

# 7<sup>th</sup> Grade Science Textbook Readability and Compatibility with the Target Age Level

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## Abstract

Textbooks are of special importance as fundamental teaching materials. The readability feature of texts which are constructed by an author is one of the most important features to be analysed in science text books. The purpose of this study is to assess the 7<sup>th</sup> grade science textbook (new), which was prepared based on the middle school sciences syllabus updated by the Ministry of National Education in 2013, in terms of its readability and compatibility with the target age level. The readability of the texts was calculated separately based on the Flesch-Kincaid formula, Gunning fog index, Sonmez formula and a Cloze test method in line with this purpose. It was concluded that the Flesch-Kincaid and Gunning formulae were not suitable for the structure of the Turkish language, that students could understand the texts only through the teacher's support according to a cloze test method, and that the Sonmez formula gave more accurate results in measuring the readability of books and texts written in the Turkish language. Suggestions are presented in light of these results.

**Keywords:** middle school, 7<sup>th</sup> grade science textbook, readability

## 1. Introduction

Textbooks are used principally because they are prepared according to a certain organization in compliance the Ministry of National Education's programme. They are one of the most important resources in planned and programmed education studies (Koseoglu et al., 2003). The students' ability to follow textbooks is very important since textbooks play a significant role not only in determining the purpose and plan of a lesson, but also in assisting classroom activities by presenting and organizing the content in accordance with the curriculum, and in making the learning process more attractive for students (Kulm, Roseman, & Treistman, 1999). Research has revealed that teachers rely on books because they are both compatible with the curriculum and from them, their teaching decisions are generated. Due to this, it is important that textbooks used by students and teachers should be reviewed and analysed from several perspectives (Dikmenli, Cardak, & Altunsoy, 2008).

The readability of a book depends on whether it is comprehensible and legible for the reader. Readability level depends on the length of the sentences and the complexity of the language used in the book (Soyibo, 1996). Readers use their past knowledge and experiences to generate meaning from a text (Alvermann, 1989). Readability can be expressed both as speed reading and reading comprehension level of the students with respect to the material they are reading (Tekbiyik, 2006). In measuring the readability of texts about cell divisions in a 9<sup>th</sup> grade biology textbook at high school, Dikmenli, Cardak, and Altunsoy (2008) observed that the Flesch-Kincaid and Gunning formulae were not suitable due to the structure of Turkish language whereas the cloze test gave better results in measuring the readability of Turkish texts. The author of a book aims to teach students new or unknown target concepts, establish an open communication with the reader and properly communicate the content to the reader (Mikk, 2001). The readability of a text depends upon how easily it can be understood by the reader (Fry, 2002). Soyibo and Bermadee (1998) reported that most students could not sufficiently understand the texts and despite that, the students at city centre schools were more capable of comprehending them compared to those at rural schools. Furthermore, female students were more capable than males in this regard. In his research, Ulusoy (2009) used a fill in the blanks test to determine the readability levels of sixth, seventh and eighth grade students of texts selected from social sciences and sciences textbooks. A total of 237 students answered the fill in the blanks tests. The results of the analysis demonstrated that

more than half of the students could read the texts at instruction level; that is to say, they needed the help of their teacher to read and understand the texts.

Sonmez (2003) found that the Gunning fog index, which is used in understanding a text, was applied to many Turkish texts and did not give a consistent result. The researcher then developed a new mathematical formula (Sonmez formula) which can be applied to Turkish texts.

This study researched the compatibility of the sciences textbooks prepared in accordance with the sciences schedule updated in 2013 by the Ministry of National Education, to be used for 5 years with the 7<sup>th</sup> grade commencing in 2014, with the student level in terms of legibility. Answers were then sought for the following problems: 1. What kind of readability levels does the text in these books have according to different formulae?; 2. Are the readability levels of these texts compatible with the age levels of the students?; 3. Are the current readability formulae compatible with the structure of the Turkish language?

## 2. Methodology

The research used one 7<sup>th</sup> grade sciences textbook (new) (Annex 1) which was recommended by the Turkish Education Board of the Ministry of National Education to be studied at middle schools for five years as of 2014. Passages containing 100 words were selected randomly from this book.

### 2.1 Data Collection Method and Analysis

Document review technique was used as the data collection method in the research. Document review covers the analysis of the written materials containing information about the phenomenon being researched. Document review can be a data collection method alone in qualitative research and it can also be used together with other data collection methods (Yıldırım ve Simsek 2005, s.187).

In this study, the technique developed by Soyibo (1996) was modified and the book was read and reviewed three times, page by page, by considering all the details to be reviewed with respect to its readability characteristics. The readability of the book was calculated separately according to Flesch-Kincaid formula, Gunning formula (Soyibo 1996), Cloze test method and Sonmez formula (Sonmez 2003). Seven different sections of text, each of which contained one hundred words, were selected randomly from 7 different parts (units) of the book. The expansions of the formulae which are used in measuring readability are presented below.

