

ETHNOPROGRAMMING: AN INDIGENOUS APPROACH TO  
COMPUTER PROGRAMMING. A CASE STUDY IN OHCEJOHKA  
AREA COMPREHENSIVE SCHOOLS

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Summary:

The Finnish curriculum reform integrates programming in the National Core Curriculum in the fall 2016. Finland is not the first country in Europe to take programming as a part of the National Core Curriculum; However, Finland is the first country in Europe about to teach the Sami, the only indigenous people in Europe, to program in basic education. Teaching programming in comprehensive schools is a challenge for there is no previous knowledge how to teach programming as it is presented in the Core Curriculum. The Sami population in *Ohcejohka* (Utsjoki) is facing the challenge of programming in a more complex way: the world of Information and Communication Technology (ICT) leaves the indigenous cultures out. When keyboards and programs are lacking the language support for the indigenous people, it is leaving a large amount of information out of the current information society. The programming part of the curriculum reform does not consider that there is an ethnic minority in the North of Finland and they have a constitutional right to use their language.

The aim of this study is to find ways to support indigenous languages in the field of computer programming as it is presented in the National Core Curriculum. This study also presents *the model of ethnoprogramming*. *Ethnoprogramming* has its roots in ethnosciences, ethnocomputing and indigenous pedagogies. *The ethnoprogramming model* is based on these theories, the results of case study and the applied traditional knowledge.

The results showed that there are ways to support indigenous languages when teaching programming; however, there are some major issues preventing the further development of *ethnoprogramming* in *Ohcejohka* area schools. The condition of hardware, the lack of support for Northern Sami language, lacking ICT support, inadequate skills among the teachers and the lack of pedagogical support are preventing the further development of *ethnoprogramming* and the cause for minimal ICT usage in *Ohcejohka* area schools.

Keywords: Programming; Sami people; Indigenous people; Ethnocomputing; Ethnoprogramming; Indigenous pedagogy; Curricula;

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Vuođđooahpahusa oahppoplána vuođuštusat ođasmuvvet čakčat 2016 go programmeren laktojuvvo oahppoplána oassin. Suopma ii leat áidna Eurohpa riika, mii váldá programmerema oassin oahppoplána: Suopma lea liikká vuosttas Eurohpa riika, guhte oahpaha sámiiid, Eurohpa áidna álgoálbmoga, programmeret vuođđooahpahusas. Programmerema oahpaheapmi vuođđoskuvllas lea hástalus danin, go árat diehtu programmerema oahpaheamis oahppoplána gáibádusaid mielde ii gávdno. Ohcejoga sápmelaččat deaividit programmerema hástalusaid mángga eará dásis: diehto- ja kommunikašuvdnateknihkka dálá hámis guođđá álgoálbmogiid teknihka olggobeallái. Programmerema oassi oahppoplánarievdádusas ii váldde fuobmášupmái, ahte Davvi-Suomas ássá etnalaš minoritehta, geas lea vuođđolágalaš vuoigatvuotta geavahit ja ovddidit iežas giela ja kultuvrra.

Dán dutkanuša ulbmilin lea gávdnat vugiid, maiguin álgoálbmogiid giela sáhtá doarjut programmerema oahpahusas vuođđooahpahusplána mielde. Dutkanuš maid buktá ovdan *etnoprogrammerema málle*. *Etnoprogrammerema* ruohttasat leat etnodiehtagiin, etnodiehtogiedáhallamis ja álgoálbmotpedagogihkas. *Etnoprogrammerema málle* vuođđuduvvá dáid teorijaide, dáhpáhusdutkanuša bohtosiidda sihke lasihuvvon árbedihtui.

Bohtosat čájehedje, ahte álgoálbmogiid gielaid lea vejolaš doarjut programmerema oahpahusas, muhto *etnoprogrammerema* ovddideapmi lea váttis Ohcejoga skuvllain. Rusttegiid ortnet, davvisáme giela gielladoarjaga váilun, teknihkalaš doarjaga váilun, váilevaš diehtoteknikkalaš dáiddut ja pedagogalaš doarjaga váilun hehttejit etnoprogrammerema ovdáneami ja leat sivvan dasa, manin Ohcejoga skuvllain geavahuvvo nu unnán diehtoteknihkka.

Čoavddasánit: Programmeren; Sápmelaččat; Álgoálbmogat; Etnodihstorastin; Etnoprogrammeren; Álgoálbmotpedagogihkka; Oahppoplánat

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### Tiivistelmä:

Perusopetuksen opetussuunnitelman perusteet uudistuvat syksyllä 2016 nivouttaen ohjelmoinnin osaksi opetussuunnitelmaa. Suomi ei ole ensimmäinen maa Euroopassa, joka ottaa ohjelmoinnin osaksi opetussuunnitelmaa; Kuitenkin Suomi on ensimmäinen Euroopan maa, joka opettaa saamelaiset, Euroopan alueen ainoan alkuperäiskansan, ohjelmoimaan perusopetuksessa. Ohjelmoinnin opettaminen peruskouluissa on haaste, koska aiempaa tietoa ohjelmoinnin opettamisesta opetussuunnitelman vaatimusten mukaisesti ei ole. Saamelaisväestö Utsjoella kohtaa ohjelmoinnin opetuksen haasteet monitahoisemmin: tieto- ja viestintäteknikka nykyisessä muodossaan jättää alkuperäiskansat tekniikan ulkopuolelle. Ohjelmistot ja tiedonsyöttölaitteet ovat vailla alkuperäiskansojen kielten tukea ja näin ollen jää valtava määrä tietoa nykyisen tietoyhteiskunnan ulkopuolelle. Ohjelmoinnin osuus opetussuunnitelmauudistuksesta ei huomioi, että Pohjois-Suomessa asuu etninen vähemmistö, joilla on perustuslaillinen oikeus käyttää ja kehittää omaa kieltään ja kulttuuriaan.

Tämän tutkimuksen tavoitteena on löytää keinoja, jolla alkuperäiskansojen kieltä voidaan tukea ohjelmoinnin opettamisessa perusopetussuunnitelman mukaisesti. Tutkimus myös esittelee *etno-ohjelmoinnin mallin*. *Etno-ohjelmoinnilla* on juurensa etnotieteissä, etno-tietojenkäsittelyssä ja alkuperäiskansojen pedagogiikassa. *Etno-ohjelmoinnin malli* perustuu näihin teorioihin, tapaus tutkimuksen tuloksiin sekä lisättyyn perinnetietoon.

Tulokset osoittavat, että alkuperäiskansojen kieliä voidaan tukea ohjelmoinnin opetuksessa, mutta *etno-ohjelmoinnin* kehittämisessä on esteitä Utsjoen alueen kouluissa.

Laitteiston kunto, pohjoissaamen kielituen puute, teknisen tuen puute, riittämättömät tietotekniset taidot ja pedagogisen tuen puute estävät *etno-ohjelmoinnin* kehittymisen ja ovat syynä tietotekniikan vähäiseen käyttöön Utsjoen alueen kouluissa.

Avainsanat: Ohjelmointi; Saamelaiset; Alkuperäiskansat; Etno-tietojenkäsittely; Etno-ohjelmointi; Alkuperäiskansojen pedagogiikka; Opetussuunnitelmat

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Suostun tutkielman luovuttamiseen Lapin maakuntakirjastossa käytettäväksi\_X\_  
(vain Lappia koskevat)

## FOREWORD

There is a word *ofelaš* in Northern Sami language (Sammallahti, 1993). *Ofelaš* means a guide or a leader of a trip. It is easiest to determine my position as a researcher through this term.

I was born in Valkeala, Southern Finland and graduated from comprehensive school and upper secondary school in Luumäki. I lived the first 27 years of my life outside the *Sápmi* area. There was no Sami education available. Language was protected with law in 1992 and the first graduates in upper secondary school had the chance to write Northern Sami as a part of their studies in. I have grown up without education in my own language and culture. This has been an issue for me in many ways.

I moved to *Ohcejohka* (Utsjoki) in 2008 after bachelor studies in ICT. In the year 2012 I was one of the respondents in the Anne Länsman and Saara Tervaniemi study (2012) about language usage in *Ohcejohka*. One result of that study was that there is not enough media content for young and the existing media content does not support bilingual environment. When the National Board of Education informed in 2014 that programming is going to be a part of the curriculum reform, the idea of supporting Northern Sami language in programming was born. As a researcher I am an *ofelaš*, a guide to supporting Northern Sami programming in a municipality with indigenous people as a majority.

I would like to thank to my family: you are my inspiration. Also I owe thanks to Matti Tedre for helping me with ethnocomputing and Milja Guttorm for translating and creating the Saami terms *Etnodihtorastin* and *Etnoprogrammeren*. Most of all I would like to dedicate this thesis to my mentors Outi Korpilähde and Ludger Müller-Wille: thank you for reading, commenting and guiding.

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# 1 INTRODUCTION

It has been estimated that 350 million people out of the world population are indigenous. That is slightly more than the population in North-America. Indigenous people can be referred in many terms: tribal people, first people and native people a few to mention. The ILO Convention No. 169 uses the terms indigenous and tribal people and both of these have self-determination as a subjective criterion. According to Ethnologue (2016), there are approximately 7000 languages worldwide and indigenous people speak over 5000 languages in more than 70 countries in six continents. Clothey (2015, 63) states that 3000 languages are endangered and it is possible that 90 % of the languages around the world will disappear by the end of this century.

I am going to take a closer look of one indigenous people, the Sami, and the challenges that arise from the Finnish National Core Curriculum reform. The aim of this study is to find ways to support indigenous languages in the field of computer programming. The Sami are one people living in four countries: Finland, Norway, Sweden and Russia. According to Aikio-Puoskari (1998) the area is known as *Sápmi* among Sami people. O'Dowd (2015, 189) states that the size of the Sami population has been estimated to be 70 000 – 80 000 all in all and 5700 of them live in Finland.

The Finnish curriculum reform integrates programming in the National Core Curriculum in the fall 2016 (Opetus- ja kulttuuriministeriö 2014). According to the European Schoolnet (2014) Finland is not the first country in Europe to take programming as a part of the National Core Curriculum; However, Finland is the first country in Europe about to teach the Sami, the only indigenous people in Europe (Edinburgh University EU Society 2015), to program in basic education. Teaching programming in comprehensive schools is a challenge for there is no previous knowledge how to teach programming as it is presented in the Core Curriculum. The Sami population in *Ohcejohka* is facing the challenge of



programming in a more complex way: the world of Information and Communication Technology (ICT) leaves the indigenous cultures out. When keyboards and programs are lacking the language support for the indigenous people, it is leaving a large amount of information out of the current information society. The programming part of the curriculum reform does not consider that there is an ethnic minority in the North of Finland and they have a constitutional right to use their language. With the term 'approach', I refer to a way to look at this curriculum reform. An indigenous approach is a way to see the programming from a small indigenous people's point of view. In my study, I will let a small group of Sami teachers in Finland to speak.

Computer science is possible to see from an ethnic point of view as Tedre presented in his thesis (2002). Computer programming can be seen from that ethnical angle too. In this thesis the term '*ethnoprogramming*' is presented as a cultural approach to computer programming. *Ethnoprogramming* is a child concept to ethnocomputing presented by Tedre in his thesis (2002). I will call programming from the ethnical point of view as *ethnoprogramming* and the programmers concerning ethnic issues as *ethnoprogrammers*. These *ethnoprogrammers* will be the generation who fade the digital divide. In this study the cultural aspect is indigenous peoples' cultures; however, it can be generalized to other cultures too. *Ethnoprogramming* can be seen as a way to increase cultural knowledge among computer programmers. It can also mean a way to teach programming from a cultural point of view. *Ethnoprogramming* can be a way to save and make the current information society aware of traditional knowledge. Every program that is made from an ethnical point of view is *ethnoprogramming* and a part of a cultural heritage. At the moment computer science is causing problems in all the languages and cultures that are not based on the western way of thinking and writing. We are leaving out a large amount of traditional knowledge from our information society; it is a loss for the indigenous cultures and the world. The best way to see programming in the future would be without the ethno-prefix; programming itself would be a way to self-expression for all people and cultures like pen and paper.

Tedre (2002) is using the term digital divide when referring two groups of people: those who create digital technology and those who use it. He states that the information society was supposed to blur the borders and fill the gap between these two groups; instead the edges of the borders have become sharper. Tedre sees that the digital divide can also be seen within nations and not only between the nations: this is the case when we are talking about programming in the Finnish National Core Curriculum. The digital divide can be seen in Finland right now, it is making a gap between Finnish children and Saami children as media users. Finnish children have the possibility to be media consumers in their own language in contrast to Saami children who have to translate the media platforms or create their own media content. This means that the Finnish children can be both media producers and consumers in a school context when the Saami children can be only producers.

Gyabak (2011) has studied the possibility to bridge the digital divide with new media tools in a public school in Bhutan. The study was based on previous studies about digital storytelling and how it can improve social learning in rural communities. Gyabak did not predict that English language might be a problem when teaching digital technology in rural Bhutan. She describes the English language as “an inadvertent gatekeeper” for she did not know that the participants had previous attitudes towards English language because of the colonial history of Bhutan. The Saami have a colonial history in Finland so it is possible that there are previous attitudes towards Finnish language as well. The study in Bhutan shows that the language used in technology is more than a language. If there is programming material available in Finnish, it does not necessarily help the Saami children to learn programming because of the oppression history.

United Nations World Summit (2003) on the Information Society held in Geneva published a declaration about the common vision of the information society. Article 15 stated the role of indigenous people when building the information society:

*"In the evolution of the Information Society, particular attention must be given to the special situation of indigenous peoples, as well as to the preservation of their heritage and their cultural legacy."*

(World Summit on the Information Society 2003)

In this Sami case in *Ohcejohka* there are indigenous people and a new form of technology in education: programming. They will see programming in their cultural context and create media content from their cultural aspects. A successful curriculum reform from an indigenous point of view forces not to assimilate majority's language and culture. Information and communication technology was created for the needs of military and western science; it was not supposed to be equal. The world of computing is based on Latin alphabet and the white western science. However, equal education is a constitutional right in Finland. The Sami have a constitutional right to maintain and develop their language and culture. Teaching programming in comprehensive schools is a challenge because it can be a way to assimilate the Sami or a way to support their language and culture. This study focuses finding the ways to support indigenous language and culture in computer programming.

