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Mapping student performance towards higher education

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ABSTRACT

Student performance and consequently the access to higher education have been a means of improving the social status of individuals, while it was believed that the issues related to the reproduction of caste and social inequalities in Greece could be addressed. The study of access to tertiary education in Greece is the subject of this research work. At the end of the last class of the high school, i.e., the upper secondary school, general examinations are carried out in our country which, lead to some University Department. This work is intended to highlight the geographical dimension of the performance of secondary school pupils in order to achieve a post in higher education. For the needs of the work a spatial database in GIS environment was created from the performance of 72,619 students (1202 high schools) of the 3rd class of high school of the 2012-2013 school year.

Keywords: *Sociology of education; geography of education; school failure; GIS; mapping.*

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INTRODUCTION

The branch of Sociology that deals with education is called Sociology of Education. Given that the educational system is considered a Nation-State's pillar, engaging from a sociological point of view is considered essential. As a result, the educational structure, educational procedures or the educational reality and educational events are specialized aspects of the social structure, of social procedures and of the social reality, as well as of social events.

The characteristics of Sociology of Education focus on two points: a) starting with the national educational system, the formulation of the national schools of thought is accomplished, mostly the American, the French and the English ones, and b) having research that emphasizes on inequality as a primary goal, it leads to the conclusion that sociology of education is not distinguished from sociology of educational inequality, which by extension could be considered to be sociology of social reproduction.

The aspects of a "spatial turn" in sociology can be observed through terms such as this of "social space" by Durkheim [1], and especially as it's referred to in neo-marxist philosopher Henri Lefebvre's writings [2], in Bourdieu's ideas on habitus [3] and "social capital" [4], in Levy's meaning of "spatial capital" [5], as well as the meaning of locales by Giddens [6].

In particular, when it comes to educational research, subjects that relate to the infiltration of neoliberal ideas, such as the parental choosing of school, have been frequently approached from a spatial point of view, especially in the United States [7, 8]. In general, the "spatial turn" towards humanitarian and social sciences has also paved numerous new roads

for educational research, since it has shifted researchers' interest to the spatial aspects of power relationships in educational systems [9, 10] and has paved the way for book publications such as Brock's "Geography of Education" [11].

A basic parameter of education has to do with the socioeconomic status of the various regions within a country. A study in Pakistan highlights a poverty-education index using household data. The study showed the diversity that exists within different provinces in Pakistan (and especially in the rural areas) and that the majority of households lack the means to pay for the cost of education. Empirical analysis showed that the various socioeconomic variables such as income, regional fluctuations and consciousness play a very important part in explaining the educational sector [12].

Another study in the USA highlighted the impact of governmental credits in higher education and the spatial impact on the number of university decrees being awarded. Spatial models and linear dynamic regression techniques were used and it was shown that the number of degrees awarded within a State is affected by specific policies focusing on the funding and structure of higher education in surrounding States [13].

This study's purpose, as it has been stated above, is to contribute to educational research, aiming to accomplish that mainly through the help of GIS and mapping, thus providing a spatial aspect, which, through visualizations, could lead to measures being taken for necessary reforms.

MATERIAL AND METHODS

This study was conducted almost exclusively using the functions and procedures of Geographical Information Systems (GIS). More specifically, ARCGIS 10.1 commercial software was used. As it has been stated above, an extensive analysis of the results of the national exams for the 2012-2013 school year was conducted. The basis for that analysis was the national exam results of 72,619 high school students from all regions of Greece. The following figure (Figure 1) describes conceptually the procedure that was followed in this study, in order to achieve the expected results. It, thus, represents a conceptual diagram that describes the order in which the procedures were conducted, in order for it to represent a comprehensive imprint of the implemented methodology.

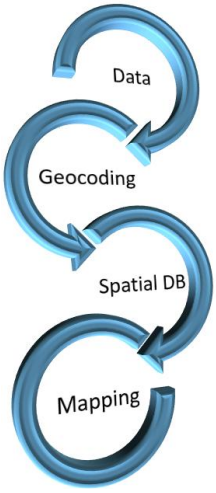

Figure 1: Methodology Workflow

The conceptual data as described above were in a table format, as it is presented in the following Table (Table1).

