

# Icelandic Ethno-Mathematics

## Etnomatemática Islandica

Kristín Bjarnadóttir, University of Iceland, krisbj@hi.is

### Abstract

During the centuries, ordinary people in Iceland had few opportunities to study mathematics and few reasons to apply it. Instead, Icelanders have composed verses since medieval times, adhering to complex rules of rhymes and alliteration. They have preserved the ancient Germanic rules of prosody in the popular pastime of composing and reciting Icelandic ballads, *ríma*, exercised by young and old, men and women.

This artistic puzzle, to compose a meaningful text within the complex constraints of length of words, length of lines, rhymes and alliteration, is a mathematical and artistic activity meeting Ubiratan d'Ambrosio's definition of ethnomathematics as intersections of culture, historical traditions, sociocultural roots, and mathematics. No material is needed, only a skilful mind and the memory to rehearse the product in the dark winter evenings and long summer nights at work.

Keywords: mathematics, verse, rhyme, alliteration, prosody

### Resumen

A lo largo de los siglos, la gente común en Islandia tenía pocas oportunidades para estudiar matemáticas y pocas razones para aplicarlas. En cambio, los islandeses componían versos desde la Edad Media, siguiendo complejas reglas de rima y aliteración. Han preservado las antiguas reglas germánicas de prosodia por el pasatiempo popular de componer y recitar baladas islandesas, la *ríma*, ejercido por jóvenes y mayores, hombres y mujeres.

Este rompecabezas artístico de componer un texto significativo respetando complejas restricciones en cuanto a longitud de las palabras y de las líneas, rima y aliteración es una actividad matemática y artística que cumple con la definición de Ubiratan d'Ambrosio de etnomatemáticas como intersecciones de la cultura, las tradiciones históricas, las raíces socioculturales y las matemáticas. No hace falta ninguna material, solo una mente hábil y la memoria para ensayar el producto en las oscuras noches de invierno y las largas noches de verano en el trabajo.

Palabras clave: matemáticas, verso, rima, aliteración, prosodia

## 1. Proposal development (problem statement, literature review, theoretical framework, methodology)

The proposal is situated in Theme 3, Ethnomathematics and languages.

### Introduction

Poetry has deep roots in Icelandic history and language. Icelanders composed poetry for kings and chieftains in medieval times (Gíslason, 1990, p. 29). In the late 18<sup>th</sup> century, dance gatherings more or less disappeared due to the resistance of the Evangelic Lutheran Church (Guðmundsdóttir, 2009). Secondly, volcanic eruptions, earthquakes and famine in that period resulted in smaller living space and lack resources for heating and lightening in a country with darkness up to 20 hours a day in mid-winter. From 1880 it was the duty of each household to oversee that children could read, knew the basics of Christendom and the four arithmetic operations in whole numbers and decimals. As most parents had not been to school, and trade was mainly operated by barter, not money, one may assume that arithmetic knowledge of the general public was minimal until after the Great War. Schools for 10–14-year-old students were often run in the homes alternatively, and school buildings were not implemented everywhere until 1974 (Bjarnadóttir, 2006).

Meanwhile, composing poetry according to complex rules of rhyming and alliteration remained as a popular pastime, also by children and adolescents in long dark winter evenings when light for reading was scarce. Thus verbal studies prevailed, both as a tool for memorization and an artistic activity. When traditional poetry is analysed, it emerges that its structure is governed by counting, mathematical laws. In particular, the pattern of alliteration is that of selecting certain permissible combinations, and avoiding others. This was practiced to the degree that many youngsters, who had few occasions to read and do paper-and-pencil arithmetic, could easily distinct between right and wrong combinations.

