

Automated Complexity Assessment of English Informational Texts for EFL Pre-service Teachers and Translators

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Abstract

Automated text complexity assessment tools are of enormous practical value in solving the time-consuming task of analyzing English informational texts for their complexity at the pre-reading stage. The present study depicts the application of the automated text analysis system the TextEvaluator as an effective tool that helps analyze texts on eight dimensions of text complexity as follows: syntactic complexity; academic vocabulary; word unfamiliarity; word concreteness; lexical cohesion; interactive style; level of argumentation; degree of narrativity, with further summarizing them with an overall genre-dependent complexity score. This research examines the complexity dimensions of English informational texts of four genres – legal, linguistic, news, and medical – that are used for teaching reading comprehension to EFL (English as a foreign language) pre-service teachers and translators at universities in Ukraine. The data obtained with the help of the TextEvaluator has shown that English legal texts are the most difficult for reading comprehension in comparison to linguistic, news, and medical texts. In contrast, medical texts are the least challenging out of the four genres compared. The TextEvaluator has provided insight into the complexity of English informational texts across their different genres that would be useful for assembling the corpora of reading passages scaled on specific dimensions of text complexity that predict text difficulty to EFL pre-service teachers and translators.

Keywords: automated complexity assessment, informational texts, text complexity, text complexity indices, the TextEvaluator, EFL pre-service teachers and translators.

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Introduction

Any kind of knowledge can be accessed through texts, and comprehending complex expository texts is essential for learning (Liben, 2010). However, selecting engaging texts for training EFL pre-service teachers and translators “at a specific level of proficiency is a demanding and time-consuming task” (Xia, Kochmar & Briscoe, 2016, p. 12). Automated analyses of text characteristics are of enormous practical value for selecting texts for students (Graesser, McNamara, & Kulikowich, 2011; Graesser et al., 2014; Dowell, Graesser, & Cai, 2016; McNamara, Graesser, McCarthy, & Cai, 2014; Napolitano, Sheehan, & Mundkowsky, 2015; Pilán, Vajjala, & Volodina, 2016; Sheehan, Kostin, & Futagi, 2009; Sheehan, Kostin, Napolitano, & Flor, 2014; Sheehan, Flor, Napolitano, & Ramineni, 2015; Sheehan, 2017). Currently, Ukraine’s educational institutions training EFL teachers and translators, as in most other countries, require in their standards that students should have successful close text reading experiences with both literary and informational texts. In practice, however, there are many instances of teaching to read informational texts superficially (*Read page X and find the answers*). To help students become more proficient readers, it is essential that at the pre-reading stage, texts should be analyzed on multiple levels of language and discourse with automated text analysis tools. Students’ deep understanding of the nature of text complexity, and close reading (Lapp, Moss, Grant, & Johnson, 2015), and the compilation of electronic text corpora with texts calibrated according to their complexity seem to be mandatory components in effective comprehension instruction. However, no studies of automatic assessment of English informational texts complexity across their genres for teaching reading comprehension to EFL pre-service teachers and translators have been conducted in Ukraine, so far. Thus, there was a need to perform the present study to explore English informational text complexity variation across a few genres used in teaching reading comprehension to EFL pre-service teachers and translators at universities in Ukraine. Therefore, the purpose of this small scale study is to illustrate the value of the TextEvaluator as an automated text analysis system that helps analyze texts of informational genres on eight dimensions of text complexity as follows: syntactic complexity; academic vocabulary; word unfamiliarity; concreteness; lexical cohesion; interactive/conversational style; level of argumentation; degree of narrativity. With this aim, the following research questions will be addressed within the scope of our study:

RQ 1. What complexity dimensions of informational texts display variation across their different genres that can be measured by the TextEvaluator tool?

RQ 2. What are overall text complexity scores for each of the genres of informational texts under analysis and texts of what genres: legal, linguistic, news, or medical are easier/more difficult for reading comprehension?

Findings from this study may add new information about the automated assessment of informational text complexity variation across genres to the existing knowledge base in the TEFL practices both in the Ukrainian and other EFL national settings. Attention to issues of the text complexity is also essential for reading comprehension instruction because the latter requires reading passages that become progressively and predictably more difficult from one level to the next. And the application of automated tools for scaling text complexity, like the TextEvaluator, is indispensable for leveling reading passages used in EFL classroom teaching and assessments practices.

