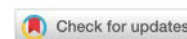


# PRODUCTIVITY OF SELECTED SUFFIXES IN THE TERMS OF MATHEMATICS

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**Abstract:** The article deals with the analysis of mathematical terms, i.e. simple nouns. Complex terms are avoided in order to prepare a detailed lexico-grammatical analysis. The research examines the term formation within the word class of nouns. Origins of the English and Slovak terms are analysed, described and compared. Latin and Greek languages are languages of science for the English language. The original languages of terms in both languages. Furthermore, Slovak terminological equivalents are compared with the English ones in term preference the Latin/Greek term or the native term if exists. According to term formation processes, the following suffixes representing bound morphemes are analysed: -er, -or, -ion. The terms formed by affixation using the selected suffixes are compared with the Slovak counterparts in terminology of mathematics. Terms are analysed according to principles for term formation. The following principles should be followed in the formation of terms and appellations, as far as possible and as appropriate to the language: transparency; consistency; appropriateness, linguistic economy; derivability and compoundability; linguistic correctness; preference for native language. Subject of analysis are terms taken from the Slovak National Corpus 10.0, i.e. English –Slovak Parallel Corpus 4.0 en, Slovak –English Parallel Corpus 4.0 sk and the British National Corpus. In the research, electronic corpora are applied. They use mathematical and statistical methods to evaluate e.g. occurrence, frequency, collocability of words. The previous mentioned methods are taken into consideration and help to prepare the effective, precise and objective analysis of the planned analysis. The research is based on both languages and comparison of terms in both parts of the corpus. Specific trends and tendencies in the strategies of term formation are analysed. Descriptive method is used and the methods of quantitative and qualitative analysis are applied. Due to analysis of two languages, contrastive and comparative approaches are entailed. Terminology records of terms are examined from lexico-grammatical point of view and on the basis of term-formation tendencies in each analysed language. i.e. Slovak language and English language. Records include entry, identification number, reference to the term, synonyms, subject field, formula, abbreviation, context, reference to the context, definition, reference to the definition.

Keywords: suffix -ion, -er, -or contrastive study, English language, Slovak language, term

2) Social Sciences, and Humanities

## Introduction

The aim of the research is to describe and analyze term formation of the selected simple terms of nouns used in mathematics in the English and Slovak languages. The research focuses on terminology analysis. Cabré considers terminology to be a separate linguistic discipline. The discipline of terminology studies and compiles specialised terms, while terminology process includes activities such as compilation, description, processing and presentation of terms related to a certain subject field, which happen either in monolingual or in multilingual environment (Cabré, 1999). Terminology data bank Termium plus defines terms as a word, multiword expression, symbol or formula that designates a particular concept within a given subject field (Termium Plus, 2012).

Basic principle for designating the mathematical terms is disambiguation: one concept - one term. Naturally, this principle is typical for one closed mathematical discipline; in different disciplines, the same term can designate different concepts (Čižmár, 2009, p.8). The definition according to which the term is „Vocabulary element naming a term defined by definition and a place in the system of concepts of a specific scientific field, technology, economy and other activities” (Masár, 1991, p. 29).

New domains and new discoveries bring new terminology. New terms are coined for technical purposes. There are three principal sources in creating new terms: reusing existing words, coining terminology on the basis of existing morphemes (mainly morphemes of Greek and Latin origin) and exploiting the phonology of the language (Hanks, 2013). Language, the most important intermediary in the process, keeps losing the old, unused words, while also gaining new words-terms. The word terminology

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is usually understood as a science of properties, creation and usage of terms (Džuganová, 2002).

Similarly, Horecký also sees the difference between terminology and nomenclature. Horecký defines terminology as a collection of specialised terms used in the scientific disciplines. Consequently, in terminology understood in this way, a nomenclature as an individual group of terms naming certain things or concepts classified according to the field system is identified. (Horecký, 1956).

Metaphorization is typical feature of fixed expressions. The primary requirement in the creation or implementation of each term, name, title, designation, etc., into practical life should be its unambiguousness. It means that multi-meaning or otherwise complicated words should be avoided" (Sokolovský, 2004). Bozdechová (2016) mentions various procedures of term-formation, namely "metaphorization, word-formation, the formation of multi-word terms of different structural types, and the formation of acronyms or abbreviations" which can also be "accompanied by borrowing and loan translation". She stresses that these procedures usually appear in combinations. Some of these procedures are widely used in certain languages, while others remain rather marginal.

