Oleksandr Sokolov, Maria Mazorchuk, V. Dobriak, Wiesław Urbaniak

Testing of the acquirement of student's general educational competence

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MUZEUM HISTORII POLSKI

Oleksandr SOKOLOV
Nicolaus Copernicus University, Poland
Maria MAZORCHUK, V. DOBRIAK
National Aerospace University named after N.E. Zhukovskiy, Ukraine
Wiesław URBANIAK
Kazimierz Wielki University, Poland

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Introduction

The national goal of any state is the development of education and access to quality education for all citizens. The main objective of the Ukrainian educational system is creation equal conditions and opportunities for children and youths in receiving quality education [Liashenko, Rakov, Bulakh et al 2009].

Since 2005, Ukraine introduced an EIT of educational achievements of secondary schools' graduates which simultaneously is the final assessment of knowledge and draft of applicants for admission to a higher educational institution (HEI). In addition to EIT, there was a special evaluation of academic ability of applicants with a special test of the overall academic competence (TOAC). This test was mandatory only for those who intend to enter to the university. Such testing is generally not only aimed at identifying the knowledge (achievement) of college graduates in certain subject areas (academic subjects) but it also clarifies the potential willingness of students to successfully continue their education.

World practice of entrance to HEIs has not established forms or similar models yet. Each country in selecting university entrants for further education has prepared its own criteria. It is very important to develop such models of educations that their factors can help HEIs' authorities to improve curricula in such a way that the time of teaching is distributed more efficiently and graduates are prepared better for the job market [Banaszak-Piechowska, Mreła, Sokołov 2013].

Analysis of test results (TOAC) will reveal the main regularities in the training of school-kids and will allow to improve development of the tests, to prove (or disprove) the need of change of the tasks format etc.

This article is devoted to research on statistical relationships in the test for the knowledge assessment. We present the results of the research methodology to the test of the general competence for students in Ukraine in the academic year 2010/2011.

1. Task of research. Inputs

The aim of this study is to identify the reliability of various statistical relationships when testing general educational competence of students. The subjects of the study are models and methods of analysis of pedagogical testing. The object of the study is to evaluate the academic performance of students in pedagogical testing.

In testing of the general academic competence there were about 5000 attendants [*Official report…*]. Table 1 presents the basic data (which was contained in the test profile) and the scale of measurement. The Input data was checked for errors and corrected.

Table 1

Output data

Output data	Scale
Age	Ordinal
Gender	Dichotomous (scale of items)
Certificate average mark	Interval
Full mark	Interval
Mark in math	Interval
Mark in Ukrainian	Interval
Region of HEI	Scale of items
Fields of study	Scale of items

2. Research methodology. Application and Experiments

Research methodology of the tests.

Statistical analysis of testing results was made using SPSS software [Moosmyuller, Rebikov 2009; Kovaleva, Rostovtsev 2002].

2.1. Verification of marks selection on the normal distribution law

Numerous methods by which the variables related to the interval scale are processed are based on the hypothesis that their values are subject to the normal distribution. For example, the distribution of marks on Ukrainian, depending on the observe frequency is the subject of the normal distribution law as shown in Figure 1.

Figure 2 (the distribution of marks on math) shows that the distribution is a subject of the normal distribution law with right-side asymmetry.

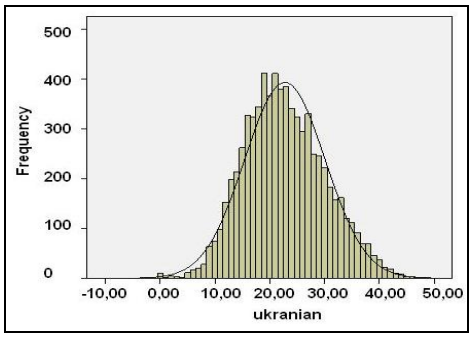

Fig. 1. Verification of the distribution law of marks on Ukrainian

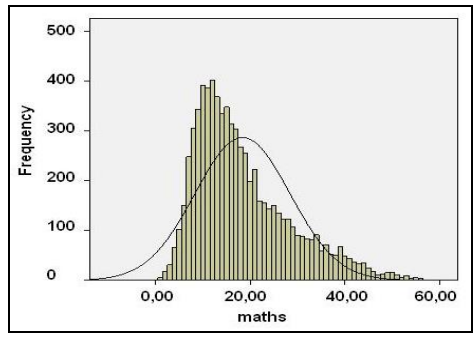

Fig. 2. Verification of the distribution law of marks on math

2.2. Descriptive statistics

This type of analysis includes a descriptive representation of the individual variables. Table 2 presents the maximum, minimum, average values and standard deviation of all parameters.

