

The Research on the Dependence of State Exam Results on Contextual Data of the Districts of Voronezh Oblast

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ABSTRACT

The research in the field of education quality indicates that contextual data, e.g. family factors, its socio-economic status, the academic resources of the family, the teaching staff, etc. have an impact on school students' academic achievements. The present article focuses on studying the dependence of the results of state examinations on contextual data of the districts of Voronezh Oblast. The purpose of this research is to analyse how contextual data affect the results of state examinations. When studying the impact of the contextual data of the districts of Voronezh Oblast on the results of state examinations under the educational programs of secondary general education and basic general education, the authors applied the methods of correlation and regression analyses respectively. The results reveal high coefficients of variation between the contextual data of the districts of Voronezh Oblast and most results of state exams, as well as high correlation between the state exam results of 2018 and 2016. The results of state examinations in school subjects most strongly correlate with two contextual factors behind the families of school students in grades 9 and 11: the proportion of school students brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education) and the proportion of school students brought up in one-parent families, with the only parent being unemployed. The study reveals continuity between the results of state examinations of 2016 and 2018 in the Russian language, Mathematics (specialized level) and Mathematics, Physics, Chemistry, Geography and Social Studies. It has also identified strong, positive and statistically significant correlation of the corresponding variations in the Russian language, Mathematics (specialized level), Mathematics (basic level) and Mathematics, Physics, Chemistry, and Literature with the number of graduates having scored 100 points in the Unified State Examination in 2018 and the number of school students having scored maximum points in the Basis State Examination in 2016. This allows acknowledging the objectivity of conducting the Unified State Examination under educational programs in Voronezh Oblast.

Keywords: the Unified State Examination, the Basis State Examination, contextual data, municipal and urban districts of Voronezh Oblast

I. INTRODUCTION

The annual State Final Certification under the educational programs of secondary general education in the form of the Unified State Examination and State Final Certification under the educational programs of basic general education in the form of the Basis State Examination provide results and relevant information about the school education in the Russian Federation.

The Federal Institute for Pedagogical Measurements (FIPI) is the institution responsible for conducting research on the results of the Unified State Examination at the federal level. Having analysed the results of the State Final Certification under the educational programs of secondary general education and typical mistakes made by the Unified State Examination participants, the Federal Institute for Pedagogical Measurements (FIPI) develops guidelines for teachers on all school subjects.

In the constituent entities of the Russian Federation, in their turn, the similar analysis of the Unified State Examination and Basis State Examination results is carried out by institutions subordinated to the authorities of the constituent entities that exercise public administration in the field of education. However, as a rule, such an analysis presents statistical data and the Unified State Examination and Basis State Examination results in numerical terms but does not consider the impact of various contextual data on the results of the State Final Certification across the administrative divisions of individual entities of the Russian Federation.

The evaluation of the Unified State Examination and Basis State Examination results should be carried out at the federal, regional and municipal levels, as well as at the level of educational institutions. Modern approaches to evaluating the results of the State Final Certification at the level of secondary general education and basic general education should imply the assessment of the impact that contextual data have on the level of students' academic performance.

There have been various studies analysing the influence of contextual data (the factors of a family where a school student is being brought up including its socio-economic status and academic resources, the teaching staff and the quality of school life) on students' academic performance [1] [2] [3] [4] [5] [6] [7]. Thus, the authors of the present article have carried out a research on the impact of contextual data on individual academic achievements of students in grade 4 in assessing the meta-disciplinary results of the educational institutions of Voronezh Oblast [8], a research on the results of the 2018 All-Russian testing of grade 4 students of Voronezh Oblast in the Russian language, who study it as a non-native, foreign language [9], and a research on the dependence of the results of monitoring the individual academic achievements of students in grade 9 of the educational institutions of Voronezh Oblast in Mathematics, Physics and Chemistry at the level of basic general education [10].

The performed analysis has revealed that there have been no research on the impact of contextual data characterizing municipal and urban districts of a constituent entity of the Russian Federation on the results of the State Final Certification under the educational programs of secondary general education in the form of the Unified State Examination and the State Final Certification under the educational programs of basic general education in the form of the Basis State Examination. Moreover, existing studies do not evaluate the cause-effect relationship in the subject area across individual constituent entities of the Russian Federation and do not account for the administrative structure of the region.

