen (1962/1979)	Kåven et al. (1995)	Nystad et al. (2002)
<i>minsttar</i>	pattern	pattern, model	pattern, formula	pattern
<i>hearva</i>	decoration (<i>stas, pynt</i>)	finery, adornment, ornament(ation), amusing person	decoration, trimming, embroidery, amusement (<i>dekorasjon, pynt, broderi, fornøyelse</i>)	
<i>girji</i>	book, letter, fur dot (<i>bok, brev, flekk i pelsen</i>)	a spot of another colour (on an animal), coloured ornamental patterns, book, letter	book, letter, spot (<i>bok, brev, flekk</i>)	
<i>hápmi</i>	shape, appearance, figure, façade (<i>form, skikkelse, utseende, fasade</i>)	exterior, appearance, carriage, semblance, outward appearance, shadow, phantom	figure, character, attitude, appearance, shape (<i>skikkelse, holdning, utseende, form</i>)	shape (<i>form</i>)
<i>málle</i>	pattern, template, shape, design (<i>mønster, mal, fasong, design</i>)	pattern, design, style	design, pattern (<i>design, mønster</i>)	type, model (<i>type, modell</i>)

Table 1. Sámi "pattern" words translated into English, Norwegian words in parenthesis

Four dictionaries provide a variety of Sámi words for "pattern": Giellatekno (2021), Konrad Nielsen's (1962/1979) Sámi–English dictionary, Kåven et al.'s (1995) Sámi–Norwegian dictionary and the two-way Sámi–Norwegian mathematics dictionary (Nystad et al., 2002). Several Sámi words for *pattern* depart from *duodji*, so we include this context in our analysis. *Hápmi* means *shape* in a

broader sense than just the shape of a geometrical figure; it includes for instance the patterned surface of a pinecone or a cactus. It is important to note that different Sámi words for *pattern* cannot be treated as discrete categories; there are often sliding transitions between them.

”Pattern” in the new curriculum

The first author is a native speaker of the Kárášjohka dialect, while the third author is a native speaker of the Guovdageaidnu dialect. The third author is also *duodji* master student at the Sámi University of Applied Sciences. Despite great differences between these two dialects, we found no significant dialect differences in the first translation of the 13 occurrences of ”pattern” in the new curriculum, here we aimed at one overarching word for each occurrence. The next step aimed at finding the most appropriate Sámi word(s) for *pattern* in each case. It turned out that *minsttar* was the most common choice of term: it occurred in ten out of thirteen cases. *Hearva*, *girji* and *málle* were, however, not chosen for any occurrence. *Hápmi* was chosen for the two contexts ”properties and structures in number- and figure patterns” for Grade 2 and ”structures and patterns in play and games” for Grade 4. The context ”investigate and describe symmetry in patterns” for Grade 6 was the only instance where the translation needed two Sámi words to cover the meaning. Both *minsttar* and *hápmi* were chosen for this meaning of ”pattern”. It is worth noticing that the Sámi word for symmetry, *symmetria*, is a new Sámi word that has recently been imported from other languages. The term appears in the Sámi mathematics dictionary (Nystad et al., 2002), but it is neither found in Nielsen’s (1962/1979) five-volume dictionary nor in Kåven et al.’s (1995) dictionary.

Because the Sámi words for *pattern* have different contextual meanings, the analysis focuses on which Sámi word to use when. To highlight these different contextual meanings, an alternative, developed translation is made for certain parts of the curriculum. The purpose of the developed translation is to illustrate how it may be more appropriate to use *hearva*, *hápmi* or *girji* instead of *minsttar*. Table 2 presents a competence aim for Grade 2 as an example. The leftmost column shows the original Norwegian curriculum text; then follows direct translations into English and Sámi. The rightmost column shows a translation that was developed by searching the literature and through discussion among the authors. This translation includes the two words *girji* and *hearva*; *girji* refers to the unit of repeat, while *hearva* is more appropriate for visual, cultural patterns.

Original text	English translation	Sámi direct translation	Developed translation
Eleven skal kunne kjenne att og beskrive repeterande einingar i mønster og lage egne mønster.	The student should recognise and describe repeating units in patterns and create their own patterns.	Oahppi galgá dovdat ja čilget geardduheadđi osiid minstariin ja ráhkadit iežaset minstariid.	Oahppi galgá dovdat ja čilget girjjiid (geardduheadđi osiid) hearvvain ja ráhkadit minstariid.

