Mathematical Thoughts Within the Sámi Culture

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Abstract

The paper is an attempt to discuss a multi-cultural view of mathematics or mathematical thoughts in connection to the education in mathematics in the Sámi Schools. The discussion takes its start from a research-project where the aim was to describe and analyze mathematical thought within the Sámi culture. The research already indicates that there are different conceptions within the Sámi culture, which could be used in the education in mathematics in the Sami schools.

Introduction and Background to the Research Area

Law on education in Sweden stipulates that Sámi children are allowed to receive their compulsory education in the Sámi School, and the Compulsory school comprise grade 1-6. There are Sámi Schools in Karesuando, Lannavaara, Kiruna, Gällivare, Jokkmokk and Tärnaby. Fundamental regulations for the Sámi Schools are expressed in the law on education and in the Sámi School ordinance, the Sámi Schools follow the national regulations, but the Sámi pupils also have to achieve familiarity with the Sámi cultural inheritance and be able to speak, read and write Sámi. In accordance with the Sámi School ordinance, teaching is carried out in both Sámi and Swedish languages, and Sámi and Swedish languages and Sámi subjects are included in all the grades. The curriculum that is defined for elementary education shall also be initiated in Sámi schools. The Swedish National Agency of education has determined a curriculum in the Sámi language. These goals to be fulfilled in the Sámi language are separate for pupils who have Sámi as their first language and for those who have Sámi as second language (Utbildningsväsendets författningsböcker 2004; Utbildningsdepartementet 1998; Skolverket 2000/2003).

In accordance with the Sámi School ordinance there is a need for an education that is aware of and has a base in the Sámi culture (Utbildningsväsendets författningsböcker 2004). Teaching and learning from a Sámi point of view is an important issue according to the regulation. In the latest Sámi School regulation, the Sámi School Board pointed out the importance of an education from a Sámi point of view to make it possible for every pupil to reach the goal of being familiar with the Sámi cultural inheritance (Sameskolstyrelsen 2007). The Swedish National Agency for Education inspected the Sámi School (Skolverket 2002) and there the teaching in mathematics the Swedish national curriculum supports another form of teaching[1] described as directed by the textbook, although the teachers expressed their wish to connect the education in mathematics with the pupils' every-day life. The inspection raised the following questions:

Hur kan barnens informella lärande användas som en resurs i matematiklärandet?

/.../Finns det, eller har det funnits, en speciell matematik inom den samiska kulturen?

(How can the Sámi pupils' informal learning be used in the learning in mathematics?

/…/Is there, or has it been, a special mathematics within the Sámi culture?) (Skolverket 2002:15)

These questions function as an introduction to my research area and led to a study of mathematical cultural knowledge within the sámi culture. The purpose of the research was to describe and analyze how sámi handicrafters and reindeer herders[2] express their mathematical thinking, and how they express the learning of the mathematical cultural knowledge. The mathematical cultural knowledge was highlighted by the concepts of *counting, locating, measuring, designing, playing* and *explaining*[3]. The learning was analyzed from the point

of learning within a cultural context with focus on the mathematical knowledge, and knowledge transforming through generations. Results of the research were published as a licentiate thesis.

The empirical material for the research-project was collected through interviews and literature study. The material was based on ten interviews with Sámi handicrafters and Sámi reindeer herders. The handicrafters and the reindeer herders were from the communities of Kiruna, Gällivare and Jokkmokk in the Swedish part of Sápmi. The interviews were recorded with recorder, videotape or by notes. The interviews were conducted according to two different strategies. Strategy one focused on the persons´ life story. There the persons were asked to tell about her/his life from a yearly base. The second strategy was based on a question form with more direct guiding questions.

The final aim of the research-project is to focus on possibilities and problems with the development of a multicultural education in mathematics in the Sámi Schools. This paper is an attempt to discuss the mathematical thoughts within the sámi culture, and an attempt to start to discuss a multi-cultural education in mathematics in the Sámi Schools. To be able to view a multi-cultural education in mathematics and mathematics as a Sámi cultural knowledge, it is necessary to show some theoretical grounds for a multi-cultural view of mathematics or mathematical ideas.

