ATLANTIS PRESS

Advances in Social Science, Education and Humanities Research, volume 341

5th International Conference on Arts, Design and Contemporary Education (ICADCE 2019)

The Research on the Relationship Between the Results of the Monitoring of the 9th Grade Students' Individual Academic Achievements in Mathematics, Physics and Chemistry at the Level of Basic General Education

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***Abstract*—The article focuses on the empirical research on the relationship between the results of the individual academic achievements monitoring of the 9th grade students of Voronezh region general education establishments in Mathematics, Physics and Chemistry at the level of basic general education. It indicates and describes the stages, content, conditions and procedure of conducting the empirical study. While conducting the empirical study, in order to assess the correlation between the results of the monitoring of the 9th grade students' individual academic achievements in Mathematics, Physics and Chemistry at the level of basic general education, the following statistical methods were applied: correlation and regression analysis and one-way analysis of variance. These methods jointly allow identifying the internal connections and patterns of correlation between the results of the monitoring of the 9th grade students' individual academic achievements in Mathematics, Physics and Chemistry at the level of basic general education.**

Keywords—research; education; individual academic achievements; monitoring; assessment; students; Mathematics; Physics; Chemistry

I. INTRODUCTION

Nowadays, in the Russian Federation the Unified system for assessing the quality of education is being implemented, the main focus of which is the assessment of students' academic results. Such assessment is conducted consistently at the federal, regional and municipal levels, within the educational establishment and, finally, at each student's personal level. The system of general education is provided with large amounts of empirical data on different individual academic achievements of the students due to conducting various monitoring research on the territory of the Russian Federation, ranging from international comparative studies, such as PIRLS, PISA, TIMSS, etc., national research on the quality of education, such as National study of the quality of education (*Rus.* - NIKO) and All-Russia testing (*Rus.* - VPR) to regional assessment monitoring and intra-school systems for evaluating planned results of mastering the general educational program at the corresponding levels of general education.

However, in the national studies there is no analysis of correlation between the students' results in Mathematics, Physics and Chemistry at the level of basic general education. Consequently, there is a contradiction between the need to analyse the correlation of the students' results in Mathematics, Physics and Chemistry at the level of basic general education and the absence of such an assessment. Actually, a student's mathematical education basis is fundamental for the development of their results in Physics and Chemistry. Moreover, subject-specific results in Physics formed in students are the basis for the development of their results in Chemistry.

To resolve the detected contradiction, the authors' purpose in the present article is to assess the correlation between the results of the monitoring of individual academic achievements of the 9th grade students of Voronezh region general education establishments in Mathematics, Physics and Chemistry at the level of basic general education.

According to the hypothesis proposed and being tested in our study, if the patterns that characterize the influence of the

correlation between the results of the monitoring of the 9th grade students' individual academic achievements in Mathematics, Physics and Chemistry are identified, it will allow to determine how subject results in Mathematics affect subject results in Physics and Chemistry, and how subject results in Physics affect subject results in Chemistry when assessing individual academic achievements of the 9th grade students of Voronezh region general education establishments.

II. METHODOLOGY OF THE EMPIRICAL STUDY

In order to assess the correlation between the results of the monitoring of individual academic achievements of the 9th grade students of Voronezh region general education establishments in Mathematics, Physics and Chemistry at the level of basic general education, the statistical methods of correlation and regression analysis and one-way analysis of variance were used [1] [2] [3]. These methods jointly allow identifying the internal connections and patterns of correlation between the results of the monitoring of the 9th grade students' individual academic achievements in Mathematics, Physics and Chemistry at the level of basic general education.

Correlation is regarded as a property indicating the interrelation between a series of numeric sequences, i.e. it characterizes data interrelation. When searching for correlation dependence, a probabilistic connection of one variable x with another - y is revealed. Thus, correlation analysis allows concluding on the strength of the relation between the x and y data pairs. A more accurate estimation of the strength of relationship between quantitative characteristics can be made when determining the measure of concordance of resulting and factor characteristics variation. To measure the strength of relationship between the resulting y and factor x characteristics, we apply a linear correlation coefficient.

Regression analysis allows deriving analytical relationship, which demonstrates how the average value of the resulting characteristic changes under the influence of one or several independent values. In this context, a range of other factors that also influence the resulting characteristic are taken as constant or average levels. Thus, regression analysis allows to understand how, on average, one value, for example, y, changes with corresponding changes of another value x; and vice versa, to what extent the variable value x, changes for one unit change in the value of y.