Table 2. Translations of ”pattern”. Sámi pattern words are highlighted

Discussion

Fyhn and Hansen’s (2019) study focused on visual repeating patterns. The teacher in their study chose to depart from patterns that were closely related to the children’s experiences with local Sámi culture and language. This is probably an important part of the reason why the teacher consistently chose to use *hearva* instead of the curriculum’s *minsttar*. Their example highlights how the choice of which

Sámi word to use in translations may differ depending on what kind of patterns the students are investigating. If the children were to investigate other kinds of patterns, e.g. number patterns or repeating letter sequences, the choice of Sámi word might have been different.

A possible explanation for the many occurrences of *minsttar* in the translations is that the term *minsttar* has evolved and progressed past the traditional meaning (template) to become a term that covers more aspects of the meaning of "pattern". *Minsttar* would thus also cover more abstract patterns, such as patterns in algebra and algorithms. The contextual meaning of *hápmi*, *hearva* and *málle* describe visual aspects. Because of this, these terms may seem narrower in meaning than *minsttar*. Sámi and Finnish are Finno-Ugric languages, as opposed to Norwegian, Swedish, and English. The Finnish mathematics curriculum is published in Swedish as well as in Finnish, because Swedish is an official language in Finland. It turns out that the word "pattern" (*mönster*) occurs only twice in Finland's mathematics curriculum (Utbildingsstyrelsen, 2015). Mathematical reasoning for Grades 1–2 and 3–6 is focused on finding similarities, differences, and patterns. Regarding algebra for Grades 3–6, the students investigate patterns in number sequences. Here the Finnish word "regularities" (*säännönmukaisuuksia*) is translated into "pattern" (*mönster*) in Swedish. However, according to Giellatekno (2021), *säännönmukaisuuksia* means *njuolggadus* in Sámi, which in turn means "rule" or "guideline" in English.

Closing remarks

The mathematics curriculum in Norway will be translated into three Sámi languages: North -, Lule - and South Sámi. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2010), North Sámi is definitely endangered while South Sámi and Lule Sámi are severely endangered. This means that there are no strong populations who speak the Sámi languages and who can comment on potentially misleading or slightly wrong translations of terms in the mathematics curriculum. This demonstrates the importance of choosing words and terminology with great care when translating a new mathematics curriculum text; the curriculum's choice of words must make sure that Sámi children's teaching is rooted in their local culture. The analysis in this paper may contribute to a more appropriate translation of the mathematics curriculum. Omitting the huge variety of Sámi words for *pattern* in translations from Norwegian to Sámi might lead to the exclusion of words with more narrow and precise meanings. This must be avoided since it may in turn contribute to language deprivation. More research on Sámi mathematics teaching practice is needed to determine which Sámi words are most appropriate for *pattern* in different parts of the curriculum.

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References

- Barton, B., Fairhall, U. & Trinick, T. (1998). Tikanga reo titāi: issues in the development of a Māori mathematics register. *For the Learning of Mathematics*, 18(1), 3–9.
- Cole, M. (2009). Editorial. The perils of translation: a first step in reconsidering Vygotsky's theory of development in relation to formal education. *Mind, Culture, and Activity*, 16, 291–295.