II. METHODOLOGY OF THE EMPIRICAL STUDY

For the purpose of analysing the results of the 2018 Unified State Examination and Basis State Examination, we applied the contextual data of municipal and urban districts of Voronezh Oblast obtained from statistical data of the 2018 State Final Certification in educational institutions of Voronezh Oblast, open statistical data for 2018, the procedure for rating municipal educational institutions of Voronezh Oblast, and statistical data on the educational system of Voronezh Oblast collected by the Department of Education, Science and Youth Policy of Voronezh Oblast.

When studying the impact of contextual data of municipal and urban districts of Voronezh Oblast on the results of the Unified State Examination and Basis State Examination in 2018, the statistical methods of correlation and regression analyses were applied [11] [12] [13].

Correlation is a property that indicates and characterizes the relationship between numerical sequences. Establishing a correlation is discovering a probable connection of one variable - x with another - y . Correlation analysis allows making a conclusion about the strength of the relationship between x and y . A more accurate assessment of the strength of relationship between quantitative features can be carried out when identifying the correlation between the variation in the effective and factorial features. To measure the strength of the relationship between the effective - y and factorial - x features, a linear correlation coefficient is used.

Regression analysis is applied to establish the analytical dependence that indicates how the average value of the effective feature changes under the influence of independent variables. Regression analysis shows how much the variable - y changes with the corresponding changes of the variable - x , and inversely, to what extent the variable - x changes for one unit change in variable - y .

On the one hand, the application of correlation and regression analyses helps to reveal statistical relationship between the obtained variables, while on the other hand, it allows working out mathematical expressions characterizing the patterns of relationships between these variables. The present research has identified the patterns of influence and the internal relationship between contextual data of municipal and urban districts of Voronezh Oblast and the results of the 2018 Unified State Examination and Basis State Examination.

III. PRESENTATION OF RESULTS

In order to evaluate the results of the Unified State Examination in 2018, the authors selected the results in the following school subjects: the Russian Language, Mathematics (specialized level), Mathematics (basic level), Physics, Chemistry, Informatics and ICT, Biology, History, and Social Studies. They constitute over 10% of the total number of the 2018 Unified State

Examination participants of Voronezh Oblast with assessed results.

Statistically significant variations in the results of the Unified State Examination in school subjects with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast are presented in "Table I".

TABLE I. STATISTICALLY SIGNIFICANT VARIATIONS IN THE RESULTS OF THE UNIFIED STATE EXAMINATION IN SCHOOL SUBJECTS WITH THE CORRESPONDING VARIATIONS IN ALL CONTEXTUAL DATA OF MUNICIPAL AND URBAN DISTRICTS OF VORONEZH OBLAST

Contextual data	The subject of the Unified State Examination									
	Russian Language	Mathematics, specialized level	Mathematics, basic level	Physics	Chemistry	Informatics and ICT	Biology	History	Social Studies	All 9 subjects
All contextual data	78.7% (p=0.004)	68.7% (p=0.026)	75.9% (p=0.009)	72.6% (p=0.011)	70.4% (p=0.033)		80.2% (p=0.001)	68.5% (p=0.048)	79.6% (p=0.003)	69.5% (p=0.04)
Density of population (people per sq. Km)	12.4% (r=-0.352 P=0.041)	14% (r=-0.374 P=0.029)		19,1% (r=0.437 P=0.01)						
% Of teachers of the highest qualification category	12.7% (r=0.356 P=0.039)									
% Of school students being brought up in one-parent families, with the only parent being unemployed	13.4% (r=-0.367 P=0.033)		15.3% (r=-0.391 P=0.022)	13.9% (r=-0.373 P=0.03)			14.1% (r=-0.375 P=0.029)	12.6% (r=-0.355 P=0.039)	14.1% (r=-0.376 P=0.028)	20.4% (r=-0.452 P=0.007)
% Of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education)	20.2% (r=-0.449 P=0.008)	22.7% (r=-0.477 P=0.004)		29.5% (r=-0.543 P=0.001)			25.7% (r=-0.507 P=0.002)	11.9% (r=-0.344 P=0.046)	13% (r=-0.361 P=0.036)	22.1% (r=-0.470 P=0.005)
Contextual data having no impact on the results of the Unified State Examination in school subjects: % of local budget expenditures on education in 2018 (of the total local budget expenditures of the municipal or urban district); the average salary of teachers in a general educational institution (% of the average salary of teachers in Voronezh Oblast); computers-per-student ratio; teachers-per-student ratio; % of school students being brought up in one-parent families; % of school students being brought up in families with both parents being unemployed; % of school students having unfavourable living conditions; the number of students in grade 11 with health limitations; the number of school students with Russian as a non-native language; % of winners and awardees of the regional round of the All-Russian Academic Olympiad for School Students; % the proportion of graduates having scored 100 points; % of school students not having passed the minimum threshold.										