Literature Review

The Text Complexity Model

Text complexity refers to the level of challenge a text provides to the reader (Lapp et al., 2015). Sheehan et al. (2009) claimed that the processes engaged in reading informational texts differ substantially from those involved in reading literary texts. The term *informational texts* means “any text written with the main objective of transmitting information about the natural or social world and incorporating specific features to achieve that objective” (Duke, 2000, p. 205).

While building a coherent mental representation of a text, readers rely on the following four types of cognitive processes: (1) making sense of the words comprising a text; (2) using relevant syntactic knowledge to define meaningful propositions; (3) using observable textual clues to infer connections across sentences and larger sections of text; and (4) using relevant prior knowledge and experience to develop a mental representation of a text (Sheehan et al., 2014). We consider the above said cognitive features reliable and relevant for a text complexity model (text complexity expectations) with a minor extension of component (4) concerning prior knowledge and experience. EFL pre-service teachers and, especially, translators read target texts from both “equivalent” and “non-equivalent” subject-related domains. “Equivalent” fields consist of texts featuring the same content regardless of language, e.g., chemistry, mathematics, etc., while “non-equivalent” domains incorporate texts of field-specific content that varies not according to language, but to the local systems (Hall et al., 2007), e.g., legal texts, etc. Given that, foreign informational texts from “non-equivalent” areas can contain more complexities connected with background knowledge than texts from “equivalent” fields.

To successfully comprehend a text, competent readers must be proficient: 1) at understanding the individual sentences presented within a text (*syntactic complexity*); 2) at making sense of the words comprising the text (*vocabulary genre-specific difficulty*); 3) at inferring connections across ideas (*lexical cohesion; interactive/conversational style; level of argumentation*); 4) and at using prior knowledge about rhetorical patterns (*textual organization*) (Sheehan et al., 2014).

Syntactic complexity as “the range of forms that surface in language production and the degree of sophistication of such forms” (Ortega, 2003, p. 492) reflects the extent to which sentential clauses and phrases are embedded in the text: greater complexity reflects a higher degree of textual ambiguity, structural density, and ungrammaticality (Graesser, McNamara, Louwerse, & Cai, 2004). Sentence complexity has a more significant impact on working memory performance than the length of the sentences (Marton, Schwartz, Farkas, & Katsnelson, 2006).

Vocabulary genre-specific usage that has an impact on informational text processing depends on the type of vocabulary employed. The study undertaken by Lee (2001) reports that informational texts employ from 66% to 71% of words from the so-called “core vocabulary” (a list of 2000 common words), whereas literary texts use from 81% to 84% of such lexemes (Lee, 2001). This finding suggests that informational texts employ fewer common words that are easier to understand. In addition to academic vocabulary, two more components impact the “understanding words” process: *word concreteness* and *word unfamiliarity* (Sheehan et al., 2014, p. 197). *Word concreteness* is the degree to which the text contains content words that are concrete,

meaningful, and evoke mental images (Pitler, & Nenkova, 2008). Concrete words are easier to process than abstract words. The latter verbalize concepts whose visual representation is more difficult, thus complicating text comprehension (Pitler, & Nenkova, 2008). Texts that “contain more abstract words are more challenging to understand” (Dowell et al., 2016, p. 78). Texts “with large numbers of rare words are expected to be *more* difficult” (Sheehan et al., 2014, p. 195).

Narrativity, and degree of *interactive conversational style* indices feature “the extent to which a text requires knowledge of more familiar discourse structures, while the *level of argumentation* measures the extent to which a text requires knowledge of less familiar discourse structures” (Sheehan et al., 2014, p. 198). Informational texts “tend to incorporate fewer well-known structures (cause-effect, comparison-contrast, and problem-resolution)” (Sheehan et al., 2009, p. 1978) that presumably complicate informational text processing. Narrativity is closely “affiliated with word familiarity, world knowledge, and oral language” (Dowell et al., 2016, p. 78). It is considered an essential component of reading ease: “the greater the portion of a student’s total reading is narrative, the greater the ease” (Liben, 2010, p. 4). Some research findings claim that reading expository texts is more challenging to students than narrative texts “in terms of reading fluency and comprehension” (Sáenz, & Fuchs, 2002, p. 31). Informational expository texts present topics less familiar to the readers that might create more challenges for comprehension.

In sum, the authors’ survey of research findings on text complexity has shown that complexity expectations can relate to the following features: 1) text (sub-)genre, namely, whether the text is literary, informational with its specific type of subject-related domain (“equivalent” or “non-equivalent”), or mixed; 2) text sentence structures, vocabulary composition, connections across ideas and textual organization. However, there is still a need for establishing what dimensions of complexity English informational texts display variations across different genres, and texts of what genres are easier/more difficult for reading comprehension as scaled with automated text complexity evaluation tools.

