

Efficiency of Teaching Based on the Comparison of Textbooks

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Abstract:

Introduction: The paper's introduction contains a set of notes concerning high-quality preparation of pupils and students and doing best to achieve adequate efficiency related to the educational process, where pupils' or students' personality development and activation together with their key-competence and self-cultivation development, as well as preparation for the labour market, successful versatility plays a role of great importance. The pupils' or the students' capability to work with information included in the natural language test is considered to be of a great importance for their further professional or private life. Therefore, any school is responsible for the quality of education and teachers should work with adequate and up-to-date, high quality teaching and learning aids.

Purpose: The purpose of the study was to monitor and verify the didactic efficiency of the proposed chapters for the Economics textbook at a technical secondary school in Hlohovec, as well as to check the quality of the proposed textbook in relation to the outputs of the educational process.

Methods: The following methods and techniques related to the investigation of a developed Economics textbook have been applied: natural pedagogic experiment; questionnaire; cloze test; didactic test and statistical methods for data processing.

Conclusions: The research has shown that the created textbook for Economics is appropriate for students. We believe that introducing newly developed textbooks/teaching materials into the teaching process (despite modern types of media) may contribute to improving the quality and efficiency of the educational process.

Key words: textbook, educational process, efficiency of the educational process, quality of the educational process.

1 Introduction

Nowadays, the educational process aims at the student's personality development. In terms of education, we are currently experiencing continuous efforts to increase the quality of education and modernize schools. In schools, students should be provided with such education which would enable them to successfully integrate into practice and react flexibly to the changes in the labour market (Andress, 1911).

Technical and vocational education and training (TVET) makes a significant contribution to the economic competitiveness and welfare in a global knowledge-based economy. The main challenge for vocational education and training is to meet the requirement for new skills of individuals and respond to changes in the world of work in

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accordance with the principles of lifelong learning (Hrmo, Krištofiaková & Miština, 2015).

The most important prerequisite for achieving this goal is to provide high-quality preparation for individuals' future careers. This should be also accepted by teachers. A teacher, as an important factor in the educational process, may significantly contribute to the quality of education and its efficiency improvement by introducing new teaching aids, teaching methods, modern technologies etc. into the teaching process (Bajtoš & Kmecová, 2013, Dobrovská & Andres, 2016).

Khairutdinova, Selivanova and Abildina (2016) performed a research using an educational experiment. Students from different educational institutions were divided into groups based on their age. The main finding of this research was that there is a constant increase in the level of students' subjectivity. A similar research was mentioned by Avella, Kebritchi, Nunn and Kanai (2016). They provided an overview of the applied methods and the advantages of university education in LA.

Each school wishing to succeed in the competition must adjust to the new labour market conditions and make constant changes leading to the improvement in the quality of services provided.

2 Quality of education in schools

In today's world, quality and innovation are prerequisites for the competitiveness of states, businesses and schools. Quality is a condition for the existence of schools and we can agree with the argument that the future of a nation and mankind/people depends largely on the quality of education.

The quality of school can be evaluated based on two basic criteria (Bajtoš, 2010), the output criterion (amount of knowledge and experiences the student gains and their use in real life); and the criterion of affect (formation of the student's personality, his/her value system, motivation necessary for further education leading towards self-cultivation).

Lin-Siegler (2016) states in his article that students believe that success in science primarily depends on extraordinary talent, which has a negative impact on their motivation to learning. Deci, Ryan, Vallerand and Pelletier (1991) describe social-contextual factors, which are responsible for internal motivation and which support internalization leading to required results of education.

Schools, as educational institutions, should promote complex student personality development. It bears the primary responsibility for improving students' general and vocational knowledge, as well as the development of all components of their personalities and social roles the students are being prepared for. Education should be focused on the students' successful integration into the professional and social life. Following this aspect, we can say that schools play an extremely important role in the life of an individual (Bajtoš & Orosová., 2011).

It is essential for schools to provide the students with high-quality education that is a prerequisite for proper acquisition and development of competences (Turek & Albert, 2005). Richardson (2004) examined teaching and learning from the point of view of a student. He was interested in how to reveal the intricacy of language and educational requirements in the form of unknown discussion, genres and learning practices a student must be ware of as a participant of the educational culture of economics.