On the one hand, the use of correlation and regression analysis will allow revealing the nature of statistical relationship between the experimental variables obtained, while on the other hand, it will help to reveal mathematical expressions characterizing the patterns of relationship between these experimental variables. The experimental variables - k, being studied in the present research, are the results of individual academic achievements monitoring of the 9th grade students of Voronezh region general education establishments in Mathematics and Physics.

One-way analysis of variance (ANOVA) is used to compare the mean values for three or more samples. One-way analysis of variance is essentially the study of the influence of one or several independent variables, usually called factors, on the dependent variable. A factor is an independent variable that affects the dependent variable. The dependent variable in this study is represented by the results of individual academic achievements monitoring of the 9th grade students of Voronezh region general educational establishments in Physics and Chemistry.

In the procedure of the 9th grade students' individual academic achievements monitoring on the evaluation of subject results for grade 8 within the implementation of Federal State Education Standards (*Rus.* - FGOS) for basic general education participated:

- 3920 students of the 9th grade, assessed for the level of subject results in Mathematics and Physics for grade 8;
- 3972 students of the 9th grade, assessed for the level of subject results in Mathematics and Chemistry for grade 8;
- 4142 students of the 9th grade, assessed for the level of subject results in Physics and Chemistry for grade 8;

The results of the monitoring of the 9th grade students' individual achievements on the evaluation of subject results for grade 8 at the level of basic general education are presented in the corresponding report [4].

The methodical approach to analyse the results of evaluating the correlation between subject results of students' individual academic achievements monitoring was used by the authors [5] [6] [7].

III. RESULTS

Let us carry out the necessary calculations within the following stages:

- Constructing a correlation matrix and assessing the nature of relationship between variables.
- Constructing regression and identifying mathematical expressions that characterize the patterns of relations between variables.

During the first stage, based on data aggregation, the following correlation values were obtained ("Table I").

TABLE I. CORRELATION MATRIX OF THE RESULTS OF THE MONITORING OF THE 9TH GRADE STUDENTS' INDIVIDUAL ACADEMIC ACHIEVEMENTS ON EVALUATING SUBJECT RESULTS AT THE LEVEL OF BASIC GENERAL EDUCATION

	Mathematics, Grade 8	**Physics, Grade 8**
Physics, Grade 8	0,62	
Chemistry, Grade 8	0,587	0,586

Analysing the calculations presented in the correlation matrix ("Table I"), considering Cheddock's scale [1] to assess the correlation, the following conclusions can be made:

- The correlation between the results of Voronezh region general educational establishments students, who participated in the individual academic achievements monitoring in school subject "Mathematics, Grade 8" (as a percentage of the maximum score), and in school subject "Physics, Grade 8" (as a percentage of the maximum score) is positive and apparent;
- The correlation between the results of Voronezh region general educational establishments students, who participated in the individual academic achievements monitoring in school subject "Mathematics, Grade 8" (as a percentage of the maximum score), and in school subject "Chemistry, Grade 8" (as a percentage of the maximum score) is positive and apparent;
- The correlation between the results of Voronezh region general educational establishments students, who participated in the individual academic achievements monitoring in school subject "Physics, Grade 8" (as a percentage of the maximum score), and in school subject "Chemistry, Grade 8" (as a percentage of the maximum score) is positive and apparent.

Within the second stage, regressions were constructed and mathematical expressions were identified that characterize the patterns of relations between the results of the individual academic achievements monitoring of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Physics and Chemistry for grade 8 at the level of basic general education. Regression analysis was conducted using IBM SPSS Statistics software product.

"Table II" presents regression coefficients calculation of the correlation between the results of the individual academic achievements monitoring of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Physics for grade 8 at the level of basic general education. Based on this calculation, the values of the constant and the coefficient were determined, indicating the levels of significance and confidence intervals.

The final regression equation to identify the correlation between the results of the individual academic achievements monitoring of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Physics for grade 8 at the level of basic general education is determined by the following formula:

$$y = 18{,}395 + 0{,}569x \quad (1)$$

TABLE II. CALCULATION OF REGRESSION COEFFICIENTS

Coefficients								
Model		Non-standardized coefficients		Standardized coefficients	t	Significance	95,0% Confidence interval for B	
		B	Standard error	Beta			Lower limit	Upper limit
1	***(Constant)***	18,395	,522		35,269	,000	17,372	19,418
	Mathematics, Grade 8	,569	,011	,620	49,521	,000	,547	,592

The value of the coefficient shows that with the increase in the students' subject result in school subject "Mathematics, Grade 8" by 1%, the value of subject results in school subject "Physics, Grade 8" increases by 0,569%.

