

***Lávvu* as a teaching arena: identification of mathematical activities**

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*Teachers at Guovdageaidnu lower secondary school cooperated with researchers in translating Bishop's mathematical activities from English into North Sámi. They found that at least three Sámi words are needed to cover the meaning of the activity "locating". In this paper, we conduct a further investigation of how the Sámi translations of mathematical activities work, and we explore whether the suggested verbs are sufficient. The context in our study is a teaching unit in *lávvu*—a traditional Sámi dwelling—where the teaching was carried out by lower secondary school students. The analysis reveals that one more Sámi word is needed to fully cover the meaning of the activity "locating". In addition, two Sámi words and not one, are needed to cover the meaning of the activity "designing".*

Keywords: Bishop's activities, measuring, designing, locating, Sámi education.

Introduction

Teachers at Guovdageaidnu lower secondary school in Norway have developed an interdisciplinary teaching unit related to building a *lávvu*, a traditional Sámi¹⁶ dwelling, with a focus on mathematics (Fyhn, Meaney, Nystad & Jannok Nutti, 2017). As part of this project, their Grade 10 (final year of compulsory school) students teach younger students about *lávvu* and mathematics. We present a teaching unit in which the students teach at another school. Both schools are Sámi schools located in rural areas in the northern part of Sápmi. A large amount of the people who live in these areas are experienced with raising and living in a *lávvu*. As such, this approach to teaching provides opportunities for the school to connect knowledge and experiences from local everyday practices to concepts in school mathematics. The teaching unit focuses on a) the organisation of the poles that shape the framework of the *lávvu* and b) the size (area) of the floor inside the *lávvu*. The teaching unit is based on the mathematics curriculum for Grade 7, "[t]he aims of the studies are to enable pupils to select suitable measuring tools and carry out practical measurements in connection with day-to-day life" (Ministry of Education and Research [KD], 2013, p. 8).

Guovdageaidnu lower secondary school is located in the northern part of Sápmi, and the language spoken in this area is a dialect of North Sámi¹⁷. The school's teachers believe in what local, culture-based mathematics education can provide. One reason for this is the "glow" they observe in students' eyes when lessons in mathematics are based on local culture (Fyhn, Jannok Nutti, Nystad, Eira & Hætta, 2016). Their experiences are in line with Matthews, Cooper and Baturó's (2007) observations that many Indigenous students perceive mathematics to be a subject in which they must become "white" to succeed. This paper is about young students' mathematics teaching in an Indigenous

¹⁶ Sámi is an Indigenous people who live in the northern part of Fennoscandia. Sápmi is the North Sámi name for the Sámi people's historical settlement area. Retrieved from <https://snl.no/samer>

¹⁷ When the term Sámi is used in this paper it means north Sámi unless otherwise stated.

language and in a cultural context, and is in accordance with Trinick, Meaney and Fairhall's (2016) point that Indigenous mathematics education should relate to both culture and language.

Bishop (1988) claims that just as every cultural group generates its own language and religious beliefs, each cultural group is also capable of generating its own mathematics. He argues that mathematics is the outcome of six activities—*counting*, *locating*, *measuring*, *designing*, *playing* and *explaining*—that have appeared in every investigated culture to date. Bishop's activities constitute a framework for projects where Guovdageaidnu lower secondary school's mathematics teachers cooperate with researchers. They developed a mathematics teaching unit based on Sámi braiding (Fyhn, Jannok Nutti, et al., 2017), where the activities *counting* and *playing* were found relevant for describing the Sámi cultural practice of making *ruvden* (round-shaped) cords. This led to the need to translate Bishop's (1988) activities into North Sámi. Fyhn et al. (2018) encountered several challenges during the translation process; for instance, Sámi languages do not use overarching terms in the same way as Germanic languages do. The north Sámi language has several meanings of the mathematical activity *locating* (Fyhn et al., 2018). One meaning is finding a suitable area to place a *lávvu*, while another meaning of the word is to search for and find something. A third meaning is to find something that is lost. One aim of our study is to elaborate further on possible North Sámi translations of Bishop's (1988) activities. Another aim is to quality check Fyhn et al.'s (2018) findings that three different North Sámi words—*bidjat*, *gávdnat* and *ohcat*—are necessary to cover the meaning of the English word "locating" (Sámi translations are listed in infinitive form). It is important to test the translations in different contexts to increase their accuracy.