The primary objective of education is to prepare students for life, to prepare graduates who have a specific professional profile and are able to assert themselves in real life.

Therefore, it is important to apply both the theoretical and the practical components of education in schools. This is the only way we can prepare students for the labour market (Bajtoš, 2003).

Following this, it should be noted that teaching quality assessment is necessary. This is even more true when introducing new textbooks/teaching materials.

3 Quality evaluation of teaching materials

The term teaching material quality refers to its clarity, readability and complexity. Teaching materials should promote students' progress and provide them with everything necessary for effective learning.

The methods used for teaching quality evaluation may be divided into three basic groups: experimental method, expert methods, and statistical methods that examine various textbook parameters obtained by measuring the individual characteristics of the teaching content in the textbook. Such parameters include, for example, the average text size, its readability, and the difficulty level of the text. Text readability is determined by: Cloze test, Fog index and Gunning-Fog index (Kmecová, 2010; Turek, 2008).

- A. *Experimental method* – is based on a pedagogical experiment, which is the most objective method for textbook quality evaluation. The independent variable is the textbook/teaching materials. In the experimental study group, the students and the teacher use a new textbook/teaching material and the control group uses the previous textbook. The intervening variables (objectives of the lessons, the teacher, students, classroom, teaching methods, timetable etc.) should be the same in both the experimental and the control group. After the experiment, the knowledge, skills and attitudes of the students in both groups is compared (Turek, 2008, as cited in Kmecová, 2010, p. 46);
- B. *Expert methods* – assess the adequacy, methodology, attractiveness, complexity and other textbook parameters resulting from the statements of certain groups of observers – experts, teachers, students, etc. In this method, questionnaires have an irreplaceable role (Kmecová, 2010, p. 46);
- C. *Statistical methods* – these methods examine various curriculum parameters obtained by examining individual characteristics of the teaching context in the textbook. Such parameters include (Turek, 2008, as cited in Kmecová, 2010, pp. 47-49):
 - a) average text size – the number of words in the textbook within one teaching unit.
 - b) text difficulty level – may be determined by:
 - *linguistic-quantitative methods* are based on measuring the textbook difficulty level, arrangement of measurable units of verbal text, such as terminology, sentence structure, etc. These methods include Flesch's or Pisarek's method for measuring text difficulty, Mistrik's formula of measuring text clarity, etc.

As an example, Flesch's method for measuring text difficulty is given. Flesch created a formula which laid the groundwork for educational applications in this field. It refers to measuring text readability (Reading Ease - RE) for subjects with a certain level of skill. This is measured as follows: First, a sample from the text (extent – 100 words) is chosen systematically. Subsequently, the average number of syllables per word (SL) is counted. Finally, the average

sentence length in terms of the number of the words (WL) is counted and the gathered data are inserted into the following formula:

$$RE = 206.853 - 0.846 SL - 1.015 WL.$$

In this measurement, the scale ranges from 0 (the easiest texts) to 100 (the most difficult texts). In other words, texts are assigned a score on the Flesch's scale, which indicates the suitable level of education for understanding the particular text.

- *subject evaluation methods*: the difficulty level is determined through information obtained by questions from certain groups of subjects, such as experts or textbooks direct users (students and teachers).

These methods include The Complex Measurement of Text Difficulty by Nestlerová, Průcha and Pluskala. 10 random text samples are taken from the textbook/teaching material, the extent of each sample is 200 words. From each thematic unit, 5 more samples are taken (the extent of the samples is 100 words). The words and terms in samples are counted, the average length of sentences and their parts is calculated, and on this basis, the parameters of the textbook are determined.

In this measurement, the scale ranges from 0 (minimal difficulty) to 10 (maximum difficulty).