**Flesch-Kincaid Formula:** The following information was obtained for each text sample, placed in the formula and then the readability of the text was calculated:

1—Number of syllables in the whole text

2—Number of sentences in the whole text

3—Average sentence length (L) was obtained by dividing one hundred words by the number of sentences in the sample text.

4—Word length (N) was obtained by dividing total number of syllables into 100 words.

5—Readability level (easy reading) based on Flesch-Kincaid Formula was obtained by using the following equation: Easy Reading =  $(L \times 0.39) + (N \times 11.8) - 15.59$

6—Readability age of the book was obtained by  $(L \times 0.39) + (N \times 11.8) - 10.59$  formula.

7—The average readability level was taken as obtained from seven different text samples in each book and thus the readability of that book was determined. The legibility age of the book was also calculated by the same means (Soyibo, 1996).

**Gunning Formula:** Seven different sample texts containing one hundred words were selected randomly. The following information was obtained from each sample:

1—The number of sentences in one hundred words was counted.

2—Average sentence length (L) was calculated by dividing the number of words by the number of sentences.

3—The number of the words with three or more syllables was counted in each sample. The average number of these words (N) was calculated in each sample.

4—Easy reading level of each text was found by using the following formula: Easy Reading Level =  $(L + N) \times 0.4$

5—The comprehensibility level of the book was calculated by using the easy reading level equation.

The result is good, i.e. the text is considered comprehensible, if it is between 3 and 11; the text is too long if it is between 12 and 14; and it is considered close to legal text if it is more than 15 (Sonmez, 2003).

**Sonmez Formula:** The following information was determined from each sample in the book:

1—The number of unknown words in the text. The texts selected from the book were studied by 70 students at middle school in the 7<sup>th</sup> grade, and the number of unknown words was determined. For each text, the average of these numbers was taken and considered the number of unknown words in the text.

2—Total number of words in the text. There are total one hundred words in each text.

3—Total number of sentences in the text.

Sonmez's comprehensibility rate was calculated using the following formula:

1. Word rate =  $\frac{\text{Number of words in the text}}{\text{Number of sentences in the text}}$
2. Difficulty rate =  $\frac{\text{Number of unknown words in the text}}{\text{Number of words in the text}}$
3. Meaning rate =  $\frac{\text{Number of unknown words in the text}}{\text{Number of sentences in the text}}$
4. Comprehensibility rate =  $\frac{\text{Meaning rate}}{\text{Word Rate}} \times \text{Difficulty rate}$

The results obtained were compared with Sonmez's (2003) table on comprehensibility rate and comprehensibility levels (Table 1).

Table 1. Sonmez's (2003) comprehensibility rates and comprehensibility levels table

Comprehensibility rate	Comprehensibility level of the text
1.00 – 0.99	Totally meaningless
0.98 – 0.26	Meaningless
0.25 – 0.16	Vague
0.15 – 0.09	Unclear
0.08 – 0.04	Comprehensible through help
0.03 – 0.001	Comprehensible
0.00099 – 0.0001	Clear and comprehensible
0.000001 – 0	Provides complete communication

**Cloze Test Method:** For each text sample selected, the following information was obtained by having 70 students study each one, and the readability of this text was then calculated by placing this information into the formula:

1—Every sixth word was regularly omitted from the beginning of the text. The place of every omitted word was left blank.

2—All books were requested. These texts which were employed by the students were not taken into evaluation. The text form in the original sample was considered correct and synonymous words were not considered correct.

3—Expected Number of Correct Answers (X): Number of Gaps in the Text x Number of Students

4—Total Number of Answers Taken (Y): The number of correct words given by the students for the gaps in the text.

$$\% \text{ Achievement} = \frac{Y}{X} \times 100$$

Here ratings of 60% and higher show that these texts are quite suitable for the student level and that students are capable of independently understanding these texts; 40-59% ratings show that students can only understand the texts through the teacher's help; 39% and lower ratings show that the text is difficult for students 39 (Koseoglu et al., 2003).

### 3. Results and Discussion

This study researched the sciences textbook studied at 7<sup>th</sup> grade level for its readability and compatibility with the target age level. Four different readability formulae were used in the research. In this investigation, seven samples of text were randomly selected from the 7th grade sciences textbook (Annex 1). Readability formulae were then applied to each passage of text in the book. The average of the readability rates was taken, and the resulting readability levels of the book were obtained. The readability formulae that we applied and the findings that we reached are as follows:

The titles and page numbers of the text passages containing one hundred words selected from the book are shown in Table 2.