Two basic groups of terms can be identified on the basis of the number of the constituents, i.e. a) one word terms, b) multi-word terms. Each group contains its types and subtypes. Subject of analysis are one word terms. They are divided into non-derived and derived terms. Research focuses on one word derived terms. One word derived terms can be formed by prefixes, suffixes or simultaneously by prefixes and suffixes. The base word represents the background for derivation.

## Methods

In the research, electronic corpora are applied. They use mathematical and statistical methods to evaluate e.g. occurrence, frequency or collocability of words. The previous mentioned methods are taken into consideration and help to prepare the effective, precise and objective analysis of the planned analysis. The research is based on both languages and comparison of terms in both parts of the corpus. Specific trends and tendencies in the strategies of term formation are analysed. Descriptive method is used and the methods of quantitative and qualitative analysis are applied. Due to analysis of two languages, contrastive and comparative approaches are entailed. Terminology records of terms are examined from lexico-grammatical point of view and on the basis of term-formation tendencies in each analysed language. i.e. Slovak language and English language. Records include entry, identification number, reference to the term, synonyms, subject field, formula, abbreviation, context, reference to the context, definition, reference to the definition. Termium Plus states that terminological analysis is "The analysis of terms in context and of the concepts designated by them within a given subject matter in order to determine their interrelationships" (TERMIUM Plus, 2012). Methods of term recordings are included. Data are collected from an electronic corpus the Slovak Academy of Sciences called from the Slovak National Corpus 10.0, i.e. English –Slovak Parallel Corpus 4.0 en. Current version par-sken-4.0 is available in the amount 556 mil. tokens (261 mil. Tokens for the Slovak part, 295 mil. tokens for the English part).

## Formation of terms

Word formation is the process of creating new words from the material available in the language after certain structural patterns. For instance the noun driver is formed after the pattern v+-er, i.e. a verb stem + the noun-forming suffix –er. The meaning of the noun driver is related to the meaning of the stem drive- and the suffix –er (Ginzburg, 1966, p.135). According to Kvetko (2015) term formation processes are based on the word formation processes. Word formation or word building is the process of building new words by means of existing elements of language according to certain patterns and rules. All the words in Modern English may be classified into derivational types according to the structures of the stems they are based on. There are simple words, derived words and compound words (Ginzburg et al. 1966, p.133). The derivational or word-formation level of analysis of word-structure is concerned with the description of typical derivative relations between morphemes within the word and derivative correlation between morphemes between different types of words. In the research the second approach is applied, i.e. the approach of morphemic level of words. Words are classified according to the number and type of morphemes they consist of. Suffixes may also be classified according to the lexico-grammatical character of the stem the suffix is usually added to. Suffixes –er, -or, -ation are added to verbal stems, e.g. speaker, writer, etc. The derivative morpheme is the morpheme detached from the root and grammatical morphemes in the derived word. It refers to the semantic element defined by the string of appropriate semantic features.

We distinguish these ways of word formation in English: principal processes: affixation, compounding and conversion. Shortening, back-formation, blending and word manufacture or coinage fall into minor processes.

Derivation is the most common process to form new words in English language. It is defined as a process of adding affixes to words to create new words. In this group we differentiate prefixes and suffixes. Prefixes are added to the beginning of the word (such as prefix bi- in bilingual). Then suffixes are added to the end of the word (such as suffix -ish in greenish). Infix is an affix that is incorporated inside another word. Affixation means building a new word by adding a derivational affix to a derivational base. (Lančarič, 2016, p.81).

Siegel in Štekauer (2000) distinguishes two classes of affixes. This classification is based on the different phonological and morphological behaviour of the two classes. Class I and Class II affixes.

Class I prefixes (+boundary) include e.g. in-, con-, de-.

Class II prefixes (# boundary) include e.g. anti-, pro-, circum-.

Class I (+boundary) suffixes are Latinate ones -able, -en, -ate, -ion, -ity, -y (noun forming)

Class II (# boundary) suffixes are -ness, -less, -ly, -al (noun forming).

Class I suffixes, introduced by +boundary, admit phonological changes (divide vs. division), and cause a rightward shift of the main stress (telegraph vs. telegraphy). Class II suffixes are introduced by # boundary which blocks phonological changes (divide vs. dividing); therefore, they never cause stress shift. Morphologically, these classes differ in that class II affixes may only attach to words while class I affixes may combine with stems. If both class I and class II affixes occur in a word, a class II affix generally follows a class I affix (Štekauer, 2000).