### Poetic form

Poetic form is a kind of structure into which the words of a poem are set. *Metre* is the rhythmic element of a poem. *Syllables* are composed of vowels, usually accompanied by one or more consonants. *Metre* is composed of syllables of which a *metrical foot* is composed. A sequence of *feet* makes up a *metre* (Cochrane, 2003). In poetry, as well as in ordinary speech, the syllables have different stress. In phonetics, the different stresses have conventional marks. They are denoted / for a stressed syllable, and ◡ unstressed syllable. A line in a verse is divided into *feet*, each foot has a stressed syllable and one or more unstressed syllables. One common kind of a two-syllable foot is called *trochee* with one stressed syllable and one unstressed syllable:

| / ◡ | | / ◡ | | / ◡ | | / ◡ |  
Foun-tain | head and | source of | riv-ers (H. D. Thoreau: Low anchored cloud)

Three syllable foot, the *dactyl*, has one stressed and two unstressed syllables:

| / ◡ ◡ | | / ◡ ◡ | | / ◡ ◡ | | / ◡ ◡ |  
Wo-man much | missed, how you | call to me, | call to me (T. Hardy: The voice)

## The Icelandic language, poetry and prosody

The Icelandic language belongs to Germanic Indo-European languages. Its rhythm is characterized by that every word has primary stress on its first syllabus (Aðalsteinsson, 2011). The second syllabus is usually unstressed. The third syllabus, if the word is composed of two or more two-syllable words, has a stress but lower than the first.

Example:       | / ˘ | / ˘ | / ˘ |  
                   | Ey-ja- | -fjal-la- | -jök-ull | (pronounced: Ey-ya- | -fyad-la- | -yok-ull )

In this word, the primary stress is on the syllable Ey, a secondary stress on fjal-, and on yök- again primary stress. This can vary, however, according to the content of a phrase.

In ancient Germanic rules of prosody there is rhyming and alliteration in addition to the rhythm. Composing and reciting ballads, *ríma*, is a popular pastime. *Ríma* is governed by rules, both of rhythm and alliteration. We shall analyse the poetical structure and its composition for mathematical patterns.

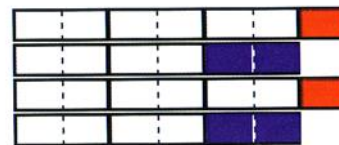
### Ferskeytla – the quatrain form

The basic form of verses in *ríma* is a four-lined verse form known as *ferskeytla*, the quatrain form, a four-line stanza. An example of its basic form is:

/ ˘	/ ˘	/ ˘	/
Hall-ar	deg-i	kem-ur	**kvold**
/ ˘	/ ˘	/ ˘	
kald-ur	and-ar	sval-inn	
/ ˘	/ ˘	/ ˘	/
Nótt-in	blá-dimm	blæ-ju	**tiold**
/ ˘	/ ˘	/ ˘	
breid-ir	yf-ir	dal-inn	

(Aðalsteinsson, 2011, p. 7)

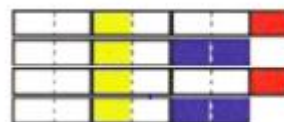
More simply the basic form of the quatrain may be denoted by the pattern:



The first and third line contain three and a half feet of the kind *trochee* while the second and the fourth contain three feet. Moreover, there is *rhyming* at the end of the lines, *end-rhyming*: *kvold* – *tiold*, *sval-inn* – *dal-inn*. The rhyming is denoted by colours.

The rhyming is usually at the end of the line, but can also exist within the lines, according to the complexity or so-called costliness: how precious the structure of the verse is intended to be. This *inner rhyming* is a further enrichment of the form (Eiríksson & Björgvinsson, 2001). An example of this pattern may be found in the following quatrain written in English where the inner rhyme is denoted by yellow colour.

She is **fine** as morn' in **May**  
 mild, di**vine** and **clever**,  
 like a **shining** summer **day**  
 she is **mine** for**ever**.



The regular end-rhyme is *May-day* and *clever-(for)ever*. The verse has been further decorated with an internal circular rhyme: *fine*, *divine*, *shining* and *mine*. The inner rhyme can be located in a variety of ways.

## Alliteration

*Alliteration* requires that two words in the first line must begin with a vowel or the same consonant, placed in the line according to fixed rules. The first stressed syllable in the second line must also begin with a vowel or the same consonant. This alliterative pattern is then repeated in the third and fourth lines (Gíslason, 1990, p. 103).