I have one main research question and two sub-questions in this study:

Q1: How can we support the indigenous Northern Sami language as a mother tongue when teaching programming in comprehensive school?

Q1a: What kind of support do the teachers in *Ohcejohka* need when teaching programming as it is presented in the Finnish National Core Curriculum??

Q1b: How the current ICT resources should be developed when teaching programming for indigenous people in *Ohcejohka*?

The first question is the most important one and the other two are sub-questions. I am using e-mail surveys and interviews as data collecting methods and use qualitative analysis to find answers to these questions.

This is a multidisciplinary study done from media education point of view. Ethnocomputing and ethnomathematics are derived from ethnosciences and

anthropology, programming and computing are a part of the computer science field, linguistic landscape is a sociolinguistic approach and indigenous and Sami pedagogies have their roots in education and humanistic sciences. However, I am not focusing on these disciplines very deeply. The essence of media education is to get the people understand the media.

This thesis begins with introduction chapter where I present the essential terminology and background for this study. The second chapter presents the theoretical framework and the third chapter the research questions. In the fourth chapter, I will introduce the Sami case in *Ohcejohka* and in the fifth chapter the results. In the sixth chapter, I will interpret the results and present the model of *ethnoprogramming*. The last chapter is for conclusions.

## 2 PROGRAMMING AND INDIGENOUS PEOPLE

Today it would be more sensible to just learn English in order to learn programming; in this Latin-based world programming languages do not take into account programming as a cultural issue. The language usage study done in *Ohcejohka* by Länsman and Tervaniemi (2012) pointed out that as much as the software is needed in Sami language, one Sami recipient did not need software in Northern Sami because he/she had learned already to use computer software in another language. If the Sami choose the western culture because it offers better technology, it will lead to assimilation.

### 2.1 Who are indigenous?

The term 'indigenous' is referring to indigenous people. In the Cultural Survival article it is said that there is no definition for indigenous but there can be seen some common characteristics among indigenous people. Indigenous people have their own language. They have a small population inside a dominant culture of the country. They still practice their cultural traditions and at last, some of them live in a territory that is, or used to be, theirs. They identify themselves as indigenous people. According to Gayim and Myntti (1995), the term 'indigenous' is problematic because it is referring to people who were the first in the land. For example, in Africa or India the ethnic background is not so simple: in India, the entire population can be described as indigenous for they have lived in India past several millennia. Indigenous may not be the best term globally. According to Shaskolsky-Sheleff (1991) the term has also been criticized for being difficult to understand and that the term is actually a relic of colonial thinking: it raises

suppositions that 'indigenous' is an issue only in the former colonized countries and it is ignoring the similar groupings in other countries. However, the term indigenous is most used in academic and official context as the other terms like tribe or the 'Fourth World' people are seen too political or pointing to a specific continent.

International Labour Organization (ILO) is an agency working under United Nations (UN). ILO has been founded in 1919 and the main goal is to achieve peace that is based on social justice.<sup>1</sup> ILO created the first convention<sup>2</sup> "Indigenous and Tribal Populations Convention" or C107 in June 1959 and it concerned "*the Protection and Integration of Indigenous and Other Tribal and Semi-Tribal Populations in Independent Countries*". This ILO convention defined the term indigenous to concern the two basic terms: indigenous and tribal (ILO, 1959). The convention was replaced in 1989 with ILO convention 169 and this convention updated the definition of indigenous and tribal people. The convention defines the indigenous people as "*peoples in independent countries who are regarded as indigenous on account of their descent from the populations which inhabited the country, or a geographical region to which the country belongs, at the time of conquest or colonization or the establishment of present state boundaries and who, irrespective of their legal status, retain some or all of their own social, economic, cultural and political institutions.*"

(International Labour Organization 1989)

These tribal or indigenous people must identify themselves as indigenous or tribal. The convention 169 supports the indigenous and tribal peoples' rights in the framework of the state they are living. It has been open for ratification since 1989 and 22 countries have ratified ILO C169 to date. Finland is not one of those countries. (ILO, 2016).

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<sup>1</sup><http://www.ilo.org/global/about-the-ilo/lang--en/index.htm>

<sup>2</sup>[http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100\\_INSTRUMENT\\_ID:312252](http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312252)

The concept 'ethnic minority' is broader than the concept 'indigenous'. References to a colonial history are missing from the definitions of an ethnic minority although many ethnic minorities may have experienced colonialism. However, there are some common features between indigenous people and ethnic minority: they are both victims of oppression, assimilation of even physical destruction (Gayim & Myntti 1995).

The etymology of the word 'ethno' can be traced to a Greek word ethnos: it means people, nation or foreign people. Tedre, Kommers and Sutinen (2002) present that the ethno-prefix in the concept of ethnocomputing is referring to a wider difference in culture that are based on language, history, religion, customs, intuitions and on the subjective self-identification of the people. Indigenous approach can be seen as an ethnic approach as well.

The Sami are indigenous people of Scandinavia who also form an ethnic minority in Finland, Sweden, Norway and the Russian Federation (Helander, 1994; Gayim & Myntti 1995) I use both of these terms in my study. However, according to the ILO 169 (1989) convention the people must identify as indigenous to be indigenous. The Sami are identified themselves as indigenous people and the concept of indigenous people is used when referred to Sami people.

## 2.2 The terminology in programming

In my thesis I will try to keep the programming terminology as simple as I can. Programming terminology is hard to define even for a computer scientist and the deeper terminology is not essential for my study.

Every action that an electronical device does, must be programmed. In the year 2013 the president of the United States Barack Obama took part of the campaign in Computer Science Education Week and the message was clear: "Don't Just

Play on Your Phone, Program It"<sup>3</sup>. President Obama appealed for the American children to try out computer programming for it is important individually and to America's future as well.

According to Keränen, Korhonen and Tolonen (2013), programming is communicating with computers; When you talk with your mother, you usually use your native tongue. When you go abroad you use the local language or English to communicate. If you want to communicate with a computer, you use a programming language to do so.

A processor of a computer understands only commands that are written in the machine code. It is possible to write programs directly using the machine code; however, the machine code is numerical and hard to handle directly. Usually the computer programmers use a higher-level programming language when programming. The source code is then translated to a machine code using for example a compiler. A compiler is, according to Hietanen (2001, 789), a computer program that searches for syntax errors from the source code. The source code is the code file a programmer writes following the rules of the programming language used (Hietanen, 2001, 790).

A programming language can be all-graphic or all-text or both. Like a natural language, every programming language has a grammar and a vocabulary: together they form the syntax of a language. A syntax of a programming language defines the rules of combination of characters and symbols that are considered to be correctly structured document. The syntax defines what special character can be used when programming. If the syntax does not contain a special character that is used in programming, the compiler returns a syntax error.

Programmer advantages knowing mathematics and physics. In game programming the objects need to follow the rules of physics to look and feel real. (Keränen et al. 2013, 37) Programming can be seen as a way to learn physics

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<sup>3</sup>The White House, <https://www.whitehouse.gov/blog/2013/12/09/don-t-just-play-your-phone-program-it>, 20.12.2015



and mathematics, especially through game programming. If you throw a ball in a computer game, it would not drop without the computer programmer knowing the concept of gravity.

### 2.3 Indigenous computer programming

I studied the C++ programming language so I am going to use it as an example. C++ is one of the most popular programming language in the world and it can be approached as a traditional procedural programming language or use for object-oriented programming. The procedural programming is a traditional programming style that is based on three programming structures: variables, data structures and subroutines that are also known as procedures. Procedural programming uses subroutines to operate data structures. Object-oriented programming language binds together the procedure and the data structure as an object. (Hietanen, 2001). C++ was tested for special characters that Sami languages contain. The main reason for the test was to see how the compiler reacts when a programmer uses some other language than traditional English. In the example below there is a test program that has two Northern Sami words: just a print-out word *Čieđđá* and a subroutine called *Čálihit* [Print].

```

#include <iostream>

using namespace std;

void čálihít(string str) {
    cout << str << endl;
}

int main() {
    čálihít("Čieđđá");

    return 0;
}

```

The example above does not work. The compiler in C++ gives a syntax error. It can be presumed that the syntax of the C++ programming language does not contain Sami language characters. Now we are the very essence of the problem of indigenous languages and ICT: the character set support in programming languages and in computer programs. If the computer language does not support a character set that allows any characters different from the English language, it is unlikely that the programmed software does. If the programmed software happens to be, for example, an educational platform for Finnish schools, the Sami users cannot use their language on the platform.

C++ and Northern Sami are both languages but they have a huge difference in popularity. The survival of the small indigenous languages can be helped with the support of today's technology. The roots of that technology are in the programming languages, programmers and programs. *Ethnoprogramming* is aiming to increase the common knowledge in all of these levels: increasing the knowledge of programmers about the language issues among indigenous people the programmers could use programming languages that support small languages and thus create software for larger audiences.

Duveskog (2004) has studied teaching students in Tanzania to program with Java. Tanzanian students cannot be compared with the Sami students in

*Ohcejohka*; According to Keskitalo and Sarivaara (in printing) the Sami have more or less urbanized and their living area, *Sápmi*, locates in the wealthy Scandinavia. However, there are some interesting aspects in Duveskog study teaching Java in Tanzania. The English language was not the teachers or the students mother tongue and as Duveskog points out; it was hard to explain programming in a way the students will understand (Duveskog, 2004). This problem is the same in the *Ohcejohka* case. In an Al Bawaba article that was published July 2016 it is said that it would be more sensible to just learn English in order to learn programming; in this Latin-based world programming languages do not take into account programming as a cultural issue. The article is all about a computer scientist Ramsey Nasser who created an Arabic programming language. His idea is based on the fact that most of the programming languages are based on the Latin characters and do not work when trying to program using Arabic. (Al Bawaba, 2016). I see the world of programming in a very similar way than Ramsey Nasser; If we want to see a new generation of computer programmers who blur the borders of language, gender and culture, the ethnic side of computing needs to be in public debate.

#### 2.4 The importance of the Sami languages

Language is an issue: European Commission (2011) and Clothey (2015, 67) state that the lingua franca in information and communication technology and programming is English. Skuttnab-Kangas and Dunbar (2010, 69) state that English language skill among indigenous, minority and tribal children can be compared to computer skills: it is required in the working life but to succeed, you need more than that. Working life appreciates native-like English skills. If you have skills in one or two popular languages, you are appreciated more. If you have skills in a minority language, it is not marketable. However, the monolingual

English speakers are the losers because they do not have the advantages of multilingualism.

Häkkinen (2007) and Aikio (2009) have studied that Finnish language has loanwords from the Sami languages<sup>4</sup>. The Sami languages take loan words from the main languages of the Sami area countries: Finnish, Swedish, Russian and Norwegian. All of these languages loan words from English language. According to Turku University (Turun yliopisto 2014) English language is not a threat to Finnish language because Finnish language has 5,2 million native speakers worldwide (Ethnologue 2016). However, according to a Sami Parliament report, in the years 2007-2008 there were 490 students learning a Sami language in school and 316 of those were studying Northern Sami (Saamelaiskäräjät 2009). Northern Sami is the first language for 1744 speakers in the year 1995. Today the Sami people in Finland are recognized as the indigenous people of Finland and they have the constitutional right to maintain and enhance their language and culture (Aikio-Puoskari 1998). However, according to Keskitalo, Määttä and Uusiautti (2013) the educational assimilation started by the church in the 1600s and after the Second World War schools tried to assimilate the Sami into the Finnish population. This led to illiteracy and language shift among the Sami (Aikio-Puoskari 1998). Nevertheless, according to Kuokkanen (2005) the Sami language could not be systematically erased like some other indigenous languages and the language became the main focus of the Sami ethno-political movement in the late 1960s. Today the days of colonization are over and the Sami languages in Finland are protected by law (Finlex 2003). However, the school system is again in the place where it can have an effect to the future of Sami languages. The digital age is full of Anglicism and according to the Opetushallitus's article *Kieli koulun ytimessä* (2016) the survival of the small languages depends on two things: the attitude towards the language in the community and the will to offer services in the language.

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<sup>4</sup> Loanwords mostly deal with nature

In *Ohcejohka* case it is difficult to say which one is the mother tongue if a family is speaking both Sami and Finnish languages. It is possible that one child speaks them both as a mother tongue. According to Bühmann and Trudell (2008), multilingual education refers to the formal use of more than two languages in the curriculum. Countries with multiple regional languages of wider communication or more than one official language may support multilingual education that includes children's mother tongues and the more widely spoken languages of the nation. Immersion education refers to a model in which the student is entirely 'immersed' in a language that it is not the mother tongue for most or all curriculum content. Where the student is from a majority language community, immersion education can be quite effective, but when the student is a minority language speaker, immersion can significantly impede academic achievement.

In Finland there is a law on compulsory schooling. According to the law (Finlex 1998) the Sami children must be taught in Sami language. The official languages in Finland are Finnish and Swedish. However, Sami languages have an official position in teaching, especially in Sami area. According to UNESCO (2003) report, schools and new media<sup>5</sup> usually provide information in the dominant language at the expense of the endangered language. You need a language to access new media platforms but not just any language (Opetushallitus 2016). You need the language of the majority. Ethnic minorities are easily forgotten if the school is bilingual and the services are available at least one of the school languages. It is said that in most cases bilingual education means a dominant second-language and a minority mother tongue (Bühmann & Trudell 2008).

The children in early education in *Ohcejohka* have three language options in school: Finnish, Northern Sami and the language immersion group. None of the early education children's parents chose all-Finnish class for their child in the year 2015. The language immersion class has 50% of teaching is in Finnish and 50% is in Northern Sami. In this thesis Northern Sami is referred as an indigenous

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<sup>5</sup>New media can be interpreted as the interactive contents accessed via Internet, (Wikipedia, New Media 2016)

language. Bühmann and Trudell (2008) define an indigenous language as a language spoken by indigenous community. When I use the term mother tongue, I am referring to a language that it the first-spoken (Bühmann & Trudell 2008).

## 2.5 Computer programming and the Finnish National Core Curriculum

The European Schoolnet (2014) has published a research about programming in the schools in Europe. It is said in the research that Norway has no plans of integrating programming into the curriculum. Norway has the leading role of producing materials in Northern Sami language. If we are looking at the list of countries that have taken or are about to take programming as a part of their national curriculum, Finland is the only country where Sami people have a legal status. It means that no other country will provide learning materials for the Sami. According to the Edinburgh University EU Society (2015) the Sami people are the only indigenous people in the European Union area so Finland is the first country in Europe to teach indigenous people to program.