- *text readability* – is determined by cloze test, Fog index and Gunning-Fog indexem.
- 1) Cloze test – from the textbook/teaching material a random sample (250 words is taken). The first part of the text (35 words) is without any changes, but the 36th and then each tenth word (i.e. 46th, 56th, 66th, etc.) is omitted, until 20 words are omitted. Then a selected group of students who the textbook is intended for, is asked to fill in the missing words or to replace them by synonyms. If they fail to complete at least 13 missing words, the text is too difficult for them. Cloze test is easy to implement by using computer technology (Kmecová, 2010, p. 328).
 - 2) Fog index – from the textbook/teaching material, a sample (about 100 words) is taken. It is more efficient to work with more samples from one textbook. The average length of sentences in the sample is calculated through dividing the total number of words in the sample by the number of sentences. Using the formula

$$FI = \frac{(\text{average sentence length} + \text{number of long words}) \times 2}{5} + 5;$$

it is possible to calculate Fog index. The ideal score is about 12. In good textbooks/teaching materials, the score is 11 or lower.

- 3) Gunning Fog index – a random sample, the extent is about 100 words, is taken from the textbook/teaching material. It is more efficient to take more than one sample. The average number of words in the selected samples and the percentage of long (3 or polysyllabic) words is calculated. Gunning Fog index is calculated as follows:

$$\text{GFI} = (\text{ANW} + \% \text{LW}) \times 0.4^1$$

The calculated index represents the number of years of study necessary for comprehensive reading of the textbook/teaching material. The value of the index may be lowered by using simple vocabulary and short sentences (Kmecová, 2010, pp. 328-329).

4 Empirical verification of the didactic efficiency of the textbook

We present the preliminary results of the research on didactic efficiency of textbooks in vocational education. The research was implemented by the author at a technical secondary school in Hlohovec, Slovakia.

4.1 Research objectives

The main objectives of the research were:

- to monitor and verify the didactic efficiency of the proposed chapters of the Economics textbook at a technical secondary school in Hlohovec;
- to check the quality of the proposed textbook in relation to the outputs of the educational process of Economics.

4.2 Focus of the research

- content of the Economics textbook;
- students' satisfaction with teaching economics using the particular textbook / teaching material;
- findings about the students' attitudes and views on the quality of teaching Economics.

4.3 Research methodology

The following methods and techniques related to the evaluation of the created Economics textbook were applied:

- a) natural pedagogic experiment;
- b) questionnaire;
- c) cloze test;
- d) didactic test;
- e) statistical methods for data processing.

4.4 Research hypotheses

H: Economics is taught more efficiently with the use of chapters contained in the developed textbook than with the use of the currently used textbook.

In order to verify the main hypothesis, 5 sub-hypotheses were formulated. In this paper, partial results obtained from the verification of three working hypotheses are presented:

H1: The students in the experimental class achieve better results, when writing the Economy didactic test, within cognitive area than the students in the reference class.

¹ GFI = Gunning-Fog Index;
ANW = average number of words per sentence;
LW = percentage of long words.

H2: At the end of experiment, an evaluation of learning process provided by students in the experimental group will be more positive than by the students in the control group.

H3: The clarity of the created test will be higher than 65%, while the evaluation will be done with the use of Cloze test.

4.5 Statistic verification of hypotheses

4.5.1 H1 hypothesis

In order to verify the partial hypothesis H1, the non-standardized test with objective score system (NR Test) was applied. The students' performance was comparable with the performance of other students.

In research, the statistical method of Mann-Whitney U-Test was used. Based on the calculated values, the null hypothesis was rejected at a significance level of 0.05 in favour of the alternative hypothesis. There were significant differences between the students' performance in the experimental and control study groups.

Table 1

Results of didactic test outputs in the experimental and control class – finishing with a school-leaving certificate

| <u>STUDY- Group</u> | |
|---------------------|---------------------|
| <u>EXP</u> | <u>CON</u> |
| $n_1 = 16$ | $n_2 = 10$ |
| $\bar{x}_1 = 20.75$ | $\bar{x}_2 = 16.60$ |
| $s_1^2 = 1.96$ | $s_2^2 = 12.71$ |

For a quantitative trait of final DT score, in the cognitive area, a non-parametric Mann-Whitney U-Test at high frequencies was used.

