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The Problem of Translatability of Texts of The Sublanguage of Mathematical Logic in English-Kazakh Translations

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Abstract
This article delves into the challenges and considerations surrounding the translation of mathematical logic texts, emphasizing its linguistic aspects and the relevance of its sublanguage nature in scientific discourse. By examining translations across English-Kazakh languages, the study aimed to uncover shared features and divergences, contributing to a deeper understanding of the translation process in scientific contexts. Various methods and techniques related to translation research and semantic analysis were employed aiming to establish clearer correspondences between source and target languages. Key findings highlight that the sublanguage of mathematical logic is notably receptive to lexical borrowings, particularly at the semantic level, which enhances the translatability of these texts. The research underscores how borrowings contribute to a more uniform structure across scientific literature, thereby increasing relative translatability. In conclusion, the research asserts that a thorough linguistic perspective on translation can significantly aid translators working with scientific sublanguages. By elucidating effective translation strategies for different lexical units, the study encourages further exploration into the translatability of scientific discourse, particularly in mathematical logic.

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Introduction

The translatability of texts, especially in specialized fields such as mathematical logic, raises important questions about the nature of translation itself. Translatability involves the ability to reproduce semantic, stylistic, and intra-linguistic information from a source language (SL) to a target language (TL). Translatability focuses on both communicative and functional aspects. Communicative translatability emphasizes transferring the conceptual content and meaning from the SL to the TL. Here, the focus is largely on the ideas and messages conveyed rather than the specific linguistic forms. Functional translatability, on the other hand, focuses on the stylistic and intra-linguistic nuances of the text. It encompasses the transfer of meanings that are tied to the linguistic structure itself, suggesting how functional translatability preserves things that are expressed alongside what is expressed.

English-Kazakh translation terminology is saturated with international scientific terms that gives a strict scientific text solidity and greater scientific weight. Kazakh synonyms usually have a weakened shade of scientific, formality, therefore, foreign-language terms are often preferred in book styles. At the same time, scientists of terminology note, not without reason, that the scientific style is overloaded with borrowed words (Bektaev, 1986; Zhumagulov, 2011). This remark can rightfully be attributed to any national scientific terminology. However, scientists often do not object to the use of international terms, noting that when borrowing them, the measure should be preserved, and the calculation itself should be motivated. Moreover, international terms are subject to the internal laws of the linguistic development of the modern Kazakh language, its national identity. Deliberately replacing international scientific terminology with national ones will not solve the problem of scientific terminalization of the national language of science, since internationalization as a general linguistic phenomenon having multilayered or polylingual translation is a characteristic of the Kazakh language.

This multilayered translational challenge defines polylingual translation as a term that could imply not just the translation of words but also the consideration of socio-political contexts influencing how concepts are understood and communicated across different cultures. Each language does not just translate a term but translates a whole conceptual paradigm, shaped by historical and cultural factors. Observations about poly-translation further emphasize the emerging necessity for a nuanced understanding of how terms are translated not only within mathematical discourse but across various disciplines and languages. The assertions (Pym, 2023) and observations (Evteev & Latyshev, 2018) made in previous studies provide a foundation for understanding the complexities involved in translating nuanced texts. Moreover, a comprehensive grasp of poly-translation encourages a new conceptual framework for translating terms, one that respects and acknowledges the multifaceted nature of language and meaning-making.

The current study stemmed from the ongoing debates surrounding translatability, particularly within specialized sub-languages like mathematical logic, which underscore the nuanced nature of translation as both an art and a science. These debates have highlighted distinctions between absolute and relative translatability, considerations of semantic and functional dimensions, and provided insights into the complexity of transferring meaning across languages. Among the conclusions drawn of these debates is the complexity of the very nature of the idea of translation, which is seen not merely a mechanical process but rather a rich, theoretical field deeply rooted in linguistic, cultural, and communicative factors. These conclusion about translatability serve as essential guideposts for scholars and practitioners alike, shaping the future of translation studies and practice. This study delves a little deeper into these debates and conclusion, and attempted.

The significance of this work lies in its identification of factors that facilitate high translatability, such as extensive lexical borrowing and the symbolic nature of mathematical language. This study also addresses the complexity of translatability and untranslatability within scientific texts, specifically through the lens of phraseological units. These units provide insight into the nuances of translating specialized terminology and concepts. With internet as a primary information source, English remains the foundational language for computer science and technology. This reinforces the need for familiarity with established international terminology. The process of translation should prioritize the integrity of these established terms while adapting them to Kazakh syntax and semantics. When translating scientific and educational literature, we should prioritize the original language from which terminology is derived.