To avoid misunderstandings, we refer to the teaching students as 'teenage teachers (TTs)', and the school where the teaching took place as the 'learning school'. The learning school is a compulsory school comprised of 1st–10th grades. Grade 5–10 students at the learning school are referred to as 'learning students (LSs)'. The TTs included eight 10th grade students: four girls and four boys. Our study focuses on the TTs' teachings of mathematics and seeks to answer the following research question: How do the TTs' teachings about *lávvu* relate to Bishop's (1988) activities of "measuring", "locating" and "designing"? For pragmatic reasons, we chose to narrow our focus to only three of the six activities, due to the restricted size of this paper. The research question is illuminated by a presentation of how the North Sámi version of these three activities works in the analysis of the TTs' teaching unit.

Intangible cultural heritage of the Sámi

An intangible cultural heritage includes traditions or living expressions inherited from our ancestors and passed on to our descendants (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2018). According to the core curriculum in Norway (KD, 2017), intangible cultural heritage is an important topic in Sámi schools. The traditional upbringing of children is one part of intangible cultural heritage. Learning through observation, participation and trial-and-error is central to the upbringing of Sámi children (Balto, 2005). Children may try out a task, and success or failure to accomplish the task is valued in the community as part of the learning process.

The intangible cultural heritage of the Sámi includes how to raise a traditional *lávvu*. When raising a *lávvu*, one starts with three poles, the *válddahagat*, which are Y-shaped in one end, as shown in Figure 1. The *válddahagat* are assembled together in a triangular construction that is stable and reliable

(Keskitalo, Fyhn & Nystad, 2017). When the *válddahagat* and the remaining poles with straight ends are assembled, they constitute the framework of the *lávvu* (Buljo, 1994). How to arrange the poles around the fireplace in the *lávvu* centre is also part of Sámi intangible cultural heritage.

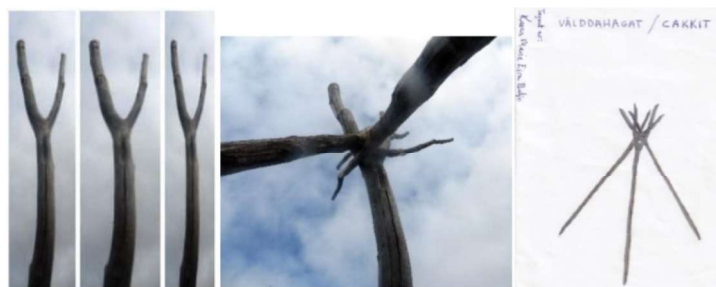


Figure 2. *Válddahagat*. Right: drawing by K. M. E. Buljo. Middle and left: photo by K. Nystad. Reprinted from "Sámi Cultural Properties of the Numbers Three and Four" by J. H. Keskitalo, A. B. Fyhn and K. Nystad (2017), *Journal of Mathematics and Culture*, 11(3), pp. 81–111. Reprinted with permission

Culture and mathematics

Mathematics is an outcome of human activities (Bishop, 1988). Work related to the practical experiences of Sámi cultural traditions allows for inductive approaches to mathematics, but in school, mathematics is often taught through a deductive approach. *Counting* is defined as organizing and comparing discrete entities. *Playing* is defined as participating in games and play while following more or less fixed rules. *Locating* is defined as placing and finding things, people and events in space. *Measuring* is comparing, arranging and quantifying values that cannot be counted. *Designing* is creating or processing a material that can be used for something, either aesthetically or practically. *Explaining* is about moving away from the activity itself and putting it in context with other phenomena. Bishop (1988) also noted that one should never exclude one activity when performing another activity. One activity may share features with another activity, and one mathematical activity can lead to another (Shockey & Silverman, 2016) (see Figure 2).