Table 2

Descriptive statistics

	Minimum	Maximum	Mean	Std. Deviation
Mathematics	0,00	56,00	18,3611	10,05216
Ukrainian language	0,00	47,00	22,7573	7,33260
test	1,00	103,00	41,1184	15,13085

Based on these results, we can conclude that on average, students wrote the test on math worse than on the Ukrainian language.

2.3. Respondents age

The distribution of the average of the full test for the knowledge assessment score according to the age group is presented in Table 3.

Table 3

Comparative analysis of the average value of the Ukrainian language test with the average mark value in different age groups

Age group / Mean value	Up to 18 years	18 years	19 years	20 years	21 years	More than 22 years
Total score – 41,1	42,4	38, 1	38,1	39	39,5	36,4
Range	21–40	21–40	21–40	21–40	21–40	21–40
Percent – %	55,6%	56,3%	54,8%	56,7%	58,5%	57,1%

Approximately the same number of people aged 20–21 years old participated in the survey (Fig. 3).

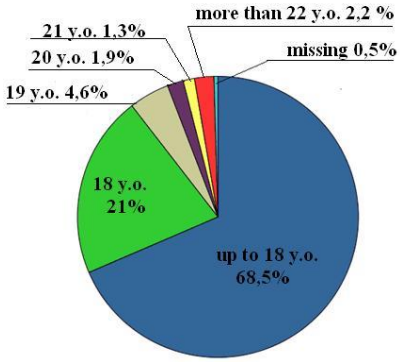

Fig. 3. Age of the respondents

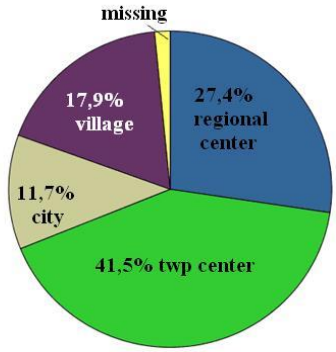

Fig. 4. Location of the schools

People of 22 years old did not participate in testing. Note that none of those aged below 20 and more 22 years old have scored over 80 points.

The distribution of the average score on the test, depending on the location of the school is shown on Figure 4.

Distribution of the average full TOAC score depending on the location of schools is presented in Table 4.

Table 4

The location of the school and the mean score

Location of a school / Mean value	Regional center	Twp center	City	Village
Total score – 41,1	46,11	40,14	37,88	38,29

The highest scores were achieved by students from schools that are located in regional centers.

2.4. Faculty specialization

Figure 5 shows a histogram of dependence between faculty specialization and frequency of students number tested.

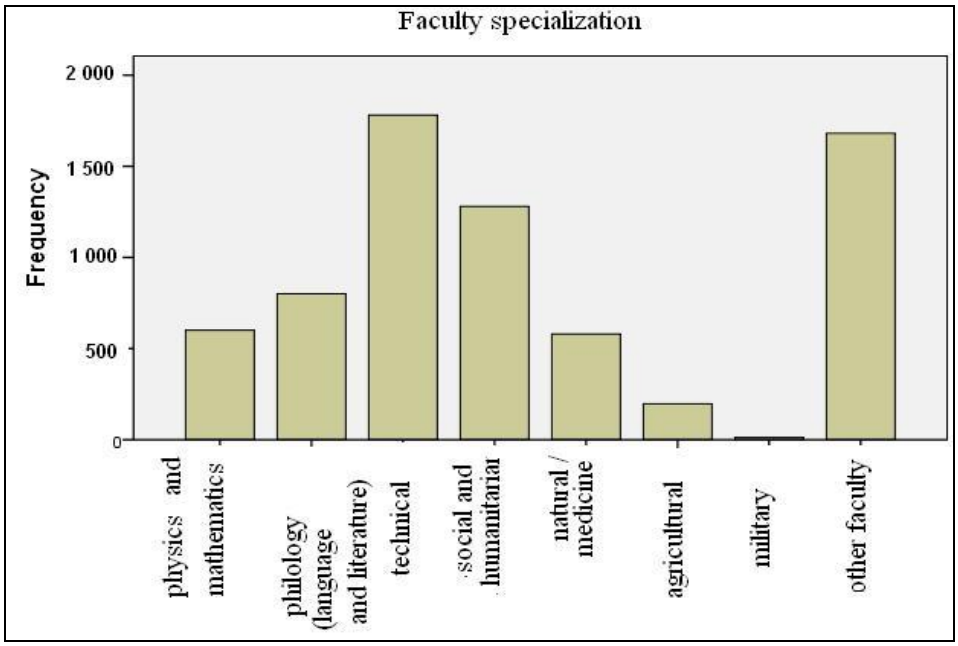

Fig. 5. Amount of respondents and specialization of faculty

The distribution of the average TOAC full score depending on the faculty specialization is presented in Table 5.