Literature Review

Translation theorists have rightly argued that the problem of translatability is far from getting exhausted (Dementieva & Ivleva, 2020); other believed that this problem has so far been examined merely from a general theoretical point of view (Dashinimaeva, 2021). Imami & Mu'in (2021) simplified this problem by clearly advocating either full translation or no translation, and assumed: "cultural problems in

translation arise due to differences between the two languages in expressing identity and lifestyle. Translators find it difficult to translate abstract or concrete concepts in the source language/culture (SL/C), completely unknown in the target language/culture (TL/C)" (p.178). Barchinoy (2024) believed that while using the linguistic tools of a certain language, the translator must have a deeper understanding of certain cultural phenomena that are symbolic of language units or words. This suggests that the fundamental tenet of cultural linguistics is that language and culture are mutually constitutive (Mohebbi, 2023). Hence, to prevent offense or misunderstandings, translators need to be aware of the social mores and cultural sensitivities of their intended audience (Malhotra, 2023).

Proponents of extreme views on translatability do not, as a rule, specify the concept of "translatability," i.e., the translatability of what exactly is in question: thought, style, or form of linguistic work, and what kind of functional style. Hence, there are numerous references to "untranslatable cases" and giving birth to the concept of 'untranslatability'. Untranslatability has been seen as a problematic concept in Translation Studies, rooted in outdated translation views as doomed to failure (Foran, 2023). Byrne-Taylor highlights that the notions of untranslatability could provide theory with a new lease of life (Taylor, 2022). While dealing with the term "untranslatability" in translation studies, we refer to linguistic, cultural and contextual difficulties that highlight how difficult it is to accurately convey the meaning of a source text in a target language (Badaoui, 2024). In this context, Othman (2024) considers discussion of (un)translatability frequently geared towards equivalence or, more commonly, a lack thereof.

In other words, each language contains certain distinctive characteristics that are both compatible and incompatible to translations, and are also distinct from other languages (Fagsao & Mi-ing, 2020). When we compare two languages, we need to refer to Cozma's statement which asserted that, owing to differences between two languages in contact, it is natural that any translated text should be characterized by a certain degree of distortion or loss in comparison to its original (Cozma, 2022). However, translatability is also often seen as the meaning to be conveyed from one language to another without being subjected to significant change (Abdelkarim & Alhaj, 2024).

Researchers have also refrained from making categorical statements about the concept of translatability, and argued to examine this problem of translatability in terms of diachronic analysis, in the light of dialectics of language contacts (Farnia & Gerami, 2021; Kenzhebaev, 2016; Zhurkenovich et al., 2021). The dialectical understanding of translatability does not exclude the fact that there are "limits to the principle of translatability", which are interpreted differently in the critical domain (Zekavati & Seddighi, 2012). From the point of view of scientific methodology, therefore, any proof of translatability (or untranslatability) by purely inductive means cannot be accepted as legitimate; it is impossible to derive a general position from individual examples alone, even if there is a considerable number of specimens to prove translatability.

Translation research deals with the challenging issue of translatability. This is the possibility of finding the equivalent of a source language unit in a target language. However, the concept of incomplete translatability has developed due to linguistic or cultural differences. Context plays a crucial role in translation studies. Some authors link this problem with fully transferring the meaning of the original word, without changing its source structure into another language (Saurbayev, 2013). Translation ultimately represents a difficult activity. Moreover, some challenges appear at all stages of the translation process. This is because each language represents the world in a completely different way. Besides, each language has its own special linguistic as well as syntactic structures and rules, and it differs concerning the way it structures sentences (Al-Bdour, 2022).

There is always a different number of "limitations on translatability", which points to the subjectivity of the authors in this matter, a subjectivity that we believe is explained by the fact that the authors mean the language as a whole and are not limited to the framework of a particular sublanguage (which would reduce the number of "limitations" in several cases). In the translation context, weaknesses are factors that prevent the achievement of a successful translation. The term 'weakness' is closely related to 'error;' however, not all weaknesses are necessarily errors. Translation errors are related to inaccuracy in meaning transferred from the source text (ST) to the target text (TT) (Sofyan & Tarigan, 2022).

Theoretical Framework

The current study highlights a fundamental principle in translation theory—the distinction between absolute and relative translatability. Absolute Translatability implies total and perfect correspondence between the SL and TL. However, as indicated, this concept is largely theoretical and seldom achievable in practice due to inherent differences in languages—such as grammar, idiomatic expressions, and cultural references. On the other hand, Relative Translatability acknowledges the partial equivalences that can be achieved through translation. It permits flexibility, recognizing that while perfect equivalence may not be possible, effective communication can often still be attained through careful consideration of context, meaning, and form. Hence, the principle of translatability, together with the question of equivalence and invariance of translation inherent in absolute and relative translatability, forms the basis for the theoretical

explanation of translation. It is the cornerstone and the most important postulate of translation theory as a definite and now finally established branch of philology.

This dual framework of absolute and relative translatability serves various purposes within translation theory. 1. *Theoretical Constructs*: Absolute translatability may be used as a hypothetical benchmark against which the successes and failures of translations can be measured. It aids in articulating theoretical discussions about what constitutes a successful translation. 2. *Practical Application*: In real-world translations, especially within scientific and technical domains, translators must often work with relative translatability. They must prioritize conveying meanings and ideas effectively while navigating the limitations posed by linguistic differences. 3. *Guiding Principles*: Understanding the implications of these translatability concepts helps to guide translators in their decision-making processes. It allows them to recognize when to prioritize semantic fidelity over stylistic fidelity and vice versa, depending on the context and purpose of the translation.

