

WCES 2012

## Comparing different readability formulas on the examples of science-technology and social science textbooks

Umit Izgi <sup>a\*</sup>, Burcu Sezginsoy Seker <sup>b</sup>

<sup>a</sup>Hacettepe University, Education Faculty, Ankara, Turkey

<sup>b</sup>Balıkesir University, Education Faculty of Necatibey, Balıkesir, Turkey

### Abstract

The aim of this article is to compare various formulas to determine the readability levels of texts in 4th and 5th grade Social Science and Science-Technology text books. For this purpose, "Flesch, FOG, Gunning, Sönmez and Ateşman" readability formulas were used. The study sample comprised of randomly selected 4 texts which were used in 4th and 5th grade Social Science and Science-Technology textbooks in the 2009-2010 academic year at Ankara. As a result, when the readability levels of texts in the textbooks are examined, it has been revealed that the results of formulas' are not consistent with each other.

© 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of Prof. Dr. Hüseyin Uzunboylu

Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).

*Keywords:* readability, science and technology text book, social science text book

### 1. Introduction

In order to have teaching achieve its targets, there is a need for teaching tools. Among these tools, the most widely used ones are textbooks. "Textbooks are printed education and teaching materials that are appropriate for the student's age and level of knowledge, equipped with cognitive and affective skills, constituted of rich texts, prepared in line with principles that curricula are based on, and convey the information they contain to students" (Çiftçi, Çeçen & Melanlıoğlu, 2007, p.39). Textbooks are of significance particularly in primary education. Thus, the properties of books to be written at primary education level and the texts in these books come into prominence (Kılıç et al, 2001). The concept of comprehension has a significant position in the foundations of learning. When it is considered that learning occurs largely through reading and reading comprehension, the need to select texts carefully comes into prominence (Çiftçi, Çeçen & Melanlıoğlu, 2007). With regards to the selection of texts that are appropriate for the level of the student, the Regulation of the Ministry of National Education on Textbooks contains the statement of (1995) "the words and sentence structures must be appropriate for the level of the student" (As cited in Zorbaz, 2007). In the standards of the Board of Education and Discipline under the Ministry of National Education on properties textbooks are required to have, criteria on the readability of the textbook by the student group it addresses have been ignored. The number of studies conducted in our country on the readability of textbooks is limited. With regards to textbooks, which are a very important tool in the education-teaching process, the absence of the concept of readability in textbook assessment scales appears to be a significant deficiency (Ulu Kalın, 2007).

\* Umit Izgi. Tel.: +90-312-297-8625

E-mail address: [umitizgi@hacettepe.edu.tr](mailto:umitizgi@hacettepe.edu.tr)

“Readability can be defined as the status of texts read by the reader in a manner that is easy or difficult to understand” (Ateşman, 1997, p. 71). The number of words in a sentence, the number syllables in a word, the number of ideas emphasized in a sentence, and the continuity of the ideas in a text are the properties determining readability (Tekbıyık, 2006). According to Güneş (2003), short and simple structured sentences are better learnt than long and complex structured sentences. In this context, it can be said that whilst selecting texts to be used in a textbook, there is a need to take word-sentence lengths into consideration and as age increases, word and sentence lengths can also increase (Çiftçi, Çeçen and Melanlıoğlu, 2007). According to Sönmez (2003) there is a need for the contents of textbooks to be ordered in a gradual manner and in a manner that makes them a prerequisite of each other. It is easier to learn and remember information in a text written in such a manner. For this purpose, the topics need to be based on meaningful basic concepts and principles and structured in a coherent manner. Göğüs (1978), who defines readability as the reading and comprehension of a text by a student at a certain level, states that readability is a very important property in learning to read because children and youngsters can not read every text and even if they are able to read them, they can not achieve the objectives expected from them (As cited in Çiftçi, Çeçen & Melanlıoğlu, 2007). The most comprehensive definition of readability is accepted to be the definition of Dale and Chall (1948). Dale and Chall define readability as follows; “Readability is the total of all elements related to printed material that influences the success the reader group achieves using the material. Success is a result of the comprehension of the material, reading of the material at an appropriate level, and the material being considered interesting by the reader, ” (As cited in Güyer, Temur & Solmaz, 2009, p.753). The purpose of readability is to determine the difficulty of the test by taking sentence and word lengths of texts and number of unknown words into account. Determination of the degree of difficulty of texts and accordingly, the determination of the suitability of texts to the student level is the basic problem of readability (Ateşman, 1997). According to Acarlar, Ege, & Turan (2002), short and simple syllable structures provide convenience in perception in Turkish. Accordingly, it can be considered that short and simple structured words and sentences facilitate perception. By considering this, whilst selecting texts for textbooks, taking word-sentence lengths into account and increasing word and sentence lengths as age increases can be suggested.