Table 2. Titles and page numbers of the texts containing one hundred words selected from the book for readability

Text No	Title	Text Page Number
1	Systems in our Body	25
2	Force and Energy	70
3	Substance Structure and Properties	129
4	Reflection in Mirrors and Absorption of Light	156
5	Human Beings and Environment Relations	164
6	Electrical Energy	186
7	Solar System and Beyond	213

#### *Flesch-Kincaid Formula*

Easy reading level and readability age of the book according to Flesch-Kincaid formula are shown in Table 3.

Table 3. Readability of the book according to the Flesch-Kincaid Formula

Text	Number of Sentences	Number of Syllables	L	N	Easy Reading Level	Legibility Age
1	9	287	11.11	2,87	22.61	27.61
2	11	314	9.09	3,14	25.01	30.01
3	9	310	11.11	3,1	25.33	30.33
4	10	318	10	3,18	25.83	30.83
5	8	289	12.5	2,89	23.38	28.38
6	10	307	10	3,07	24.54	29.54
7	11	266	9.09	2,66	19.35	24.35

The average of the easy reading level is taken from all texts to find the general easy reading level of the book. The easy reading level of the book according to Flesch-Kincaid formula was found to be 23.721. The legibility age of the book was likewise calculated by taking the average of the legibility ages of all texts and found to be 28.721.

#### *Gunning Formula*

The easy reading rate of the book according to Gunning formula is shown in Table 4.

Table 4. Readability of the book according to Gunning (Fog Index) Formula

Text	Sentence	L	N	Easy Reading
1	9	11.11	53	25.644
2	11	9.09	63	28.836
3	9	11.11	56	26.844
4	10	10	55	26.000
5	8	12.5	53	26.200
6	10	10	70	32.000
7	11	9.09	49	23.236

The general easy reading level of the book was found by taking the easy reading level's average in all the passages of text. The easy reading level of the book according to Gunning formula was found to be 26.96. As this result was higher than 15, it was concluded that the book was written in a manner which was too complex to be understood, close to legal language.

### ***Sonmez Formula***

The readability of the book according to Sonmez formula is shown in Table 5.

Table 5. Sonmez's (2003) comprehensibility rate for the sample texts in the book

Text	Number of Sentences	Unknown Words	Words Rate	Difficulty Rate	Meaning Rate	Comprehensibility Rate
1	9	1.171	11,11	0.0171	0.19	0.0002924
2	10	0.228	10	0.00228	0.0228	0.000005198
3	9	1.014	11,11	0.01014	0.1127	0.0001029
4	10	0.186	10	0.00186	0.0186	0.00000346
5	8	1.228	12.5	0.01228	0.1535	0.0001508
6	10	1.057	10	0.01057	0.1057	0.000112
7	11	0.314	9.09	0.00314	0.0285	0.00000984

The comprehensibility rate of the book, determined by taking the average of the comprehensibility rates of the seven texts that we randomly selected, was found to be 0.0000966. Accordingly, it was concluded that the book was clear and comprehensible according to Sonmez's (2003) comprehensibility rates and comprehensibility levels (Table 5).

### ***Cloze Test Method***

The comprehensibility rates of the sample texts according to the cloze test are shown in Table 6.

Table 6. Comprehensibility rates of the sample texts in the book according to the cloze test

Text	Number of Blanks	Number of Students	Total Number of Correct Answers	Comprehensibility Rate
1	20	70	721	51.5
2	20	70	533	38.07
3	20	70	830	59.28
4	20	70	659	47.07
5	20	70	548	39.14
6	20	70	449	32.07
7	20	70	690	49.28

The comprehensibility rate of the book was calculated by taking the comprehensibility rate average of these seven texts. The comprehensibility rate of the book was found to be 45.201. Accordingly, it was concluded that the students can only understand the texts in the book with the teacher's help according to a cloze test method (Table 6).

When we considered the comprehensibility rates of the sample texts according to Sonmez's formula, it was concluded that the texts in the 7<sup>th</sup> grade sciences text book were comprehensible. These findings uphold Sonmez's research (2003). Furthermore, it was seen that the readability ages of the book were higher than the age of the middle school students according to the Flesch-Kincaid formula. The determination of the fact that Gunning and Flesch-Kincaid formulae are not a suitable method in measuring readability supports the findings of Guven 2010; Dikmenli et al. (2008) and Cepni et al. (2001). The conclusion that a cloze test method is not suitable could have originated from the fact that middle school students do not have sufficient preliminary information about cloze tests.

#### 4. Conclusion and Suggestions

The results of this research reveal that the Flesch-Kincaid and Gunning formulae are not compatible with the structure of the Turkish language in measuring the readability of the middle school 7<sup>th</sup> grade sciences textbook. Students could only understand the texts with the teacher's help according to a cloze test method and the Sonmez formula gave more accurate results in measuring the readability of the books and passages of text written in Turkish. It is therefore recommended that the Sonmez formula be applied in such readability measurement studies. Attention should be paid to using simple, plain and clear language when editing textbooks.

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