Let us theoretically explain the issue raised in this study with an example. The challenges of translation of mathematical logic, particularly in the context of mathematical terminology like "ring," sheds light on the broader complexities of language development and interdisciplinary communication. In this example, the word "ring" has various meanings across languages, and its translation can lead to potential misunderstandings, especially when the term spans different domains like mathematics and everyday language. The term "ring," as stated, was introduced by David Hilbert, reflecting a pivotal moment in algebra's evolution. The Kazakh translation of "ring" as "sakina," which refers to a piece of jewellery, exemplifies how a term can carry culturally specific meanings that may not translate directly to the mathematical abstraction intended in other languages. This highlights the translational difficulties in achieving clarity and precision in multilingual contexts. This example illustrates the importance of historical context in understanding the development and introduction of such concepts. The etymology and conceptual history of mathematical terms often reveal the interplay of regional linguistic influences, contributing to the richness—but also the complexity—of translation efforts.

This example of the mathematical term "ring" serves as an indicative subject that underscores the broader implications of multilingual translation challenges in technical and mathematical fields. Recognizing and addressing these issues in interdisciplinary communication is vital for advancing clarity and mutual understanding in our increasingly globalized world. Modern scientific literature, especially in fields such as mathematics, is predominantly written in English. This trend extends to scientific conferences and discussions across various disciplines.

In another example, the word “digit” derived from the Arabic term "syfr," emphasizes the crucial role of the concept of zero in algebra. This etymological background enriches our understanding of mathematical concepts. In the Kazakh language, significant borrowings from Arabic and Persian reflect a natural multilingualism and the interconnectedness of cultures and knowledge. The influence of various language roots in everyday vocabulary assists in the comprehension of scientific terms, suggesting a positive outcome of multilingual exposure.

The theory of translation should focus on the content, not the form. It suggests creating a system of invariant semantic units and establishing regular correspondences between languages based on their formal expression. Ultimately, the focus will be on investigating the relations between the forms. in compliance with this theoretical underpinning, translation studies deal with concrete texts and language systems. Not all results from contrasting languages are useful for translation studies, but studying linguistic phenomena across different languages is valuable for translation theory. Translation studies require typological studies that investigate linguistic expressions of a concept in both languages, leading to new interlanguage correspondences. We used semantic analysis of translation by selecting semes in the source text and corresponding units in the translation language.

Methodology

Research Design

The study followed qualitative research design demonstrating the theoretical underpinnings of nuanced texts and enabling the content analysis. The study also focused on the theory of translation to examine invariant semantic units and establishing inter-relationships between English-Kazakh languages. The qualitative approach also helped in investigating the concept of translatability with its semantic and functional dimensions.

Research Procedure

When conducting this research, we examined the questions about the definition of methodology, the choice of methods and techniques of translation research. We delved into the intricacies of translation within a particular language pairing, in order to become well-versed in the realm of contrastive linguistics. It was necessary to adopt this procedure because this branch of study involves analyzing multiple languages

to identify commonalities and divergences between them. The translatability of texts of a particular sublanguage of science, a sublanguage of mathematical logic, was also investigated.

Sampling and Data Collection

Since this study belonged to a specialized field, it was necessary to make a comprehensive retrospective analysis of prior studies. The data comprised secondary studies and a corpus consisting of 1340 English-Kazakh term pairs isolated from the texts of 971148 words in length. This data was fit to study the translatability of mathematical logic texts using the example of logical and mathematical terms since these texts displayed a high terminological saturation and terms were most information-rich and important units in scientific communication.

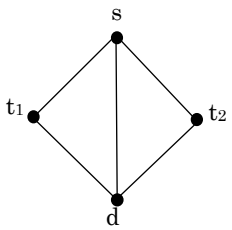
Results and Findings

Levels of Appropriateness of Translation of Terms and Their Mutual Relationship

To understand the translatability of the corpus terms under study in a communicative plan, we can distinguish three levels of appropriateness of translation of terms and establish the relationship between these levels with regards to the degree of translatability terms. In the translation of terms, the exact rendering of the concepts corresponding to these terms plays a primary role. Therefore, the levels of adequacy of translation of concepts are distinguished according to how accurately the concepts are rendered in the TL. Though translators have a vast knowledge regarding translation and linguistic theories and other relevant studies, there are still some drawbacks often found in translation. This includes parts (lexical items) where the exact meaning comes in several forms (Duklim, 2022). These signs are recorded in language by the corresponding texts. The term as a text is compared to the meaning and denotation. The denotation associated with the text is the scope of the corresponding term. Thus, the exact rendering of the term means not only the possible more exact rendering of the meaning associated with the text to be translated but also the possible more exact rendering of the scope of the term – the denotation of the translation text.

During the process of translating a text from one language to another, the translator takes into account not only the words used in the original language but also their meaning. The goal of translation is to replace the original text with a new one that has the same meaning in the target language. In other words, if the original text is represented by t1 and its meaning by ***s*** (it denotes sense), the translated text t2 should have the same meaning as ***s***.