### 1.1. Studies Conducted in our Country on Readability

One of the first and most significant studies in Turkey on readability is the study of Ateşman, (1997) in which Flesch’s readability formula was adapted to Turkish. This study is significant in that it has enabled the development of a readability formula for Turkish and the measurement of readability in a reliable manner (Zorbaz, 2007).

In the study of Budak (2005), the validity of the Gunning Fog Index has been tested and with the formula developed by Sönmez, the Gunning Fog Index has been compared. In conclusion, it has been determined that in the comprehension of the text, the syllable number of words the Fog Index is based on are not determinant and the elements, whose meanings are unknown in the text, which Sönmez’s formula has been based on, are determinant.

Ulu Kalın (2007) has examined Social Science textbooks of grades 4, 5, 6, and 7 in primary education using the Cloze and Fog tests. In line with the Fog test applied to Social Science textbooks of grades 5, 6, and 7, where the readability level should have been at a primary education level, it turned out to be at an academic level. In the study, the Cloze test has also been applied to 120 students selected using the simple random sampling method. By means of findings obtained from the Fog and Cloze tests applied in the study, it has been determined that Social Science textbooks for grades 4, 5, 6, and 7 in primary education are not suitable for the target group.

In the study of Ulusoy (2009), the reading levels of texts selected from Social Science and Science textbooks of 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> grade students have been aimed to be determined by using gap-filling tests. A total of 237 students have responded to the gap-filling tests. Results of the analysis have indicated that more than half of the students required the assistance of their teachers in order to read and comprehend the texts.

In the study of Güyer, Temur, & Solmaz (2009) titled “Computer Based Text Readability Analysis”, they have stated that especially in cases where the number of texts increase, the possibility of manual calculations leading to incorrect results increases. In such a case, the conclusion that it is inevitable to require the support of software has been reached and the development of an electronic Turkish text analysis (eTma) has commenced. The software is still in the development phase.

In the study of Geçit (2010) titled “The Evaluation of the Readability Degree of the Social Sciences Textbooks of the 5<sup>th</sup> Grade of Elementary School according to the Flesch Formula Applied to Turkish”, the Flesch formula

applied to Turkish by Ateşman has been used. This study, which has been conducted in order to determine the level of readability of texts in the book by taking word and sentence lengths as a basis, has the property of being a descriptive study. As a result of the evaluations performed, it has been determined that the level of readability of the book is at a medium difficulty according to the Flesch formula adapted to Turkish by Ateşman.

In light of conducted studies, it can be said that readability formulas provide an idea on the difficulty of the text. Readability measurements can only achieve an accurate result if it is dealt together with the qualitative properties of the text (Zorbaz, 2007). In this respect, it is difficult to say that developed formulas can determine readability on their own. Level of readability can also vary from person to person. This is because, unknown words can also influence readability and unknown words can be different for everyone.

## 2. Methodology

This study, which has been conducted for the purpose of determining readability levels of texts in 4<sup>th</sup> and 5<sup>th</sup> grade Science-Technology and Social Science textbooks with various formulas, has the property of being descriptive. The sample of the study consists of 4 randomly selected texts from the Ministry of National Education's primary school 4<sup>th</sup>-5<sup>th</sup> grade Social Sciences and Science-Technology textbooks accepted by the Board of Education and Discipline under the Ministry of National Education and used in the province of Ankara during the 2009-2010 academic year.