In addition, there are end-rhymes. Here is an example of this art in English:

She is fine as **morn'** in **May**  
**mild**, divine and clever,  
like a **shining** summer day  
**she** is mine forever.

The alliteration in the two first lines is composed of the m-s in the words *morn'*, *May* and *mild*. In the second one the s-s in *shining*, *summer* and *she*.

The rules on the alliteration are: At least one of the alliterated syllable in the first line must have primary stress. Secondly, the second alliterated syllable may only be at the maximum two feet interval and the second one only two feet away from the alliterated syllable in the second line, which is always situated in the first stressed syllable.

In a quatrain with three and a half feet in the first and third lines, the following combinations are or are not allowed. In the first line, the alliterative syllables are situated in feet 1 and 2, not allowed, too far from the alliterative syllable in the second line

in feet 1 and 3, allowed

in feet 1 and 4, not allowed, too far between the two alliterative syllables in the first line

in feet 2 and 3, allowed

in feet 2 and 4, not allowed, the stressed syllables have secondary stress

in feet 3 and 4, allowed

Here three combinations out of six are allowed. In poems with five feet in the first line, five out of ten combinations are allowed for the same reasons, etc.

## More complex forms of poetry

As in poetry in other languages, Icelandic poetry can be composed of different length of metrical feet. The *trochee* and the *dactyl* are common. The metres can also be of different lengths all of which occur frequently in traditional Icelandic poetry:

three feet: *trimeter*; four feet: *quatrameter*, *quatrain*; five feet: *pentameter*; six feet: *hexameter*; etc. In traditional poetry, the rules described above for alliteration in the quatrain, are the same in the trimeter, the pentameter and the hexameter.

## Conclusion

Ethnomathematics is defined by Ubiratan D'Ambrosio (2001) as intersections of culture, historical traditions, sociocultural roots, and mathematics. For centuries, Icelandic children in school age did not have opportunities or need to exercise traditional arithmetic in the absence of money and trading in shops, while the tradition of composing and reciting poetry, constructed in a mathematical structure of certain permissible combinations, was intrinsic in their socio-cultural roots. This tradition has survived in modern Icelandic culture up to present days, while more traditional mathematics is now prevailing in well heated and lightened modern schools.

## **2. Contributions, findings: Stating the relevance and pertinence of the work's contribution to the respective thematic area.**

### **Statement**

In the absence of dance and musical instruments, the tradition of composing and chanting poetry was highly evaluated and pursued in the dark homes in pre-industrialized Iceland of 19<sup>th</sup> century and earlier.

Most common people, who often were taught only little arithmetic, studied rhythm and rhyming through complicated rules of rhymes and alliteration.

One may state that **composing and chanting poetry served as a support or even substitution for arithmetic education in that it promoted counting and number sense. Being intrinsic in the socio-cultural circumstances, composing poetry may be considered as ethnomathematics.**

## References

- Aðalsteinsson, R. I. (2011) Bragfræði fyrir unglíngastig grunnskóla [Prosody for adolescents in schools]. Reykjavík: Námsgagnastofnun.
- Ambrosio, U. (2001). Ethnomathematics. Link between tradition and modernity. Rotterdam: Sense publishers.
- Bjarnadóttir, K. (2006). *Mathematical education in Iceland in historical context. socio-economic demands and influences*. Roskilde: Roskilde University. (IMFUFA-tekst : i, om og með matematik og fysik; No. 456).
- Cochrane, R. (2003). *Studying poetry. The secret gems of poetry revealed*. Second edition. Bishops Lydeard: Studymates
- Eiríksson, K. & Björgvinsson, J. B. (2001). *Óðfræðiágrip*. [Synopsis for poetrical studies]. Mosfellsbær: Ferskeytlan.
- Gíslason, G. Th. (1990). *The Challenge of Being an Icelander*. Reykjavík: Almenna bókafélagið.
- Guðmundsdóttir, A. (2009). Siðferði gleðinnar. Um danskvæði og dansmenningu fyrri alda. [The moral of joyousness. About dance songs and dance culture in previous centuries]. *Saga* 47(1), 102–121.