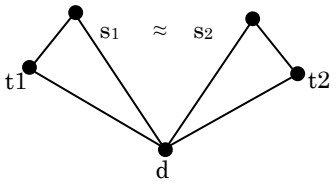
There are three levels of adequacy in translation: the first level is the most accurate, where the meaning and denotation (hereafter d) of the original text are conveyed precisely. Denotation can be used in some cases as denotative meaning — a conceptual core of meaning, a semantic component abstracted from different shades (connotations). For example: *'algorithm'* is translated differently as *"algorıtm", 'propositional calculus' – or "propozısıalyq esepteý".* Translation at the first level of adequacy, therefore, occurs most often when translating logical and mathematical terms. This level of adequacy can be represented as follows:



t_1 – term on SL
t_2 – term on TS
s – general sense of the text t_1 and t_2
d – general denotation of the text t_1 and t_2

Scheme (1)

The second level of adequacy is considered to be that in which the term corresponding to the original text (i.e., pair) is accurately rendered, although the original meaning is only approximately rendered. In practice, the translator does not always succeed in accurately rendering the meaning of the original text, i.e., the text–meaning pair (t1, s2) in the SL corresponds to the pair (t2, s2) in the TL, since the meaning of s1 only approximately matches the meaning of s2 (this fact is rendered as s1≈s2). It is also not possible to establish precise criteria for evaluating the "error" in meaning transfer in translation, i.e., to evaluate how different the meanings of s1 and s2 are. Nevertheless, even in the case where s1≈s2, it is possible to evaluate the "accuracy" of the translation, since the term ***d*** is also associated with the text t1 and the meaning of s1, which should remain unchanged during the translation. Schematically, the translation at the second level of adequacy can be represented as follows:

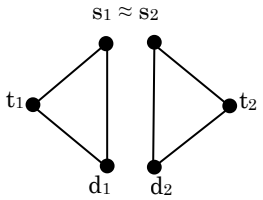


t1 – term on SL
t2 – term on TL
s1 –sense of the text t1
s2 – sense of the text t2
d – general text t1 and t2 denotation

Scheme (2)

In this example, we have some mathematical terms along with their translations. For instance, *'logical product'* is translated as *"logıkalyq ónim", 'singular transform'* as *"sıngýlárlyq transformasıa",* and *'direct clause'* as *"tikeleı núkte"*. These translations are considered adequate at the first level. However, it is worth noting that when translating mathematical texts, the translator may make slight changes from the original to ensure better understanding. This is especially true if the author's wording is not accurate. The second level of translation adequacy is found in some isolated cases.

Finally, the third level of adequacy is when the meaning and denotation are only approximately transmitted, and represented schematically.



t_1 – term on SL
t_2 – term on TL
s_1 –sense of the text t_1
s_2 – sense of the text t_2
d_1 – text denotation t_1
d_2 – text denotation t_2

Scheme (3)

The corpus of mathematical logic terms that we studied did not contain any examples of translation. The texts we analyzed showed that when translating such terms, the denotation can be distorted, and this is done by entering the terms on the SL and the TL in a strictly definitive way. Therefore, achieving a third-level adequate translation of logical and mathematical terms can only happen if the translator makes inaccuracies.

Levels of Adequacy of Term Translation Related to Translatability

There are also three levels of adequacy of term translation related to translatability. If we translate a term at the first level of adequacy, the translation is as accurate as possible in terms of communication, and it has absolute translatability in terms of communication. On the other hand, if the translation of the term is carried out at the second level of adequacy, the translation may not be fully accurate, but it is still acceptable in terms of communication. Thus, the meaning of the term can still be conveyed, indicating the term's relative translatability in the communicative plan. When translating logical and mathematical terms, their denotation (the scope of the concept expressed by the original term) always remains unchanged. This is because translations of these terms are carried out at least at the second level, which ensures that the invariant of the translation is always a denotation. This is due to the deductive construction of mathematical logic. Since translation is almost always possible at the first level of adequacy, there is almost always absolute translatability in the communicative plan within the corpus of terms for mathematical logic.

Translatability in the communicative plan is especially important for scientific terms, and even more so than translatability in the functional plans. However, the degree of translatability of terms in the functional plan is also critical for translators of specialized texts. High relative translatability is due to the large linguistic similarity of the source language (SL) and target language (TL) terms, which makes translation easier. As a result, several linguistic factors impact the degree of translatability of texts in functional terms. These include polysemy, synonymy, word order, other grammatical factors, emotionally colored vocabulary, and phraseology. This work cannot determine all the parameters of translatability for this corpus of terms; however, we will consider the influence of borrowing terms from the Kazakh sublanguage of mathematical logic on the translatability of the corpus of terms in functional terms.

When translating logical and mathematical terms, the meaning of the original term remains unchanged, regardless of the language used. The invariant of terms in the sublanguage of mathematical logic is always a denotation, due to the way mathematical logic is constructed. This means that there is almost always absolute translatability in the communicative plan. Translatability in functional terms is important for translators of special texts. The degree of translatability depends on various linguistic factors such as polysemy, synonymy, word order, grammatical factors, and the presence of emotionally coloured vocabulary and phraseology.