Table 2

Null and alternative hypothesis – H1 verification

| | |
|-------|--|
| H_0 | There are no differences between the performance of the students in the experimental and control study groups. |
| H_1 | There are differences between the performance of the students in the experimental and control study groups. |

The calculated value 11.13 was compared with the critical value (1.96). The calculated value $u >$ critical value, therefore the null hypothesis was rejected, and the alternative hypothesis was confirmed. Between the performance of the students of both groups (in the program finishing with a school-leaving certificate), at a significance level of 0.05, there were statistically significant differences (Kmecová, 2010, pp. 97-98).

For illustration purposes, the results of the measured parameters in the group finishing with a certificate of apprenticeship are presented. The results of measured parameters

(arithmetic mean, median, modus, standard deviation, variance, variation margin, variation coefficient, minimum, maximum) are shown in Table 3.

Table 3

Results of measured parameters in experimental and control group – finishing with a certificate of apprenticeship

| <u>Measured parameters</u> | <u>Apprenticeship–Group</u> | |
|------------------------------------|----------------------------------|----------------------------------|
| | <u>EXP [$n_1=19$]</u> | <u>CON [$n_2=26$]</u> |
| Arithmetic mean \bar{x} [points] | 19.25 | 17.35 |
| Median \tilde{x} | 19 | 17 |
| Modus \hat{x} | 17/22 | 17 |
| Standard deviation s | 1.94 | 3.05 |
| Variance s^2 | 3.76 | 9.28 |
| Variation margin R [%] | 20.00% | 48.00% |
| Variation margin R [points] | 5 | 12 |
| Variation coefficient V [%] | 10 % | 17 % |
| Maximum x_{\max} [%] | 88.00% | 88.00% |
| Maximum x_{\max} [points] | 22 | 22 |
| Minimum x_{\min} [%] | 68.00% | 40.00% |
| Minimum x_{\min} [points] | 17 | 10 |

From the results shown in Table 3, we can see that in the final didactic test, the average score (arithmetic mean) of the experimental group is higher than the score of the students of the control group. As for the performance of the students in the control group, there were big differences. The difference between the highest and the lowest score was 12 points (48%). On the other hand, in the performance of the students of the experimental group, there were small differences. The sample was rather homogeneous. The difference between the highest and the lowest score was 5 points.

The working hypothesis H1 was confirmed both in the program finishing with a school-leaving certificate and the program finishing with a certificate of apprenticeship. Its probability is therefore 95%. Between the students' performance in both groups (in the program finishing with a certificate of apprenticeship) were, at a significance level of 0.05, there were statistically significant differences (Kmecová, 2010, pp. 98-99). The average score (arithmetic mean) of the final DT in the experimental group (finishing with a school-leaving certificate) was 20.75 points, in the control group (finishing with a school-leaving), the score was 16.60 points, which means that the students in the experimental group achieved better results than the students in the control group. Similarly, in the program finishing with a certificate of apprenticeship, the experimental group's arithmetic mean (19.25) was higher than the average score of the control group (17.35).

4.5.2 Hypothesis H2

In order to verify H2 hypothesis, Mann-Whitney U-Test at high frequencies was applied. The students filled in the questionnaire for teaching quality evaluation of and the questionnaire for evaluation of subject teaching quality in order to verify the H2 hypothesis.

The questionnaire comprised 23 questions (Kmecová, 2010, pp. 146-150). For illustration purposes, we present the answers to the questions related to the verification of H2 hypothesis in the program finishing with a school-leaving certificate.

Question 1

Was the Economics textbook motivating in various proportions and relationships, i.e. encouraged you to activity and increased your interest in learning from the textbook?

a) always; b) often; c) sometimes; d) not very often; e) never

Table 4

Results of measured parameters in experimental and control group – with a school-leaving certificate

| <u>Scale</u> | <u>Experimental group</u> | | <u>Control group</u> | |
|----------------|----------------------------|----------|----------------------------|----------|
| | <u>Number of responses</u> | <u>%</u> | <u>Number of responses</u> | <u>%</u> |
| a) | 2 | 12.50 | 0 | 0.00 |
| b) | 11 | 68.75 | 0 | 0.00 |
| c) | 3 | 18.75 | 3 | 30.00 |
| d) | 0 | 0.00 | 5 | 50.00 |
| e) | 0 | 0.00 | 2 | 20.00 |
| Σ / [%] | 16 | 100.00 | 10 | 100.00 |