### 2.1. Problem Sentence and Sub-Problems

How are the readability levels of 4<sup>th</sup> and 5<sup>th</sup> grade primary school Science-Technology and Social Science textbooks according to the Gunning, Fog, Flesch, Ateşman and Sönmez formulas?

- a) How is the comparison of readability levels of a text selected from the 4<sup>th</sup> grade Science and Technology textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez* formulas?
- b) How is the comparison of readability levels of a text selected from the 5<sup>th</sup> grade Science and Technology textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez* formulas?
- c) How is the comparison of readability levels of a text selected from the 4<sup>th</sup> grade Social Sciences textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez*?
- d) How is the comparison of readability levels of a text selected from the 5<sup>th</sup> grade Social Science textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez* formulas?

### 2.2. Data Collection and Analysis

The Gunning, Fog, Flesch, Ateşman and Sönmez readability formulas have been used in the collection and analysis of data.

**a. The Fog Index according to the Gunning Formula:** The Fog Index is a mathematical formula developed by, Robert Gunning in 1952. When the Fog Index is between 3 and 11 the text is fine, between 12 and 14 the text is a little long, and above 15 it is considered to be close to legal parlance and unacceptably complicated (Berry, 2002; As cited in Sönmez, 2003). Calculation: The Fog Index:  $(\text{Number of Words}/\text{Number of Sentences} + \text{number of words consisting of three or more syllables}) \times 0,4$

**b. Age of Reading according to the Fog Formula:**

$S = \text{Total number of words} / \text{number of sentences}$   $N = \text{Total number of multisyllabic words} / \text{number of words in the paragraph}$   
 $US (\text{Grade/Class Level}) = 0,6 (N+S)$  Age of reading book =  $LW + 5$

**c. The Flesch-Kincaid Formula:** In the calculation of the text, first of all the average sentence length is obtained by dividing the total number of words in the text into the total number of sentences and this is given a name. (For instance, average sentence length). Then, the number of vowels per word is determined. All vowels are counted and this is divided into the number of words and is given a name. (For instance, average word length) By placing these in their suitable places in the formula below, the intended readability coefficient is obtained. This number shall be a number between 0 and 100 and the closer the number is to 100, the more readable it is considered. Calculation:  $206,835 - (1,015 \times \text{ASL}) - (84,6 \times \text{AWL})$

**d. The formula developed by Ateşman:** The formula developed by Flesch has been adapted to Turkish in the following manner by Ateşman (1997): Calculation: Readability Number =  $198,825 - 40,175 x_1 - 2,610 x_2$   
 $x_1$  = Average word length in syllables,  $x_2$  = Average sentence length in words

**e. The Formula Developed for Turkish by Sönmez:** According to the formula, the number of foreign, unknown words, phrases, terms, concepts, figurative expressions, similes, formulas, symbols etc in a text are divided into the number of all words in the text and then squared. The obtained number is a number between zero and one depending on the text. As this number gets closer to one, then it becomes more meaningless and as it gets close to zero it becomes clearer and comprehensible. Calculation: Word rate = number of words in the text / number of sentences in the text; Difficulty rate = number of foreign words, terms, formulas, figurative expressions, symbols, and concepts in the text / number of words in the text; Meaning rate = number of foreign words, terms, formulas, figurative expressions, symbols, and concepts in the text / number of sentences in the text; Comprehensibility rate = (meaning rate / word rate) x difficulty rate

### 3. Findings

In this section, there are findings and comments with regards to the sub-problem of the study.