- Devlin, K. (1998). *The language of mathematics. Making the invisible visible*. W. H. Freeman and Company.
- Duolljá, S. E. K & Gaski, H. (2020). Samisk. In *Store norske leksikon* [Great Norwegian Encyclopaedia]. <https://snl.no/samisk>
- Fishman, J. A., Gertner, M. H., Lowy & E. G. Milán (1985). *The Rise and Fall of the Ethnic Revival: Perspectives on Language and Ethnicity*. Mouton Publishers, Walter de Gruyter & Co.
- Fyhn, A. B. & Hansen, L. (2019). Exploration of patterns in different contexts. In U. T. Jankvist, M. Van den Heuvel-Panhuizen & M. Veldhuis (Eds.), *Proceedings of the Eleventh Congress of the European Society for Research in Mathematics Education (CERME11, February 6–10, 2019)* (pp. 1672–1679). Freudenthal Group & Freudenthal Institute, Utrecht University and ERME.
- Fyhn, A. B. & Hætta, O. E. (2019). Samiske språk og kultur som matematikkressurs. *Tangenten – tidsskrift for matematikkundervisning* [Tangenten – Journal of mathematics teaching], 30(3), 20–26.
- Fyhn, A. B., Eira, E. J. S., Hætta, O. E., Juuso, I. A. M., Nordkild, S. I. & Skum, E. M. (2018). Bishop Sámegillii – utfordringer ved oversetting av matematikkdidaktisk fagterminologi [Bishop into Sámi language – challenges in translating terminology in mathematics education terminology]. *Nordic Studies in Mathematics Education*, 23(3-4), 163–184.
- Fyhn, A. B., Eira, E. J. S. & Sriraman, B. (2011). Perspectives on Sámi Mathematics Education. *Interchange*, 42(2), 185–203. <https://doi.org/10.1007/s10780-011-9154-3>
- Giellatekno (2021). *Neahttadigisániid deaddilaste-teavsttas* [Internet dictionary]. <https://sanit.oahpa.no/sme/nob/>
- Guttorm, G. (2007). Duodji – Sámi handicraft – who owns the knowledge and the works? In J. T. Solbakk (Ed.) *Traditional knowledge and copyright* (pp. 61–94). Sámi kopijija.
- Guttorm, G. & Labba, S. (2008). *Ávdnasis duodjin. Dipmaduodjesániit*. [Materials from Sámi handicraft. Terminology from Sámi handicraft with soft materials]. Dat.
- Hermansen, I. H. (1993). *Guovdageaingaákti*. Landbruksforlaget.
- Hætta, S. K. (2016). *Čuoldin. Samisk grindveving* [Sámi Weaving]. Guldal REC.
- Kåven, B., Jernsletten, J., Nordal, I., Eira, J. H. & Solbakk, Aa. (1995). *Sámi – dáru sátnegirji. Samisk–norsk ordbok*. [Sámi–Norwegian dictionary]. Davvi girji o.s.
- McMurchy-Pilkington, C., Trinick, T. & Meaney, T. (2013). Mathematics curriculum development and indigenous language revitalization: contested spaces. *Mathematics Education Research Journal*, 25(3), 341–360. <https://doi.org/10.1007/s13394-013-0074-7>
- Ministry of Education (2013). *Curriculum for the common core subject of mathematics*. <https://www.udir.no/kl06/MAT1-04?lplang=http://data.udir.no/kl06/eng>
- Ministry of Local Government and Modernisation (1989). *Lov om Sametinget og andre samiske rettsforhold (sameloven)*. Adjusted 2021. [The Sámi act]. <https://lovdata.no/dokument/NL/lov/1987-06-12-56>

- Ministry of Education and Research (2019). *Læreplan i matematikk 1.–10. trinn. Fastsett som forskrift av Kunnskapsdepartementet 15.11.2019* [Mathematics curriculum for grades 1–10]. <https://data.udir.no/k106/v201906/laereplaner-1k20/MAT01-05.pdf>
- Nielsen, K. (1979). *Lapp dictionary. Based on the dialects of Polmak, Karasjok and Kautokeino* (Volume II, G-M). Universitetsforlaget (2nd edition. First edition 1932–1962).
- Nystad, A., Valkeapää, N. H., Nergård, A. & Gaup, E. U. (2002). *Matematihkkasánit – dárogielas sámegillii, sámegielas dárogillii*. [Mathematics terminology – from Norwegian to Sámi and from Sámi to Norwegian]. Sámi oahpahusráđđi (Second edition. First edition 1990).
- Organisation for Economic Co-operation and Development, OECD (1999). *Measuring Student Knowledge and Skills. A New Framework for Assessment*. OECD Programme for International Student Assessment, PISA. OECD.
- Roberts, T. (1998). Mathematical registers in Aboriginal languages. *For the learning of mathematics*, 18(1), 10–16.
- Sara, M. N. (2004). Samisk kunnskap i undervisning og læremidler. [Sámi knowledge in teaching and teaching materials] In V. Hirvonen (Ed.). *Samisk skole i plan og praksis. Hvordan møte utfordringene i O97S? Evaluering av Reform 97*. Čálliid Lágádus.
- Threlfall, J. (2005). Repeating Patterns in the Early Primary Years. In A. Orton (Ed.) *Continuum Studies in Mathematics Education: Pattern in Teaching and Learning of Mathematics* (pp. 18–30). Continuum (Original work published in 1999).
- United Nations Educational, Scientific and Cultural Organisation (2010). *UNESCO Atlas of the World's Languages in Danger*. <http://www.unesco.org/languages-atlas/index.php>
- Utbildningsstyrelsen (2015). *Grunderna för läroplanen för den grundläggande utbildningen 2014*. Utbildningsstyrelsen. https://www.oph.fi/sites/default/files/documents/166434_grunderna_for_laroplanen_verkkojulka_isu.pdf
- Zazkis, R. & Liljedahl, P. (2002). Generalization of patterns: The tension between algebraic thinking and algebraic notation. *Educational Studies in Mathematics*, 49(3), 379–402. <https://doi.org/10.1023/A:1020291317178>