Table 5

Null and alternative hypothesis – H2 verification, program finishing with a school-leaving certificate

| | |
|-------|--|
| H_0 | In the opinions of students of the experimental and control group whether the Economics textbook was motivating, i.e. encouraged them to activity and increased the interest in learning, there were no differences. |
| H_2 | In the opinions of students of the experimental and control group whether the Economics textbook was motivating, i.e. encouraged them to activity and increased the interest in learning, there were differences. |

The calculated value 3.98 was higher than 1.96 (critical value), which means that the null hypothesis was rejected, and the alternative hypothesis was accepted.

H2 hypothesis (question 1, program finishing with a school-leaving certificate) was confirmed. In the opinions of the students in the experimental and control groups regarding the motivational aspect of the Economics textbook, i.e. whether it encouraged

their activity and increased the interest in learning, there were statistically significant differences (Kmecová, 2010, p. 109-110).

H2 (question 1) was also conformed in the program finishing with a certificate of apprenticeship.

Question 2

Were the topics in the Economics textbook easy to learn?

a) very easy; b) quite easy; c) some of them were easy, some of them were difficult; d) rather difficult; e) very difficult.

Table 6

Null and alternative hypothesis – H2 verification, program finishing with a school-leaving certificate

| | |
|-------|--|
| H_0 | In the opinions of the students in the experimental and control groups (Were the topics in the Economics textbook easy to learn?) were no differences |
| H_2 | In the opinions of the students in the experimental and control groups (Were the topics in the Economics textbook were easy to learn?) were differences. |

The calculated value 2.69 is higher than the critical value (1.96), which means that the null hypothesis was rejected. Based on the analysis of the above-mentioned results, we can say that the H2 hypothesis was confirmed. At the end of the experiment, the students in the experimental group evaluated the teaching process more positively than the students in the control group. This finding was confirmed both in the program finishing with a school-leaving certificate and the program with a certificate of apprenticeship.

4.5.3 Hypothesis H3

The students' evaluation of the quality of the developed textbook/teaching material refers mainly to evaluating and comparing the clarity of the created teaching material and the currently used textbook in Cloze test.

The results of measuring the text clarity through Cloze test

Cloze test belongs to the statistical methods of textbook quality assessment. In the research, three samples of three units were randomly selected from the created teaching material for Economics. The same number of samples was taken from the currently used Economics textbook. The samples from both the developed and currently used textbook formed the topic of the experimental teaching unit, i.e. they were selected from the same thematic units. The students in the control group (both in the program finishing with a school-leaving certificate and a certificate of apprenticeship) completed the texts with missing words (in the currently used textbook) or replaced them by synonyms. To allow the clarity comparison of the currently used textbook and the developed teaching material, the same activity was done in the experimental group, where the students were asked to complete 20 missing words in three randomly selected samples in the created

teaching material. If students were unable to complete at least 13 missing words (65%), the teaching material was rated as difficult.

The total number of the correctly completed words in cloze test in percentage both in the program finishing with a school-leaving certificate and a certificate of apprenticeship is shown in Figure 1.

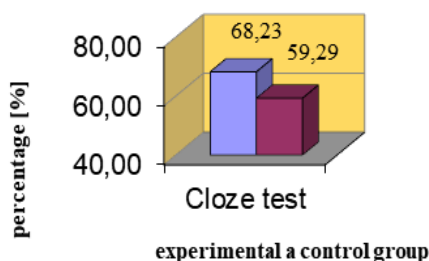


Figure 1. Total number of completed words in cloze test in percentage.

