

BIOLOGY TEXTBOOKS AND THEIR TEXT DIFFICULTY

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Abstract: *This article presents the most important knowledge of the text difficulty evaluation of 22 current Czech biology textbooks for the 6th - 9th grades. The text analysis was carried out according to my own methodology. Results indicate that the average values of text difficulty increase from the 6th to 8th grade (from 32.11 points to 37.56 points). The textbooks for the 9th grade are characterized by a low text difficulty level (35.89 points). The scale of the biology text difficulty is a part of this paper.*

Key words: *Text difficulty, syntactic factor, semantic factor, scale of difficulty, biology textbooks*

Abstrakt: *V článku jsou obsaženy zásadní poznatky o hodnocení obtížnosti textu 22 současných českých učebnic přírodopisu pro 6. až 9. ročník základní školy. Analýzy textů byly realizovány vlastním metodickým postupem. Dosažené výsledky ukazují, že průměrné hodnoty celkové obtížnosti výkladového textu se zvyšují od 6. do 8. ročníku (od 32,11 bodu do 37,56 bodu). Učebnice pro 9. ročník se vyznačují nižší obtížností (35,89 bodu). Součástí článku je i navržená stupnice obtížnosti textů pro učebnice přírodopisu.*

Klíčová slova: *Obtížnost textu, syntaktický faktor, sémantický faktor, stupnice obtížnosti, učebnice přírodopisu*

Introduction

This article outlines a theoretical and practical perspective for the analysis of biology textbooks. It is possible to mention that textbooks have remained the most important tools in the process of education. In the Czech Republic there are more than six publishing companies producing biology textbooks. Some teachers do not know which one to use in their biology lessons because they do not have any information concerning their quality. The quality of textbooks has been studied by experts in different countries (Schmidt 1991, Olechowski 1995, Ottich - Kowalczyk 1992, Shepardson - Pizzini 1991). In our country

these studies have been realized too (Hrabí 2003, Pluskal 1996, Průcha 1984, 1997).

My experimental evaluation of the biology textbooks results in a finding whether a textbook is appropriate for learning or not.

Material and methods

Text difficulty was studied in biology textbooks for the 6th to 9th grades. Biology textbooks of the publishing companies FORTUNA (1997, 1999), JINAN (1998, 2000, 2001), NOVÁ ŠKOLA (1998), PRODOS (1998, 1999, 2000), SCIENTIA (1997, 1998, 2000, 2001) and SPN (1998, 1999) were examined. Exact citations are written in the chapter Literature. Eleven characteristics of text difficulty were examined. Ten samples of text from each of the biology textbooks were selected, and each sample consisted of 100 or more words (ΣN). Particular characteristics of difficulty, their symbols, definitions, ways of calculation are written as follows:

T - text difficulty; $T = T_s + T_p$ (points),

T_s - syntactic factor; $T_s = 0,1 \times \bar{V} \times \bar{U}$ (points),

\bar{V} - average length of sentence (number of words),

\bar{U} - syntactic complexity of sentence,

T_p - semantic factor,

$$T_p = 100 \times \frac{\sum P}{\sum N} \times \frac{\frac{\sum P_1}{2} + 2\sum P_2 + \sum P_3 + \sum P_4}{\sum N}$$

$$\frac{\sum U}{\sum N} \times 100 \quad - \text{proportion of verbs (\%)},$$

$$\frac{\sum P}{\sum N} \times 100 \quad - \text{proportion of substantives (\%)},$$

$$\frac{\sum P_1}{\sum N} \times 100 \quad - \text{proportion of common terms (\%)},$$

$$\frac{\sum P_2}{\sum N} \times 100 \quad - \text{proportion of scientific terms (\%)},$$

$$\frac{\sum P_3}{\sum N} \times 100 \quad - \text{proportion of factual terms (\%)},$$

$$\frac{\sum P_4}{\sum N} \times 100 \cdot - \text{proportion of repeated terms (\%)}.$$

Average values of the text difficulty were calculated for particular grades. Two other characteristics – average value of syntactic factor and average value of semantic factor were calculated. The most important statistical characteristics were calculated too.

These symbols and formulas were used:

x – measured value

n – number of measured values

$n-1$ – number of degrees of freedom

\bar{x} – arithmetic mean; $\bar{x} = \frac{\sum x}{n}$

s – standard deviation; $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$

$s_{\bar{x}}$ – mean error; $s_{\bar{x}} = \frac{s}{\sqrt{n}}$

v – variational coefficient (%); $v = \frac{s}{\bar{x}} \times 100$

According to previous and presented results, the scale of the biology text difficulty was formed.