**a)** The findings pertaining to the calculation of the level of readability of the 4<sup>th</sup> grade *Science and Technology* textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez* formulas are as follows: **According to the Gunning formula;** Fog index = 30,61 (legal parlance, very complicated), **According to the Fog formula;** Reading age of the book = 15,44 (Must be at the 4<sup>th</sup> grade level, 10-11 years old), **According to the Flesch test;** Level = 34,71 (Grade/class level), **According to the Ateşman formula;** Readability = 56. 451 (medium difficulty), **According to the Sönmez formula;** Readability rate = 0.0084 (text is clear and comprehensible). When different readability formulas are applied to the same text, it can be observed that the results differ. However, the examined text is the same. It can be observed that the Ateşman and Sönmez formulas are consistent with each other. This text is of medium difficulty according to Ateşman and considered to be easy and comprehensible according to Sönmez. However, the formulas (Fog, Flesch, Gunning) have turned out to be above the grade/class level. The text that is suitable for age 15.44 according to Fog (in other words 8<sup>th</sup> grade level) is at a grade/class level of 34.00 according to the Flesch test.

**b)** The findings pertaining to the calculation of the level of readability of the 5<sup>th</sup> grade *Science and Technology* textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez* formulas are as follows: **According to the Gunning formula;** Fog index = 26,04 (legal parlance, very complicated), **According to the Fog Formula;** Reading age of the book = 15,26 ( Must be at the 5<sup>th</sup> grade level, 10-11 years old), **According to the Flesch test;** Level = 38,55 (Class/Grade level), **According to the Ateşman formula;** Readability = 111,31 (Very easy), **According to the Sönmez formula;** Comprehensibility rate = 0,019 (the text is comprehensible). The readability level of the text selected from the 5<sup>th</sup> grade *Science and Technology* textbook is at a legal parlance level and is very complicated. Whilst it was expected to be between 11-12 years old range, it was determined to be in the grade level 15.26. According to the Flesch test, it was determined to be 38.55. The Flesch and Fog tests have not provided consistent results with each other. When the same text is examined according to the Ateşman formula, it was construed to be very easy with a readability score of 111.31. Finally, when it is calculated according to the Sönmez formula, it can be observed that the text is a comprehensible text with a comprehensibility score of 0.019. It is striking that the obtained results are consistent according to the Ateşman and Sönmez formulas.

**c)** The findings pertaining to the calculation of the level of readability of the 4<sup>th</sup> grade *Social Sciences* textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez* formulas are as follows: **According to the Gunning formula;** Fog index = 58,59 (legal parlance, very complicated), **According to the Fog Formula;** Reading age of the book = 12,59 ( Must be at a 4<sup>th</sup> grade level, 10-11 years old), **According to the Flesch test;** Level = 19,098 (Above the grade level), **According to the Ateşman formula;** Readability = 69,835 (medium difficulty), **According to the Sönmez formula;** Comprehensibility level = 0,001 (Text is comprehensible). The readability of a text in the 4<sup>th</sup> Elementary Grade Social Sciences textbook has been examined in line with various formulas. According to the Fog, Gunning, and Flesch models, the text is not close to elementary 4<sup>th</sup> grade level; it has a complicated language and is higher than the grade/class level. However, it is possible to say that the Ateşman and Sönmez formulas are similar to

each other. The text is at a medium difficulty according to Ateşman and has been considered to be comprehensible according to Sönmez. This case can also be considered to be a reflection of intercultural differences.

**d)** The findings pertaining to the calculation of the level of readability of the 5<sup>th</sup> grade *Social Sciences* textbook according to the *Gunning, Fog, Flesch, Ateşman, and Sönmez* formulas are as follows: **According to the Gunning formula;** Fog index =28,68 (close to legal parlance, unacceptably complicated), **According to the Fog formula;** Reading age of the book= 12,38( It must be at the 5<sup>th</sup> grade level, 11-12 years old), **According to the Flesch test;** Level = 18,84 (Above grade/class level), **According to the Ateşman formula;** Readability = 74,1(Easily readable), **According to the Sönmez formula;** Readability rate = 0,004(Text is clear and comprehensible). The readability level of the text selected from the 5<sup>th</sup> grade *Social Sciences* textbook is close to legal parlance and very complicated according to the Gunning formula.