The value of the standardized coefficient (18,395) shows the number of standard deviations by which the value of the results in school subject "Physics, Grade 8" increases as the value of the results in school subject "Mathematics, Grade 8" increases by one standard deviation. The calculation of 95% Confidence intervals for the regression coefficient and the constant (see "Table II") shows that in case the sample is represented in the form of population, its coefficient with 95% reliability will range from 0,547 to 0,592.

The calculated value of the Student t-test is t = 49,521 (which exceeds the t-critical = 1.9605696), that is why the null hypothesis is rejected. What is more, the significance level is p <0,001, so the null hypothesis is rejected again. Consequently, there is a statistically significant linear relationship between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in "Mathematics, Grade 8" and "Physics, Grade 8" at the level of basic general education.

"Table III" presents general information on the regression model.

TABLE III. GENERAL INFORMATION ON REGRESSION MODEL

Model information										
Model	R	R square	Adjusted R square	Standard error of estimation	Statistics of changes					Durbin-Watson
					R square change	F change	Degree of freedom 1	Degree of freedom 2	Significance of F change	
1	,620	,385	,385	14,41259	,385	2452,287	1	3918	,000	1,864

The determination coefficient R square is 0,385. This means that 38,5% of the variations of the 9th grade students' subject results in Physics change with the corresponding variations of subject results of the 9th grade students of Voronezh region general educational establishments in Mathematics.

The value of the Durbin-Watson criterion that verifies satisfaction of the condition of observation independence, is within 1 <1,864 <3, which reflects that the condition of residual independence is satisfied [8], and apparently, projection based on the least-squares procedure is not violated. Consequently, this model of simple linear regression is sufficient; there is a linear relationship between the variables.

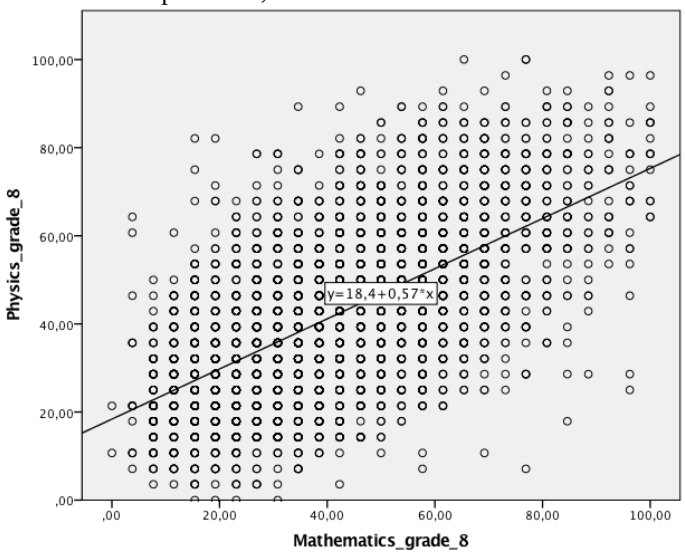

Fig. 1. Regression of the correlation between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Physics for grade 8 at the level of basic general education (vertically – Physics, Grade 8, horizontally – Mathematics, Grade 8).

"Fig. 1" demonstrates the regression line, which reflects the nature of the relationship between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Physics for grade 8 at the level of basic general education.

"Table IV" provides the results of one-way ANOVA analysis to identify the presence or absence of a relationship between variables.

The value of the F-criterion ("Table IV") is 2452,287 (which exceeds the F-critical = 3,84383335), corresponds to the achieved level of significance p <0,001, therefore, the null hypothesis on the absence of relationship between variables is rejected [8]. Thus, the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on the evaluation of subject results in "Mathematics, Grade 8" and "Physics, Grade 8" at the level of basic general education have strong relation.

For this regression model, distribution of residual represents a normal distribution ("Fig. 2"), the regressogram of standardized residual ("Fig. 3") is a right line, which proves a normal distribution of residual, and therefore, satisfaction of this condition for conducting linear regression analysis [8]. It confirms the legitimacy of applying a linear regression analysis.

TABLE IV. ONE-WAY ANOVA ANALYSIS RESULTS

ANOVA						
Model		***Sum of squares***	***Degree of freedom***	***Mean square***	***F***	***Significance***
1	Regression	509395,576	1	509395,576	2452,287	,000
	Residual	813857,297	3918	207,723		
	Total	1323252,873	3919			

Another obligatory requirement for applying linear regression analysis is the satisfaction of homoscedasticity condition, which should provide equal spread of values of the dependent variable for any values of the independent variable. The presented scatter diagram of standardized residual as a function of standardized predicted values ("Fig. 4") shows that the spread of standardized residual is approximately the same for all values of the standardized predicted value, that is, the condition of homoscedasticity is satisfied [8].