The Finnish National Core Curriculum defines the goals in a national level. The school-specific curriculum defines the goals in this specific school and binds them together with the national goals. The school-specific curriculum might consider cultural aspects and other local issues that a core curriculum does not. In my study the school-specific curriculum must deal with the fact that the school is bilingual and other of these languages, Northern Sami, is considered indigenous and endangered as Keskitalo, Uusiautti and Määttä (2013) see it.

The Ministry of Education and Culture has approved the frame of the new curriculum 22.12.2014<sup>6</sup>. The National Core Curriculum is based on positive

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<sup>6</sup><http://www.oph.fi/ops2016/perusteet>, 22.11.2015

learning experiences, collaborative working and interaction<sup>7</sup>. The Finnish Board of Education says in their online-briefing that "*municipalities may develop their own innovative approaches to implementing the curricula, differing from those of other municipalities*". Schools start working according the new curriculum in autumn 2016.<sup>8</sup>

In the National Core Curriculum, the programming means logical thinking and problem solving: every problem can be sliced into pieces and solving those pieces, you can solve the actual problem. This does not make everyone a programmer, for some it is enough to understand how machinery works. However, in the future it is almost necessary to know the basics: according to Vorderman (2015), programming is going to be a part of the future jobs in some way. Table 1. presents the forms of programming in the National Core Curriculum.

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<sup>7</sup>[http://www.oph.fi/english/current\\_issues/101/0/the\\_fnbe\\_has\\_confirmed\\_the\\_new\\_core\\_curriculum\\_for\\_basic\\_education](http://www.oph.fi/english/current_issues/101/0/the_fnbe_has_confirmed_the_new_core_curriculum_for_basic_education), 22.11.2015

<sup>8</sup>The Finnish National Board of Education

[http://www.oph.fi/english/current\\_issues/101/0/what\\_is\\_going\\_on\\_in\\_finland\\_curriculum\\_reform\\_2016](http://www.oph.fi/english/current_issues/101/0/what_is_going_on_in_finland_curriculum_reform_2016), 22.11.2015

Table 1. Programming in the National Core Curriculum (Finnish National Board of Education 2016)

ICT competence (T5) classes 1-2.	The pupils gain and share experiences of working with digital media and age-appropriate programming tasks.
Key content areas related to the objectives of mathematics in grades 1-2:  C1 thinking skills.	The pupils begin familiarizing themselves with the basics of programming by formulating and testing step-by-step instructions.
ICT competence (T5) classes 3-6.	When trying programming, the pupils learn to understand how decisions made by people affect the way technology works.
Objectives of instruction in mathematics in grades 3-6.	O14 to inspire the pupil to formulate instructions in the form of computer programs in graphic programming environments.
C1 thinking skills in grades 3-6.	they plan and execute programs in a graphic programming environment.
Objectives of instructions in crafts in grades 3-6.	They practice with functions produced with the help of programming, such as robotics and automation.
ICT competence (T5) grades 7-9.	Programming is practiced as a part of the studies of different subjects.
Objectives of instruction in mathematics in grades 7-9.	To guide the pupil to develop his or her algorithmic thinking and skills in applying mathematics and programming in problem-solving.
C1 Thinking skills and methods in grades 7-9.	The pupils programme while learning good programming practices.
C3 Experimentation in grades 7-9.	Embedded systems are used in crafts, i.e. programming is applied in the designing and producing.



The National Core Curriculum is integrating various forms of programming in education. Table 1. presents the objectives in programming: children will learn logical thinking, problem solving, programming in graphical environments and with a real programming language. Teachers are in need of training. For example, Toikkanen (2015) writes in an article in the Koodiaapinen's web page, that over 300 teachers in the Oulu area are studying programming and the coming changes in the Koodiaapinen's Massive Open Online Course, or MOOC. The core curriculum is full of expressions like "embedded systems" or "algorithmic thinking" that the teachers are unaware without training.

The MOOC-courses are probably quite good for explaining what programming in a comprehensive school is. However, it does not take into account regional differences. The MOOC focuses only in the core curriculum and the instructions given there, explaining what they mean, because it is like said, a massive open online course. Teachers in Finland are not in equal position to teach programming; the teachers in the Sami area are facing computer programming as a part of the National Core Curriculum in a more complex way: first they have to know what to teach and then translate the materials into Sami.

## 2.6 The current material available

The programming hype in Finland has brought a lot of books in the market, for one example Hello Ruby by Liukas (Liukas 2015). It was said to be the best book about programming for children. The one point of bringing programming a part of curriculum is to give girls an experience of programming<sup>9</sup>. However, Liukas does

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<sup>9</sup>According to Koodiaapinen (2013) 23% of ICT professionals in Finland are women and only 4% of the students that started in the Aalto University ICT master's programme in the year 2013 were women.

not consider any cultural issues. Neither does Koululaisen ohjelmointikirja [Computer Coding for Kids] (Vorderman 2015). It presents programming using examples and various options how to start: No fairytales, no preferring girls or boys, just facts and examples. In the Introduction it explains what programming is, the second chapter is for Scratch, the third is for Python, fourth chapter explains what is inside a computer and fifth chapter tells about programming in the real world. Nevertheless, the Sami teachers do not have the time or knowledge to compare the materials and make it fit to the local curriculum.

There are materials online too. Code.org<sup>10</sup> is a non-profit organization that is working worldwide. According to the code.org web page, they believe that quality computer science and programming education should be available to every child. Code.org includes a curriculum of its own and can be used when teaching computer science or programming. Code.org has been translated into dozens of languages. However, Northern Sami language was not one of the translated languages. 58% of the content was translated in Finnish on March 2016.

Scratch<sup>11</sup> has been translated over 40 languages but Sami languages are not on the translation list. However, Scratch is available on Finnish.

## 2.7 My position as a researcher

The family is an important factor in the Sami culture (Lehtola 2012). It is important to know what family a person represents. In picture 1. I am defining my position as a Sami.

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<sup>10</sup>code.org was not translated 30.3.2016. However, the teachers started to translate code.org voluntarily during this study.

<sup>11</sup>A graphic programming language developed in MIT Media Lab, <https://scratch.mit.edu/about/>



Picture 1. From the arms of my *áhkku* (grandmother) to a cultural conscious researcher.

My grandmother and grandfather had Northern Sami as their domestic language and mother tongue. However, their children were assimilated to the Finnish language when they went to school in the 1940s and 1950s (Aikio-Puoskari 1998). My mother had Northern Sami as her mother tongue and she had to have her education in Finnish from the first grade on. It was ordinary to repeat the grade until the Finnish language was learnt and they could perform the tasks required. Science Daily (2014) writes about traumas; It is known in psychology that traumatic events can induce behavioral disorders that are passed down to the next generation. In this case it meant that my mother did not have the courage to teach me Northern Sami language when I was a child. The schools outside the Sami area did not teach Sami languages back in the 1980s when I started school;

Sami language achieved the status of a mother tongue in comprehensive schools in 1995. It was possible to take a matriculation exam in Northern Sami in 1991 (Aikio-Puoskari 1998); Nevertheless, when I graduated from upper secondary school in the year 2000, I had studied for 12 years without any education in Northern Sami language. When I was studying for my Bachelor of Engineering in Information Technology in Lappeenranta, I had my first course in Northern Sami. It was organized by the Sámi Education Institute in Inari and it was one of the first virtual courses in Northern Sami language in the year 2007.

The Sami history has had an effect to my personal life. However, without the history I probably would have chosen another topic for my thesis. My Sami background and experiences as a Sami have had an influence to my personal opinions involving the Sami education. I think that revitalizing Northern Sami language requires seizing New Media: increasing the digital material such as games and make it accessible to all via the Internet. There are some studies that show the lack of media content in Northern Sami: Rasmussen study (2013) about the differences in bilingual education system in *Ohcejohka* and *Tana* communities and Länsman and Tervaniemi study about the language situation in *Ohcejohka* (2012) just to mention a few. In my opinion the Sami need a same kind of seizing the popular culture as did the Alaskan indigenous people Inupiaq when they created *Kisima Injitchunja* [Never Alone] video game (The Washington Post, 2014). The story is based on their indigenous folklore and the storytelling is done in their indigenous language. According to the National Network of Libraries of Medicine (2016) English is spoken among Inupiaq because of the colonization: they were also denied their own language in the school dormitories.

Creating games requires computer programmers. Programming is going to be a part of basic education in the fall 2016. My background as a Sami is the reason why I am interested of ways to support Northern Sami when teaching programming. It is a possibility to create a generation of culture conscious programmers.

### 3 RELATIONS OF ETHNOPROGRAMMING

#### 3.1 Ethnomathematics, Ethnocomputing and Ethnoprogramming

Ethnocomputing was first mentioned by Tedre (2002) in his thesis: "Ethnocomputing. A Multicultural View on Computer Science". The roots of ethnocomputing are in ethnosciences and in ethnomathematics. Ubiritan D' Ambrosio (1985) presented the concept of ethnomathematics in 1985. The essential idea is to broaden the concept of mathematics to cover indigenous and tribal cultures. D 'Ambrosio is referring to the third world with his ethnomathematics concept and the curriculum development there. However, there are indigenous people in the arctic who have ethnomathematics point of view too. For example, Lipka and Mohatt (1998) studied the ways of Yup'ik and the ways to Yup'ik based mathematics teaching. He based his research on ethnomathematics. He found out that Yup'ik mathematics related to nature and conditions: especially how to avoid death in the Arctic. Lipka and Mohatt saw that the patterns in Yup'ik crafts could be used in mathematics teaching and form a mathematics tool kit. The pattern could teach geometry, fractions, algebra and problem solving as well as the stories behind the patterns.

Ethnocomputing in Ghana was a study Babbit, Lachney, Bulley and Eglash (2015). It was focusing on ethnomathematics and ethnocomputing: the researchers had an assumption that using the traditional textile stamping tradition in teaching and learning mathematics would improve the learning results. They saw the ethnomathematics also as a tool to empower students in Ghana and break the myth that only white Asian students have the math in their genes. The results showed that the using of the traditional stamping figures in

teaching had a significant advantage for the scored compared to GeoGebra based lessons.

Computer science has roots in mathematics and it is interdisciplinary by nature although the value of computer science is mostly instrumental in most interdisciplinary studies. Ethnocomputing is presented with an assumption that computing is a dialectic process where the society has an impact on Computer Science (Tedre et al. 2002). The ethno-prefix is referring to differences in culture based on language, history, religion, customs, institutions and subjective self-identification. They define computation as the combination of

1. The organized structures and models used to represent information (data structures),
2. The ways of manipulating the organized information (algorithms)
3. The mechanical and linguistic realizations of the above, and
4. The applications of all of above.

The focus is not in the terminology; it is in the way that these computational concepts are presented. (Tedre, 2002)

*Ethnoprogramming* is a form of ethnocomputing. However, the National Board of Education named the programming part of curriculum as programming and not computing. The hours for teaching programming are taken from the mathematics lessons although every teacher is responsible to teach programming as a part of the lectures. Computers have an essential role when teaching and learning programming although it is possible not to use computers in early education. As a combination of these issues: *ethnoprogramming* is a concept under ethnocomputing and it includes an assumption that different cultures will bring different views to programming on a dialectic process.

### 3.2 Indigenous pedagogies and ICT

There are not any studies about Sami people and programming or ICT affection to their culture. However, there are studies about indigenous people and ICT. For example, Allen, Resta and Christal (2002) studied in the Four Directions project the role of technology in Native American schools. Four Directions project goal was to create a culturally responsive curriculum for native American students using technology. Although they saw that technology is a two-edged sword: as it can be useful in preserving language and culture, it can also do the opposite. In this study the American Indians saw the western culture as a threat as the young exposed to the western culture in form of games and television programs. In the Case *Ohcejohka* the Sami people are living in the wealthy Scandinavia and there is no possible way to avoid contact with the western world. Like it is stated in the Four Directions project: it is easier to sharpen the positive side of the sword. The study found some positive ways to use technology: preserving oral information, preserving cultural material, digital repatriation and education. Education part is essential for my study because the teachers had similar problems than in case *Ohcejohka*: they were lacking material to teach indigenous people. Technology was used as a tool in this case to increase distant learning options: curriculum sharing via electronic environments, web site and telecommunication projects.

UNESCO Institute for Information Technologies in Education published a policy brief in 2011 with policy recommendations for governments to support ICT usage in indigenous education. These policies encourage schools in indigenous areas to create their own policy framework that gives the indigenous communities the authority for example over the school's curriculum and still meet the National standards. Schools serving indigenous children need their own e-policies that ensures the full access to information society. This means the adequate hardware and Internet connections. Wireless network capacity should be increased especially in rural areas. Schools in the indigenous areas should be developed as ICT resource centers for the community to use when the school is not in

session. The report also states like the Four Directions study that indigenous communities are using ICT to preserve traditional knowledge. Government should support the community to create and develop content in local language: this way the indigenous community has the right to control their cultural intellectual property. The report states that ICT-supported curriculum resource development requires three kind of expertise: knowledge in culture, pedagogy and technology. The Four Directions project developed local content creating teams where teachers were the expert in pedagogy, the community elders were the expert in culture and the students were the experts in technology. This kind of model could work in *Ohcejohka* too.

The report also states that the research done in indigenous education and ICT should be encouraged and funded:

*"Specifically research is needed to determine the local content to be incorporated into the curriculum, level of access to ICT devices and connectivity needed to support the curriculum, indigenous language requirements, technical infrastructure requirements and training and technical support requirements (Unesco, 2011)"*

The *Ohcejohka* study does not determine the local content in the future curriculum. It reflects the teachers' knowledge about programming and ICT at the moment. However, there is a chance that this study finds answers for example technical infrastructure requirements because that is the first thing preventing programming. First you need the hammer, then you need the instructions how to use it. The report is suggesting for example that standard character sets need research and development and I agree as the current computing world does not support indigenous minority languages.

The report sees online education for teaching as one solution of supporting ICT in indigenous education. Indigenous people will have to leave from their current living area to cities to become teachers and very often they will not return. In the *Ohcejohka* case there are indigenous teachers in the *Ohcejohka* area schools. The online education is needed for extra education in ICT for these teachers. The



Sami teachers in *Ohcejohka* are competent in language, culture and pedagogy but they are lacking the ICT training needed.