The TextEvaluator as an Automated Text Complexity Evaluation Tool

Many automated text complexity evaluation tools help select texts that are aligned with the text complexity expectations discussed above. A web-based software tool called the *TextEvaluator* analyzes eight dimensions of text complexity structured into the following four categories: 1. *Sentence Structure*: 1.1. Syntactic complexity. 2. *Vocabulary Difficulty*: 2.1. Academic vocabulary; 2.2. Word unfamiliarity; 2.3. Concreteness. 3. *Connections across Ideas*: 3.1. Lexical cohesion; 3.2. Interactive/Conversational style; 3.3. Level of argumentation. 4. *Organization*: 4.1. Degree of narrativity. Detailed information on how the *TextEvaluator* functions is available in research publications (Napolitano et al., 2015; Sheehan et al., 2014; Sheehan et al., 2015).

In addition to the above said sophisticated indices, the *TextEvaluator* also provides its users with a range of traditional textual measures: word total, sentence total, average words per sentence, paragraph total, average words per paragraph, quoted words total (Sheehan et al., 2015).

All component scores are reported on a scale that ranges from one to 100. *Overall Text Complexity* score is computed on an alternative quantitative scale that ranges from 100 to 2000. This score is genre-dependent: if the value is within a specific range, the text is defined as

informational, literary, or mixed (Sheehan et al., 2015). This tool allows educators to enter a short passage (maximum number of words is 1600) and quickly receive a readability profile of the text. Out of all automated text complexity evaluation tools surveyed by the authors of this paper, the TextEvaluator appears to be capable of providing deep insight into the informational text complexity, further summarizing it with an overall genre-dependent complexity score. These properties would be helpful for educators to assemble English text corpora for developing reading comprehension skills in EFL pre-service teachers and translators.

Methods

The purpose of this study was to examine variations in complexity dimensions of English informational texts of different genres measured by the *TextEvaluator*. A database of reading passages from English informational texts of the four genres (linguistic articles, news texts, legal articles, and medical texts) was assembled for consideration in the analyses. EFL pre-service teachers and translators in Ukraine use texts of those genres as the reading matter for developing comprehension skills. The texts from the researchers' corpus are intended for senior students of TEFL and Translation programs of Ukrainian universities with C1–C2 levels of language proficiency defined by the Common European Framework of Reference.

All of the English informational texts under analysis were authentic and not subject to any modifications. Continuous reading passages of 500-510 words were randomly selected. Presumably, text passages of that size are convenient for teaching reading comprehension and its assessment during an academic hour confined to 80 min.

To generate a set of component scores for each text, the TextEvaluator tool was used. A set of eight TextEvaluator qualitative measures were selected for this study: syntactic complexity, academic vocabulary, word unfamiliarity, concreteness, lexical cohesion, interactive/conversational style, level of argumentation, degree of narrativity. After uploading and processing the texts, the above said indices were presented in tables by the tool. The results were averaged to obtain the mean values. Table one illustrates key differences in text complexity indices of English linguistic articles, news texts, legal articles, and medical texts.

Results and discussion

In this section, the authors present and discuss the main results on variations in complexity dimensions of English legal, linguistic, news, and medical texts obtained with the help of the TextEvaluator.

Variations in complexity dimensions of English informational texts measured by the TextEvaluator

The authors' primary research interest was on the differences in informational text complexities as a function of the genre. All of the text complexity indices obtained with the help of the TextEvaluator and discussed further showed differences as a function of the informational text genre. Table one displays a comparison of the average values of complexity indices for English legal, linguistic, news, and medical texts from the authors' corpora.