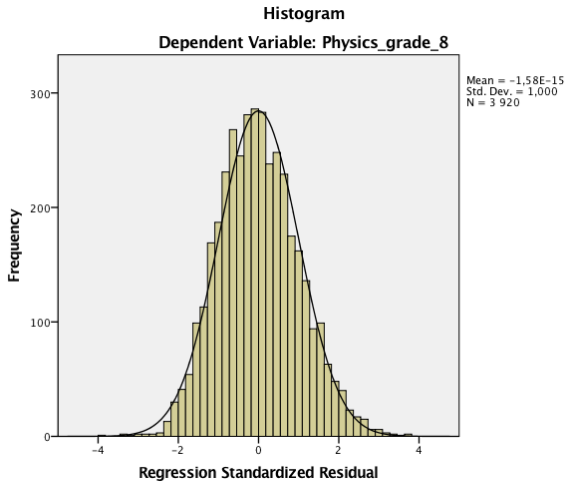

Fig. 2. Standardized residual bar chart.

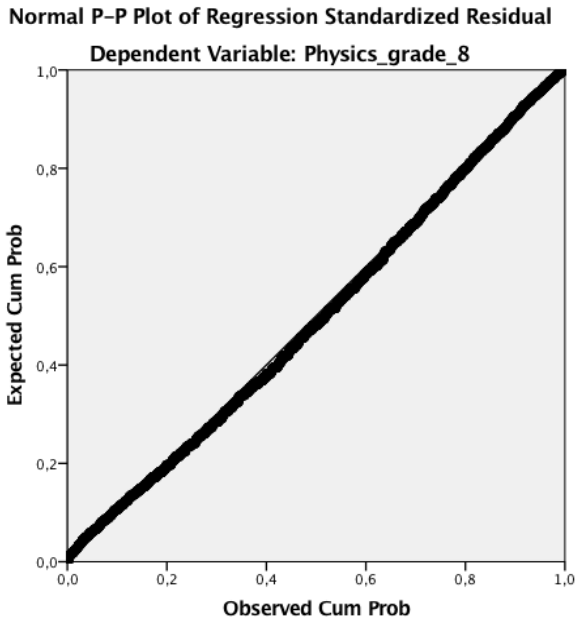

Fig. 3. Regressogram of standardized residual.

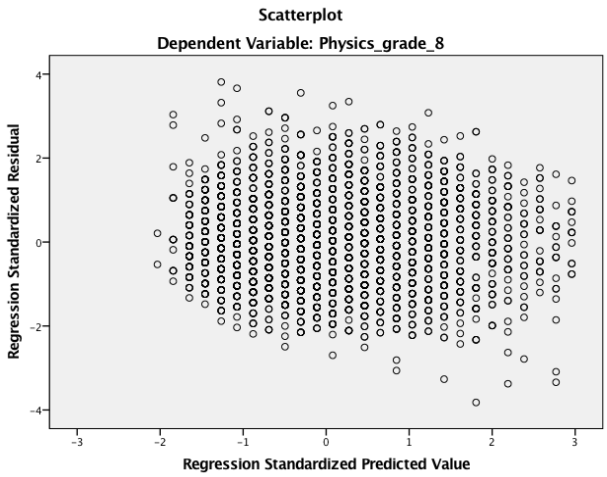

Fig. 4. Scatter diagram of standardized residual as a function of standardized predicted values.

Regressions were constructed and mathematical expressions were identified that characterize the patterns of relations between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on the evaluation of subject results in Mathematics and Chemistry for grade 8 at the level of basic general education.

"Table V" presents calculations on regression coefficients of the correlation between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Chemistry for grade 8 at the level of basic general education. Based on this calculation, the values of the constant and the coefficient were determined, indicating the levels of significance and confidence intervals.

The final regression equation to identify the correlation between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Chemistry for grade 8 at the level of basic general education is determined by the following formula:

$$y = 22,25 + 0,595x \quad (2)$$

The value of the coefficient shows that with the increase in the students' subject result in school subject "Mathematics, Grade 8" by 1%, the value of subject results in school subject "Chemistry, Grade 8" increases by 0,595%.

TABLE V. CALCULATION OF REGRESSION COEFFICIENTS

Coefficients								
Model		*Non-standardized coefficients*		*Standardized coefficients*	*t*	*Significance*	*95,0% Confidence interval for B*	
		B	*Standard error*	*Beta*			*Lower limit*	*Upper limit*
1	*(Constant)*	22,250	,586		37,990	,000	21,102	23,398
	Mathematics, Grade 8	,595	,013	,587	45,716	,000	,569	,620

The value of the standardized coefficient (22,25) shows the number of standard deviations by which the value of the results in school subject "Chemistry, Grade 8" increases as the value of the results in school subject "Mathematics,

Grade 8" increases by one standard deviation. The calculation of 95% Confidence intervals for the regression coefficient and the constant (see "Table V") shows that in case the sample is represented in the form of population, its coefficient with 95% reliability will range from 0,569 to 0,62.