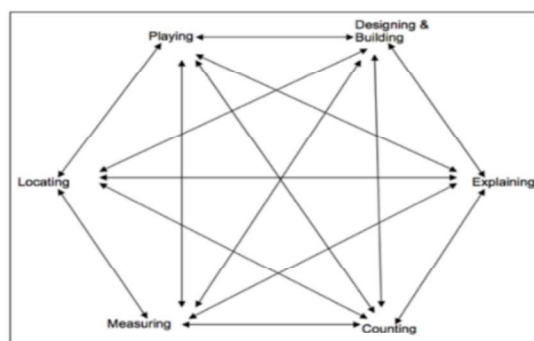


Figure 3. Bishop's (1988) six activities. Reprinted from "Ten Years Later: A Look Back on the History of the *Journal of Mathematics and Culture*" by T. Shockey and F. Silverman (2016), *Journal of Mathematics and Culture*, 10(2), p. 10–35. Reprinted with permission

Lipka, Adams, Wong, Koester & Francois (2019) point out that the Yup'ik tend to use converting asymmetric forms into symmetric ones in their measurement. This is similar to how you adjust the poles around the fireplace when raising a traditional *lávvu*.

Method

Our study is a collaboration between two researchers and one teacher. While the researchers are native speakers of Norwegian, the third author is a native speaker of Sámi. Due to language differences, discussions in the analysis process were carried out in Norwegian. The third author was one of the professional teachers who worked with the TTs. The first author is a Norwegianized Sámi who was educated in the Norwegian school system and speaks Norwegian as their first language. The Norwegian school have no tradition of including Sámi culture in their teaching. Thus, for generations, many Sámi children have neither been educated about the Sámi language nor the Sámi culture (Høgmo, 1986).

The analysis presents a selection of Sámi words, which best categorizes the data in relation to Bishop's (1988) three activities: *locating* (*bidjat*, *gávdnat*, *ohcat*), *measuring* and *designing* (*hábmēt*). Traditionally, searching and finding (*gávdnat*) where to place (*bidjat*) the *lávvu* is a process that depends on the terrain. Wind direction must also be taken into consideration. The Sámi word *ohcat* means to search for something for which one does not know the whereabouts. There was no need for this locating activity, *ohcat*, during the teaching unit; no search was conducted for anything that was lost. The data consist of several sources that provide descriptions of the teaching unit. An audio recorder was placed near the fireplace, close to the centre of the *lávvu*. In order to avoid misunderstandings, the audio recordings were translated from Sámi to Norwegian by an interpreter who spoke the same Sámi dialect as the TTs. In addition, some key portions of the recordings were retranslated by the third author during a meeting between the three authors. These sentences were immediately transcribed in Norwegian by the first author. The third author's choice of verbs was preferred in order to avoid a loss of information related to cultural knowledge. To supplement the recordings of the TTs' teaching activities, the analysis was also based on photos from a small part of the teaching unit and the first author's field notes. The field notes were handwritten in the form of keywords and figures, and later the same day, the notes were written up as continuous text on a computer.

Findings

The mathematical focus in the analysis in this paper is on measuring, but the analysis also revealed that activities related to Bishop's (1988) activity *locating* involved *measuring* (*mihtidit*) and *designing* (*hábmēt*). The TTs brought along the equipment necessary to build a traditional *lávvu*, and sorted it on the ground before the teaching started (Nordkild, field notes, 2017, author's translation). Equipment for building the *lávvu* included three *válddahagat*, poles for the rest of the framework, canvas, a chain, stones for the fireplace and a stepladder.

Then, the teenage teachers put the straight end against the ground, causing the Y-shaped poles to be standing on their own (comment: may look like a pyramid). When this is done, they move the Y-shaped poles around. (Nordkild, field notes, 2017, author's translation)

The TTs placed (*bidjat*) the straight end of each *válddahagat* on the ground, as shown in Figure 3. They adjusted the poles by moving them in order to shape a regular figure, just as Lipka et al. (2019) described that Yup'ik elders turn asymmetry into symmetry. The first author's comment in the field notes, "may look like a pyramid", refers to the outcome of the Sámi verbs *hábmēt* and *heivehit*, which mean to create and to adjust [what you have created]. They then moved (*heivehit*) the poles, which

involved the activity *designing* (*hábmēt*). A pyramid is neither a Sámi construction nor concept; however, the first author's reference to a pyramid reflects how she has been socialized into mathematics as it is taught in Norwegian schools.



Figure 3. Raising the framework of the *lávvu* (author's own photo)

... one of the other teenage teachers grabs the three *válddahagat* on the underside and budes the construction of the Y-shaped poles that are set up. (Nordkild, field notes, 2017, author's translation)

By budging the *válddahagat*, the TTs were *measuring* the stability of the *válddahagat* without saying anything. This is an example of how the activities of *playing* and *measuring* are intertwined. As Keskitalo et al. (2017) surmised, there are no formal proofs in traditional Sámi knowledge. It is a well-known and accepted cultural truth that the three-pole structure shaped by the *válddahagat* is stiff and stable.