Table 1: Excerpt from a table of initial data.

student code	school code	town	score
5464366	45	Athens	19.5
5464565	56	Athens	12.5
5646454	23	Athens	15
5665467	56	Athens	11.2
5674567	56	Athens	17
5674657	87	Athens	18.1
5754675	89	Athens	18.6

6456464	76	Athens	12.5
6575467	98	Athens	14.3
7456675	67	Athens	17.2

Each entry of the table above contains the following: student code, school where they belong (school code), type of high school, educational specialty course, the Directorate of Secondary Education where the school belongs, individual grades for each course and the student's national exam total grade score. In order to conduct a spatial analysis on the performance of high school seniors for the 2012-2013 school year, the total performance was split into five (5) categories, depending on the total grade score. These categories are presented in the following figure (Figure 2).

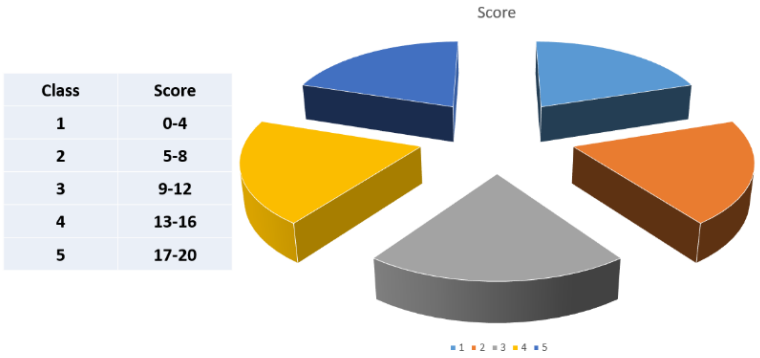

Figure 2: Categories based on the total grade score on the national exams.

This classification, based on the students' total grade score brings changes to the previous diagram. Based on this classification each student is distributed into one of the following categories. For example, a student whose final grade score is 12.3 is classified in Category 4, a student whose final grade score is 17.24 is classified in Category 5 etc. What follows is the addition of students in each class per school. This way we achieve performance reduction of students in schools. Thus, the total sum of students in each performance category is shown for each school. The next process is the geocoding of schools. The term geocoding refers to the process of finding geographic coordinates. Usually these are expressed either as geographic longitude and latitude (φ, λ), or as coordinates in a Cartesian system (x, y). In this specific case a geocoding was conducted based on each school's address. Initially each school was linked based on its code and its postal address. The file that was created is of the following form (Figure 3).

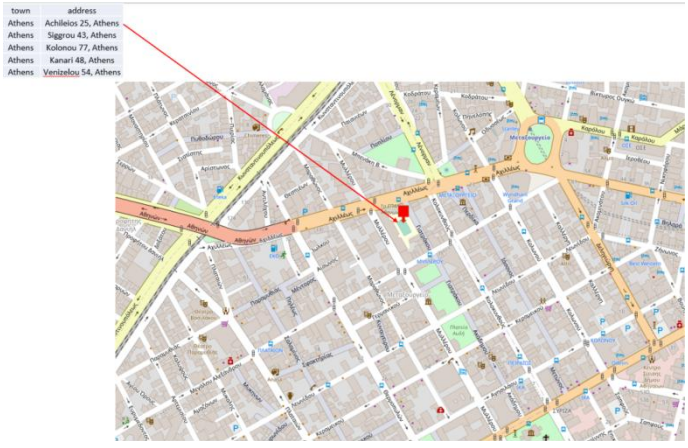

Figure 3: Geocoding example.

Using Google Maps and more specifically the Google Geocoding tool, it was possible to link the school's address with the following geographic coordinates.

With geocoding, each school's coordinates were shown on a Google map-backdrop. Consequently, since the schools were given geographical coordinates (latitude and longitude), i.e. WGS84, we transformed the file into ΕΓΣΑ87 (GGRS87), which is the Greek geodetic reference system.

The final product was a shape-type point file, where each point corresponds to a school, which can be used in ArcGIS software. The connection of each point-school with the previously constructed table that contained the sum of students in each performance category per school was conducted in an ArcGIS environment. Specifically, the spatial database of schools contains 1202 entries that refer to 1202 schools from the totality of the Greek territory. This is the initial spatial database, on which the following analysis will be based on.

The following step is the connection of this point-based information with the analysis levels conducted in this study. The analysis level is the Kallikratis-Municipality. This reduction was basically conducted using ArcGIS' function spatial join. It refers to a spatial connection of the point-based school file and the multi-angular Municipality file. The result of this procedure is a new spatial database, whose entries have five categories according to school performance.