The calculated value of the Student t-test is t = 45,716 (which exceeds the t-critical = 1,9605617), that is why the null hypothesis is rejected. What is more, the significance level is p <0,001, so the null hypothesis is rejected again. Consequently, there is a statistically significant linear relationship between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in "Mathematics, Grade 8" and "Chemistry, Grade 8" at the level of basic general education.

"Table VI" presents general information on the regression model.

TABLE VI. GENERAL INFORMATION ON REGRESSION MODEL

Model information										
Model	*R*	*R square*	*Adjusted R square*	*Standard error of estimation*	*Statistics of changes*					*Durbin-Watson*
					R square change	*F change*	*Degree of freedom1*	*Degree of freedom 2*	*Significance of F change*	
1	,587	,345	,345	16,25261	,345	2089,945	1	3970	,000	1,822

The determination coefficient R square is 0,345. This means that 34,5% of the variations of the 9th grade students' subject results in Chemistry change with the corresponding variations of subject results of the 9th grade students of Voronezh region general educational establishments in Mathematics.

The value of the Durbin-Watson criterion that verifies satisfaction of the condition of observation independence, is within 1 <1,822 <3, which shows that the condition of residual independence is satisfied [8], and apparently, projection based on the least-squares procedure is not violated. Consequently, this model of simple linear regression is sufficient; there is a linear relationship between the variables.

"Fig. 5" demonstrates the regression line, which reflects the nature of the relationship between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on the evaluation of subject results in Mathematics and Chemistry for grade 8 at the level of basic general education.

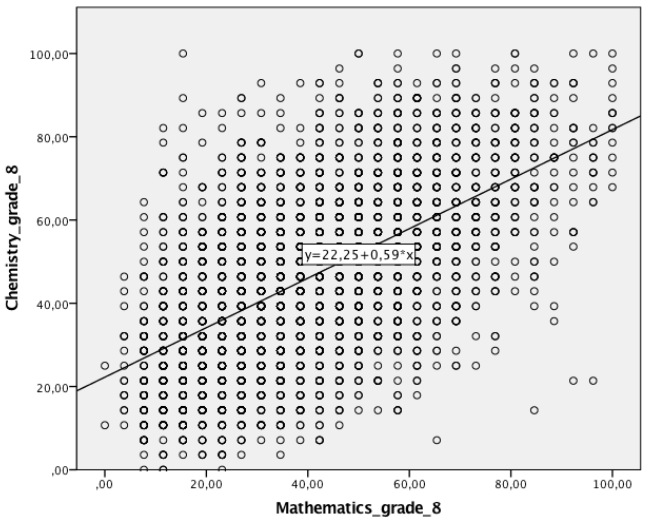

Fig. 5. Regression of the correlation between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Mathematics and Chemistry for grade 8 at the level of basic general education (vertically – Chemistry, Grade 8, horizontally – Mathematics, Grade 8).

TABLE VII. ONE-WAY ANOVA ANALYSIS RESULTS

ANOVA						
Model		*Sum of squares*	*Degree of freedom*	*Mean square*	*F*	*Significance*
1	Regression	552053,101	1	552053,101	2089,945	,000
	Residual	1048664,309	3970	264,147		
	Total	1600717,409	3971			

"Table VII" presents the results of one-way ANOVA analysis to identify the presence or absence of a relationship between variables.

The value of the F-criterion ("Table VII") is 2089,945 (which exceeds the F-critical = 3,84380223), corresponds to the achieved level of significance p <0,001, therefore, the null hypothesis on the absence of relationship between variables is rejected [8]. Thus, the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on the evaluation of subject results in "Mathematics, Grade 8" and "Chemistry, Grade 8" at the level of basic general education have strong relation.

For this regression model, distribution of residual represents a normal distribution ("Fig. 6"), the regressogram of standardized residual ("Fig. 7") is a right line, which proves a normal distribution of residual, and therefore, satisfaction of this condition for conducting linear regression analysis [8]. It confirms the legitimacy of applying a linear regression analysis.