A Multi-Cultural View of Mathematics or Mathematical Ideas

Mathematics, as we generally understand it today, has emerged in a distinctive form in Europe, but every culture generates something equivalent to mathematics that works satisfactoraly within its own context. In contrast to mathematics taught and learned in schools, Ubiratan D´Ambrosio defined the ethnomathematic. The ethnomathematic is the mathematics practiced among identifiable cultural groups with their jargons, codes, symbols, myths, and even specific ways of reasoning and inferring (D´Ambrosio 1985; 2000). According to Marcia Ascher (1991) ethnomathematics is: "… the study and presentation of mathematical ideas of traditional peoples." (1991:188). Mathematics as a cultural knowledge, according to Alan Bishop (1988), derives from humans engaging in the following six universal activities:

• Counting. The use of a systematic way to compare and order discrete phenomena. It may involve tallying, or using objects or string to record, or special number words or names.

• Locating. Exploring one's spatial environment and conceptualising and symbolising that environment, with models, diagrams, drawings, words or other means.

• Measuring. Quantifying qualities for the purposes of comparison and ordering, using objects or tokens as measuring devices with associated units or "measure-words".

• Designing. Creating a shape or design for an object or for any part of one's spatial environment. It may involve making the object, as a "mental template", or symbolising it in some conventionalised way.

• Playing. Devising, and engaging in, games, and pastimes, with more or less formalised rules that all players must abide by.

• Explaining. Finding ways to account for the existence of phenomena be they religious, animistic or scientific. (Bishop 1988:182)

The concept renders possible a broader interpretation of mathematics. Therefore, the six key activities serve as the theoretical framework for the empirical study. The activities were used as a cluster for the intention to study mathematics as a Sámi cultural knowledge. To be able to discuss mathematics as a Sámi cultural knowledge it is also necessary to define the concept of culture.

The Concept of Culture

According to Thomas Hylland Eriksen (2001), there are two different approaches to the concept of culture. The first approach pointed out the importance of history and traditions. It defined culture as traditions, values and habits, which are passed on, in a slightly changed form, from one generation to another. The other approach defined culture as that which makes communication possible, the present time is central in this definition. From a pedagogical point of view, Elisabet Jernström and Henning Johansson (1997) defined culture as "… ett helt folks sätt att leva…" (… a whole peoples way of living…)(1997:43). The concept of culture includes three dimensions:

• den materiella, som är synlig genom produkter av teknologi och hantverk. (the material, which is visible trough products and handicraft.)

• den mentala, som omfattar föreställningar, kunskaper, attityder och värderingar. (the mental, which comprises conceptions, knowledge, attitudes and values.)

• den sociala, som inbegriper mer eller mindre fasta

relationer mellan människor och hur man umgås med varandra. (the social, which includes more or less fixed relations between peoples and how peoples see each other.)(Jernström & Johansson 1997:43)

The three dimensions allow making combination of the present, the past and the future, and combination of the material and the immaterial part of the culture. This theoretical ground functions as a frame for my view of culture. However, culture is not static. There are symbols, or aspects, within the Sámi culture that function as important marks for Sámi identity, but the symbols and the meaning of the symbols, vary both for the single person and also for groups of Sámi peoples. Therefore, it is important to study culture with a flexible view. Earlier research about Sámi upbringing and the Sámi School deals with different aspects of the Sámi culture. To be able to connect the mathematical thoughts within the Sámi culture with the education in mathematics in the Sámi schools it is necessary to present research about the Sámi upbringing and the Sámi School.

Earlier Research about Sámi Upbringing and the Sámi School

Asta Balto (1997:a;b) studied the Sámi upbringing and a central factor in the upbringing is the children's training for independency. However, according to a parent in the study neither the pre-school nor the school believed the children to be independent. This is in direct opposition to the family; there Sámi children had their own responsibilities and chores. This gave adults the opportunity to teach the children problem-solving, independence and the view of learning was:" Gal dat oahppá, go stuorrula" (She/He learns when she/he gets older) (Balto 1997:b:122), therefore it was important not to criticize the children.