After the connection of student performance data with the spatial entities of all categories previously described, the creation of thematic maps with different colour grading followed. The aim of this paper was the better depiction of performance based spatial distribution.

One of the most important functions of GIS is the complex analysis of spatial and descriptive data, as well as their classification. This classification basically makes up the categorization of data into various categories depending on each user's specific need. The implementation of this function is based on specific standards for the data and leads to new generalized data. This type of classification can be implemented on either mosaic or vector data, such as those used in this paper. GIS allow for classification using different techniques, either with the aforementioned defined standards, such as equal distance categories, typical deviation etc., or classification based on user preference. In this specific case, all classifications were made using the Natural Breaks (Jenks) methodology which is the default methodology on ArcGIS. For the creation of the performance thematic maps, a common policy was maintained when it comes to symbolism. A common category system was maintained in the legend when it comes to color grading, in order for differences from map to map to be noticeable. Performance mapping was done using the spatial database that was previously constructed. A percentile reduction was conducted for the needs of mapping in all categories (in each spatial unit), in order to represent the percentage of each category per spatial unit. Mapping was also done in ArcGIS, using the software's capabilities when it comes to the visualization of performance data per spatial unit.

RESULTS

Data mapping is the first procedure that follows the completion of the spatial database. Thus, mapping the Distribution of the database's 1202 schools in Municipalities follows. The next figure (Figure 4) refers to the distribution of schools per Municipality.

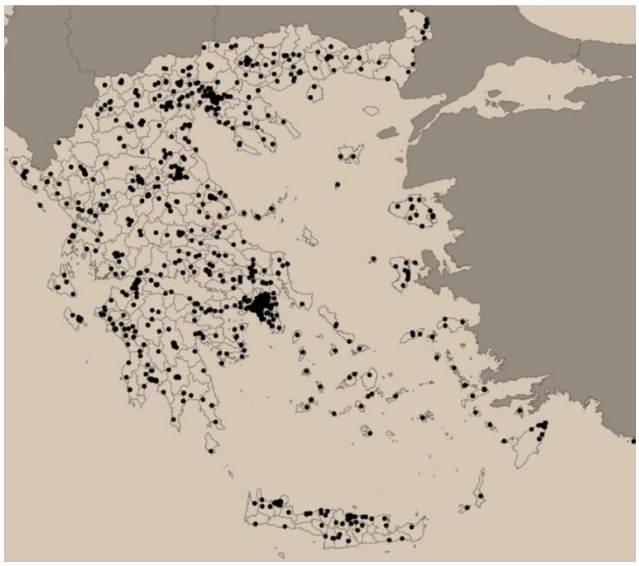

Figure 4: Distribution of schools per municipality.

By creating the map above and using a spatial join procedure, a table is created, its entries presented in the following figure (Figure 5).

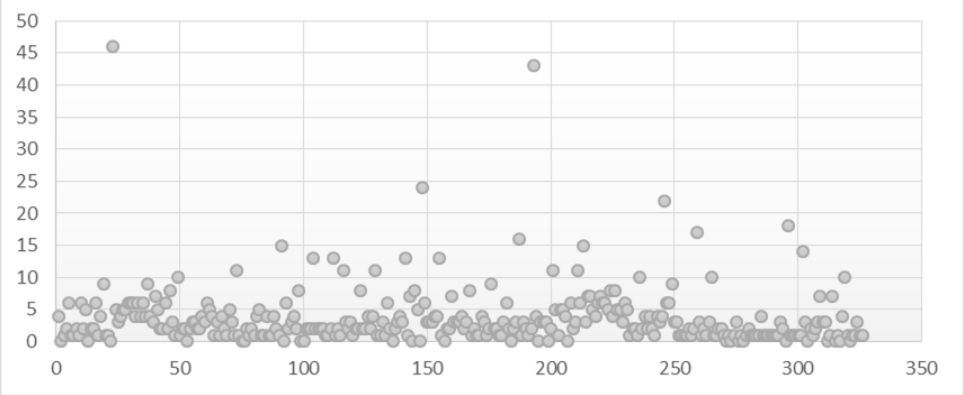

Figure 5: Number of schools per municipality

From the diagram above and according to the corresponding table, 93% of municipalities of Greece contribute to the database less than 10 schools, 6% have 10 to 20 schools and the remaining 1% are municipalities that contribute over 20 schools. The Municipality of Thessaloniki contributes 46 schools, the Municipality of Athens 43 schools, the Municipality of Patras 24 schools and the Municipality of Piraeus 22 schools.