Sonke Bierman has suggested in his article (2008) that there is not a singular indigenous pedagogy. He sees that there are multiple indigenous pedagogies worldwide and that is essential for my study. Indigenous pedagogies in Africa or India do not apply as such in Arctic areas. Studies like Lipka and Mohatt's study (1998) about Yup'ik Eskimos in Alaska are more relevant when we are looking at the Sami education. According to Darnell and Hoëm (1996, 268-269) people are contrasting new and old ways in everyday life. Preservation of ethnic traditions are set against the new and tempting alternatives that the western world provides; especially in schools. They see that there are two competing forces in Native villages: ethnicity that ties the people to their past and the forces of schooling and urbanization that draws people from their origins to new and uncertain cultural context. That is one of the reasons why the Sami need a pedagogy of their own: they are living in the western world and the western culture is present in their daily lives. If the Sami choose the western culture because it offers better technology, it will lead to assimilation. Already the Länsman and Tervaniemi (2012) study found out that one of the recipients did not need computer programs in Northern Sami because these programs were available in another language.

### 3.3 The Sami: people and pedagogy

The Sami belong to the Finno-Ugric people, who arrived in Europe and northern Eurasia about 40 000 years ago. The regions in which the Sami live, are expanded from Central-Norway and Central-Sweden through the northern Parts of Finland to Russia's Kola Peninsula. The Sami are recognized as an indigenous people in the Constitution of Finland and they are allowed to develop their language and culture. (Keskitalo & Määttä 2011).

The culture of the Sami reflects their livelihood such as reindeer herding and fishing. It also reflects their living circumstances and life in general. Sami households have been self-sufficient back in time creating traditional handicraft. The Sami have passed traditional knowledge orally in the form of tales and *yoik*, the traditional way of singing. (Gayim & Myntti 1995)

According to Helander (1994), the Sami people have been under oppression in all the Sami states. The colonization of the northern areas can be dated back to 1600's. The common belief was that the Sami culture cannot survive in a modern world and that the Sami were not able to mind their own affairs. From the 1800's there were government policies called *Norwegization* or *Swedication* aiming assimilation of the Sami population. According to Aikio, Aikio-Puoskari and Helander (1994) the *Norwegization* in Norway aimed against the Sami population for they were seen as people with only slight ability and a low-leveled culture. Kulonen, Seurujärvi-Kari and Pulkkinen (2005) state in "The Saami. A Cultural Encyclopaedia" that *Norwegization* was specified as the primary task for the schools and dormitories in Norway and the assimilation ended in the late 1940's; assimilation continued in some form up to the 1970's. In Sweden the government policies were directed against the Finns more than the Sami population. *Finnicization* had the same aims in assimilation but it was practiced on the administrative and the local level (Aikio et al, 1994). The national romantic ideology demanded that the language of Finland is Finnish and the Sami were ignored. All in all, the assimilation policies meant that the Sami did not have the right to learn their mother tongue in schools. The result was in many cases that the Sami were ashamed of their language, culture and their background. (Kulonen et al. 2005). According to Balto and Hirvonen (2008, 2) the *Sáminization* of the educational system is the main objective in Sami ethno-politics. They point out that the education material is needed in every school subject and the need was created when the Sami children had the right to study all subjects in Sami language. Norway created a curriculum for the Sami, the *Sámi curriculum*, in the reform in 1997 (Balto & Hirvonen, 19). In Finland, the schools have Finnish curriculum although it may have been translated into Sami (Keskitalo et al. 2013).

Torkel Rasmussen (2013) has studied the differences of Northern Sami usage among children in a Norwegian municipality of *Tana* in Finnmark province and in *Ohcejohka*; There are huge differences in language usage, for example, in after-school activities. *Ohcejohka* and *Tana* are only 40 km from each other. Rasmussen is criticizing the Finnish school system for failing to support the revitalization of the Sami languages. According to Rasmussen, the *Ohcejohka* schools are producing Sami speakers who are more fluent in Finnish language and the monolingual Finnish speakers do not become bilingual. There were not any significant differences in the fields of Language use in kindergarten and language of education, Language use with parents, grandparents, relatives and other adults or Language use in extracurricular activities. However, there was a slight difference in the Consumption of Sami language media: the children in *Tana* used more often the Sami media than the children in *Ohcejohka* (Rasmussen, 2015). The media has taken over the schools; it could be the media that is failing the Sami and not the school system itself. The influence of the media in a minority school needs to be researched more if the school produces only monolingual speakers. Sara has studied the Sami Radio and the Sami media. According to Sara (2007) the Sami media was created as a reaction to the assimilation politics. The dominating media left out all the indigenous issues concerning the Sami. Norway started the radio broadcast in the Northern Sami language in 1946 and Finland the year after. In 2001 Swedish and Norwegian broadcasting companies started the daily news in Sami in television: they lasted ten minutes. The Finnish broadcasting company YLE started to co-operate in 2002 and the news lengthen to 15 minutes per day. Today it is possible to listen Sami radio, read or watch Sami news online. The Sami radio has a special position among other Sami medias (Sara, 2007). The assimilation politics left the Sami people illiterate in their mother tongue and the radio was the easiest way to pass the knowledge.

According to the study about the language usage in *Ohcejohka* (Länsman & Tervaniemi 2012) the Sami people in *Ohcejohka* are very active users of the Sami media. The Finnish media is more used because there is more content in the Finnish media. There are two media channels which are used even more than their equivalents in Finnish: The Sami radio and the Sami music. Television

programs and the printed media is mostly available in Finnish; however, the Sami media is chosen every time when it is possible. Less than half of those who are active users of Northern Sami language are using Northern Sami as a text messaging language: the assimilation has left some of the active users illiterate and the phone keyboard is not supporting Sami characters. The result is the same in Linkola's (2014) study: technology does not support indigenous languages.

Although the interviewees agreed that there is a need for media contents in Northern Sami, computer software seemed to divide opinions: one recipient did not need software in Northern Sami because he/she had learned already to use computer software in another language. This tells about the very essential problem in computing: it is not available to all if you do not embrace the language of the majority. Other recipient needed Northern Sami software for computers and phones (Länsman & Tervaniemi 2012).

Sami pedagogy means a pedagogical model that is based on the history and special features of Sami people. The Sami language is in the essential role in Sami pedagogy. The need for a special pedagogy for the Sami arises from the fact that the western school system does not support the needs of the Sami as an indigenous people. Sami pedagogy needs to be developed on its own cultural basis and consider the defining inner and outer factors. The outer factors can be defined as historical and cultural burdens and the inner factors as the ways that give directions to education (Keskitalo et al. 2013).

Sami Pedagogy has three essential conceptions: time, place and knowledge. The Sami see time as sun-centered and bound to nature. The Sami have eight seasons and every season has its duties. That is why the normal 45 minutes' class schedule might not work best. Sami Education is not bound to any building or classroom and that is a definition of the concept of place. Knowledge is valued for its utility and in the school context of knowledge is not possessed by authorities. It is held in common and results from negotiations. The Sami pass the knowledge in different ways: the camp fires and the real-life working situations are the scientific seminars for the Sami. (Keskitalo et al 2012) However, the Sami pedagogy does not mention the New Media and the ways of supporting Sami

language in new domains such as computer programming. Indigenous pedagogies mention sometimes the cultural way to teach mathematics (ethnomathematics) and that computing is problematic technically or culturally. Ethnomathematics-based ethnocomputing could give some answers if it is researched more. Ethnocomputing and indigenous pedagogies have a common interface based on mathematics and it is even more highlighted in the case of *ethnoprogramming*.

### 3.4 The Linguistic Landscape and keyboard issues

Landry and Bourhis (1997) have defined the concept of linguistic landscape to refer public signs like road signs or commercial signs. Later Ben-Rafael (2006) has seen the linguistic landscape as the language in a public place. Later studies have used the linguistic landscape theory as a research tool in educational environments. Keskitalo and Määttä (2011) state that the visual and linguistic landscape of the classroom or other space used in education can be used to strengthen the Sami language and culture. It would be important that Northern Sami language is seen in the school buildings more than it is today. Keskitalo thinks that increasing the coverage of Sami languages in the school area would lead to improvement of the status of the language (Keskitalo et al. 2013). Inker-Anni Linkola (2014) has examined the equality of Sami language in an upper secondary school in Norway. Her dissertation about the linguistic landscape in a Sami school (2014) shows that the Norwegian language dominates the linguistic landscape and the Sami language has the minority language position even in a Sami school.

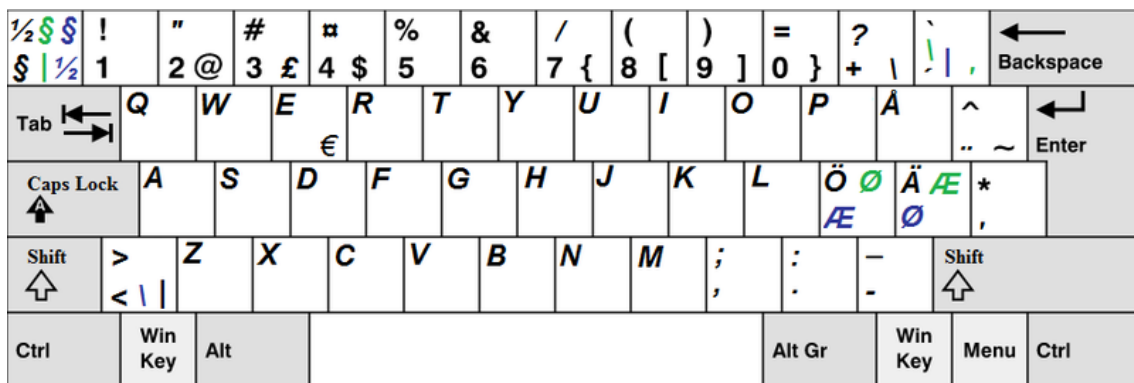
The study has an interesting point when Linkola is describing the usage of the Northern Sami special characters. These characters, Áá Čč Đđ Ɗŋ Šš ƦƦ Žž, are left out when writing advertisements or notifications using a computer. Linkola

thinks that the reason could be mechanical because the computer does not support Sami character set. Linkola says that it is also possible the computer changes the Sami characters to some other character because of interpretation. Clothey (2015, 63-75) states in her article ICT and Indigenous Education: Emerging Challenges and Potential Solutions that the most challenging issues combining indigenous education and ICT are related to language and culture. The most used languages on the Internet were English and Chinese and these two languages cover over half of the web pages in the world. Clothey claims that many of the major software packages are currently incapable of producing letters or characters for some local languages and for this the culturally relevant curriculum may be impossible challenge for linguistic minorities. She does not offer any potential solution so we have to take a look what is causing the lack of fonts.

One reason is the character set used in the computer programs. For example, older character sets like 7-bit ASCII or 8-bit ISO Latin 1 can handle 128 or 256 special characters (Wikipedia, Unicode 2016). 256 characters is not enough for all the languages in the European Union area so the indigenous and minority languages and their special characters are left out in a case like this. However, there is the Unicode character set that is developed to solve this problem. The Unicode is 21-bit system and it is possible to add over a million special characters to Unicode character system. That is enough for all the languages in the world. Nevertheless, even though the Unicode character set does exist, it does not mean that it is used when making computer programs and that is causing the lack of support when writing, for example, Northern Sami. If we are thinking the educational programs in Finland, they of course support the Finnish language special characters like Ää or Öö because Finnish language has over five million speakers worldwide (Ethnologue 2016). That is enough speakers to get the special characters to a character set even if there were only 256 places for special characters. These educational programs support also Swedish, because Swedish as Finnish uses the Latin alphabet and Swedish has ten million speakers worldwide (Ethnologue, Swedish 2016). Northern Sami has a little bit over 25 000 speakers worldwide (Ethnologue, Saami, North 2016) and it means that if the

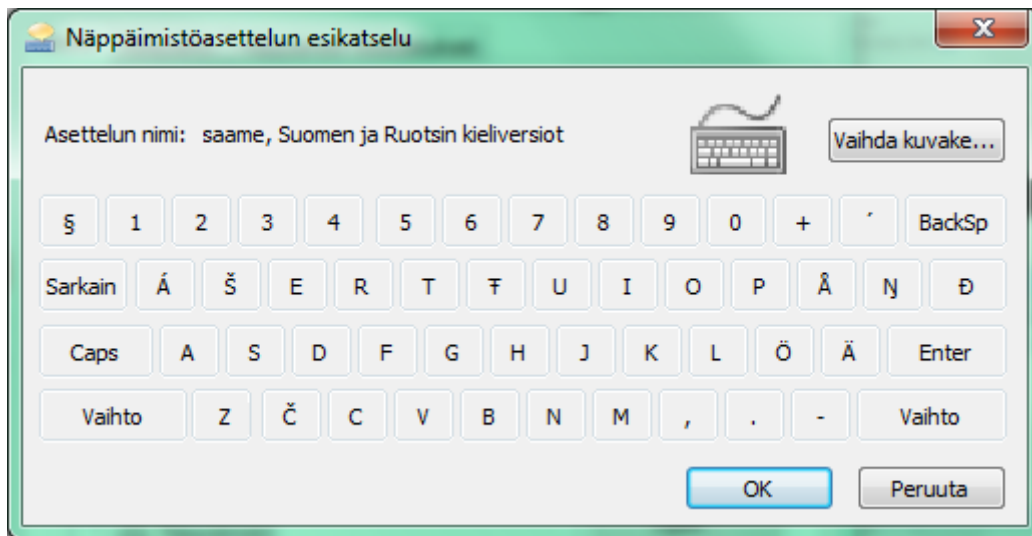
character standards used are ASCII or ISO Latin 1 the educational programs leave the Northern Sami language unsupported.

The character set by itself is not enough. The linguistic landscape has a role in combining indigenous education and ICT. Computer programming is of course logical thinking and problem solving. It is also typing. If we look at the regular keyboard in all the Finnish schools, the keyboard layout supports Finnish and Swedish languages. In picture 2. There is a Scandinavian keyboard layout and it supports Norwegian languages also.



Picture 2. The Scandinavian keyboard layout (Wikipedia)

This keyboard layout is what is actually printed in the keyboard buttons. There is a keyboard layout that supports all the Sami languages. It is accessed via language bar in Microsoft Windows operating systems. Northern Sami keyboard layout looks like in picture 3.