Words can be modified in their form, meaning or function. A suffix usually changes not only the lexical meaning of a word but also its word class (and grammatical meaning). Kvetko (2015) presented the following classification of noun-forming suffixes.

1. -or: actor, visitor, director, instructor
2. -er, -eer: speaker, reader, writer, profiteer
3. -ist: scientist, satirist, journalist
4. -ess: hostess, princess, actress
5. -ty, -ity: cruelty, certainty, oddity, stupidity
6. -ure, -ture: failure, closure, exposure
7. -dom: freedom, gangsterdom, officialdom
8. -age: passage, shrinkage, postage
9. -ance, -ence: appearance, preference, reference
10. -hood: likelihood, brotherhood, neighbourhood, manhood
11. -ing: reading, opening, lining
12. -ion, -sion, -tion, -ation: operation, action, competition
13. -ness: consciousness, willingness, goodness
14. -y, -ery: enquiry, expiry, robbery, slavery
15. -ship: censorship, kinship, ownership
16. -ment: government, management, refreshment
17. -t: complaint, restraint

The suffix -er of native origin denoting the agent, is synonymous to the suffix -ist of Greek origin which came into the English language through Latin in the 16th century. (Ginzburg, 1966, p.149). The most frequent noun forming suffixes in the Slovak terminology are presented by Masár (p. 30, 2000). Specific suffixes are classified into sections based on creation of various entities:

#### A. Persons

In order to form the names of persons, the following native and borrowed suffixes are used:

Native:

1. -teľ: doručovateľ, zlepšovateľ
2. -č: volič, triedič
3. -ník, -nik: tľmočník, požiarňik
4. -ca: sprievodca, správca
5. -ár, -ar, -iar: pripravár, mliekar, guliar

Borrowed:

6. -ista: klavirista, humanista
7. -átor: moderátor, koordinátor
8. -ér: montér, masér
9. -ant: projektant, frekventant

10. –ent: referent, dirigent

B. Objects

The most frequent suffixes are:

1. –č: vyorávač, zhrnovač

2. –ačka: skúšačka, miešačka

3. –ok: nátláčok, odpilok

4. –ina: záclonovina, stavebnina

5. –dlo: čerpadlo, kružidlo

6. –areň, areň, iareň: skrutkáreň, dozrievareň

7. –ňa: predajňa, výhrevňa

8. –ovňa: briketovňa, strojovňa

C. Features

They are necessary and often occurred in terminology.

1. –osť: prilnavosť, prchavosť, trhavosť

2. –ota: čistota, mokrota, tučnosť

D. Processes

The following native and borrowed suffixes are used:

Native:

1. –ie: zhodnocovanie, tmelenie, plnenie

2. –ba: liečba, plavba, platba

3. –ka: zväžka, vyvárka

Borrowed:

3. –izácia: matematizácia, paletizácia, privatizácia

4. –cia, –ácia: difrakcia, resekcia, diferenciácia

5. –encia: konkurencia

6. –zia: disperzia, invázia

7. –áž: betonáž, senáž

The suffix –stvo, –ctvo is used to form names of jobs, features, ranks, functions, institutions, states (e.g. betonárstvo, učiteľstvo, dobročtovstvo, veliteľstvo, ministerstvo, vlastníctvo, šialenstvo).

a) The suffix –er

The noun suffix –er is used to coin words denoting in particular 1. persons following some special trade or profession, cf. baker, hunter, etc., 2. Persons doing a certain action at the moment in question, cf., packer, chooser, giver, etc., 3. A device, tool, implement, cf. blotter, atomizer, transmitter, etc.

b) The suffix –or

Trnka (2014) mentions that nomina agentis can be created by conversion. Suffix –or intruded into the written language, i.e. the words of the domestic origin, in order to distinguish their meanings and diminish homonymy of the words, e.g. sailor – námorník; sailer - sailing ship. The origin of the suffix –or is Old Norman –our ( from Latin –atorem). From the 16.century suffixes –our and –or were unified into one form –or. In the case of non-existence of Latin noun, the suffix –or was substituted by –er. It represents the most productive suffix in the English language. Almost all verbs containing the ing form can be transformed into nomen agentis with this suffix.

c) The suffix –ion, –sion, –tion, –ation

Kvetko (2015) mentions the following alternative suffixes –ion, –sion, –tion, –ation. The suffix –ition appears to be non-productive, e.g. add - addition, part- partition.