TT: This is hanging in the middle of the opening in top of the *lávvu*.

This quote refers to a chain that hangs just above the fireplace from the top of the inside of the *lávvu*. The chain is used to cook food over the fireplace. The TTs were adjusting (*heivehit*) the poles and the chain from the top of the *lávvu*.

One issue that arose in the teaching unit was the area, or the amount of space available on the *lávvu* floor:

TT: Yes, then we test how many people there is room for in here.

The LSs looked around and started counting and suggesting different numbers between four and ten (Nordkild, Field notes, 2017, author's translation). After some time in silence, the TTs asked the LSs to test (*playing*) how many (*measuring* and *counting*) individuals there was room for within the *lávvu*. During the testing process, they also had to investigate whether or not they could make enough room for all of them inside the *lávvu* by adjusting (*heivehit*) the poles. A teacher who instructed the LSs asked the TTs if they could have everyone lie down. While everyone was lying on the ground, one TT asked:

TT: Is it comfortable to lie like this? I'm not comfortable.

The TT asked if the LSs felt comfortable and commented that she herself was not. In other words, there was a need for more space in the *lávvu* when they were lying down. The TT's question encouraged the LSs to reflect on how many people there was room for (*measuring*) when living in a *lávvu* (including sleeping space). The TT commented that, when there are five individuals lying on

each side of the fireplace, there was room for ten people in one *lávvu*. The TT then asked how many *lávvus* would be needed for the entire class of 23 LSs. The LSs' first suggestion was two, which was later revised to three. The TTs closed the session by claiming that they could adjust the number of individuals in each *lávvu* so that there would not be ten individuals in two of the *lávvus* and only three in the last one.

Discussion

The study revealed that, in order to cover the activity of *locating*, there is a need for a fourth Sámi verb, *heivehit*, in addition to the three verbs *gávdnat*, *ohcat* and *bidjat* that are suggested by Fyhn et al. (2018). Although adjusting (*heivehit*) the *válddahagat* and the other poles was part of the *locating* activity, it could also be interpreted to be part of the *designing* activity. When the TTs raised the *lávvu*, the activities *heivehit* and *hábmēt* were performed simultaneously. Because the Sámi word *heivehit* overlaps with Bishop's (1988) *locating* and *designing*, this indicates a contribution to the development of Bishop's (1988) mathematical activities in Sámi. Our analysis supports the findings of Bishop (1988) and Shockey and Silverman (2016) that several mathematical activities can be performed at the same time, and that there are no clear borders between the activities.

One of the mathematical tasks provided by the TTs involved *measuring* how many people could lie down in the *lávvu*. This is an example of an inductive approach to *measuring* the size of an area by asking students to test through trial and error. This process corresponds with Balto's (2005) description of traditional Sámi upbringing. *Measuring* how many people there is room for in a *lávvu* depends on context: the number of people who can sit comfortably in a *lávvu* will not be the same as the number of people who can sleep comfortably in one. This is also an example of how there are no clear borders between the activities of *counting* and *measuring*. The TT's work is in line with the student-centred approach to mathematics in real-life contexts described by Skovsmose (2001). It is also connected to Fyhn et al.'s (2016) description of teaching mathematics within a cultural context, because the tasks given in the teaching are about the *lávvu*.

Closing words

In the context of raising a *lávvu*, the words *heivehit*, *gávdnat* and *bidjat* are needed to determine the meaning of *locating*. In addition, the word *ohcat* covers one more meaning of *locating*. So, at least four Sámi verbs are needed in order to translate Bishop's (1988) activity *locating* into the North Sámi language found in Guovdageaidnu. Because *heivehit* can also be interpreted as *designing*, the present study indicates that Bishop's (1988) activity *designing* probably needs *heivehit*, in addition to *hábmēt*, to fully capture every aspect of the activity. Our findings suggest that a Sámi categorization of Bishop's (1988) activities may result in different categories and varying borders for those categories. Subsequent studies may contribute additional insight into the Sámi mapping of such activities. Translating mathematical activities to North Sámi and testing these translations may also contribute to the development of a Sámi mathematics curriculum.

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