Another obligatory requirement for applying linear regression analysis is the satisfaction of homoscedasticity condition, which should provide equal spread of values of the dependent variable for any values of the independent variable. The presented scatter diagram of standardized residual as a function of standardized predicted values ("Fig. 8") presents that the spread of standardized residual is approximately the same for all values of the standardized predicted value, that is, the condition of homoscedasticity is satisfied [8].

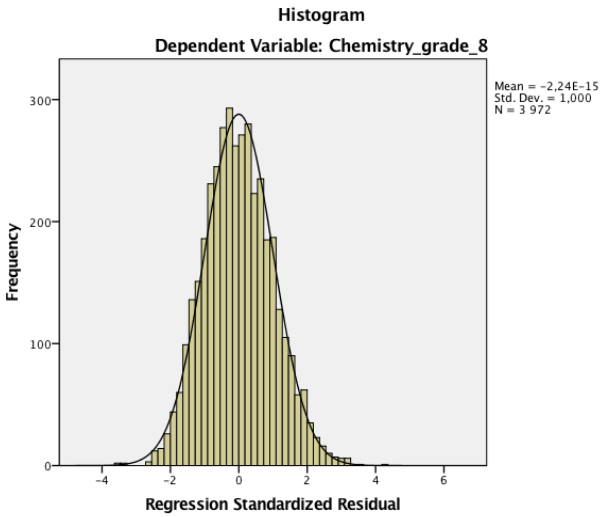

Fig. 6. Standardized residual bar chart.

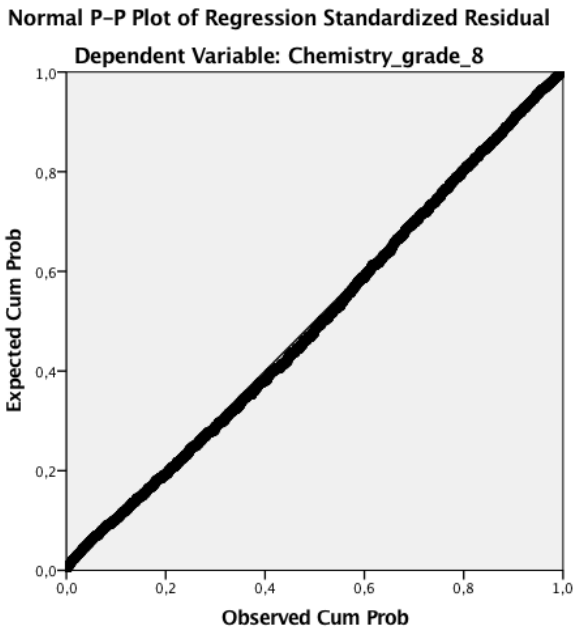

Fig. 7. Regressogram of standardized residual.

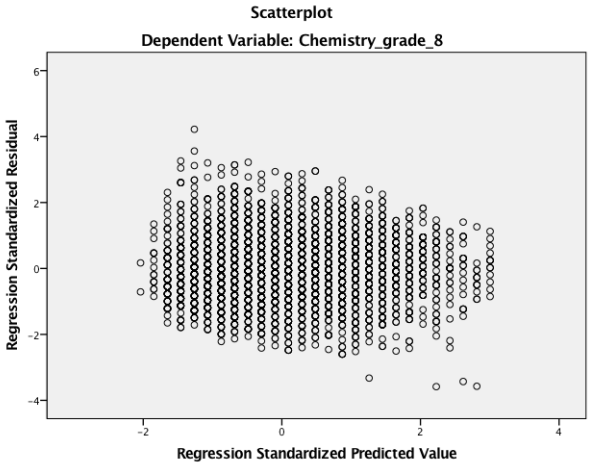

Fig. 8. Scatter diagram of standardized residual as a function of standardized predicted values.

Regressions were constructed and mathematical expressions were identified that characterize the patterns of relations between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on the evaluation of subject results in Physics and Chemistry for grade 8 at the level of basic general education. Regression analysis was conducted using IBM SPSS Statistics software product.

"Table VIII" presents calculations on regression coefficients of the correlation between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Physics and Chemistry for grade 8 at the level of basic general education. Based on this calculation, the values of the constant and the coefficient were determined, indicating the levels of significance and confidence intervals.

The final regression equation to identify the correlation between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Physics and Chemistry for grade 8 at the level of basic general education is determined by the following formula:

$$y = 19{,}599 + 0{,}647x \quad (3)$$

The value of the coefficient shows that with the increase in the students' subject result in school subject "Physics, Grade 8" by 1%, the value of subject results in school subject "Chemistry, Grade 8" increases by 0,647%.

