

READABILITY METRICS: THE CASE OF RUSSIAN EDUCATIONAL TEXTS

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Abstract

Background: When creating textbooks, test papers, tests and other methodological tools, the authors are interested in the pupils' fullest understanding of the material presented. Most of the information is contained in the text, and the way this text is perceived by readers, largely determines the quality of educational material. That is why creators of educational material should consider various audiences with different background knowledge.

Literature Review: The educational text is created based on abbreviation, paraphrase, expansion, which manifests itself in changing the parameters of the text: (a) the volume (the text can be shortened or enlarged by the inclusion of explanations or elements of another text, etc.); (b) complexity (replacement of lexical grammatical composition, splitting of complex sentence into several simple ones, etc.). The educational text is a secondary, "integral and connected, actualized, didactically organized material that possesses a lexical structure and semantics corresponding to its characteristics", which is distinguished by a special set of language facilities and a pragmatic attitude, connecting the participants of communication, is the consideration of language competence and background knowledge of the addressee.

Methods and Materials: A corpus of educational texts compiled for the research includes 15 textbooks on social studies (grades 5-11) recommended by the Russian Federal Educational Standard. Subcorpus I edited by NIKITIN contains 7 textbooks ranged from 6 to 11 grades. Textbooks for 11 grades have two levels of complexity, claimed by the authors: the basic and advanced levels. The second Subcorpus edited by BOGOLUBOV contains 8 textbooks for grades 5-11, books for 11 graders have two levels of complexity – basic and advanced. The total volume of corpus is 624 thousand tokens, 40 thousand sentences. Readability of the texts was computed with Flesch readability formula adapted for the Russian language.

Results and Discussions: The highest readability in Subcorpus I belongs to the textbook for 5th grade – 61.9, which corresponds to the average level of a 9th grader and does not meet the requirements of the 5th grade. The least readable is the textbook for the 11th grade in Subcorpus II, with readability 6.6, which corresponds to the level of university graduate. We also discovered a minor difference between the basic and advanced textbooks for grades 10-11 in Subcorpus I: 13.1 and 13.09, respectively. We may suggest that complexity of these two texts is almost identical.

Conclusions: Flesch-Kincaid readability formula adapted for Russian texts proved to be an invalid tool to provide information about text complexity. We cannot rely on the formula as it cannot be applied to estimate

either a semantic or syntactic difficulty of a text. The study demonstrated limitations of the existing formulas and suggests further studies of complexity of Russian educational text. We believe that a conclusive research on defining text metrics correlating with text complexity implies a thorough research of cohesion of Russian texts, their lexical and syntactic parameters as well as such quantitative metrics as the length of an average word and a sentence. Readability formulas designed on the range of the metrics enumerated above may contribute to the process of better selecting educational texts.

Keywords: educational text, text complexity, readability formulas, Flesch index, educational discourse

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1 INTRODUCTION

Considering the text as an object of linguistic research, we apply a multidimensional approach to its study. One of the problems of modern linguistics is the definition of evaluation parameters and text optimization. The main parameters of text are readability, comprehensibility, complexity and difficulty. Some of these parameters are determined in applied linguistics with the help of mathematical formulas and computer programs.

The educational text is created based on abbreviation, paraphrase, expansion [1], which manifests itself in changing the parameters of the text: (a) the volume (the text can be shortened or enlarged by the inclusion of explanations or elements of another text, etc.); (b) complexity (replacement of lexico-grammatical composition, splitting of complex sentence into several simple ones, etc.) [3]. The educational text is a secondary, "integral and connected, actualized, didactically organized material that possesses a lexical structure and semantics corresponding to its characteristics" [2], which is distinguished by a special set of language facilities and a pragmatic attitude, connecting the participants of communication, is the consideration of language competence and background knowledge of the addressee [12].

When creating textbooks, test papers, tests and other methodological tools, the authors are interested in the pupils' fullest understanding of the material presented. Most of the information is contained in the text, and the way this text is perceived by readers, largely determines the quality of educational material. That is why creators of educational material should consider various audiences with different background knowledge. [9].