It should be noted that students who chose the military or agriculture faculty did not get more than 80 points. In addition, the students of the military department did not write tests for more than 40 points.

Table 5

Faculty specialization and the mean score

Faculty / Mean value	Physics and mathematics	Philology	Technical	Social and humanitarian	Natural/ medicine	Agricultural	Military	Other faculty
Total score – 41,1	49,29	41,15	41,97	39,9	43,12	34,95	30,5	38,81
Range of more points	20–40 and 40–60	20–40 and 40–60	20–40 and 40–60	20–40 and 40–60	20–40 and 40–60	20–40 and 40–60	20–40 and 40–60	10–30 and 30–40
Percent – %	33,6% and 36,1%	50,8% and 38,1%	49,3% and 33,2%	52,7% and 31%	38,3% and 47,2%	65,6% and 25,4%	41,7% and 58,3%	57,2% and 29,5%

2.5. Correlation analysis

In the process of associative analysis there were identified the following types of dependencies: non-monotonic, monotone, linear and non-linear dependence.

The next stage of data analysis was to determine the correlation values between results of the test for the knowledge assessment (KAT) and an average score of a school-certificate. The variables are represented in the interval scale. To analyze the relationship between variables the Pearson's correlation coefficient was used.

Based on the calculations, the Pearson correlation coefficient between the two studied variables is equal to 0.433, and its statistical significance is ~~of~~ less than 0.001 (fig. 6).

Correlations

			score of KAT	score of School Certi
Spearman's rho	score of KAT	Correlation Coefficient	1,000	,433**
		Sig. (2-tailed)	.	,000
		N	5157	4996
	score of School Certificate	Correlation Coefficient	,433**	1,000
		Sig. (2-tailed)	,000	.
		N	4996	5887

**. Correlation is significant at the 0.01 level (2-tailed).

Fig. 6. The correlation coefficient between the average score of a school-certificate and the full score of the test for the knowledge assessment

Consequently we can conclude that between the results of the external independent testing and score of the school-certificate there is a statistically significant weak linear increasing dependence. I.e., student's achievement score during the whole schooling is in a rather low dependence on the result of the test for the knowledge assessment (Pearson coefficient = 0.433), with an increase in the average score and the results of the test for the knowledge assessment increase linearly. That is a natural reflection of events.

2.6. Unidimensional dispersion analysis (explores the influence of one or more independent variables on single dependent one). It was necessary to find out whether the geographic location of the students influences the average test score. On the basis of the constructed table (Figure 7) it is clear that the differences between tests estimates are statistically significant. In the table all the regional groups are divided into three categories based on differences in average scores. The first category includes respondents from the target group of Simferopol, the second – Donetsk and Kharkov region, the third – Kiev and Lvov regional center.

test

Regional center		N	Subset 1	Subset 2	Subset 3
Scheffe[a,b,c]	Simferopol	1418	36,6996		
	Donetsk	1451	37,7161	37,7161	
	Kharkov	1474		39,2022	
	Kiev	1402			45,4408
	Lvov	1483			46,4909
Sig.			,476	,112	,441

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 212,609.

a. Uses Harmonic Mean Sample Size = 1444,920.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = ,01.

Fig. 7. Table of heterogeneous subsets (differences between groups of the independent variable)

The study found statistically insignificant differences of average test marks based on:

– different age groups (under 18, 18, 19, 20, 21, 22, more than 22 years);
– different specializations of education (physical and mathematical, technical, philological etc.);
– statistically significant difference of average test marks is based on:
– gender differences;
– the location of the institution (the regional center, district center, town, village).

2.7. Three-factor dispersive analysis

There have been identified 3 factors: gender, age and location of the school.

Figure 8 shows that in the regional center women older than 22 years have the lowest scores on the tests, while men aged 18 have the highest average rating of tests.

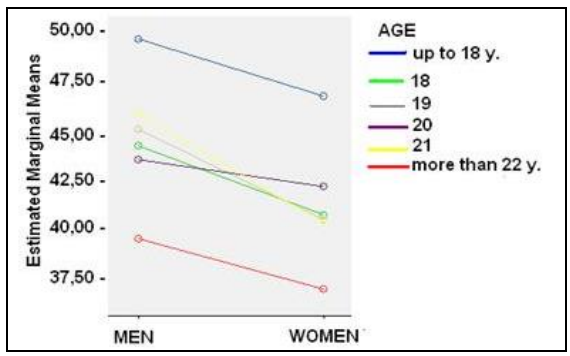

Fig. 8. Diagram of interaction of the gender and age variables (an educational institution located in the regional center)

Women on average have written the test worse than men. With that assessment the following age categories vary significantly: under 18 and more than 22 years. Women of age 20 wrote tests better than those of 18, 19, 21; in turn, the situation of the men of the same age is vice versa. Significant differences in the test writing can be traced from the Figure 9.