The students in the experimental group, both in the program finishing with a school-leaving certificate and a certificate of apprenticeship, achieved the average score of more than 13 completed words in each of the randomly selected samples. The students in the control group managed to complete less than 13 words in all three samples. The results in Figure 1 show that the average number of completed words in the experimental group accounts for 68.23%, which is more than 65%. The average number of words in the control group (in the program finishing with a school-leaving certificate and with a certificate of apprenticeship) provided the total of 59.09%, that is less than 65%, therefore, we can assume that the students find the proposed text understandable and easy to read. Based on this, we can conclude that the currently used textbook is incomprehensible and difficult to read for students.

Table 7

Cloze test results in the experimental and control group – finishing with a school-leaving certificate

| <u>STUDY-Group</u> | |
|---------------------|---------------------|
| <u>EXP</u> | <u>CON</u> |
| $n_1 = 16$ | $n_2 = 10$ |
| $\bar{x}_1 = 43.00$ | $\bar{x}_2 = 34.50$ |
| $s_1^2 = 0.79$ | $s_2^2 = 2.76$ |

To verify H3 hypothesis, Mann-Whitney U-test at high frequencies was applied.

Table 8

Null and alternative hypothesis – H3 verification

| | |
|-------|---|
| H_0 | There are no differences between the experimental and control group in the number of points achieved in cloze test. |
| H_3 | There are differences between the experimental and control group in the number of points achieved in cloze test. |

The calculated value 29.09 was higher than u_{krit} (0.05), which means that the null hypothesis was rejected and the alternative hypothesis H3 was accepted.

There were statistically significant differences in the number of points achieved in the cloze test in the compared classes.

H3 hypothesis (in the group finishing with a school-leaving certificate) was confirmed. The clarity of the created teaching material measured by cloze test was higher than 65 %. Based on the results obtained through cloze test, we may state that the clarity of the developed teaching material in the experimental group (both the program finishing with a school-leaving certificate and the program finishing with a certificate of apprenticeship) was higher than 65%. This means that the developed teaching material was not too difficult for the students, in other words it was appropriate for them. Having analysed the results, we argue that the sub-hypothesis H3 was confirmed. The students in the experimental group achieved 68.23% in cloze test, i.e. the clarity of the created text was higher than 65%.

5 Conclusions

In order to verify the main hypothesis, it was divided into 5 sub-hypotheses. In the paper there were presented the partial results of three working hypotheses.

The H1 hypothesis was confirmed at a significance level of 0.05. It was confirmed that at the end of the experiment, the students in the experimental group achieved better DT results in Economics than the students in the control group. The H2 hypothesis was also confirmed at a significance level of 0.05. At the end of the experiment, the students in the experimental group evaluated the teaching process more positively than the students in the control group. We can state that the H3 hypothesis was also confirmed. The clarity of the created teaching material assessed through cloze text was higher than 65%.

With respect to the above-mentioned results, we can assume that, in the Economics course, the teaching process is more efficient with the use of the proposed Economics textbook than the currently used textbook as the students working with it achieved better performance results in the didactic test than the students in the reference group. The same applies to teaching and learning quality – it was confirmed by the research findings that the proposed textbook enables:

- to improve the attractiveness of learning;
- to motivate students to work systematically;
- to set an individual studying tempo;
- to promote students' reading literacy and creative thinking;
- to make studying more interesting for students;
- to improve the students' results achieved in didactic tests.

The research has shown that the developed textbook for Economics was appropriate for students. The students in the experimental group were mostly satisfied with the textbook, saying that the content of the textbook attracted their attention and motivated them to activity. This resulted in a better final DT performance of the students in the experimental group, both in the program finishing with a school-leaving certificate and with a certificate of apprenticeship.

Providing schools with new textbooks created in accordance with the new knowledge from science and technology plays an important role in meeting the objectives of the educational process. In teaching vocational subjects, we recommend:

- to constantly evaluate the quality of textbooks in relation to the results of the educational process;
- to monitor the didactic efficiency of the textbooks and determine which educational function of certain textbooks fails to comply with them. Based on the findings, the missing components should be introduced into the newly created textbooks;
- to increase the quality and efficiency of the educational process by introducing newly created textbooks/teaching materials.

In conclusion, we believe that introducing newly created textbooks/teaching materials (despite modern types of media) may contribute to improving the quality and efficiency of the educational process.

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