The performed research on the correlation between the results of the Unified State Examination and the contextual data of municipal districts and urban districts of Voronezh Oblast allows making the following conclusion: 69.5% of variations in the results of the Unified State Examination in 9 school subjects change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast.

The following correlations have been identified across school subjects:

- 80.2% of variations in the results of the Unified State Examination in Biology change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;
- 79.6% of variations in the results of the Unified State Examination in Social Studies change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;

- 78.7% of variations in the results of the Unified State Examination in the Russian Language change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;
- 75.9% of variations in the results of the Unified State Examination in Mathematics (basic level) change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;
- 72.6% of variations in the results of the Unified State Examination in Physics change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;
- 70.4% of variations in the results of the Unified State Examination in Chemistry change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;
- 68.7% of variations in the results of the Unified State Examination in Mathematics (specialized level) change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;
- 68.5% of variations in the results of the Unified State Examination in History change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast.

The results of the Unified State Examination ultimately correlate with two contextual factors behind the families of students in grade 11 in municipal and urban districts of Voronezh Oblast (Table I):

- the proportion of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education);
- the proportion of school students being brought up in one-parent families, with the only parent being unemployed.

The performed analysis indicates the presence of statistically significant negative correlation and 22.1% of variations in the results of the Unified State Examination that change with the corresponding variations in the proportion of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education), in all 9 school subjects in municipal and urban districts of Voronezh Oblast. A similar statistically significant negative

correlation and the corresponding number of variation have been identified between the proportion of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education), and the results of the Unified State Examination in the Russian Language, Mathematics (specialized level), Physics, Biology, History and Social Science.

The analysis also shows a statistically significant negative correlation and 20.4% of variations in the results of the Unified State Examination that change with the corresponding variations in the proportion of school students being brought up in one-parent families, with the only parent being unemployed, in all 9 school subjects in municipal and urban districts of Voronezh Oblast. A similar statistically significant negative correlation and the corresponding number of variations have been identified between the proportion of school students being brought up in one-parent families, with the only parent being unemployed, and the results of the Unified State Examination in the Russian Language, Mathematics (basic level), Physics, Biology, History and Social Science.

Additionally, there is a statistically significant positive correlation and the corresponding number of variations between the results of the Unified State Examination in the Russian Language, Mathematics (specialized level) and Physics and the density of population in municipal and urban districts of Voronezh Oblast, as well as between the results in the Russian Language and the proportion of Russian language and literature teachers of the highest qualification category.

Meanwhile, some contextual data of the municipal and urban districts of Voronezh Oblast used in this study (Table 1) have no statistically significant impact on the results of the Unified State Examination in the subjects under analysis.

For the purpose of analysing the results of the Basis State Examination in 2018, exam results in the subjects with over 1, 000 participants in Voronezh Oblast were selected: the Russian Language, Mathematics, Physics, Chemistry, Informatics and ICT, Biology, Geography, Social Studies, and the English Language.

"Table II" shows statistically significant variations in the results of the Basis State Examination in school subjects with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast.

TABLE II. STATISTICALLY SIGNIFICANT VARIATIONS IN THE RESULTS OF THE BASIS STATE EXAMINATION IN SCHOOL SUBJECTS WITH THE CORRESPONDING VARIATIONS IN ALL CONTEXTUAL DATA OF MUNICIPAL AND URBAN DISTRICTS OF VORONEZH OBLAST