Picture 3. Northern Sami keyboard layout

The keyboard layout works with any keyboard. The keyboard layout replaces unnecessary letters with the target language special characters. The Northern Sami keyboard layout makes it possible to write Northern Sami if the program uses the Unicode standard. However, programming is creating software with typing. If the situation in Sami schools is like Linkola says: Northern Sami is left out because of technical issues, then any kind of typing is not possible in Northern Sami. That is a technical issue that will prevent programming in schools if the input devices do not support the school languages. This can be seen as the linguistic landscape in ICT: for support of the indigenous languages in ICT the linguistic landscape in ICT must be equal for the languages used. This means that the input devices, especially the keyboard, and software must support the languages used. If a school improves the linguistic landscape of ICT, eventually the linguistic landscape of the school will be more equal.



## 4 THE METHODS IN THE SAMI CASE IN OHCEJOHKA

The aim of this study is to find ways to support indigenous languages in the field of computer programming. The main question is: How can we support the indigenous Northern Sami language as a mother tongue when teaching programming in comprehensive school? There are two sub-questions that seek answers to resource problems and teachers' competencies:

Q1a: What kind of support do the teachers in *Ohcejohka* need when teaching programming as it is presented in the Finnish National Core Curriculum?

Q1b: How the current ICT resources should be developed when teaching programming for indigenous people in *Ohcejohka*?

In this chapter I am going to describe the environment and the methods for the Sami Case done in *Ohcejohka* municipality in the spring 2016. This study was done in a small bilingual Finnish municipality in the Arctic. At first this chapter presents the municipality, then the *Ohcejohka* area teachers as the respondents, the statistics of the *Ohcejohka* area schools, the data collecting and analyzing methods.

### 4.1 Ohcejohka area features

*Ohcejohka* is a Finnish municipality locating in the Arctic<sup>12</sup> area in Finland. According to the Arktinen keskus (2016), approximately four million people live in the Arctic area and 10 % of them are indigenous people.

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<sup>12</sup>The area can be defined as the northern part of the Arctic Circle,

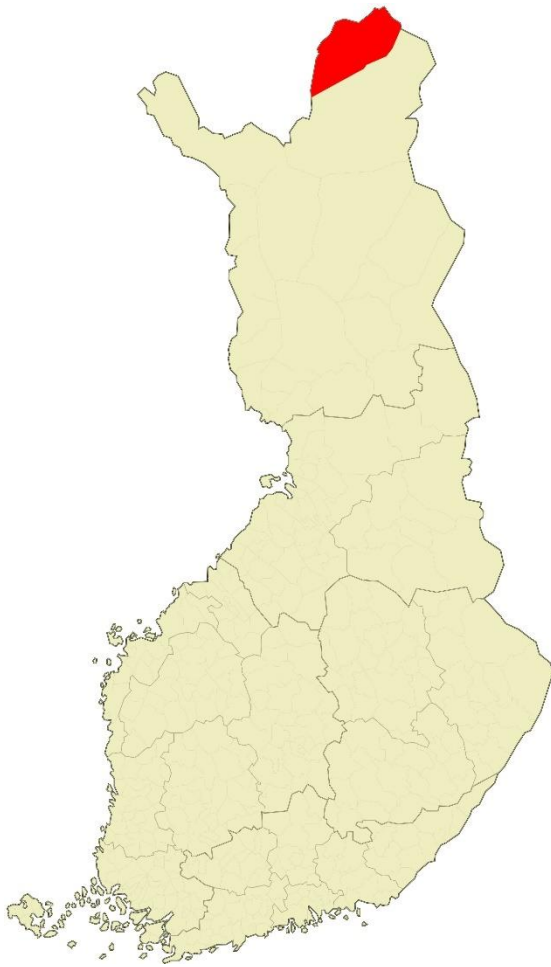


Figure 1. *Ohcejohka* location in the map of Finland. (Wikipedia)

*Ohcejohka* municipality is an independent part of the province of Lapland. The province capital is Rovaniemi. The municipality is limited by the province of Finnmark and the Norwegian municipalities of *Tana* and *Karasjok* in the north. In the South the municipality of *Inari* limits the *Ohcejohka* area.

According to Müller-Wille (1996), the first mentioning of *Ohcejohka* can be traced back to 1517 and 1551 when *Ohcejohka* was referred as a market place where the river *Deatnu* and *Ohcejohka* river meet. The name *Ohcejohka* and its Finnish counterpart *Utsjoki* come both from Northern Sami language. I will use the original Northern Sami name for the majority of Sami inhabitants. In Finland *Ohcejohka* is a part of the Sami domicile area, *Sápmi*. The municipalities of *Inari*, *Enontekiö* and the northern part of the *Sodankylä* municipality are a part of the Sami homeland. *Ohcejohka* is the only municipality where the Sami are the majority; in

other Sami domicile area municipalities the Sami are a minority within the area (Gayim & Myntti 1995).

The municipality was founded in 1876. Municipality area is 5198 square kilometers and it has 0,24 inhabitants per square kilometers.<sup>13</sup> In the year 2011 there was 1294 inhabitants in *Ohcejohka* municipality and 768 (59,4 %) of them were Sami people. Northern Sami has been registered as a mother tongue for 62 % of the children under 10 years in the *Ohcejohka* municipality. At the end of 2011 47,4% of the inhabitants in *Ohcejohka* municipality had registered Northern Sami as their mother tongue in the Finnish Population Information System. The registering of a mother tongue came possible in Finland in the year 1992. (Länsman & Tervaniemi 2012)

#### 4.2 The respondents

The respondents are teachers in *Ohcejohka* area: *Ohcejotnjálmme*, *Njuorggán* and *Gáregasnjárga* schools. I did not make any difference between part-time and full-time teachers when sending the survey. I asked lists of the teachers and their emails from school principals. According to the Chief of Education in *Ohcejohka* and the principal of *Ohcejotnjálmme* school there are 37 teachers altogether in *Ohcejohka* area schools. Number of the recipients was 43 when the survey was sent to every teacher even if they taught only one hour per week or were a substitute teacher at the moment. Number of the respondents was 19 and 16 respondents were full-time teachers.

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<sup>13</sup>[www.utsjoki.fi](http://www.utsjoki.fi)

I asked teachers to respond even though it feels like the survey is not meant for them. It is possible that the part-time teachers did feel that this survey and programming altogether are not their problem and they did not answer.

16 teachers use Northern Sami as a teaching language in *Ohcejohka* area schools; Nine of them answered to this survey. The low answering rate among teachers who use Northern Sami language in teaching can be partially the result of doing the survey only in Finnish language. The language was chosen for two reasons: I did not feel my language competency adequate to translate the survey myself and I thought that the programming and ICT survey would contain words that do not exist in Northern Sami language. Northern Sami teachers can have Northern Sami language as their mother tongue and it might be hard for them to understand the questions; however, the topic is hard for the teachers no matter what the language is. When the essential issue is the programming and Northern Sami language is lacking the proper terms, I did not see it a matter of this study to create the correct programming terminology in Northern Sami. 15 out of 21 teachers who use Finnish as their teaching language answered to this survey.

#### 4.3 Statistics of the Ohcejohka schools

The statistics are based on the information received from Laura Arola, the director of education in *Ohcejohka* municipality. In *Ohcejohka* municipality over 70 % of the students in basic education are studying either partly or completely in Northern Sami language. However, the *Ohcejohka* area schools are not Sami schools; they are Finnish schools with a Finnish curriculum (Keskitalo et al. 2013). The schools are bilingual. The languages in use are Finnish and Northern Sami. For the majority of the Sami in the municipality of *Ohcejohka* I will use Northern Sami terms *Ohcejohka*, *Njuorggán* and *Gáregasnjárga* when I am referring to schools in *Ohcejohka* area in my study.

There are three schools in the *Ohcejohka* area: *Ohcejotnjálmmi* school (Utsjokisuun koulu), *Njuorggán* school (Nuorgamin koulu) and *Gáregasnjárga* school (Karigasniemen koulu). *Ohcejotnjálmmi* school is located in the *Ohcejohka* municipality center. In *Ohcejohka* municipality center there is comprehensive school and the Sámi High School. *Njuorggán* school is located in the *Njuorggán* village in the northern border of Finland. In *Njuorggán* village there is comprehensive school classes 1-6. Classes 7-9 the *Njuorggán* students go to *Ohcejotnjálmmi* school and the distance between the schools is 45 kilometers. *Gáregasnjárga* school is located in *Gáregasnjárga* village. In *Gáregasnjárga* there is comprehensive school. The distance between *Gáregasnjárga* school and *Ohcejotnjálmmi* school is a little bit over 100 kilometers.

The language structure of *Ohcejohka* area schools is presented in table 2.

Table 2. The language structure in *Ohcejohka* municipality schools

School	Students	Finnish education	Sami education	Immersion education
<i>Ohcejotnjálmmi</i>	72	15	50	7
<i>Njuorggán</i>	13	12	1	
<i>Gáregasnjárga</i>	49	8	41	
Total	134	35	92	7

Cultural backgrounds in *Ohcejohka* are not so simple – there are Sami speaking Finnish students, Finnish speaking Sami students, Sami speaking Sami students, Finnish speaking Finnish students and a Northern Sami language immersion group.

The language structure of the teachers is presented in table 3.

Table 3. The language structure of the teachers in *Ohcejohka* municipality schools

School	Teachers	Finnish education	Sami education
Ohcejotnjálmmi	23	16	7
Njuorggán	3	2	1
Gáregasnjárga	11	3	8
Total	37	21	16

Other languages that are taught as a foreign language are Norwegian for the all-Sami students from the first grade on, English from the third grade on and Swedish from the seventh grade on.

#### 4.4 Data collecting methods

I used several data collecting methods between February 2016 and June 2016 that was the active phase in my study. First I made a survey for all the teachers and tried to locate those teachers who were willing to learn programming. After the first survey I used free programming workshops to gather teachers together who were positive about programming. These workshop groups formed the recipients for the second survey: the ideas for indigenous programming in teaching. After the second survey I went through the collected data and decided to interview one of the Sami teachers and ICT support in *Ohcejohka* municipality. During this process I kept researcher's journal.

#### 4.4.1 The Webropol survey

I used Webropol for making a survey for the teachers in the *Ohcejohka* area. Webropol<sup>14</sup> is an online survey making tool that is really easy to use. The survey was made in the beginning of February 2016. First the survey was tested using a test answer generator that is a feature in the Webropol system. I generated 10 test answers and saw that the report was working. After the test answers I reset the survey and sent the survey for evaluation. I chose two teachers outside Ohcejohka area. They evaluated the survey and made correction suggestions to improve the questions. The first survey was open 22.2.2016 – 21.3.2016. It was sent via e-mail to 38 teachers in *Ohcejohka*, *Njuorggán* and *Gáregasnjárga*.

I used one of the Finnish National Board of Education, or Opetushallitus, reports as a base for the survey. Opetushallitus has published (Kankaanranta et al. 2012) a collection of studies “Tutkittua tietoa oppimisympäristöistä – tieto- ja viestintäteknikan käyttö opetuksessa [Researches about learning environments – ICT usage in teaching]” that was edited by Kankaanranta, Mikkonen and Vähähyppä(2012). The report has four parts and one of the parts, “Tieto- ja viestintäteknisten laitteistojen ja ohjelmistojen käyttö opetuksessa [ICT hardware and software usage in teaching]”, had questions that I used in my survey.

The survey was done using Finnish language only. It should have been translated to Northern Sami language as well. The problem was that the survey included terms that do not exist in Northern Sami language and because of the schedule of this study I chose not to translate the survey.

The survey consisted of arguments and open questions. The first four questions were for background information; amount of teaching years, age group, teaching languages and did the respondent have a part-time or a full-time contract.

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<sup>14</sup>[www.webropolsurveys.com](http://www.webropolsurveys.com)

The fifth question had 31 arguments for the respondents to evaluate. The evaluation scale was 1-5 where 1 meant “Completely disagree” and 5 “Completely agree”. The third option was “I do not know”. I had a feeling beforehand that the skills levels in ICT are not so high among the teachers in *Ohcejohka* schools. I wanted to include the third option if the respondent does not understand the question or cannot quite evaluate that specific argument.

The sixth question was a check-in box matrix. It was possible to check in all the options or none of them. 19 teachers answered in every statement and some of the teachers’ check-in more than one option per statement. The statements were student administration programs, equipment and materials, office software, desktop computer, laptop computer, video projector, smart phone, tablet, network-based learning environment, smartboard, multimedia tools, educational software, learning games, software for simulation and 3D modelling. Most of these statements were in Opetushallitus’s national report of the usage of ICT in teaching and I used the national results for baseline (Kankaanranta et al. 2012). I added a few statements like laptop computer, desktop computer, video projector and smart phone and removed the statement ‘mobile devices’. I changed the statement ‘touch board’ to Smartboard.

The seventh question was “Do you want on-the-job-training?” and the options to check off were “programming”, “information and communication technology”, “something else, what?” and “I do not need training”.

The eighth question was about the training method; how would the respondent like to have the on-the-job-training? The check-in options were “local teaching”, “distance teaching” and “both”.

The last question was an open feedback field if the respondent wanted to give feedback or specify an answer.

Not one of the questions was mandatory. All 19 respondents answered to first eight questions. Eight teachers answered the last feedback question. The survey is in appendix 1. in Finnish.



#### 4.4.2 The workshops

After the survey was closed I organized computer programming workshops in *Ohcejohka* and *Gáregasnjárga*. The purpose of these workshops was to give the teachers basic information about computer programming according to the National Core Curriculum. These workshops were offered as a thank you for the teachers who replied the survey. Attending was not mandatory. Eight voluntary teachers from *Gáregasnjárga* and 10 from *Ohcejohka* and *Njuorggán* attended. The teachers had the option to decide how many workshop sessions they wanted: in *Ohcejohka* there were four different workshops and in *Gáregasnjárga* there was one workshop. One workshop session lasted approximately two hours except in *Gáregasnjárga* where the one workshop lasted four hours.

There was no other data collected in the workshops than list of participants and their e-mail addresses. The purpose of these workshops was merely educational. I kept these workshops myself because I wanted to meet the teachers in person and give something in return of answering my survey. However, the teachers had a chance to use Moodle<sup>15</sup> learning platform during the workshops. It was possible to return any ideas through Moodle platform. One of the teachers returned a programming example using Moodle platform. In the Moodle platform there were all the Sway presentations and some extra material for the teachers. For example, if the teachers asked about graphical programming, I could link some options to Moodle and they could see them there. The point using the Moodle platform was that the teachers have a programming library of their own when the new curriculum is in use.