To identify similarities between the syntax of English and Kazakh languages, we analyzed translations of eight of the most frequently used structural models of the English sublanguage, known as a tense phrase (TP), which is a sentence that contains a specifier viz., a subject or a predicate. A TP in a sublanguage represents finiteness. We found that 76.51% of the translations in our corpus were TP pairs. Our structural-comparative analysis revealed that translations with similar structures of the confrontational terms were more common among the various structural variants of the TP translations formed according to the most productive models, except for the N1 prep N2 model. Out of the nine identified variants of translations of terms formed according to our most productive A + N model, the translation of A + N → A' + N' was carried out in 93.29% of cases, for instance, *"actual infinity"* was translated as *"naqty sheksizdik"*. Among the five identified variants of translations formed according to the N1 + N2 model, the translation of N1 +N2 → N'1 +N'2 was carried out by translators in 55.94% of cases.

Table 1 shows the number of English and Kazakh TPs formed according to the same structural models. Our analysis revealed that the coincidence of the syntactic structure of the TP in translation occurred in 53.54% of cases, while the coincidence of the morphological structure of the whole-formed terms happened in 19.95% of the total number of compared terms. Overall, the number of grammatical "borrowings" in the analyzed corpus reached 73.49%. These findings indicate that scientific prose, especially terminology, is permeable to borrowing areas of language not only in terms of vocabulary but also grammar. The high degree of similarity of the structures of the terms in translation shows that the terminological subsystems of the SL and the TL deeply interpenetrate each other. When it comes to terminology, it is important to have clear definitions so that terms do not create any misunderstandings. Grammatical and syntactic means help to highlight the main linguistic identities and facilitate translation. If the terms in the source language SL and target language TL have similar structures, it makes translation easier and increases the accuracy of the translated text. This structural uniformity also makes it easier for machine translation algorithms to work effectively.

Table 1: *Coincidence of the TP Structure During Translation.*

Structural models of English TP	Structural models of corresponding Kazakh TP	Percentage of total number of matched corpus terms	Examples
A + N	A' + N'	37.79	'normal matrix' – *qalypty matrısa*
$N_1 + N_2$	$N'_1 + N'_2$	9.11	'description operator' – *deskrıpsıa operatory*
Part II + N	Pr + N	2.67	'weakened implications' – *álsiregen ımplıkasıalar*
$A_1 + A_2 + N$	$A'_1 + A'_2 + 'N$	1.83	'classical implicative lattice' – *klasıkalyq ımplıkatıvti qurylym*
$A + N_1 + N_2$	$A' + N'_1 + N'_2$	1.07	'ambiguous axioms set'— aksıomalardyń tolyq emes jıyntyǵy
Part I + N	Pr + N	0.66	'satisfying assignment' – *úlestirýdi oryndaý*
N_1 prep N_2	N'_2 prep N'_2	0.41	'generalisation by induction' – *ındýksıa boıynsha jalpylaý*
TOTAL		53.54	

Semantic borrowings in a corpus are also known as semantic calques. According to Friedman, semantic borrowings are not common in terminology (Friedman, 1968). However, this provision does not apply to the terms in this corpus. There are numerous semantic borrowings that can be categorized as complete or incomplete calques. Complete calques involve the translation of all the elements of a term word by word or morpheme by native Kazakh elements. Examples of complete calques include *'inequality' – "teńsizdik", 'pure variable property' – "aınymalylardyń tazalyq qasıeti"*, and 'inclusion of sets' – *"jıyndardy qosý"*. On the other hand, incomplete calques involve the translation of the underlined element through transliteration instead of using the native Kazakh element. Examples of incomplete calques include 'exclusive predicates' – *"tolyq predıkattar", 'weakened implications' – "álsiregen çmplıkasıalar", and 'nested recursion' – "uıa rekırsıasy"; 'descending induction' – túsý ındýksıasy "*.

Due to the large number of lexical borrowings in a sublanguage, incomplete semantic calques are more prevalent than complete ones. However, we did not differentiate between the two when conducting calculations. As a result, we identified that 81.21% of the terms in the studied corpus were translated using a semantic calculus method, which involves using terms with equivalent internal forms on the SL and the TL. It is worth noting that semantic borrowings often occur alongside morphological and syntactic borrowings for example:

$N[S_1S_2] \rightarrow N'[S_1S_2]$ *'metalanguage' _"metatil "*
$N_1 + N_2 \rightarrow' N'_1 + N'_2$ *'product spaces' "keńistikterdiń kóbeıtindisi"*

$A_1 + A_2 + N \rightarrow A'_1 + A'_2 + N$ *'compatible formal systems' " úılesimdi resmı júıeler"*
$A + N_1 + N_2 \rightarrow A' + N'_1 +$ *'ambiguous axiom set' "aksıomalardyń tolyq emes jıyntyǵy"*

In the analyzed corpus, there are 67.74% of structural-semantic calques, which are borrowings that maintain the same semantic structure. This shows that both semantic calculus (81.21%) and structural-semantic (61.01%) translations of terms are quite popular. This creates a uniformity of the semantic structure of several terms, achieving the equivalence of the internal form of 81.01% of the confrontational terms. The result is a high degree of structural and semantic coincidence, contributing to the relative translatability of this corpus of terms in functional terms.