The suffix –ation should be recognized by English speakers as an allowable means of forming nouns of action out of verbs (Ginzburg, 1966, p.155)

## Discussion and findings

In general, it can be said that the suffix –er is more general than the Slovak counterparts. It is used to coin words of the group deverbal substantives, e.g. baker - pekár, purchaser - nakupovač, as well as the group of desubstantial substantives, e.g. joiner – stolár, repairer – opravár. In the case of the Slovak counterparts of the suffix –er, it is difficult to recognize tendencies in suffix equivalence. The suffix –er has got more counterparts, e.g. suffix –ik: interpreter- tlmočník; suffix –áč, e.g. Česáč-comber, rozbíjač – breaker; suffix –eľ, e.g. darovateľ- donater, uctievatel'- worshiper; suffix –ca, e.g. dopravca- carrier, ruler – vládca, etc.

The most frequent suffix was –ion with 8227 030 occurrences in the Slovak National Corpus,

e.g. addition - sčítanie, approximation – aproximácia/ približný odhad, division - delenie, multiplication – násobenie, subtraction - odčítanie, correlation – korelácia. The terms addition, approximation, division, multiplication belong to the field of mathematical operations. The identical suffix –ion enhances quicker comprehension and language economy. The second frequent suffix is –er (4 137 793) e.g. remainder - zvyšok, integer – celé číslo. These terms belong to the field of mathematics called algebra. The suffix –or occurs in 771 473 instances, e.g. protractor- uhlomer, factor- faktor, calculator- kalkulačka, denominator- menovateľ.

The collocability of morphemes, i.e. the relations they can enter in its front and back fields belong to the form of all morphemes. In the case of specific terms on mathematics, it can be stated that majority of the terms fall into the field of algebra.

Table 1 The occurrences of suffixes in the Slovak National Corpus

-ion	8 227 030
-er	4 137 793
-or	771 473

Table 2 Contrastive terminology record of the term factor

1 (TER)	2 (IDC)	1 (EQU)	2 (IDN)
činiteľ	1	Factor	1
3 (ZDR/TER)		3 (SOU/TER)	
DGT-Acquis <a href="https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis">https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis</a>		DGT-Acquis <a href="https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis">https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis</a>	
4 (SYN)		4 (SYN)	
5 (VO)		5 (SF)	
PV – MAT		NS – MAT	
6 (SKR)		6 (ABBR)	
M		M	
7 (KON)		7 (CON)	
Model zaťaženia 71 sa musí vynásobiť činiteľom alfa ( $\alpha$ ), ako sa stanovuje v norme EN 1991 - 2 : 2003 odsekoch 6 . 3 . 2 ( 3 ) P . Hodnota $\alpha$ musí byť rovnaká ako hodnoty uvedené v tabuľke 6 alebo väčšia .		Load model 71 shall be multiplied by the factor alpha ( $\alpha$ ) as set out in EN 1991 - 2 : 2003 paragraphs 6 . 3 . 2 ( 3 ) P . The value of $\alpha$ shall be equal to or greater than the values set out in Table 6 . Thus, 1,2,3, and 6 are all factors of 6; $x-1$ and $x + 2$ are factors of $x^2 + x - 2$ , since $(x-1)(x+2) = x^2 + x - 2$	
8 (ZDR/KON)		8 (SOU/CON)	
DGT-Acquis <a href="https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis">https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis</a>		DGT-Acquis <a href="https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis">https://ec.europa.eu/jrc/en/language-technologies/dgt-acquis</a>	
9 (DEF)		9 (DEF)	
Činiteľ je základný početový výkon – činiteľ, násobenie, činiteľ rovná sa súčin		A number of polynomial that divides a given number or polynomial exactly.	
10 (ZDR/DEF)		10 (SOU/DEF)	
OLEJÁR, M. 2019. Zbierka vzorcov z matematiky. Bratislava. ISBN 978-80-89465-34-7		NELSON, D. Penguin Dictionary of Mathematics. 2008. Penguin Books. ISBN: 0141030232	
11 (MIE/EKV)		11 (DEG/EQU)	
12 (AUT)	13 (DAT)	12 (AUT)	13 (DATE)
Hudcovičová, M.	22.2. 2023	Hudcovičová, M.	22.2. 2023

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### Standards:

- ISO 704: 2009. Terminology work – Principles and methods
- ISO 22128:2008. Terminology products and services
- ISO 1087-1:2000. Terminology work — Vocabulary — Part 1: Theory and application
- Slovak National corpus 10.0
- Slovak-English Parallel corpus 4.0
- English-Slovak Parallel corpus 4.0
- British National Corpus