The structure in these workshops was the same in the first two sessions *Ohcejohka* and the session in *Gáregasnjárga*. I had prepared three Microsoft Sway presentations for the teachers: first Sway was about programming in the

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<sup>15</sup>Moodle is a free open-source learning management system.

National Core Curriculum and what does it mean, the second Sway presented the results of the survey in *Ohcejohka* schools and the third Sway explained the basic terms in computer programming. The teachers in *Ohcejohka* wanted to continue after the first two workshops; the third and the fourth workshop session was kept in a computer classroom in *Állegas centre, Ohcejohka*. The teachers had an actual chance to try out computer programming using different visual programming languages such as Scratch or Microsoft Kodu.<sup>16</sup> The teachers in *Gáregasnjárga* workshops did not want to continue programming in the spring 2016; instead they suggested a programming group for the teachers in the fall 2016.

#### 4.4.3 Other data collecting methods

In May 2016 I made a completing survey for the teachers who attended to workshops. In this completing survey I wanted to see if the teachers had any ideas about teaching programming as a part of any other subject. The questions were: “How are you going to teach programming as a part of your discipline”, “Ideas for teaching programming in Northern Sami” and “Ideas for teaching programming in Finnish”. The fourth question was again an open feedback field if the teachers had any questions, comments or any other feedback for the matter.

Nine out of 18 teachers replied to this completing survey. The completing survey was done in Finnish only and the platform used was Google forms. This survey did not make any difference in the language of the respondent. It was possible to answer in every question; I thought that even if the teacher would not teach in

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<sup>16</sup>A visual programming language especially for making games, created by Microsoft.

Northern Sami, he/she could still have some ideas of teaching programming in Sami language.

After reading through the results in the Webropol-survey and the completing survey I decided to do e-mail interviews about Northern Sami language and technical issues regarding ICT usage in teaching. Both of these e-mail interviews was made in Finnish language for I am not competent to write about programming and ICT issues in Northern Sami. Both of the recipients accepted to answer in Finnish. I chose one of the Sami teachers who had been attending to the programming workshops as a respondent. The teacher replied using e-mail and the questions are in the appendix 3. The other e-mail interview was sent to ICT support in *Ohcejohka* municipality. The questions are in the appendix 2. ICT support answered using e-mail.

I also used my researcher's journal as a material. I used Microsoft OneNote Online to save all the important numbers, dates and discussions.

#### 4.5 Analysis

This case study was made in *Ohcejohka* municipality in the spring 2016. I analyzed the material from an ethnic point of view; Computer programming in comprehensive school curricula is generally problematic in Finland because there is no previous common knowledge of teaching programming. However, indigenous people and ethnic minorities are easily forgotten when making educational decision for majority. There is need for a public discussion about programming in basic education from an ethnical point of view. This is the reason why I do not look at the computer programming as a part of basic education in general. I limit my study with my research questions: this is a study about the ways to support indigenous programming and what still needs to be done for

equal chances to everyone to learn programming at school. I am not looking ways to support computer programming in Finnish language; although a way that supports Northern Sami in computer programming can be seen as a supportive method in other languages too. I am leaving out all-Finnish methods of teaching programming and pre-school programming for they are not essential for my study.

The data collected was divided into three theme categories: the ways to support *ethnoprogramming* in *Ohcejohka* schools, the problems unsolved and the teachers' competencies. These categories had subcategories: *ethnoprogramming* class could be divided into ways to support early education, classes 3-6 and classes 7-9. The teachers' competencies category had two subcategories: strength and weaknesses.

I read the collected data thoroughly the first time when I had the responses to two surveys. I decided to collect more data in that phase. The final analysis was done when I had all the material collected: the two surveys and two e-mail interviews. I underlined the essential words or phrases and divided into theme categories creating a theme table. I used mind mapping to find out correlations between issues. Final interpretation was based on the theme table and mind mapping.

## 5 RESULTS

There was one main research question and two sub-questions in this study. The main question was about supporting an indigenous language in programming: How can we support the indigenous Northern Sami language as a mother tongue when teaching programming in comprehensive school? The sub-questions focused to finding out the teachers' competencies: are they in need of support when teaching programming or can they figure this out themselves and how should the ICT resources be developed to support indigenous programming.

The results were two-folded: on the one hand, there were ways to support *ethnoprogramming* in teaching and on the other hand there were some major issues preventing the further development of *ethnoprogramming* in *Ohcejohka* area schools. The teachers felt that they need more training in programming and pedagogical support of using ICT in education and the more specific results about the usage of hardware backed up the teachers' feelings.

### 5.1 The competency of the teachers

There were 19 respondents in the first survey and most of the recipients were over 41 years old experienced teachers. The table 4. shows the teaching experience of the respondents and the table 5. shows the age distribution of the *Ohcejohka* area teachers.

Table 4. Teaching experience of the teachers

	1-3 years	4-6 years	7-10 years	over 10 years
Teaching experience	6	2	1	10

Table 5. Age distribution of the teachers

	under 30 or over 65 yrs	31-40 yrs	41-50 yrs	51-65 yrs
Age group	3	3	5	8

16 recipients were full-time teachers. 15 recipients teach using Finnish, nine used Northern Sami, three used English and two recipients used other languages. Four recipients did not use Finnish in teaching at all.

Programming results were as suspected: 13 teachers think that they are not competent to teach programming according to the new core curriculum. 14 teachers have never taught programming.

The National results were significantly different than the results in the *Ohcejohka* case if the usage of ICT is compared. The Opetushallitus study was done in the year 2012 so it is already four years old study. It is still necessary to see what the ICT usage in *Ohcejohka* Schools is if we are thinking the current stage analysis and the training needed. In the classes 1-2 it is possible to teach programming without computer and use only equipment. In the classes 3-6 you can teach programming for example using learning games, network-based learning environment, educational software, 3D modeling, laptop computer, desktop computer, video projector and office software. In the classes 7-9 where there are one or more real programming languages to teach according to the Finnish National Core Curriculum (2016), the ICT needed in teaching are at least laptop

or desktop computer, video projector and 3D modeling. The comparison between the National results and *Ohcejohka* results are presented in the table 6.

Table 6. The comparison of the results.

	The national results in the year 2012.	The results of the ICT usage survey in Ohcejohka schools (2016)	Teachers who use Northern Sami language in teaching
(%) Uses ICT daily	52 %	16 %	17%
(%) Uses ICT weekly	31 %	24 %	20%
(%) Uses ICT regularly	83%	40%	38 %

The table shows that the teachers in *Ohcejohka* do not have routines of using IT in education. It also shows that the teachers who use Northern Sami language in teaching, use slightly less ICT in teaching than an average teacher in *Ohcejohka*. Nine teachers have answered to question:” Using ICT in education as it is mentioned in the national core curriculum is hard” the option “I cannot say”. 15 teachers see that ICT fits the way they are teaching but only three teachers use ICT on a daily basis. Eight teachers use ICT in education regularly; ICT usage on a daily or weekly basis can be seen as regular using.

If we look at the results of the teachers who use Northern Sami language in their teaching more carefully, the problematics in ICT can be seen. In figure 2. can be seen the equipment, services and hardware that the Sami teachers use.

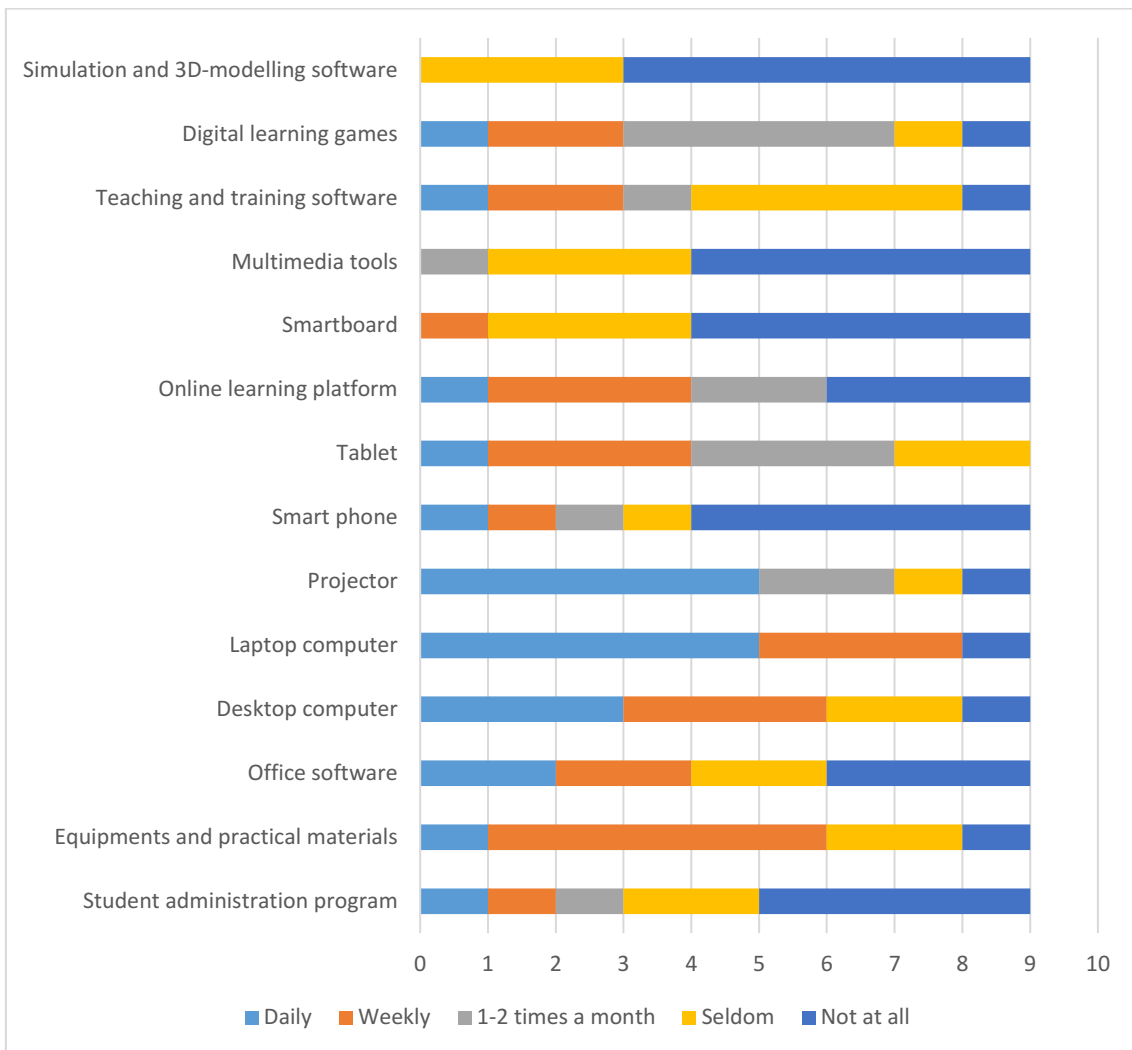


Figure 2. ICT the Sami teachers use in their education

There are 16 teachers who use Sami in their teaching. Nine of them answered to the survey. The Sami teachers use a laptop computer and a projector the most; however, over half of the Sami teachers do not use student administration program, smart phones, smartboard, multimedia tools and simulation and 3D-modelling software at all. One reason for poor ICT usage in education could be the state of the hardware and the availability of ICT support; 16 teachers say that that lack of support and the condition of the hardware in schools affect their will to use ICT in their teaching. 15 teachers feel that they need pedagogical support in using ICT in education. One teacher, that was interviewed via e-mail, said that



the reason for not using ICT in education was the lack of Northern Sami support in computer programs. This may be true: The Finnish language law requires the employees of the *Ohcejohka* municipality to communicate both in Finnish and in Northern Sami (Finlex 2003). A student administration program can be used sending messages to the guardians of the children: if the platform does not support Northern Sami language, the teachers have to choose between breaking the law and not using the system. This is a problem that can be approached through ethnocomputing and *ethnoprogramming*; Ethnocomputing considers the users outside the western culture (Tedre 2002) and *ethnoprogramming* increases knowledge among programmers and software developers.

There was a section in the survey where I asked the respondents to evaluate following 30 statements on a 5-point scale. The purpose of these statements was to evaluate the attitudes towards programming and ICT usage in teaching in *Ohcejohka* schools. None of the respondents completely agree to understand what programming means in the new core curriculum. Eight teachers think that they partially understand what programming means in the new core curriculum and six do not understand the meaning of programming at all. 15 of the teachers agree completely or partly that they want to study programming and none of the respondents partially or completely disagree with the statement 'I think it is necessary to teach programming'.

None of the teachers have taught programming before during their career and as it was mentioned earlier, most of these responded teachers have been teaching over ten years.

## 5.2 Supporting indigenous languages in programming

In the survey I wanted to see if the teachers find their language competencies adequate and do they have to translate any learning materials during lectures. 16 respondents find partly or completely their language skills adequate. However, 13 say that they have had to translate learning material from one language to another during lectures. Only 4 teachers completely or partially disagree with the translation statement.

Teachers brought up several ideas to teach programming in cultural conscious ways. However, some of the ideas are easier to fulfill than others. Teachers saw that they are still inadequate to teach programming and they need more training. Teachers also thought that programming should not be any different in Northern Sami than it is in Finnish. It is a wish for equality.

Some of the teachers replied that programming will be a nice adding to regular classes. They feel that programming will spice up the classes and make the subject more interesting for the teacher and the students. Almost all teachers still said that they need more training.

### 5.2.1 Early education, classes 1-2

Some of the teachers have a clear vision of teaching programming in the fall 2016. Especially in the answers of the lower grade teachers can be seen several ways to take programming and logical thinking as a part of teaching. Lower classes can learn logical thinking and programming as a part of play and games. The following example is from one of the programming workshops and

it was returned via Moodle as an example of teaching programming in early education. The example is translated but the picture is as it was sent.