The sublanguage of mathematical logic has a common semantic and conceptual field, which explains the significant number of grammatical, semantic and structural-semantic borrowings, as well as the desire for uniformity in the connection of the elements of terms in structural and semantic terms in SL and TL. This is further explained by the common ways of developing scientific knowledge and the communicative task of the texts. It is worth noting that multiple types of borrowings can occur simultaneously when translating the same term, such as syntactic borrowing (Part II+N→Pr+N) and hybrid lexical borrowing or incomplete semantic calques. This indicates a deep interference of the logical and mathematical terms SL and TL.The corpus presents not only a multiplicity but also a variety of types of borrowings. These are clearly shown in the following Figure 1.

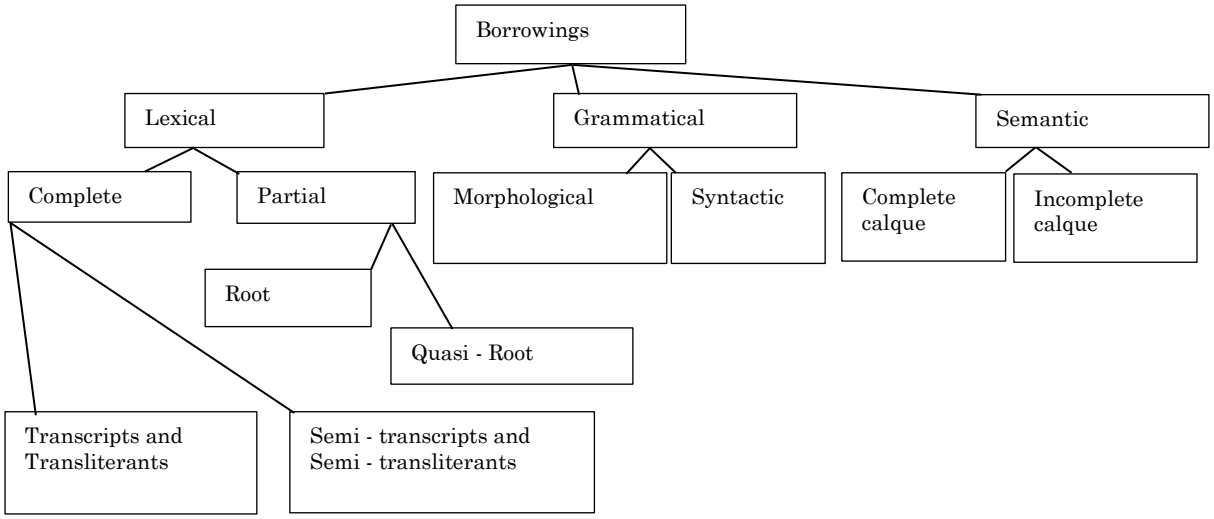


Figure 1: *Types of borrowings in the Kazakh terminological vocabulary of mathematical logic*

Lexical borrowings in the Kazakh sublanguage of mathematical logic can be distinguished into four groups: pure lexical borrowings, hybrid lexical borrowings, terms formed exclusively from native Kazakh lexemes, and terms formed exclusively from native Kazakh. Pure and hybrid lexical borrowings make up 29.68% and 38.91% of the terms in the Kazakh sublanguage, respectively. Meanwhile, 31.41% of the terms are formed from native Kazakh lexemes. The terms in the sublanguage can be either single-compound terms or terminological phrases. For example, *'existential elimination'* is translated as *"ekzıstensıaldy eliminasiasy"* in Kazakh. Thus, all three groups have both single-compound terms and terminological phrases (hereafter TP), as shown in Table 2.

Table 2: *Example of English-Kazakh Translations.*

Type	English	Kazakh transaltion
Pure borrowings	existential elimination	*ekzıstensıaldy eliminasiasy*
	equimorphe inscriptions	*ekvımorfty ınkrıpsıalar*
	meta-eemiosie	*metasemıoz*
	equivalence	*ekvıvalenttilik*
	succedent rules	*sýksedenttik erejeler*
Hybrid borrowings	stratified property	*stratıfıkasıalanǵan menshik*
	transfinite cardinal number	*transfınıttik kardınal sany*
	binary infix connector	*ekilik ınfıks qosqyshy*
	equivalence relation	*ekvıvalenttik qatynas*
	proposition	*usynys*
Terms formed from native lexemes	dense set	*tyǵyz jıyntyq*
	chain inference	*tizbekti shyǵarý*
	natural inference calculus	*tabıǵı qorytyndyny esepteý*
	concatenation	*biriktirý*
	multiply pro-sequence	*áreketter tizbegin kóbeıtý*
	mid-sequence	*ortasha rettilik*

When it comes to borrowings, there are two types: full and partial. Full borrowings are those that phonetically reproduce the sound of the word in the source language (SL) and are either a transcript (SL term that phonetically reproduces the sound of the term in SL) or a trans-literant (SL term formed by exact letter-by-letter translation). Examples of full borrowings include *"wef"* and *"singleton."* On the other hand, partial borrowings do not fully reproduce the sound of SL terms due to the peculiarities of the target language (TL). Semi-transcripts (SL terms that do not fully reproduce the sound of SL terms) and semi-transliterants (TL terms formed by inaccurate letter-by-letter translation) are examples of partial borrowings. Examples of partial borrowings include *"algorithm"* and *"denotation " respectively, "algoritm", "denotat"* in Kazakh.