Contextual data	The subject of the Basis State Examination									
	<i>Russian language</i>	<i>Mathematics</i>	<i>Physics</i>	<i>Chemistry</i>	<i>Informatics and ICT</i>	<i>Biology</i>	<i>Geography</i>	<i>Social Studies</i>	<i>The English Language</i>	<i>All 9 subjects</i>
All contextual data	68.4% (p=0.049)	70% (p=0.036)					73.6% (p=0.016)			68.7% (p=0.047)
Density of population (people per sq. Km)	22.9% (r=0.479 P=0.004)	15.2% (r=0.390 P=0.022)								14.6% (r=0.382 P=0.026)
% Of school students being brought up in one-parent families, with the only parent being unemployed	21.1% (r=-0.459 P=0.006)	14.9% (r=-0.387 P=0.024)			17.2% (r=-0.414 P=0.015)		14.2% (r=-0.377 P=0.028)	16% (r=-0.400 P=0.019)		
% Of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education)	28.2% (r=-0.531 P=0.001)	24% (r=-0.490 P=0.003)			17.8% (r=-0.422 P=0.013)			17.7% (r=-0.420 P=0.013)		12.5% (r=-0.354 P=0.04)
% Of school students having scored maximum points	17.2% (r=0.415 P=0.015)						17.5% (r=0.418 P=0.014)	14.2% (r=0.377 P=0.028)		12% (r=0.347 P=0.044)
The number of grade 9 students with health limitations	12.1% (r=0.348 P=0.044)									16.5% (r=0.406 P=0.017)
The number of school students with Russian as a non-native language	15.1% (r=0.388 P=0.023)									13.3% (r=0.364 P=0.034)
% of winners and awardees of the regional round of the All-Russian Academic Olympiad for School Students	14.3% (r=0.378 P=0.027)									
Teachers-per-student ratio	14.3% (r=0.378 P=0.027)									
Contextual data having no impact on the results of the Basis State Examination in school subjects: % of local budget expenditures on education in 2018 (of the total local budget expenditures of the municipal or urban district); the average salary of teachers in a general educational institution (% of the average salary of teachers in Voronezh Oblast); computers-per-student ratio; teachers-per-student ratio; % of school students being brought up in one-parent families; % of school students being brought up in families with both parents being unemployed; % of school students having unfavourable living conditions; % of school students not having passed the minimum threshold.										

The research on the correlation between the results of the Basis State Examination and the contextual data of municipal districts and urban districts of Voronezh Oblast allows making the following conclusion: 68.7% of variations in the results of the Basis State Examination in 9 school subjects change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast.

The following correlations have been identified across school subjects:

- 73.6% of variations in the results of the Basis State Examination in Geography change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;
- 70% of variations in the results of the Basis State Examination in Mathematics change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast;

- 68.4% of variations in the results of the Basis State Examination in the Russian Language change with the corresponding variations in all contextual data of municipal and urban districts of Voronezh Oblast.

The results of the Basis State Examination ultimately correlate with two contextual factors behind the families of students in grade 9 in municipal and urban districts of Voronezh Oblast:

- the proportion of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education);
- the proportion of school students being brought up in one-parent families, with the only parent being unemployed.

The analysis reveals the presence of statistically significant negative correlation and 12.5% of variations in the results of the Basis State Examination that change with the corresponding variations in the proportion of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education), in all 9 school subjects in municipal and urban districts of Voronezh Oblast. A similar statistically significant negative correlation and the corresponding number of variations have been identified between the proportion of school students being brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education), and the Basis State Examination results in the Russian Language, Mathematics, Informatics and ICT, Geography and Social Studies.

The performed analysis demonstrates a statistically significant negative correlation and the corresponding number of variations between the proportion of school students being brought up in one-parent families, with the only parent being unemployed, and the results of the Basis State Examination in the Russian Language, Mathematics, Informatics and ICT, Geography and Social Studies.

Meanwhile, it is important to mention the presence of a statistically significant positive correlation and the corresponding number of variations between:

- the density of population in municipal and urban districts of Voronezh Oblast and the results of the Basis State Examination in the Russian Language and Mathematics;
- the proportion of school students having scored maximum points and the results of the Basis

State Examination in the Russian Language, Geography and Social Studies;

- the number of grade 9 students with health limitations, the number of school students with Russian as a non-native language, the proportion of winners and awardees of the regional round of the All-Russian Academic Olympiad for School Students, teachers-per-student ratio and the results of Basis State Examination in the Russian Language.

It should be emphasized that some contextual data of municipal and urban districts of Voronezh Oblast utilized in this study ("Table II"), have no statistically significant impact on the results of the Basis State Examination in the subjects under analysis.

In order to carry out the correlation analysis between the results of the Unified State Examination in 2018 and the results of the Basis State Examination in 2016, the results in the following subjects were selected: the Russian Language, Mathematics (specialized level), Mathematics (basic level), Mathematics, Physics, Chemistry, Informatics and ICT, Biology, History, Geography, Social Studies, and Literature.

To analyse the correlation between the results of the 2018 Unified State Examination and the 2016 Basis State Examination the following data were used:

- the percentage of the maximum score in the Unified State Examination by subjects;
- the percentage of the maximum score in the Basis State Examination by subjects;
- the number of graduates having scored 100 points in the Unified State Examination by subjects;
- the number of school students having scored maximum points in the Basis State Examination by subjects.