Teaching texts should correspond to the age characteristics of students. Obviously, students of lower grades will not easily perceive information in the text, which is difficult for them to read. This happens when the text is poorly printed, contains complex compound sentences or a lot of new material. The current lack of testing and assessment component in teacher training provision in Russia contributes to the absence of transparent, international, educational standards that may lead to diversity in the contents of textbooks. [10].

In several works, complexity is viewed as a characteristic of the text, dependent on its internal parameters. In Russian academic discourse there is still no single terminological apparatus that denotes the characteristics of the text. In his article "On the problem of the characteristics of the text: readability, comprehensibility, complexity, difficulty" Kisel'nikov A.S., made a thorough review of the works devoted to the characteristics of the text is made and an attempt is made to distinguish between these terms.

The difficulty of the text is the broadest term, which includes several objectives (actual textual) and subjective (reader-dependent) parameters [5]. Objectivity refers to readability, comprehensibility and complexity. Subjective include age, education, background knowledge, gender, social status, place of residence, absence / presence of diseases and a few others)

A.S. Kisel'nikov suggests that when determining the readability of a text, only quantitative parameters are considered: the number of words in the text, the number of sentences in the text, the average length of the sentence, the average number of syllables in the word, the average number of characters in the word and a few others.

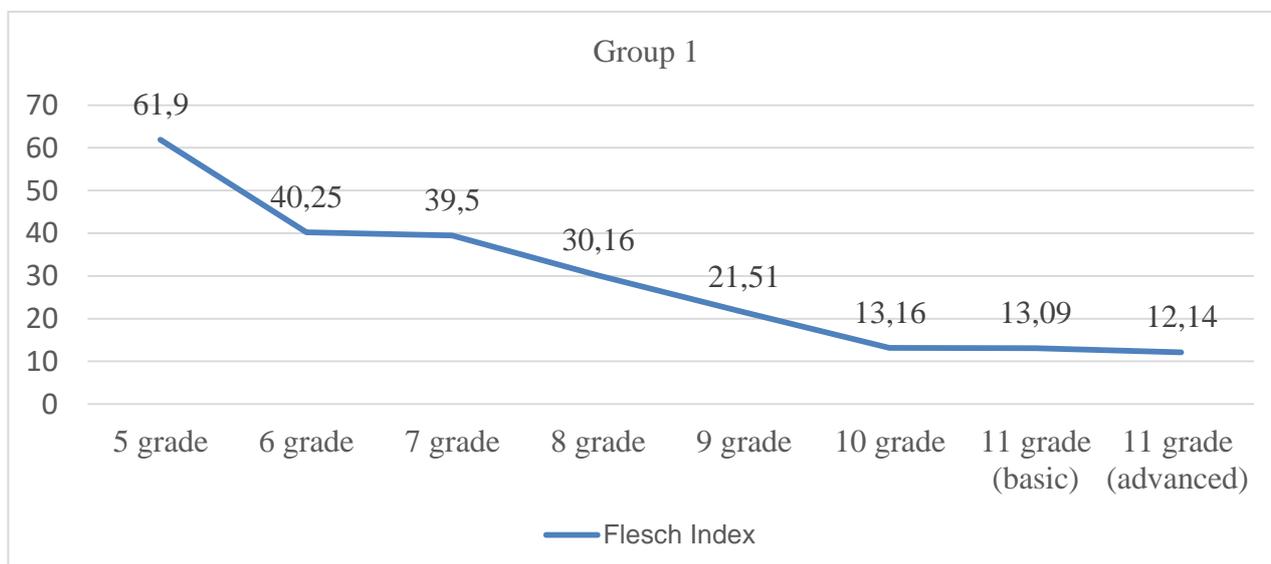