The value of the standardized coefficient (19,599) shows the number of standard deviations by which the value of results in school subject "Chemistry, Grade 8" increases as the value of results in school subject "Physics, Grade 8" increases by one standard deviation. The calculation of 95% Confidence intervals for the regression coefficient and the constant (see "Table VIII") shows that in case the sample is represented in the form of population, its coefficient with 95% reliability will range from 0,62 to 0,675.

TABLE VIII. CALCULATION OF REGRESSION COEFFICIENTS

Coefficients								
Model		*Non-standardized coefficients*		*Standardized coefficients*	*t*	*Significance*	*95,0% Confidence interval for B*	
		B	*Standard error*	*Beta*			*Lower limit*	*Upper limit*
1	(Constant)	19,599	,632		31,032	,000	18,361	20,837
	Physics, Grade 8	,647	,014	,586	46,581	,000	,620	,675

The calculated value of the Student t-test is t = 46,581 (which exceeds the t-critical = 1,9605372), that is why the null hypothesis is rejected. What is more, the significance level is p <0,001, so the null hypothesis is rejected again. Consequently, there is a statistically significant linear relationship between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in "Physics, Grade 8" and "Chemistry, Grade 8" at the level of basic general education.

"Table IX" presents general information on the regression model. The determination coefficient R square is 0,344. This means that 34,4% of the variations of the 9th grade students' subject results in Chemistry change with the corresponding variations of subject results of the 9th grade students of Voronezh region general educational establishments in Physics.

TABLE IX. GENERAL INFORMATION ON REGRESSION MODEL

Model information										
Model	*R*	*R square*	*Adjusted R square*	*Standard error of estimation*	*Statistics of changes*					*Durbin-Watson*
					R square change	*F change*	*Degree of freedom1*	*Degree of freedom 2*	*Significance of F change*	
1	,586	,344	,344	16,31431	,344	2169,786	1	4140	,000	1,852

The value of the Durbin-Watson criterion that verifies satisfaction of the condition of observation independence, is within 1 <1,852 <3, which shows that the condition of residual independence is satisfied [8], and apparently, projection based on the least-squares procedure is not violated. Consequently, this model of simple linear regression is sufficient; there is a linear relationship between the variables.

"Fig. 9" demonstrates the regression line, which reflects the nature of the relationship between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on the evaluation of subject results in Physics and Chemistry for grade 8 at the level of basic general education.

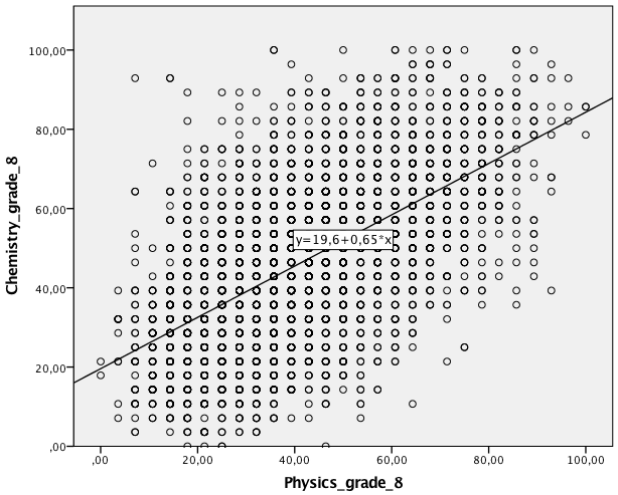

Fig. 9. Regression of the correlation between the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on evaluating subject results in Physics and Chemistry for grade 8 at the level of basic general education (vertically – Chemistry, Grade 8, horizontally – Physics, Grade 8).

TABLE X. ONE-WAY ANOVA ANALYSIS RESULTS

ANOVA						
Model		*Sum of squares*	*Degree of freedom*	*Mean square*	*F*	*Significance*
1	Regression	577503,280	1	577503,280	2169,786	,000
	Residual	1101888,999	4140	266,157		
	Total	1679392,279	4141			

"Table X" presents the results of one-way ANOVA analysis to identify the presence or absence of a relationship between variables.

The value of the F-criterion ("Table X") is 2169,786 (which exceeds the F-critical = 3,84370596), corresponds to the achieved level of significance p <0,001, therefore, the null hypothesis on the absence of relationship between

variables is rejected [8]. Thus, the results of individual academic achievements of the 9th grade students of Voronezh region general educational establishments on the evaluation of subject results in “Physics, Grade 8” and “Chemistry, Grade 8” at the level of basic general education have strong relation.

For this regression model, distribution of residual represents a normal distribution ("Fig. 10"), the regressogram of standardized residual ("Fig. 11") is a right line, which proves a normal distribution of residual, and therefore, satisfaction of this condition for conducting linear regression analysis [8]. It confirms the legitimacy of applying a linear regression analysis.