There are two types of partial borrowings: root and quasi-root. Root borrowings only transliterate or transcribe the root or base of the word. An example of a root loanword is *"equimorphe inscriptions,"* which is transliterated as *"ekvımorfty ınkrıpsıalar."* Quasi-root borrowings are terms that have been significantly assimilated into the TL. *"Quantifier"* is an example of a quasi-root loanword, translated as *"kvantor."* Some borrowings are though partial but they fit well into the Kazakh text because they are formed based on Kazakh grammatical models. They have Kazakh suffixes and endings, numbers, and cases. Examples of such fit-partial borrowings include *"transitivity,"* which is translated as *"transitivtik,"* or "*binary infix connector,"* which is translated as *"ekilik ynfıks qosqyshy,"* and *"concatenation,"* which is translated as *"biriktirý."*

Hybrid borrowings are even more adapted than root and quasi-root borrowings in Kazakh texts. The loanword forms in hybrid borrowings are always partial borrowings and are associated with native word forms according to all the rules of Kazakh grammar. Examples of hybrid borrowings include "recursive set," which is translated as *"rekýrsıvti jıyn,"* and "*Hausdorff space,"* which is translated as *"Haýsdorf Keńistigi."*

Borrowings have a higher degree of signedness than original terms. Loaned units have properties of that sign, such as unambiguity, unemotionality, and unproductivity, which makes them more translatable than original lexical units. The high degree of signification of the terms in the corpus under study, due to a significant number of lexical borrowings, increases the relative translatability of the corpus in functional terms. In this corpus, 29.68% of pure lexical borrowings are root and quasi-root borrowings. When hybrid borrowings are added, the number of terms containing borrowed lexemes reaches 68.58%. These terms fit well into the Kazakh text and are adapted phonetically and grammatically.

Using loaned lexical units in mathematical logic sublanguage increases the degree of signedness of the terms. Loaned units exhibit properties of that sign, such as unambiguity, unemotionality, and unproductivity, making them more translatable than the original terms. The high degree of signification of the corpus under study is due to a significant number of lexical borrowings. This increases the relative translatability of the corpus in functional terms. The large number of both pure and hybrid lexical borrowings in the sublanguage of mathematical logic contributes to a high degree of internationalization of the terms, increasing the linguistic similarity of the terms being confronted. This also increases their "material similarity" and their "recognition" by the translator. Consequently, the translatability of the corpus is also increased in functional terms.

The influence of semantic and grammatical borrowings on the translatability of the corpus is complex and not always easy to attribute. Even if a term appears for the first time in the language, it can still be a result of an independent appearance in the language or the result of searching for an adequate translation. In the corpus under study, the attribution of the terms of the TL to semantic and grammatical borrowings is conditional to some extent. To determine the degree of similarity of the structures of the terms in the English and Kazakh sublanguages of mathematical logic, we need to compare their grammatical structure. This will help us understand how similar the structures of these terms are, even when their meanings are the same.

In sublanguages that involve confrontational terms or grammatical calque, grammatical borrowings can occur at both the morphological and syntactic levels. We differentiate between morphological borrowings and syntactic borrowings. The former is identified through similarities in word endings, while the latter is identified through TP. Morphological borrowings include models of terms that are similar in structure. The designations used in the article, for example, we have adopted N – noun; A – adjective; S – base; P- prefix; Suf -suffix; Part I – present participle; Part II – past participle; Pr – participle used in TL; prep. – a preposition.

a) N[S] → N'[S1S2], for example: *'box' – "tekshe", 'branch' – " sala", 'bound' – "sheti", 'clause' – "klaýza", 'dual' – " dýal"*.

Such correspondences were observed in 5.63% of the total number of terms compared.

b) N[SV] → N'[SV], for example: *'provability' – "dáleldeý múmkindigi", 'valuation' – "baǵalaý", 'connective' – "baılam"*.

Such correspondences were observed in 9.93% of the total number of terms compared.

c) N[PS] → N'[PS], for example: *'subtheory' – "sub teorıasy", 'contraposition' – "qarsy pozısıa"*.

Such correspondences occurred in 2.24% of the total number of terms compared.

d) N[S1S2] → N'[S1S2], for example: *'equisignificanee' – "ekvıvalenttilik"*.