2 METHODS

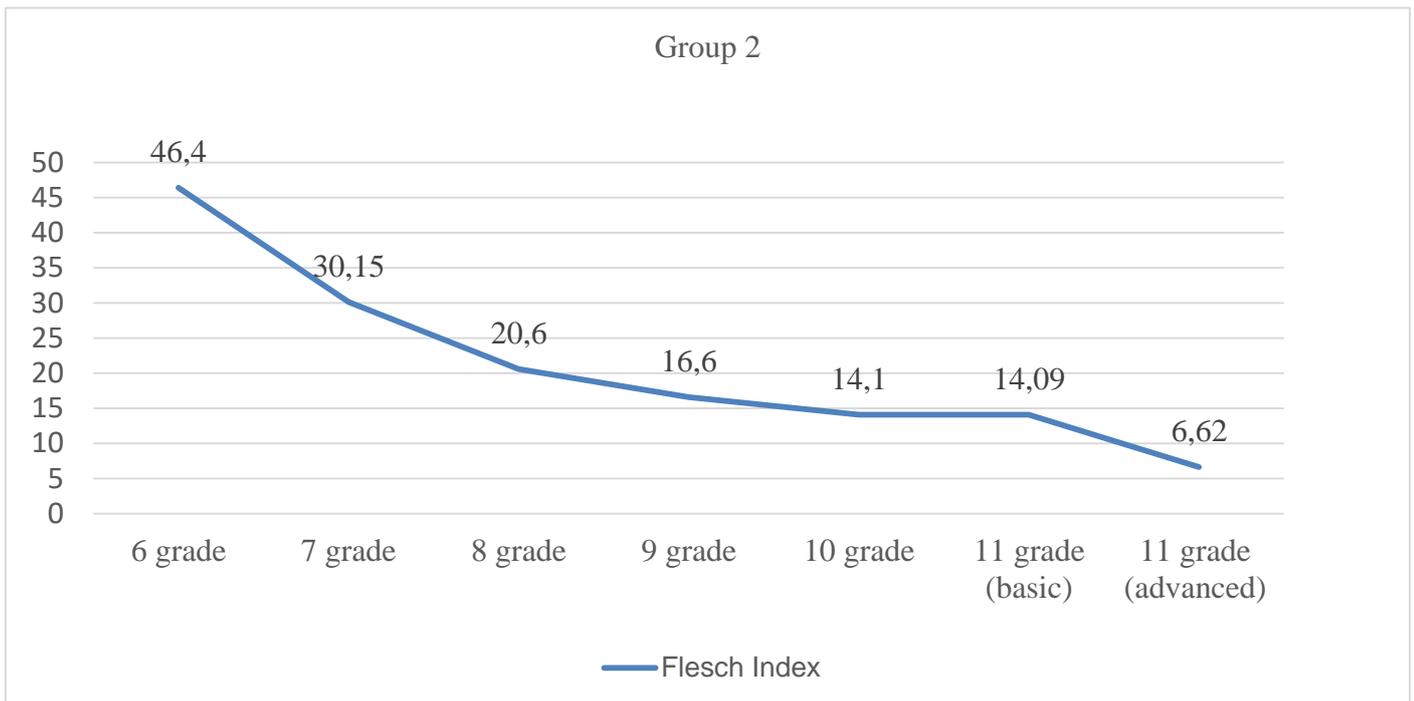
At this stage of study, we focused on the readability of educational texts. A corpus of educational texts was created by our research team. It includes the content of 15 textbooks on social studies (grades 5-11). Both series of textbooks are on the list of recommended Federal Educational Standard. This corpus was analyzed by the following readability formulas: Flesch readability formula and Flesch–Kincaid both, these formulas were adapted to Russian language. That was made in connection with the fact that in Russian the average sentence length is shorter than English sentence and the words on average are longer [11]. Other formulas did not require any adaptation. The Coleman-Liau index is based on a series of symbols in words, not syllables. The formula is calculated at the level of the average number of letters and sentences per 100 words. Dale - Readability Formula. Initially, the program was guided by a list of 763 words that every average American student should understand by the last year of training. Words that are not on this list are considered difficult to understand. Over time, the formula was improved, and by 1995 the list of words expanded to 3,000 words. However, it was not possible to ascertain at any lexical minimum the founders of the Russian development rely on the calculation of this index. Automatic Readability Index (ARI) defines readability as follows: the number of characters is divided by the number of words with spaces, then the number of words by the number of sentences. Simple measure of Gobbledygook (SMOG) formula was developed by Harry McLaughlin. To determine the readability index, consider the number of sentences in the text and the number of "compound words" (more than three syllables) in each.