Table 1. Average value complexities of English legal, linguistic, news, and medical texts: Means (M) and standard deviation (SD)

#	Component	Legal Texts		Linguistic Texts		News Texts		Medical Texts	
		M	SD	M	SD	M	SD	M	SD
1	Syntactic Complexity	81	5.83	73.4	7.71	60.4	5.75	47	4.34
2	Academic Vocabulary	91	7.69	90.8	5.19	65.2	6.97	60	9.38
3	Word Unfamiliarity	97.2	4.17	90	9.30	82.2	3.54	80.2	11.96
4	Concreteness	19.4	2.42	19.6	4.76	31	4.24	43	5.73
5	Lexical Cohesion	50.8	8.4	61.4	5.08	47.6	6.47	58.6	5.95
6	Interactive/ Conversational Style	7.4	3.38	27.4	20.13	32	18.95	30.4	11.2
7	Level of Argumentation	47.8	11.77	43	13.42	37.2	4.07	26.6	12.49
8	Degree of Narrativity	50.6	12.59	50.4	8.36	84.2	1.72	45.6	4.32
9	TextEvaluator Complexity Score	1542	45.34	1382	147.70	1046	63.44	824	177.04

Regarding *syntactic complexity* differences, there is one general result of interest: the relative complexity levels of legal ($M_{\text{legal}}=81$) and linguistic ($M_{\text{linguistic}}=73.4$) texts are the highest, followed by news texts ($M_{\text{news}}=60.4$). Greater values of syntactic complexity indicate higher degrees of text complexity. The lowest value of syntactic complexity of medical texts ($M_{\text{medical}}=47$) points to their relative reading ease. Medical texts under research are prescription medication instructions whose writers do their best to produce clear and explicit texts. Any reading miscomprehension by the customers/patients may create hazards to their health.

Word difficulty in legal, and linguistic texts is greater when compared to news, and medical texts. This was found according to both their academic vocabulary ($M_{\text{legal}}=91$; $M_{\text{linguistic}}=90.8$; $M_{\text{news}}=65.2$; $M_{\text{medical}}=60$), and word unfamiliarity ($M_{\text{legal}}=97.2$; $M_{\text{linguistic}}=90$; $M_{\text{news}}=82.2$; $M_{\text{medical}}=80.2$). Higher values of both of these indices for legal, and linguistic texts indicate their higher complexity. Word concreteness is nearly twice lower for legal and linguistic texts ($M_{\text{linguistic}}=19.6$; $M_{\text{legal}}=19.4$) than for news and medical texts ($M_{\text{medical}}=43$; $M_{\text{news}}=31$). Those indices also contribute to the comprehension difficulty of the former texts. Concreteness lower values indicate higher complexity. A higher degree of abstractedness of legal and linguistic texts may be due to their incorporated terminology, in contrast to news texts which do not contain too many terms.

Lexical cohesion is a lexical relationship across successive sentences (Sheehan et al., 2015). According to the *lexical cohesion* indices, news ($M_{\text{news}}=47.6$), and legal ($M_{\text{legal}}=50.8$) texts appear to be more difficult for reading comprehension when compared to linguistic ($M_{\text{linguistic}}=61.4$), and medical ($M_{\text{medical}}=58.6$) texts as they display lower values of lexical cohesion that indicate higher complexity. Previous research findings suggest that, in general, texts that are easier for comprehension are more lexically cohesive, and complex texts are less cohesive (Flor, & Klebanov, 2014). Whereas news texts have the most challenging lexical cohesion ($M_{\text{news}}=47.6$),

they compensate for this to a greater extent than other compared texts do at the narrativity level ($M_{\text{news}} = 84.2$).

According to *interactive/conversational style* whose lower values indicate higher complexity, legal texts ($M_{\text{legal}} = 7.4$) are approximately four times more challenging than are linguistic ($M_{\text{linguistic}} = 27.4$), medical ($M_{\text{medical}} = 30.4$), and news ($M_{\text{news}} = 32$) texts.

The *level of argumentation* indicates “whether comprehension of successive sentences requires the processing of argumentative conjuncts (e.g., *although, on the other hand*) and/or negations” (Sheehan et al., 2015, p. 9). The above-said component demonstrated higher values in legal ($M_{\text{legal}} = 47.8$), and linguistic ($M_{\text{linguistic}} = 43$) texts. News texts ($M_{\text{news}} = 37.2$) occupy the middle position, and medical texts ($M_{\text{medical}} = 26.6$) display the lowest values out of the four genres under comparison. Given that a high score on the argumentation component increases text processing difficulty (Sheehan et al., 2013), this paper’s findings suggest higher complexity of legal, and linguistic texts and comparative reading ease of prescription medication instructions.

The *narrativity* index suggests that news texts ($M_{\text{news}} = 84.2$) are the least challenging for reading comprehension. A high score on their narrativity component contributes to their processing ease. In contrast, medical texts with the lowest degree of narrativity ($M_{\text{medical}} = 45.6$) are more challenging for processing this text component. Displaying approximately the same degree of *narrativity*, legal ($M_{\text{legal}} = 50.6$) and linguistic ($M_{\text{linguistic}} = 50.4$) texts are between news texts (the lowest complexity), and medical texts (the highest complexity).