Another obligatory requirement for applying linear regression analysis is the satisfaction of homoscedasticity condition, which should provide equal spread of values of the dependent variable for any values of the independent variable. The presented scatter diagram of standardized residual as a function of standardized predicted values ("Fig. 12") shows that the spread of standardized residual is approximately the same for all values of the standardized predicted value, that is, the condition of homoscedasticity is satisfied [8].

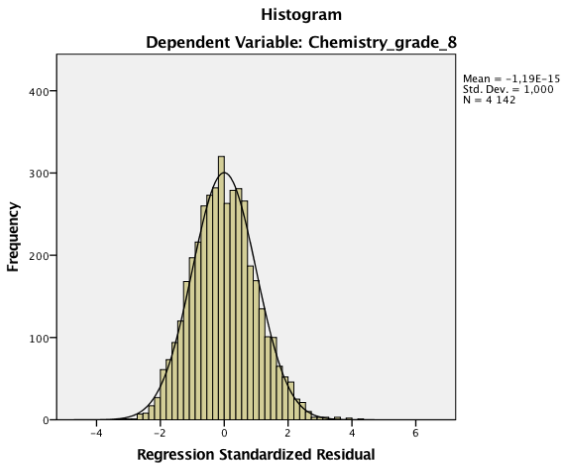

Fig. 10. Standardized residual bar chart.

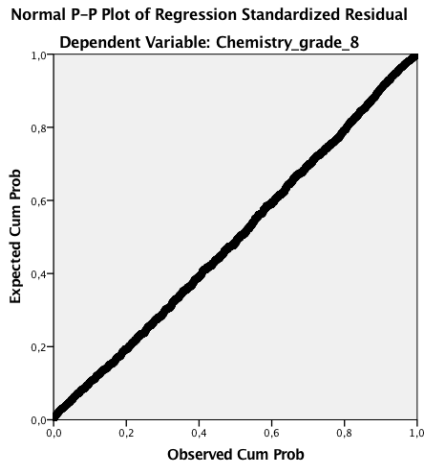

Fig. 11. Regressogram of standardized residual.

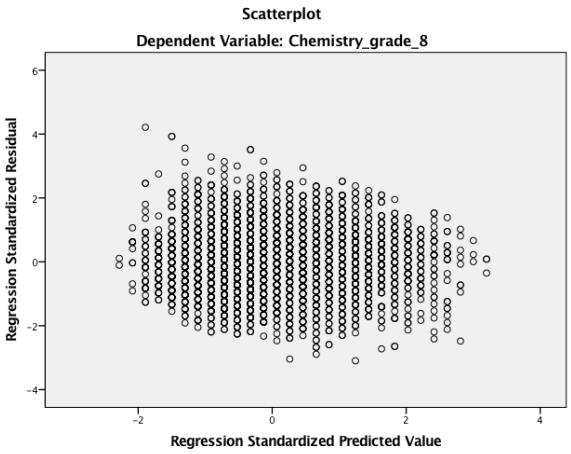

Fig. 12. Scatter diagram of standardized residual as a function of standardized predicted values.

Accordingly, the conducted analysis of the influence of subject results in Mathematics on subject results in Physics and Chemistry, and of subject results in Physics on subject results in Chemistry for grade 8 showed:

- Between subject results in Mathematics and subject results in Physics and Chemistry; subject results in Physics and subject results in Chemistry for grade 8 there is a positive and apparent connection;
- Between subject results in Mathematics and subject results in Physics and Chemistry; subject results in Physics and subject results in Chemistry for grade 8, there is a statistically significant positive linear relationship;
- 38.5% of variations of subject results of the 9th grade students in Physics change with corresponding variations of subject results of the 9th grade students of Voronezh region general educational establishments in Mathematics;
- 34.5% of variations of subject results of the 9th grade students in Chemistry change with corresponding variations of subject results of the 9th grade students of Voronezh region general educational establishments in Mathematics;
- 34.4% of variations of subject results of the 9th grade students in Chemistry change with corresponding variations of subject results of the 9th grade students of Voronezh region general educational establishments in Physics.

IV. CONCLUSION

The results obtained in the course of the study serve as a theoretical and methodological basis for solving relevant theoretical and practical problems of applying methods of evaluating and analysing the results of the 9th grade students’ individual academic achievements, when assessing subject results in Mathematics, Physics, and Chemistry within the implementation of Federal State Education Standards (Rus. - FGOS) for basic general education. The

results of the study develop the theoretical foundations for creating and using new methods of studying the mutual influence of the level of students' subject results.

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