3 RESULTS AND DISCUSSION

The first group of textbooks contained 7 textbooks ranged from 6 to 11 grades. Textbooks for 11 grades have two levels of complexity, claimed by the authors: the basic and advanced levels. The second group of textbooks has 8 textbooks grades 5-11, also books for 11 graders have two levels of complexity – basic and advanced. The total volume of corpus is 624 thousand tokens, 40 thousand sentences.

The history of studying the readability of the text has been around for about 70 years. One of the first researchers of text readability is the American scientist Rudolf Flesch. In the late 40's and early 50's of the XX century. The Flesch index was developed. Here we used adapted formula for Russian language - Flesch Index = $206.836 - (1.52 \times \text{average length of the sentence}) - (65.14 \times \text{average number of syllables in the word})$. Two constant parameters for Russian language were calculated by I. Osborneva in her dissertation [8].





The most readable is the textbook in group 1, 5th grade –index is 61.9, which corresponds to the average level of complexity of the text and correlated to the level of 9th grader and does not meet the requirements of the 5th grade. The least readable is the textbook for 11th grade in group 2, index is 6.6, which corresponds to the level of university graduate. Also, on the chart you can trace the steady reduction tendency in the Flesch index, as the class and complexity of the studied subject increase.

We traced a minor difference between the basic and advanced textbooks for grades 10-11 in group 1. The readability of the basic textbooks in group 1 for the 10th and 11th grades is 13.1 and 13.09, respectively, the index of the advanced textbook is 12.4. We may suggest that quality of these two texts is almost identical the differences might be found on the level of semantics.

A series of textbooks in group 2 begins with grade 6 - index 46.4, grade 7 - 30.1, grade 8 - 20.6. The textbooks of the basic and advanced level have respectable difference in the level of readability of 14.13 and 6.62. That demonstrates the difference in lexical and morphological level of these two textbooks and might demand additional resources on comprehension and understanding the contents of the book.

The second formula used is Flesch-Kincaid Formula [6], which has the following interpretation:

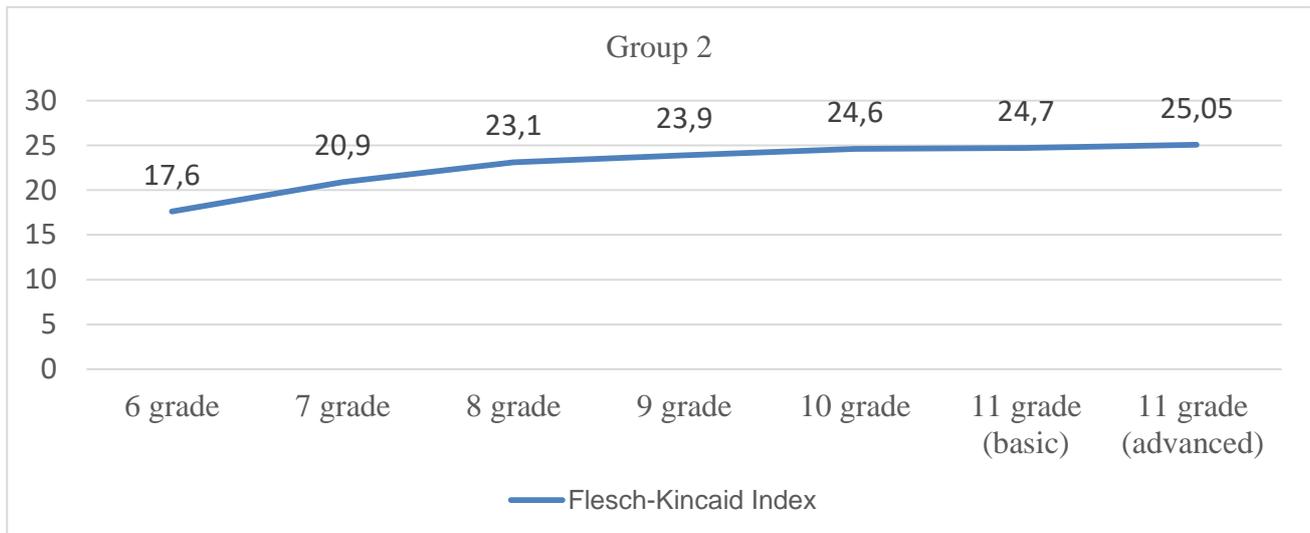
$$FK = (0.39 \times \text{average sentence length}) + (11.8 \times \text{average number of syllables in the word}) - 15.59.$$