In the district center women older than 22 years old wrote the test much worse than men, at the same time situation of the age groups of 20 and 21 years old is vice versa: men have better average score of testing than women.

Figure 10 here is very significant because the distribution of scores between age groups (and gender difference) in district and regional centers is opposite.

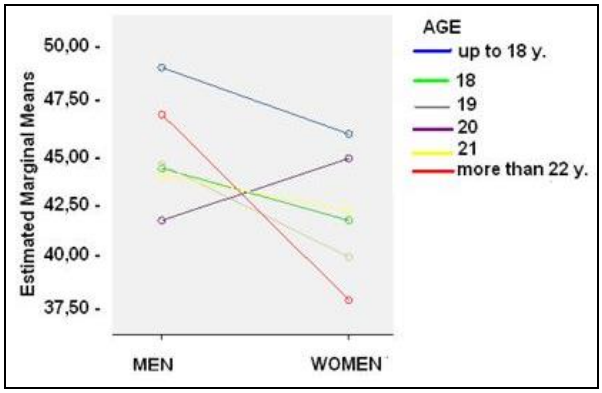

Fig. 9. Diagram of interaction of the gender and age variables (an educational institution is located in the district center)

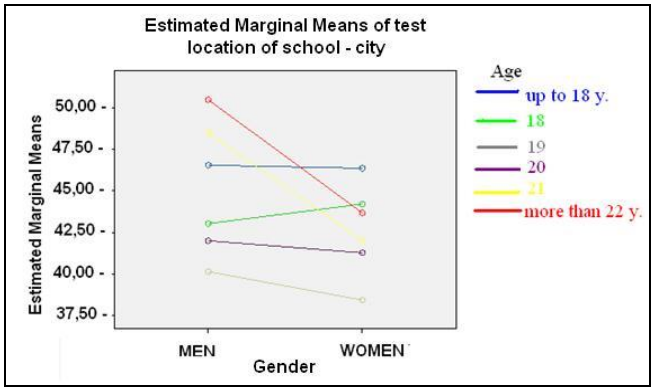

Fig. 10. Diagram of interaction of gender and age variables (an educational institution is located in city)

The lowest testing marks were got by students of 18–20 years old. Men over 21 have the highest scores. Women older than 21 years old wrote test better than those of age 18–20.

Conclusions

The analysis of the experience of the entrance campaign in Ukrainian universities shows that with the introduction of TOAC positive developments have taken place to ensure equal access of citizens to higher education on the principles of objectivity and fairness.

According to the results of the study it can be concluded that:

1. Knowledge of the Ukrainian language of school attendants is much higher than knowledge of mathematics.
2. Students who choose as their specialization military or agriculture have the lowest test scores.
3. Men are generally better at writing tests (although the men born in 1994–1995 years were 14% worse than of women).
4. Women are stable in the test writing, depending on age and location of general educational institutions.
5. Motivation to learn of students from the regional centers is significantly higher than of students from large cities.
6. Age of incomers and specialization of educational institutions do not have a strong influence on the result of training.

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Abstract

According to the Bologna Accords, in recent years the education sector in Ukraine has been undergoing via some changes: Ukraine switched to the multi-level education, many universities introduced the credit-modular system of

knowledge, assessment and a successfully implemented distance learning system, based on External Independent Testing (EIT) [http://www.ihep.org/]. Ukraine provides equal access to education.

However, despite the positive developments in the field of education, in 2010, only 17% of students received the highest possible score in a test of mathematics, and in 2011, only 7% received 180.5 points and above [*Results of social…*]. And that is despite the fact that according to the psychometric analysis: 58% test items can be classified as „optimal".

This paper is devoted to investigation of results and search of statistical relationships of indicators in tests of the general competence and knowledge assessment of students, which took place in Ukraine in 2011.

A general methodology for finding significant statistical relationships between certain characters is described in the article. We used standard methods of statistical analysis: finding the value of the distribution, the methods of descriptive statistics, one-dimensional analysis of variance. The calculations were carried out with the help of software SPSS.

A brief interpretation of test results is given. These results are accompanied by graphics and tables. The study drew conclusions about the level of general education of students in Ukraine in 2011. Objectiveness of test for the knowledge assessment scores is substantiated.

Key words: students, test, test for the knowledge assessment, statistical analysis, education.