Another research is an evaluation study of the realization of the Sámi School in Norway by Vuokko Hirvonen (2004). The aim of the study was to evaluate how the regulations (O97S), contained in the Sámi curriculum have been implemented in Sámi schools. The O97S curriculum is a result of the fact that Sámi parents, teachers and educational administrators were not satisfied with education of the Sámi. The separate Sámi curriculum is nevertheless an adaptation of the Norwegian curriculum, according to Hirvonen. The planning has been based on the Norwegian school environment and on the views of the majority population. The Sámi views and conceptions of learning and teaching have mainly been left in the background or have been considered as secondary. The evaluation study takes the perspective of indigenous peoples, minorities, and multiculturalism as its starting point. One of the primary questions of the evaluation is how a curriculum helps minorities, indigenous teachers and pupils to maintain and strengthen their own identity and culture. Despite this the Sámi views have been treated as secondary in the curriculum; the teachers and the schools have to have multicultural competence and to be familiar with Sámi history, traditions and cultural concepts in order to fulfil the demands in the Sámi curriculum. They also need to take the Sámi pupils' special characteristics and needs as a starting-point, and to make the status of the Sámi people as an indigenous people visible in the teaching. The study pointed out the need of teacher-education:" Teachers need additional education and training; they need to learn new skills and ways of thinking." (Hirvonen 2004:129). The evaluation also promoted the development of new activities, new ways of teaching and new visions in the schools to make it possible to realize the Sámi School. The view of mathematics as a cultural knowledge is a new vision, which demands new activities and a new way of teaching.

Education with a Culturally Based Curriculum

Jerry Lipka with others (1998; 2005) worked collaboratively with Yup'ik Eskimo elders, teachers, mathematicians and mathematics educators in Alaska to transform the curriculum by incorporating local knowledge into culturally based mathematics lessons. The work embedded mathematics within the everyday Yup'ik experience, culture and language and brings to light Yup'ik conceptions of numeration, measuring, geometry, and problem solving. The study by Jerry Lipka represents a concrete way to transform curriculum and pedagogy. The learning within this work emanates from a shared context that exists within the classroom and within the community. Starting from this common ground, the teachers are able to provide opportunities for extended learning from the familiar into the less familiar areas. The students' everyday knowledge is used in the classroom situation, both academically and socially. Today the collaborative research by Lipka has developed a supplement elementary school math curriculum, Math in a Cultural Context (MCC). The math curriculum brings the local knowledge into a core of academic curriculum. A theoretical model, MCC's Theoretical Model, was designed. The model includes math content knowledge, which is informed by both Western schooling and the Yup'ik elders, pedagogical knowledge, which is informed by both school-based practices and ways of teaching, communicating, and learning in Yup'ik communities, and a contextual knowledge, ways of connecting schooling to students' prior knowledge and everyday knowledge of the community. This was designed

to be an adaptive curriculum to make it possible to fit all teachers, students, and circumstances. My research's aim has a lot in common with this study. The licentiate research-project indicates that there are for example conceptions within the Sámi culture, which express the mathematical thinking within the Sámi culture.

An earlier research-project by Henning Johansson (1985) was intended to connect education with culture. The purpose of the project was to develop an education with a base in the pupils' cultural background. The results of the project showed that when education was based on the pupils' cultural background it impacted both the teaching methods and the content in school. The pupils in the project obtained better results compared to other pupils in the same area. Johansson meant that when there is a difference between the culture in school and the culture at home, the school becomes too abstract for the pupils. According to Roger Säljö (2000) education based on the children's perspective is an appealing thought, but it is important to remember that teaching and learning in school sometimes means being confronted with knowledge which does not necessarily have a clear ground in a persons everyday-life. The everyday-life thinking belongs to the every-day context and the scientific thinking belongs to the scientific-context. The school is situated, according to Aadu Ott (2000), in a context between the everyday-context and the scientific-context. The problem is whether the school should take its start from the scientific-context and the scientific-concepts or if the pupils should learn for the everyday-life. The solution, according to Ott connected to social constructivism, is perhaps to take the base from the pupil's everyday-life and its concepts and to aim for the pre-scientific concepts. There are obviously both possibilities and problems attached to the wish to connect education with the pupils' everyday-lives and culture. In this paper, I intend to start the discussion of multi-cultural education in mathematics in the Sámi Schools based on results of the research-project (Jannok Nutti 2007).