The formula has two variables (the average sentence length and the average number of syllables in the word) and two constants - 0.39 for the average sentence length and 11.8 for the average number of syllables. The adaptation of the FK formula for the analysis of texts in Russian was also made by I. Osborneva based on the results of a comparative analysis of the average length of a word in the collated languages - English and Russian - based on six million words from one hundred English (original) and Russian (translated) literary texts [8]

The variant of the FC formula for the Russian language is as follows: $FK = (0.5 \times \text{average sentence length}) + (8.4 \times \text{average number of syllables in a word}) - 15.59.$

The results of the analysis with the use of Flesch-Kincaid formula demonstrated close results.

Readability of the text declines in correlation with increasing of grade. In group 1 we observe difference in 4 points between textbook for 5th and 6th grade that correlates with results demonstrated by Flesch reading formula. Nevertheless, this formula did not detect difference in basic and advanced level textbooks in group 2. The difference in readability is less than 1 point, at the same time previous formula detected difference in 8 points.



Other formulas demonstrated similar results to above mentioned formulas and demonstrated correlation between readability and grade of textbook.

4 SUMMARY

Reading formulas proved to be a good instrument of statistics that can provide an information about general structure of the text. We can assume on how many percent of the student will be able to comprehend the information provided by the textbook. At the same time, we cannot completely rely on these formulas as they cannot be applied on estimation of semantic or syntactic difficulty of the text. Another important component of educational process that cannot be assessed by the formulas is the knowledge and experience of the teacher and prior knowledge of students. Nevertheless, this study demonstrated that recent textbooks on social science do not correspond to readability level set up in the formulas. This study requires further development with the use of advanced readability formulas with the use of syntactic analyzers for Russian language. Thorough research of syntactic and semantic structure of textbooks would make a conclusion about the difficulty of the educational texts. The use of readability formulas may contribute to the process of designing and combining the content for textbooks as it can be analyzed simultaneously, so the editorial board or author may correct the content before publishing.

5 CONCLUSIONS

When analyzing the comprehensibility of a text, quantitative parameters are supplemented with parameters of "familiarity" and "abstractness" of words. As you can see, the area of this term includes not only quantitative, but also 'qualitative' parameters. Analysis of the complexity of the text in this sense is a much more extensive task: along with a wide range of quantitative parameters, the characteristic under consideration assumes the inclusion of qualitative parameters, the analysis of lexical units of the text (multivalued words, nationally-labeled lexical units, lexical minimum dictionary and frequency dictionaries) abstract "units (formulas, graphs, schemes, etc.), analysis of the links at the level of the sentence and the text as a whole (anaphor and antecedent, synonymy, reference, etc.).

The difficulty of the text is determined based on an analysis of the complexity of the text in relation to a specific target audience (or an individual reader), because the text of one complexity can have a different difficulty [4]. The further development of computer technologies and software designed for analysis of text complexity can improve the quality of textbooks and increase the level of pupils and students academic knowledge.

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