*Building blocks*

- *programmers: 5-6 students (pre-school – 2<sup>nd</sup> grade) and teacher*
- *wooden building blocks needed (already are in the classroom):*
  - *3 blue and red cubes*
  - *3 blue and red right angle prisms*
- *other aim: learn to use the right names for geometric objects*
- *Students build a tower of blocks behind a visual barrier (for example inside a copy paper box)*
- *Teacher has a set of similar wooden building blocks. Students guide him/her to build a similar tower.*
- *Teacher understands only the following commands:*
  - *grab with your hand*
  - *put in front/on top/behind/*
  - *next to right/next to left/in the center/*
  - *on the right side/on the left side*
  - *blue/red*
  - *cube and right angle prism*

*You can change parts and everyone can have their turn to be the one following the orders. After the idea is learned, it is possible to add more forms and colours.*

*Example block tower in the picture. (Figure 3.)*

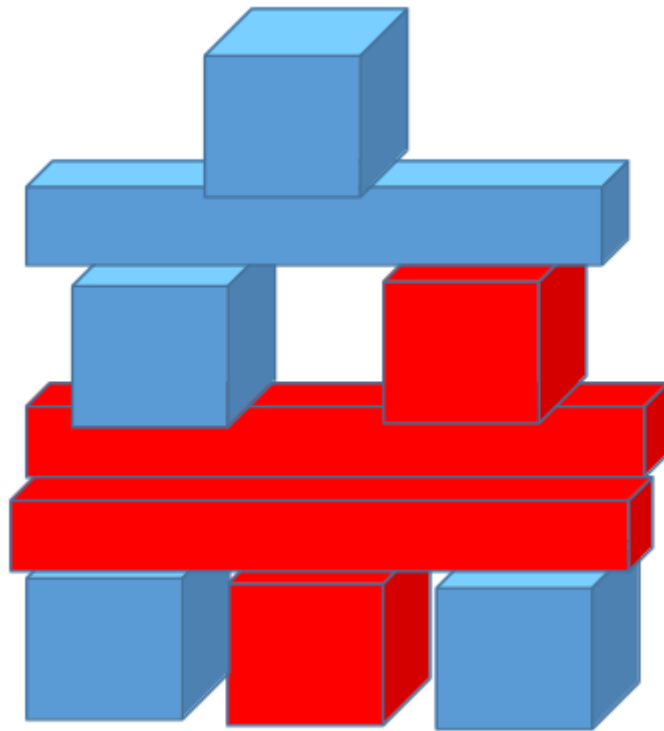


Figure 3. Example tower of the building block programming exercise

This kind of programming exercise can be done in any language and it combines mathematics and logic teaching to Sami pedagogy through the Sami language. The programming demands in The Finnish National Core Curriculum were “The pupils gain and share experiences of working with digital media and age-appropriate programming tasks.” and “The pupils begin familiarizing themselves with the basics of programming by formulating and testing step-by-step instructions.” This task fulfills the demands and is possible to integrate in Sami teaching. (The Finnish National Core Curriculum 2016)

This example above was the only example given via Moodle platform. The other examples are collected from the survey done after the programming workshops. There were open questions about teaching programming in the survey: do the teachers have any ideas of supporting Sami language in programming or Finnish language in programming.

One example of programming that was mentioned in the survey was giving driving instructions to someone. It combines logical thinking and dividing a problem into pieces:” first you drive straight, then you turn left, then...” Driving instruction exercise and the building block exercise do not use any technical terms of programming; however, it is possible to merge the terms in this kind of exercise. Giving driving instructions is common to all cultures in some form. However, this is not programming, this is teaching logic and logic is needed in programming.

The teachers who teach the early classes had the clearest vision about programming as a part of their classes. One of the teachers responded in the survey that the programming fear has lifted. One teacher had found the programming games for illiterate children from code.org and planned to use them as a part of the teaching.

### 5.2.2 Classes 3-6

The essential issues regarding programming in this age group were programming in graphic programming environments, understanding how decisions made by people affect the way technology works, robotics and automation. The survey brought up one good example of bringing programming as a part of other classes: a programmable sewing machine. Programmable sewing machine brings programming as a part of craft teaching. In indigenous cultures traditional crafts have an important role and according to Sami pedagogy the traditional knowledge and language has passed on when making crafts. For Sami languages crafts are a strong language environment (Länsman & Tervaniemi 2012). Bringing programming as a part of crafts teaching in a form of a programmable sewing machine does not form a threat to indigenous language. However, it will bring

some technical terms as a part of crafts class. It is essential for *ethnoprogramming*: combine something old and something new.

One teacher had an idea of combining literature teaching and programming. In the example the teacher thought to combine the terms of narrative literature (person, plot or milieu) to programming project. In this project it would be possible to practice writing and the terms of narrative literature when creating a game story. It would be possible to get to know a language as a phenomenon.

Nevertheless, the results in this group were flat. A sewing machine can be used to demonstrate how machinery works and how a person may affect to machinery. It can demonstrate automation. Still if we think the possibilities of programming that Finnish children have: they can, for example, program in a graphic environment in their own language because the most popular graphic programming platforms are available in Finnish. None of the teachers had ideas how to fulfill the graphical environment programming or robotics.

### 5.2.3 Programming using an actual programming language, classes 7-9

According to The National Core Curriculum, this is the hardest group when teaching programming. Programming is practiced as a part of the studies of different subjects and it should combine mathematics, programming and algorithmic thinking in problem solving. Pupils learn good programming practices and use embedded systems in crafts. Any real examples to this kind of programming did not come up in the results. No teacher is competent to teach real programming. The problems preventing *ethnoprogramming* seem to escalate in this group. The results show the factors that are preventing *ethnoprogramming*:

1. The keyboards use Nordic layout<sup>17</sup> preventing the typing without Sami keyboard layout. It has to be installed before it can be used. It is possible to select the Sami languages as the default keyboard layout; however, the actual keyboard is Nordic. When a student learns to type Sami languages with a Nordic keyboard, he/she has to memorize the special keys. Eventually typing becomes automatic but in the learning phase it is difficult to know where the keys are when there is not the actual symbol printed in the key.

The letter Y is problematic when using the North Sami keyboard layout: you have to switch to Finnish layout just to get the letter Y and then switch back to Northern Sami layout to get the special characters. All in all, it can be said that the current keyboard layout system does not support typing in Sami, or any other small or indigenous language.

The lack of the actual keys in the keyboard makes the usage of Sami languages in passwords almost impossible. Although the Sami special characters can be used to form stronger passwords because the special characters are harder for computer to calculate and break.

2. Computer programs do not support typing in Sami languages. For example, the system in the Finnish matriculation examination does not support Sami languages. It has been possible to write the matriculation examination in Sami languages since 1994. Sami teachers say that they will not use ICT in teaching if it does not support Sami—it is just too complicated.
3. The resources are inadequate. Some of the teachers said that it would be really interesting to teach programming using for example a programmable sewing machine but there are not resources to purchase a suitable

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<sup>17</sup>Nordic layout is a keyboard with Finnish, Swedish and Norwegian keys. All the Sami languages are missing although the Sami area *Sápmi* is in all of these countries

machine. 3D printers or programmable cutters cost and the schools cannot afford new machinery.



## 6 DISCUSSION

In this chapter, I am going to present the model of *ethnoprogramming* and two examples. The actual code in *ethnoprogramming* examples can be unreadable to western computer scientists. *Ethnoprogramming* is not threatening the Lingua Franca position English language has in computer science. The idea is to reach those students who see the English-based programming terms as abstract symbols, not words.

### 6.1 The model of ethnoprogramming

The results in the Sami case in *Ohcejohka* show some elements for supporting *ethnoprogramming* in teaching. However, there are some major issues to solve if there is a common will to support *ethnoprogramming*. I used mind mapping to find the correlations between the problems: the essential issues interlock in the *ethnoprogramming model* (Figure 4.).

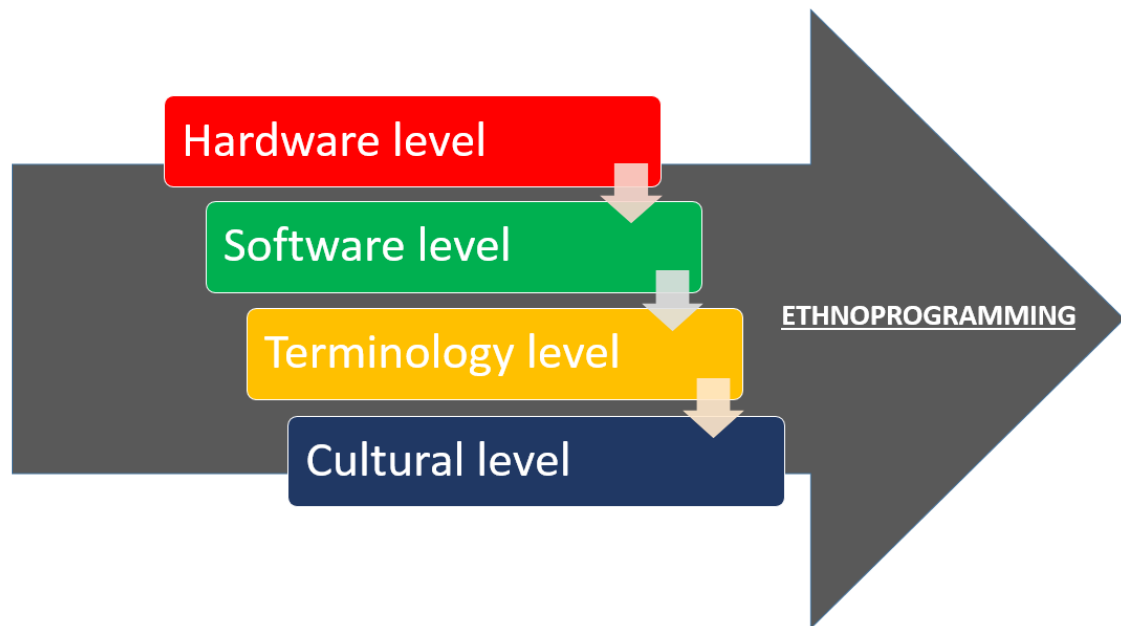


Figure 4. Ethnoprogramming model

The idea in the *ethnoprogramming model* is that if the first level does not exist, then the rest of the levels cannot exist alone and support programming in a cultural context. The first level is the hardware level. The surveys and interviews brought up several issues concerning hardware: the lack of keyboards in the right language, the condition of the hardware and the lack of ICT support. Hardware level contains all the hardware issues needed for *ethnoprogramming*. As an example of the hardware level, typing is easier when keyboards are in the right language. This can be solved using E-Ink keyboards, morphic keyboards that adapt the keyboard keys to user's language.

The second level is the software level. The results of the surveys and interviews revealed severe issues in software design. Finnish Language Act (Finlex 2003) determines that Sami have the right to use their language in the Sami area municipalities. *Ohcejohka* has the Sami majority. This means that school must provide information to school systems in both languages: in Finnish and in Northern Sami. If the learning management system used does not support Northern Sami as a language, it means that *Ohcejohka* is not following the

Language Act or the learning management system cannot be used. Software level is a combination of two things: the software used in the right language and software design that considers ethnic users. This means that the essential programs need to be translated and the existing programs must support indigenous languages. Technically this is possible already by using UNICODE character support in programming; the correct consciousness is lacking.

Together the hardware level and the software level form the linguistic landscape of programming that technically supports the language of the user: it makes typing fast possible in new media platforms. These two levels include the adequate resources obtaining necessary hardware and software and in ICT support needed for these two levels.

The third level is the terminology: programming includes plenty of technical terms. Minna Kamppuri (2011) says in *Theoretical and Methodological Challenges of Cross-Cultural Interaction Design* that when we are planning to design technology to a particular cultural context, the dilemma is to fit the technology to existing values (Kamppuri 2011) In terminology this means a solution of translating the terminology: How much is needed to translate and what should remain as it is? However, there is a need for terminology in *ethnoprogramming* and it should be understandable to the teacher and the student. At the moment, the Sami teachers do not have any kind of programming terminology in Northern Sami available.

The fourth level is cultural level. Duveskog taught programming in Tanzania and realized that when English is not the teachers or the students' mother tongue, it makes teaching programming difficult (Duveskog 2004). The best results in *ethnoprogramming* can be achieved when the teacher and the students speak the same language and the small indigenous language speakers do not have to speak the language of the majority. Language is one aspect of the culture. The actual teaching must fit to the knowledge of the students: The programming examples must be that kind of problems that the students see as a problem. In indigenous cultures the problems can be related to nature; the weather for example can prevent traditional chores completely. *Ethnoprogramming* should be

taught on cultural basis. The following examples show that programming is possible in a cultural context.

## 6.2 Ethnoprogramming examples: Northern Sami

Programming is all about learning a new language. The language of programming is usually English despite the programming language used. If English is not the student's native language, it is logical to use the student's native language together with the English language in a learning situation (Bühmann & Trudell 2008).

There was a C++ programming example in the chapter 2.3 that did not work because of the special characters in Northern Sami language:

```
#include <iostream>  
  
using namespace std;  
  
void čálihít(string str) {  
cout << str << endl;  
}  
  
int main() {  
čálihít("Čieđđá");  
return 0;  
}
```

The syntax of the C++ programming language does not contain Sami language characters despite the language has the UNICODE support. There are some

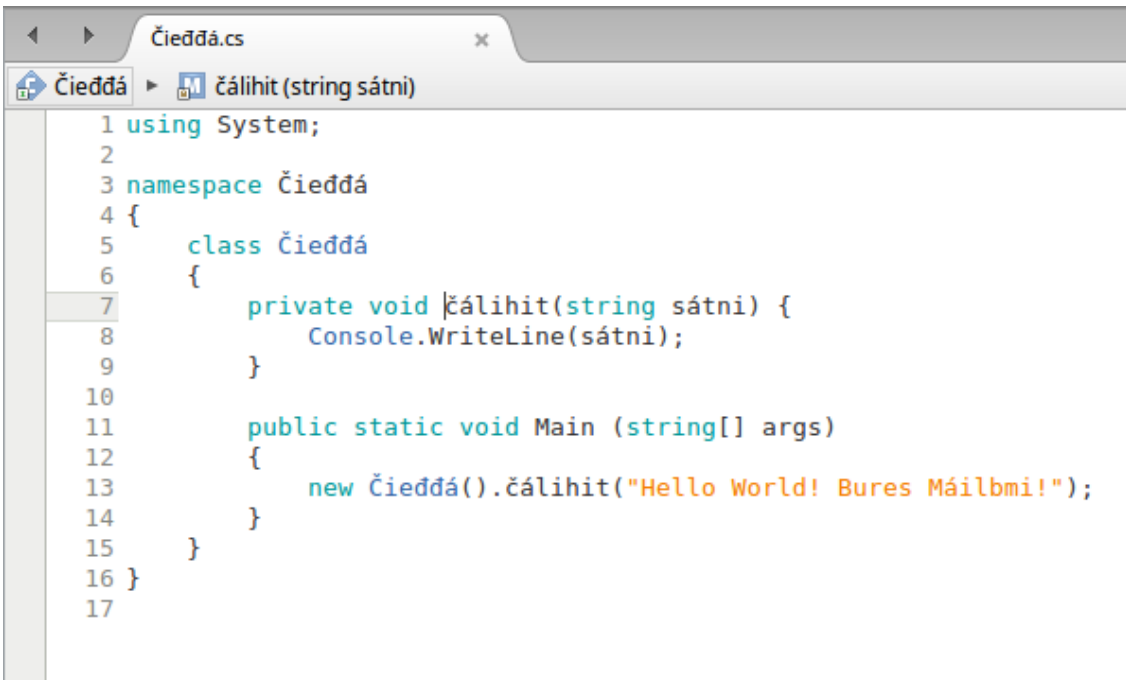
programming languages with the UNICODE support: *Java*, *C++* and *C#* for example. However, the support may be limited. If the same example is tested with *Java*, that is another popular programming language, the program works:

```
public class Čieđđá {
    private static void čálihít(String str) {
        System.out.println(str);
    }
    public static void main(String[] args) {
        čálihít("Čieđđá");
    }
}
```

*C#* supports special characters in variables, procedures and functions: the example program works. There are programming languages can be used with Northern Sami language or any other language using special characters like Finnish and Swedish. It is logical to use the student's native language together with the English language in learning situation and programming in a school context does not need to be the exception. However, this kind of programming requires that the teacher not only knows the programming language but the indigenous language as well.