Mathematical thoughts and the view of learning within the Sámi culture

The purpose of the research-project (Jannok Nutti 2007) was to describe and analyze mathematical thought within the Sámi culture. The results show that there are several conceptions, for example different names of reindeer herds according to the approximate number of reindeer in the herd. Special reindeer is used as an aid for counting or approximation, and as an aid for the localisation of reindeer. The numbers of marked reindeer calves are counted by making marks on a wood-stick, by saving the parts from the ear of the marked calves', or by making notes on a paper. Locating occurs through well-known objects in the nature, by the wind, or by the rivers. The cardinal points are based on the landscape, the rivers or lakes, and the valleys around them. The measurements and measure methods are based on the body, example of measure units; *lavkas*, *salla, goartil, čuovddegoartil, suorpma guovddu,* g*iehta govddu,* and *čuovdemihttu*. Depth of snow and water was measured with a stick or a rope and the measuring unit; *goartil* or *salla,* or by the body. Distance was measured with the time it took to walk a distance, sound (a distance measure unit is; *beanagullan*) or sight. Time was regulated by heat, light and/or by seasonal activity. The eight seasons were used to divide the year, and the perspective of time could be expressed by a circular spiral towards the future. Designing involves the Sámi buildings, the goahte and different store buildings and the Sámi handicrafts. The designing is visible in both the design of the shape and the design of the pattern. The manufacture of clothes demands knowledge in for example straight angles, parallel lines, area, symmetry and the knowledge of changing two dimensions to three dimensions. The reindeer marks make visible the characteristic shapes with special terminology. Learning is based on encouragement and involvement in the work. Stories are important in learning as are explaining or instructing. It is important to develop close relationships to for example the nature and the reindeer. It is also important to let the children feel that their help is needed, for example with chores. It does not matter if the children make mistakes while learning, but it is important to try to do the chores orderly. In summary, the view of knowledge and learning is one of tradition and creativity; because the handicrafters and the reindeer herders expressed both a traditional and a flexible view of the culture and the knowledge.

Summary

Today, mathematical education is often directed by books (Skolverket, 2002)**;** although the Swedish national curriculum supports another form of teaching. The aim of my research was to describe and analyze the mathematical knowledge and view to learning within the Sámi culture expressed by Sámi handicrafters and Sámi reindeer herders, and to connect this to the education in mathematics in the Sámi Schools. My research already indicates that there are different conceptions within the Sámi culture according to Bishop's six activities, which could be used in the transformation of both the curriculum and pedagogy in the school, similar to the research of Lipka. Nevertheless, the objective of developing a culturally based education in mathematics

in the Sámi Schools is a source of both possibilities and problems (Säljö 2000; Ott 2000) and there is need for further research.

Notes

1 The curriculum in mathematics (Skolverket 2000) defined mathematics as: "Matematik är en levande mänsklig konstruktion som omfattar skapande, utforskande verksamhet och intuition." (Mathematics is a living human construction which includes activities which are creative, investigate and intuitive.) (2000:27). Problem solving has always had an important role in the mathematics education. Moreover, has mathematics a close connection to other school subjects. A goal for year 5 is that the pupils should have so much mathematical knowledge so that they are able to solve concrete problems from the pupils' surroundings.

2 The Sámi reindeer herders and Sámi handicrafters were chosen as informants from the results from an earlier study (Jannok Nutti, 2003). Both the Sámi reindeer herding and the Sámi handicraft were pointed out as important carriers of premathematical thinking within in the Sámi culture.

3 Bishop 1988

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