"Table III" presents statistically significant variations in the results of the Unified State Examination of 2018 and the Basis State Examination of 2016 in Voronezh Oblast.

TABLE III. STATISTICALLY SIGNIFICANT VARIATIONS IN THE RESULTS OF THE UNIFIED STATE EXAMINATION OF 2018 AND THE BASIS STATE EXAMINATION OF 2016 IN VORONEZH OBLAST

The Unified State Examination	The Basis State Examination										
	Russian Language (% of the maximum score)	Russian Language (the number of students having scored maximum points)	Mathematics (% of the maximum score)	Mathematics (the number of students having scored maximum points)	Physics (% of the maximum score)	Physics (the number of students having scored maximum points)	Chemistry (% of the maximum score)	Chemistry (the number of students having scored maximum points)	Geography (% of the maximum score)	Social Studies (% of the maximum score)	Literature (the number of students having scored maximum points)
Russian Language (% of the maximum score)	23.3% ($r=0.483$ $p=0.004$)										
Russian Language (the number of graduates having scored 100 points)		99% ($r=0.987$ $p=0.000$)									
Mathematics (specialized level) (% of the maximum score)			26.7% ($r=0.517$ $p=0.002$)								
Mathematics (specialized level) (the number of graduates having scored 100 points)				99.5% ($r=0.997$ $p=0.000$)							
Mathematics (basic level) (the number of graduates having scored 100 points)				94.2% ($r=0.970$ $p=0.000$)							
Physics (% of the maximum score)					45.9% ($r=0.679$ $p=0.000$)						
Physics (the number of graduates having scored 100 points)						81.7% ($r=0.904$ $p=0.000$)					
Chemistry (% of the maximum score)							37.2% ($r=0.610$ $p=0.000$)				
Chemistry (the number of graduates having scored 100 points)								84.5% ($r=0.919$ $p=0.000$)			
Geography (% of the maximum score)									14.1% ($r=0.376$ $p=0.031$)		
Social Studies (% of the maximum score)										30.2% ($r=0.549$ $p=0.001$)	
Literature (the number of graduates having scored 100 points)											92.6% ($r=0.962$ $p=0.000$)

The conducted correlation analysis allows making the following conclusion: there is a statistically significant positive correlation between the results of the Unified State Examination in 2018 and Basis State Examination in 2016 in Voronezh Oblast and the corresponding number of variations ("Table III") in the Russian language, Mathematics (specialized level) and Mathematics, Physics, Chemistry, Geography and Social Studies.

The analysis of the correlation between the number of graduates having scored 100 points in the Unified State Examination in 2018 and the number of school students having scored maximum points in the Basis State Examination in 2016 has identified a strong, positive and statistically significant correlation and the corresponding number of variations (Table III) in the Russian Language, Mathematics (specialized level), Mathematics (basic level) and Mathematics, Physics, Chemistry, Literature.

Thus, the study has revealed a statistically significant correlation between the results of the Unified State Examination, Basis State Examination and all contextual data of municipal and urban districts of Voronezh Oblast.

The results of the Unified State Examination и Basis State Examination in school subjects strongly correlate with two contextual factors behind the families of school students in grades 9 and 11 of municipal and urban districts of Voronezh Oblast: the proportion of school students brought up in families with neither of the parents having higher education (in one-parent families - the parent having no higher education) and the proportion of school students brought up in one-parent families, with the only parent being unemployed.

It is essential to highlight that the study has revealed continuity between the results of Basis State Examination in 2016 and the Unified State Examination in 2018 in the Russian Language, Mathematics (specialized level) and Mathematics, Physics, Chemistry, Geography and Social Studies. It has also identified strong, positive and statistically significant correlation of the corresponding variations in the Russian language, Mathematics (specialized level), Mathematics (basic level) and Mathematics, Physics, Chemistry, and Literature with the number of graduates having scored 100 points in the Unified State Examination in 2018 and the number of school students having scored maximum points in the Basis State Examination in 2016. This allows acknowledging the objectivity of State Final Certification under the educational programs of secondary general education and the State Final Certification under the educational programs of basic general education in Voronezh Oblast.

IV. CONCLUSION

The obtained results provide theoretical and methodological background for addressing topical theoretical and practical issues of establishing the correlation between the results of state examinations and contextual data of the districts of Voronezh Oblast. The results demonstrate the way to apply new methodological means to analyse the impact of contextual data on school students' academic performance. The conclusions made can be further used to make pedagogical and managerial decisions at the regional and municipal levels, as well as at the level of educational institutions.

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