#### 4. Discussion and Suggestions

There are numerous mathematical formulas in the literature for the purpose of determining the readability levels of texts. It is possible that many more shall be developed. Through the use of such formulas, the values of texts in educational terms can be determined. Formulas, which take not only word and sentence lengths into account but also unknown words, figurative expressions, terms, symbols, and foreign words and measure the special properties of texts, can be developed for Turkish textbooks. The comprehensibility of a text can be construed through association with the cognitive and conceptual development of the reader. Readability levels can be included among qualities required for books. The Ministry of National Education and the Board of Education and Discipline can undertake a joint initiative for reviewing the “Regulation on the Examination and Evaluation of Textbooks and Education Tools” and amendments can be made concerning the readability of textbooks. Readability provides the opportunity to make an interpretation on the comprehensibility levels of texts. However, basing readability levels only on quantitative calculations shall not be consistent. In addition to this, formulas can be developed for the measurement of the qualitative properties of texts. Research must be conducted on whether or not readability is a relation between comprehending what you read in texts and remembering. Texts in textbooks of other subjects at all grade/class levels can be analyzed for readability levels with the readability models mentioned in this study.

#### References

- Acarlar, F., Ege, P.&Turan, F. (2002). Development of language and reading skills of children in relation to the top of Turkey. *Turkish Journal of Psychology* 17 (50), 63-73.
- Ateşman, E. (1997). Measuring readability in Turkish. *Journal of Language*.58: 71-74.
- Budak, Y. (2005). A critical view over determining the readability level of wrting materials. *Eurasian Journal Of Educational Research*, 21: 76-87.
- Çiftçi, Ö.; Çeçen, M.A.& Melanlıoğlu, D. (2007). Evaluation of the sixth class in terms of readability of text in Turkish textbooks. *Electronic Journal of Social Sciences* <http://www.esosder.org> 6(22) :206-219.
- Dale, E., Chall, J. S. (1948). A formula for predicting readability. *Educational Research Bulletin*. January 21 and February 17, 27:1-20, 37-54.
- Geçit, Y. (2010). Primary 5 grade social studies textbook readability, Flesch adapted according to the formula assessment of the degree to Turkish. 9. *National Primary School Teacher Education Symposium (20 -22 May 2010)*, Elazığ, 2010, p.47-49
- Güneş, F. (2003). The importance of the teaching of reading-writing the sentence. *Turkishness Science Research* 13:39-48.
- Güyer, T., Temur, T. & Solmaz, E. (2009). Computer-aided analysis of the readability of text. *Journal of Turkish Educational Sciences* , Fall, 7(4), 751-766.
- Kılıç, Z.; Atasay, B.; Tertemiz, N.; Seren, M Ercan, L. (2001). *Guide to subject area, review the textbook, science 4-8*, Ankara: Nobel Publishing.
- Semerci, Ç. & Semerci, N. (2004). Primary (1-5. Class) a general assessment of mathematics textbooks. *Journal of Education*, Spring/2004, Number 162. Retrieved from <http://yayim.meb.gov.tr/dergiler/162/semerci.htm> .
- Sönmez, V. (2003). A mathematical approach to determining eğitselliğini texts (eternal model). *Educational Research*, 10:24-39, Ankara: Anı Publishing
- Tekbıyık, A. (2006). High school physics textbook, the level of readability and suitability of the target age. *Kastamonu Education Journal*,14(2): 441-446.
- Ulu Kalın, Ö. (2007). Primary 4, 5, 6 and 7 Measurement of social studies textbooks in class legibility. *National Primary Education Congress, 16- 17 November 2007*, Beytepe, Hacettepe University, Ankara.
- Ulusoy, M. (2009). Complete the reading test used to measure the level of space and readability. *Journal of Turkish Educational Sciences*,7(1): 105-126.
- Zorbaz, K. Z. (2007). Turkish textbooks, and readability levels of tales on the assessment of word-sentence lengths. *Education Theory and Practice* 3(1): 87-101.