Recommended scale of the biology text difficulty:

sixth grade T = 31 – 34 points

seventh grade T = 33 – 36 points

eighth grade T = 35 – 38 points

ninth grade T = 37 – 40 points

Results

The most important characteristics of text difficulty are written in Table 1.

The total difficulty of text in the biology textbooks for the 6th grade demonstrates that the obtained values vary from 29 to 39 points. The values of the syntactic factor fluctuate from 5 to 10 points. The values of the semantic factor are very different and vary from 19 to 25 points. According to this study it is possible to mention that the biology textbooks of the majority of the publishing companies are suitable for teaching, with the exception of the textbook of the Prodos publishing company.

The text difficulty in the biology textbooks for the 7th grade shows that text difficulty varies from 30 to 43 points. The values of the syntactic factor fluctuate from 6 to 10 points. The values of semantic factor achieve 22 to 35 points. According to these results it is possible to mention that a lot of the studied textbooks are convenient for biology teaching, with the exception of the textbooks of the Nová škola and Prodos publishing companies.

The analyses of the biology textbooks for the 8th grade demonstrate that text difficulty varies from 35 to 40 points. The values of the syntactic factor fluctuate from 8 to 11 points. The values of the semantic factor vary from 23 to 31 points. According to these obtained results it is possible to state that the textbooks of the Jinan, Scientia and SPN publishing companies are suitable for biology teaching.

The analyses of the biology textbooks for the 9th grade demonstrate that text difficulty varies from 30 to 41 points. The values of the syntactic factor fluctuate from 10 to 13 points. The values of the semantic factor vary from 18 to 28 points. According to these results it is possible to state that the textbooks of the SPN publishing company are suitable for biology teaching.

Table 1: Main components of text difficulty in the biology textbooks

Grade	Publishing company	Text difficulty (T)	Syntactic factor (Ts)	Semantic factor (Ts)
Sixth	Fortuna	32.07	7.86	24.21
	Jinan	30.65	9.77	20.88
	Nová škola	30.85	5.47	25.38
	Prodos	38.69	7.63	31.06
	Scientia	28.91	10.12	18.79
	SPN	31.51	6.66	24.85

Seventh	Fortuna	33.88	9.19	24.69
	Jinan	30.14	9.45	20.69
	Nová škola	43.10	7.63	35.47
	Prodos	38.47	7.45	30.94
	Scientia	32.43	10.08	22.35
	SPN	34.69	6.47	28.22
Eighth	Fortuna	39.78	9.25	30.53
	Jinan	36.24	11.28	24.96
	Prodos	40.37	7.58	32.79
	Scientia	34.58	11.27	23.31
	SPN	36.83	8.70	28.13
Ninth	Fortuna	41.32	12.94	28.38
	Jinan	34.97	11.55	23.42
	Prodos	34.72	10.40	24.32
	Scientia	29.85	11.75	18.10
	SPN	38.57	12.26	26.31

The main statistical values of text difficulty in the studied biology textbooks are given in Table 2. The obtained results of the mean values of text difficulty show this range: from 32 to 38 points. The variability is not high. The mean values of the syntactic factor vary from 8 to 12 points. It demonstrates that sentences are not very long and complicated. The variability is quite high. Mean values of the semantic factor vary from 24 to 28 points. These results demonstrate that terms are not very difficult. The variability is quite high.

Table 2: Main statistical values of text difficulty in the biology textbooks

Grade	Text difficulty				Syntactic factor				Semantic factor			
	\bar{x}	s_g	s	v	\bar{x}	s_g	S	v	\bar{x}	s_g	s	v
Sixth	32.11	1.38	3.39	10.56	7.92	0.73	1.78	22.47	24.19	1.72	4.22	17.44
Seventh	35.45	1.89	4.64	13.09	8.38	0.57	1.39	16.56	27.07	2.28	5.58	20.62
Eighth	37.56	1.09	2.45	6.52	9.62	0.73	1.63	16.95	27.94	1.74	3.89	13.92
Ninth	35.89	1.94	4.34	12.09	11.78	0.42	0.94	7.98	24.11	1.73	3.86	16.01

Conclusion

This article presents findings about evaluation of text difficulty in 22 biology textbooks. The results indicate that the average difficulty increases from the 6th

grade (32 points) to the 8th grade (38 points). The textbooks for the 9th grades show lower difficulty level.

The presented scale of the biology text difficulty enables us to evaluate the textbooks according to text difficulty, and to choose an optimum biology textbook for our teaching. The most suitable textbooks can be the ones of the SPN or Scientia publishing companies.

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