The classification of student performance, as it has been mentioned before, was conducted based on their performance on the national exams. Under this classification each student is classified based on their performance in one of the following categories. For example, a student whose final grade score is 12.3 is classified in Category 4, a student whose final grade score is 17.24 is classified in Category 5 etc. An important element, which should be mentioned, is that from a total of 72,619 students, whose performance is checked and mapped in this study, a balance is observed as far as their total grade score in the national exams is concerned.

As it has been mentioned before, all mapping classifications were conducted using the Natural Breaks (Jenks) methodology which is the default methodology on ArcGIS.

Thus, in Category 1, as expected in absolute numbers, the Municipalities of Thessaloniki, Athens and Patras are shown to have the lower performance numbers. Furthermore, the Municipalities of Agrinion, Kerkyra and Rhodes show higher numbers in performance Category 1. In Category 2, in absolute numbers, the Municipality of Thessaloniki and Athens are shown to have the lower performance numbers. In Category 2, just like in Category 1, the Municipalities of Agrinion and Rhodes show higher numbers in performance. In Category 3, in absolute numbers, the Municipalities of Thessaloniki and Athens are shown to have the lower performance numbers. In Category 4, just like in Categories 1, 2 and 3, the Municipality of Agrinion shows higher numbers in performance. In Category 5, in absolute numbers, the Municipality of Thessaloniki and Athens are shown to have the lower performance numbers. In Category 5, just like in Categories 1, 2 and 3, the Municipality of Agrinion and Rhodes show higher numbers in performance.

The Municipalities with the worst percentile performance (over 50%), when it comes to Category 1 (0-4) are the following: Municipality of Thermo, West Achaia, Amario Crete, Ikaria and the Thracian municipalities of Myki, Avdiron, Iasmos and Maronias-Sapon. The Municipalities with the worst percentile performance (over 50%), when it comes to Category 2 (4-8) are the following: Municipality of Serifos, Kimolos and Tilos. The Municipalities with the worst percentile performance (over 50%), when it comes to Category 3 (8-12) are the following: Municipalities of Pogonion, Northern Tzoumerka, Aghios Efstratios, Symi and Viannos. The Municipalities with the best percentile performance (between 30 and 50%), when it comes to Category 4 (13-16) are the following: Municipality of Paxi, Southern Pilion, AghiosEfstratios, Trizina, Kythera and Kasos. The Municipalities with the best performance (over 50%), when it comes to Category 5 (17-20) are the following: Municipality of Deskati, Nemea, Sifnos, Halki, Kandanos-Selinos and in Attica the Municipalities of Kropia, Kiffisia, Rafina-Pikermi, Pallini, AghiaParaskevi, Filothei-Psychiko, Vyronas and NeaSmyrni.

DISCUSSION

This study presented a mapping and a spatial analysis of the performance of high school senior students in the national exams for the 2012-2013 school year. This study can contribute to a generalized review of the management policies in secondary education. Using the study's results, policy makers can focus more in problematic areas and with appropriate decision making they can look for solutions. As it was mentioned before, studies on the geographical aspect of inequality in Europe are far and few between, in contrast to similar studies for African countries. The high disparity between regions in Greece, when it comes to specific educational characteristics has been pointed out in comparative

studies from international organizations [14]. Hence, it is imperative to have studies that include the geographical aspect, in order for the results to be more factual [15].

CONCLUSIONS

In general, according to the existing knowledge regarding the state of secondary education and the performance mapping in this study, the high percentage of low performance is more common in mountainous, remote and border areas, something that highlights the importance of lacking infrastructure and services for the preparation of high school senior students. Furthermore, the low percentage of high performance present a similar case, as lower success correlates to spatial inequalities in tertiary education. There are however regions that combine a high percentage of low performance and a low percentage of high performance, something that classifies them to the completely marginalized regions, where success to accessing tertiary education is an unlikely outcome. In these exact regions, multiple disadvantages accumulate, most of which can be attributed to severe socioeconomic disadvantages and income inequality.

Generally speaking, the large urban centers (Athens, Thessaloniki, Patras etc) are the ones that show better performance both by percentile as well as by the absolute student number (which is to be expected given their size). This is corroborated by a simple mapping of the parameters of the spatial database that was created as well as by the charts that were presented.

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