Such correspondences occurred in 1.99% of the total number of terms compared.

e) N[S1{S2S3}] → N'[S1{S2S3}], for example: *'auto-homeomorphls' – "avtogomeomorfızm", - 'metaeemiosie' – "metasemıoz"*.

Discussion

This study examined the influence of borrowing terms in the Kazakh sublanguage of mathematical logic on translatability in functional terms. For this purpose, lexical, semantic, and grammatical borrowings were examined sequentially. It was assumed that the correlated terms in both languages express the same scientific concept, and their scope and quality were unchanged since the meaning of terms in mathematical logic was strictly defined by the definition. Some English words are not borrowed through translation but rather influenced by the English language itself. An example of this is the term "stream plan" coined by Maximova (1973), which used the term "negation" instead of other commonly accepted terms, which resulted in the formation of "stream plan" from "structures with implication and negation" (p. 463).

This study provides a thorough analysis of borrowing phenomena in the Kazakh sublanguage of mathematical logic, illuminating the complexities of linguistic exchange in this specialized field. The findings encourage a reevaluation of traditional perspectives on language borrowing, particularly in the context of scientific sublanguages under three levels: levels of borrowing, impact on scientific text structures and factors contributing to high translatability. The first level, Levels of Borrowing was understood with four levels of borrowing: lexical, morphological, syntactic, and semantic. Out of all four levels, the semantic level demonstrates the greatest openness to borrowing, contrasting traditional views that prioritize lexical borrowing in national languages. The second level of Impact on Scientific Text Structures, was examined as integration of borrowings resulting in greater uniformity in the structure of scientific texts, enhancing the linguistic similarity between source language (SL) and target language (TL) segments. The final level, Factors Contributing to High Translatability involved several elements namely (1) Lexical Borrowing and Symbolic Nature where the prevalence of borrowed terms contributes to a tighter integration of concepts across languages; (2) Morphological and Syntactic Similarity where a significant overlap (73.49%) in term structures between SL and TL promotes mutual intelligibility was observed; (3) Semantic Structure Uniformity, where a high percentage (61.21%) of semantic alignment was found linked to the widespread use of semantic calculus in translation practices; (4) Common Intellectual Paradigms which involved shared approaches to scientific knowledge to enhance translatability; and (5) Selective Borrowing, which eliminated incompatible elements from the terminology of both languages reinforces structural and semantic coherence.

In addition, the study examined the functional translatability showing the interrelationship between terminological systems in SL and TL, forming the basis for high relative translatability, promoting effective communication of complex ideas. The applications for translators helped in understanding the translatability of scientific sublanguages as they can equip translators with insights into more efficient translation strategies for specialized texts. The study also established correspondences between SL and TL facilitating smoother translation processes by highlighting systematic relationships in terminology.

Conclusion

This study delved into the challenges and considerations surrounding the translation of mathematical logic texts, emphasizing its linguistic aspects and the relevance of its sublanguage in scientific discourse. It notes that both domestic and international research has been conducted in this specialized field, showcasing a comprehensive retrospective analysis of prior studies. Key findings highlight that the sublanguage of mathematical logic is notably receptive to lexical borrowings, particularly at the semantic level, which enhances the translatability of these texts. The research underscores how borrowings contribute to a more uniform structure across scientific literature, thereby increasing relative translatability. The results of this study made evident the ways of transmitting international scientific terms in the Kazakh scientific and technical language. It also showed that international terms are translated mainly by word-formation calculus, namely using semi-cliches, and neologisms that align with the structures of the Kazakh language. This process involves adapting foreign terms by either creating new words based on existing Kazakh lexical elements or by using affixes that are native to the language. This approach not only aids in the assimilation of international scientific terms but also ensures that they resonate with the linguistic patterns familiar to Kazakh speakers.

The significance of this work lies in its identification of factors that facilitate high translatability, such as extensive lexical borrowing and the symbolic nature of mathematical language. The study also addresses the complexity of translatability and untranslatability within scientific texts, specifically through the lens of

phraseological units. These units provide insight into the nuances of translating specialized terminology and concepts. The study employs various methods and techniques related to translation research and semantic analysis, aiming to establish clearer correspondences between source and target languages. By examining translations across multiple languages, it seeks to uncover shared features and divergences, contributing to a deeper understanding of the translation process in scientific contexts. In conclusion, the research asserts that a thorough linguistic perspective on translation can significantly aid translators working with scientific sublanguages. By elucidating effective translation strategies for different lexical units, the study encourages further exploration into the translatability of scientific discourse, particularly in mathematical logic.

This study was, however, limited to very narrow parameters of translatability. Further investigations into the dynamics of sublanguage borrowings across different scientific disciplines may be carried out. Comparative studies examining borrowing patterns in other scientific sublanguages could also contribute to a more comprehensive understanding of how language evolves in technical contexts. Additionally, exploring the cognitive and cultural implications of these linguistic shifts might enrich the discussion surrounding scientific communication in multilingual settings. In conclusion, the study emphasizes the importance of examining the nuanced interactions between languages within specialized domains, providing valuable insights for both linguists and translators engaged in the field of scientific communication.

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