The *Overall Text Complexity* score, computed on a quantitative scale ranging from 100 to 2000, decreases monotonically across legal ($M_{\text{legal}} = 1542$), linguistic ($M_{\text{linguistic}} = 1382$), news ($M_{\text{news}} = 1046$), and medical ($M_{\text{medical}} = 824$) texts. This score is indicative of the relative difficulty level of legal, and linguistic texts, and a lower difficulty level of medical texts within the four genres of English informational texts under comparison.

Complexity levels of text components of English legal, linguistic, news, and medical texts in comparison

It is also of interest to investigate the overall text complexity of each particular genre to predict its relative ease or difficulty for reading comprehension of EFL pre-service teachers and translators. According to the comparative analysis of complexity values on the eight components of informational texts of the authors’ corpus featured in Table two, legal texts display the highest values of complexity on the following six components: syntactic complexity, academic vocabulary, word unfamiliarity, word concreteness, interactive/conversational style, and level of argumentation. The remaining two components (lexical cohesion, and degree of narrativity) also demonstrate high values of complexity. This finding suggests that legal texts are the most difficult for reading comprehension compared to linguistic, news, and medical texts. Medical texts showed values of the lowest complexity on their three components: syntactic complexity, concreteness, and level of argumentation. In addition, their overall text complexity score is the lowest. Thus, it appears that medical texts are the least challenging for reading comprehension out of the four genres compared.

Table 2. *High and low complexity levels of text components of English legal, linguistic, news, and medical texts*

#	Component	Comparatively High Complexity Level	Comparatively Low Complexity Level
1	Syntactic Complexity	legal texts ($M_{\text{legal}} = 81$); linguistic texts ($M_{\text{linguistic}} = 73.4$)	medical texts ($M_{\text{medical}} = 47$)
2	Academic Vocabulary	legal texts ($M_{\text{legal}} = 91$); linguistic texts ($M_{\text{linguistic}} = 90.8$)	n/a
3	Word Unfamiliarity	legal texts ($M_{\text{legal}} = 97.2$); linguistic texts ($M_{\text{linguistic}} = 90$)	n/a
4	Concreteness	linguistic texts ($M_{\text{linguistic}} = 19.6$); legal texts ($M_{\text{legal}} = 19.4$)	medical texts ($M_{\text{medical}} = 43$); news texts ($M_{\text{news}} = 31$)
5	Lexical Cohesion	news texts ($M_{\text{news}} = 47.6$)	linguistic ($M_{\text{linguistic}} = 61.4$)
6	Interactive/ Conversational Style	legal texts ($M_{\text{legal}} = 7.4$)	news texts ($M_{\text{news}} = 32$)
7	Level of Argumentation	legal texts ($M_{\text{legal}} = 47.8$); linguistic texts ($M_{\text{linguistic}} = 43$)	medical texts ($M_{\text{medical}} = 26.6$)
8	Degree of Narrativity	medical texts ($M_{\text{medical}} = 45.6$)	news texts ($M_{\text{news}} = 84.2$)
9	TextEvaluator Complexity Score	legal texts (1542)	medical texts (824)

Conclusion

The current study aimed to examine differences in syntactic complexity, academic vocabulary, word unfamiliarity, concreteness, lexical cohesion, interactive/conversational style, level of argumentation, degree of narrativity between English informational text genres associated with different levels of text complexity. The TextEvaluator, a text complexity evaluation tool, helped successfully establish the complexity indices for English legal, linguistic, news, and medical texts from the authors' corpora compiled for teaching reading comprehension to EFL pre-service teachers and translators. According to the overall text complexity score computed with the TextEvaluator tool, text complexity decreases monotonically across English legal, linguistic, news, and medical prescription texts. On the whole, the authors' results confirm previous evidence that informational texts reveal differences in text complexity as a function of the text genre.

Limitations of this small-scale study should be noted. Additional research focused on variations in linguistic properties across genres that make one genre easier to read than the other is needed. Another perspective is to study factors in the reading process that can impede comprehension related to reader, task, and context in addition to text complexity. Despite these limitations, however, the current findings are informative in the complexity levels of English informational texts of a particular genre. The results reported in this study suggest that the TextEvaluator system could help university instructors make more informed judgments when selecting texts for use in teaching close reading of EFL informational texts to EFL pre-service teachers and translators.

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