Usually the first program that a programmer does is the "Hello world"-program. It prints to the screen a "Hello world" - text. There had to be used more complex programming on these examples because we wanted to know, could a procedure, a variable, or a function be named using Sami languages.

In Figure 5. there is an example of a Hello World-program. The program is done using *C#* and Northern Sami language in variables and functions.



```

1 using System;
2
3 namespace Čiedđá
4 {
5     class Čiedđá
6     {
7         private void čálihit(string sátni) {
8             Console.WriteLine(sátni);
9         }
10
11         public static void Main (string[] args)
12         {
13             new Čiedđá().čálihit("Hello World! Bures Máilbmi!");
14         }
15     }
16 }
17

```

Figure 5. An example of a Hello World-program using C#, Northern Sami and English languages (code: Sauli Sarre, CC BY-NC-SA 4.0).

If a programmer would use only the English language, the word *čálihit* would be 'write', and *Čiedđá* would be whatever you want the program to print out. In this case *Čiedđá* means a light of dawn, and it was picked out for this example just because it contains three of the special characters.

There are non-English-based programming languages that are based entirely on special characters. Northern Sami can be integrated to English programming but there are real languages that cannot be integrated: they need a programming language of their own. This paper presents one non-English-based programming language, the Arabic Heart.

### 6.3 Arabic قلب programming language

Another example is قلب, or “heart” in English, the programming language developed by Ramsey Nasser [16]. Programming with the قلب language can be done all in Arabic. It challenges the monocultural nature of programming and the ASCII character set normally used. Nasser has created several algorithms with قلب, for example, an algorithm that calculates the Fibonacci sequence. A Hello World-program can be done all in Arabic using the heart; there is the print-command قول and then the Hello World-phrase:

قول "محب ابي علم!"

Raymond Nasser sees the programming from an *ethnoprogramming* point of view: programming languages, libraries, and APIs used may be out of reach to those cultures whose alphabet are not Latin-based. Nasser’s programming languages is more than functional: it is visual (Nasser 2016).

## 7 CONCLUSIONS

The aim of this study is to find ways to support indigenous languages in the field of computer programming as it is presented in the National Core Curriculum. The main research question was: How can we support the indigenous Northern Sami language as a mother tongue when teaching programming in comprehensive school? It can be said that this research found some ways to support indigenous language in teaching programming. There are ways to teach programming in lower classes and support indigenous language and culture. However, the lower class teaching was mostly logic activities without computers. According to the programming demands presented in the table 1. these logic exercises can be used in teaching the classes 1-2. In the classes 3-6 there were two ways to teach programming: a programmable sewing machine and an idea to teach literature using programming. However, this does not fulfill the National Core curriculum demands completely. The graphical programming environments are lacking in the classes 3-6 group and none of the teachers had any ideas how to teach robotics.

As significant were the findings preventing indigenous people programming, computing or even accessing new media platforms. The sub-question was: How the current ICT resources should be developed when teaching programming for indigenous people in *Ohcejohka*? According to the *ethnoprogramming* model presented in the discussion section, indigenous programming needs support in four different levels: hardware level, software level, terminology level and cultural level. Hardware and software levels include the adequate resources and support for using the hardware and software in the school context. Technically it is possible already to create equal environments for computing. When the technical level is achieved, the software level can be fixed to respond the world languages.

The other sub-question concerned the competencies of the teachers: What kind of resources do the teachers in *Ohcejohka* need when teaching programming as it is presented in the Finnish National Core Curriculum? Results showed that the



teachers in *Ohcejohka* do not use ICT in teaching regularly. The condition of hardware, the lack of support for Northern Sami language, lacking ICT support, inadequate skills among the teachers and the lack of pedagogical support are the cause for minimal ICT usage in *Ohcejohka* area schools. The teachers will need extra education in programming and pedagogy and technical support when they start teaching according the new curriculum. The schools in *Ohcejohka* area need more resources to get the hardware needed as the UNESCO Institute for Information Technologies in Education report (2011) already recommended. The issues preventing indigenous ICT and programming today are more political than technical: indigenous schools need adequate resources for fixing the linguistic landscape in ICT. The report suggested that these indigenous schools could be developed as technology center for the community and that could be one way to approach this problem. The supporting indigenous technology would not be only for the school but the whole community. (UNESCO 2011).

If we want to see a new generation of computer programmers who blur the borders of language, gender and culture, the ethnic side of computing needs to be researched and discussed. It would be interesting to see what the learning results in *Ohcejohka* schools will be if there were for example E-Ink keyboards in use and how does the *ethnoprogramming* model work in practice.

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## Appendix 1. The Webropol survey in Finnish

### Kartoituskysely: Ohjelmoinnin opettamisen valmiudet ja koulutustarpeet Utsjoen koulujen perusopetuksessa.

Ohjelmointi tulee opetussuunnitelmaan vuonna tänä vuonna. Ohjelmointi kuuluu laaja-alaiseen opetukseen, joten kaikilla opettajilla on vastuu ohjelmoinnin opettamisesta. Ohjelmoinnin opetusta on nyt runsaasti tarjolla esimerkiksi verkko-opetuksena. On kuitenkin jonkin verran eroa sillä, opetetaanko ohjelmointia Helsingissä tai vaikkapa arktisilla alueilla saamelaisemmistöisissä kunnassa.

Olen Outi Kaarina Laiti ja opiskelen Lapin Yliopiston maisteriohjelmassa pääaineenani mediakasvatus. Pohjakoulutukseltani olen tietotekniikan insinööri suuntautumisvaihtoehtonani mediaviestintä. Käytän kyselyn vastauksia Pro Gradu-tutkimuksessani sekä laatiessani koulutusta. Vastaamalla kyselyyn annatte suostumuksenne käyttää vastauksia tutkimuksessani sekä koulutuksen laadinnassa.

Teen kehittämistutkimusta ohjelmoinnin opetuksen käynnistämisestä Utsjoen kouluissa. Pyydän teitä vastaamaan nimettömään kyselyyn ja edistämään tutkimustani. Vastaaminen ei vie kuin lyhyen aikaa ja auttaa kartoittamaan koulutustarpeita sekä muita valmiuksia uuden opetussuunnitelman käyttöönotossa.

**Kysely on tarkoitettu kaikille opettajille ja toivon, että mahdollisimman moni teistä vastaa. Kyselyn perusteella teillä on mahdollisuus saada juuri teille räätälöityä koulutusta ohjelmoinnista perusopetuksessa .**  
Kiitos!

#### 1. Montako vuotta olet opettanut? \*

- 1-3 vuotta
- 4-6 vuotta
- 7-10 vuotta
- Enemmän kuin 10 vuotta

#### 2. Mihin seuraavista ikäryhmistä kuulut? \*

- |          | Alle 30-vuotiaat      | 31-40-vuotiaat        | 41-50-vuotiaat        | 51-64-vuotiaat        | 65 vuotta täyttäneet  | En halua vastata      |
|----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Ikäryhmä | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

#### 3. Opetatko päätoimisesti vai sivutoimisesti? \*

- Päätoimisesti
- Sivutoimisesti

#### 4. Mitkä ovat opetuskielisi? \*

- englanti
- norja

- saame
- suomi
- Joku muu, mikä?

5. Arvioi seuraavia väittämiä omalta kohdaltasi: \*

	Täysin eri mieltä	Jokseenkin eri mieltä	En osaa sanoa	Jokseenkin samaa mieltä	Täysin samaa mieltä
Ohjelmoinnin opettaminen on mielestäni tarpeellista	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Haluan opiskella ohjelmointia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Olen joskus opettanut ohjelmointia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minulla on riittävät valmiudet opettaa uuden opetussuunnitelman mukaisesti ohjelmointia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ymmärrän, mitä ohjelmoinnilla tarkoitetaan uudessa opetussuunnitelmassa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Koen kielitaitoni riittäväksi opetukseen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Olen joutunut kääntämään opetustilanteessa oppimateriaalia toiselle kielelle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opetuskielellä on vaikutusta oppimistuloksiin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tietotekniikan opetuskäyttö tapahtuu tietokonehuokassa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tietotekniikan opetuskäyttö tapahtuu omassa huokassa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tietotekniikan opetuskäyttö edellyttää käyttövuoron varaamista	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minulla on mahdollisuuksia vaikuttaa kouluni tietotekniikan hankintoihin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
En ole saanut käyttöni tarvitsemiani tietotekniikan välineitä	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saan riittävästi teknistä tukea tietotekniikan käyttöön	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Käytössäni olevat laitteet ja ohjelmistot toimivat toimivat hyvin yhdessä	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Laitteiston kunto ja tukipalvelujen saatavuus vaikuttavat suhtautumiseeni tietotekniikan käyttöön opetuksessa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Tietotekniikan käyttö sopii opetustyyliini	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Käytän tietotekniikkaa, jotta oppilaat oppisivat käyttämään modernia teknologiaa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tiedän, millaisiin opetus-/oppimistilanteisiin tietotekniikan käyttö soveltuu	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Osaan valmistella tunteja, joilla oppilaat käyttävät tietotekniikkaa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kykenen löytämään Internetistä hyödyllisiä opetussuunnitelmaresursseja	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Osaan asentaa opetusohjelmia tietokoneelleni	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tarvitsen pedagogista tukea tieto- ja viestintätieteiden käyttöön opetuksessani	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saan oppilailta ideoita tieto- ja viestintätieteiden käyttöön opetuksessani	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Koulussani ei ole helppo lähteä kehittämään uusia uusia toimintatapoja	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saan muilta opettajilta tukea omiin tieto- ja viestintätieteiden opetus käytön toimintatapoihini	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Työyhteisöni ilmapiiri on myönteinen uusien asioiden kokeilemiseen opetuksessa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Olen saanut riittävästi koulutusta tietotekniikan käytöstä	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tietotekniikan hyödyntäminen opetussuunnitelman mukaisesti on vaikeaa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tunneillani tietotekniikka tukee opetettavan sisällön opetusta	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kokeilen uusia asioita tunnilla	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### 6. Kuinka usein käytät allaolevia laitteita ja sovelluksia opetuskäytössä? \*

	<input type="radio"/>	<input type="radio"/>	1-2 kertaa Päivittäin Viikottain kuukaudessa	<input type="radio"/>	En Harvemmin ollenkaan
Opiskelun hallintajärjestelmä	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Välineistö ja käytännön materiaalit (soittimet, kuvataiteen tarvikkeet, piirtoheittimet, laskimet, laboratoriovälineet...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yleiset toimisto-ohjelmat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pöytätietokone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kannettava tietokone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Videoprojektori	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Älypuhelin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tabletlaitteet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Verkko-oppimisympäristö	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Älytaulu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multimediatuotannon työkalut	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opetus- ja harjoitusohjelmistot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digitaaliset oppimispelit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Simulaatio- /mallinnusohjelmat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 7. Haluatko koulutusta? \*

- Ohjelmoinnista
- Tieto- ja viestintäteknikasta
- Jostakin muusta, mistä?
- En mielestäni tarvitse lisäkoulutusta

### 8. Haluaisitko koulutuksen mieluiten:

- Lähiopetuksena
- Etäopetuksena
- Sekä lähiopetuksena että etäopetuksena

### 9. Haluatko tarkentaa vastaustasi johonkin kysymykseen tai kommentoida?



Appendix 2. A Sami teachers E-mail interview questions.

1. In which programs Northern Sami language can be used in teaching? Is there any?
2. In which programs Northern Sami language cannot be used in teaching? Wilma (learning management system)? Electronic matriculation exam?
3. If there was a keyboard that has Northern Sami support, would it be helpful? To compare, now there are Finnish keyboards in schools.
4. Is it hard to write Northern Sami language using Finnish keyboard and a Northern Sami keyboard layout?
5. Do you use the program in teaching if it lacks the support for Northern Sami language?

### Appendix 3. E-mail interview questions for the ICT support in Ohcejohka.

1. Do the systems in Ohcejohka area schools support Northern Sami in writing? Has there been any problems?
2. Do the systems in Ohcejohka municipality support Northern Sami in writing? Has there been any problems?
3. Are there any guidelines in the Ohcejohka municipality of using Northern Sami in ICT? For example, does the file name system support Northern Sami?
4. How about Northern Sami keyboard layout, has there been any problems in using?
5. Does the e-mail system in the Ohcejohka municipality support Northern Sami language?
6. Are there any limitations in ICT that prevent using Northern Sami language in Ohcejohka municipality systems? Like old character sets in programs: ASCII or Iso Latin1?
7. Would it be more reasonable that there were Northern Sami keyboards in Ohcejohka area schools instead of Nordic keyboards?
8. If there were Northern Sami keyboards; How would it affect for example passwords? Would it be possible to write a password in Northern Sami language? Would the password be stronger if user uses Northern Sami special characters in the password?