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Spatial Analysis of the National Evaluation of Scholastic Achievement (ENLACE) in Schools of the Municipality of Juarez, Chihuahua

Estudio georreferencial de la Evaluación Nacional de Logro Académico en Centros Escolares (ENLACE) en el Municipio de Juárez, Chihuahua: análisis espacial

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Abstract

This research was focused on analyzing the results of the first National Assessment of Academic Achievement for Scholar Centers (ENLACE; acronym in Spanish) applied during the year 2006 in the Municipality of Juarez (State of Chihuahua, Mexico). In order to conduct the spatial analysis a geographical information system (GIS) was used to make a georeferenced database where all variables were connected to a point representing a school. Results of the examinations expressed as deficient, elemental, good or excellent were spatially distributed over the urban area of Ciudad Juárez. Apparently there is a high spatial correlation between ENLACE's results with the socioeconomic level of people. In this way results going from good to excellent were spatially located over the sectors more developed of the city. Poor results going from Insufficient to Elemental were spatially located at places with higher deficits of infrastructure and low socioeconomic levels.

Key words: High-stakes test, academic achievement, schools, geographical information system.

Introduction

This work analyzes the results of the database ensuing from the application of the National Evaluation of Scholastic Achievement (ENLACE) for the specific case of the Municipality of Juarez, Chihuahua. The examination was applied in Mexico for the first time during the school year 2006-2007.

Theoretically speaking, part of the potential given to ENLACE came from implanting it in the environment of Geographic Information Systems (GIS), using georeferencing of schools. Once in this environment, this research report included spatial analysis and thematic mapping of key variables, and their relationship in the urban space of Ciudad Juarez, with socioeconomic variables that help give a spatial explanation of the ENLACE results.

The main objective of this work is to describe the database created from the results of ENLACE as applied in the Municipality of Juarez, and the relationship of the level of advancement of the students tested with the socioeconomic variables that make up the schools' environment. The purpose is to analyze whether or not this assessment is statistically strong enough to show the problems of education in this county, and to provide analytical elements that will serve to improve education there. This was accomplished by georeferencing the ENLACE data for each primary and junior high school, and includes the production of thematic mapping for key variables.

I. Theoretical framework

1.1 ENLACE

The virtual portal ENLACE is designed to gather census information (from all elementary schools of all types and modalities) in two major subjects of student's

basic training program: Spanish and mathematics. Thus, the databases produced would have the capacity to show statistically, areas of the city, schools and school zones, and those of its groups and teachers who require greater support and attention in order to achieve the educational goals proposed by their educational authorities.

Thus, the design of the database will permit, if its design is carried out in this way, the production of comparative and spatial as well as more specific quantitative analyses. The practice of evaluation suggests that there is already an established and assessable criterion of excellence, and that a review of the instruments used is necessary.

The intent is to verify whether initiatives can be separated from local public policies of support for basic education in the schools of the city with the information available, based on its coverage and quality, and possibly, to evaluate parallel sources of information that might be useful for this purpose.

1.2 Scholastic achievement of elementary education

Scholastic achievement is a universal theme, whose concept is constantly being transformed and complemented because its study is correlated with the socioeconomic and cultural dynamic which daily configures and characterizes the fabric of society. That is to say, the study of school performance must be directly linked to the social structure. UNESCO's *Education for All Global Monitoring Report 2005* (2005) affirms that "...education usually reflects society rather strongly: the values and attitudes that inform it are those of society at large" (p. 14.)

For this reason, scholastic achievement as an object of study, especially in the case of elementary education, should be based on the assumption that there are significant variations involving the environment, because this not only accommodates a variable (that of examination scores), but also a series of cultural and socioeconomic indicators which provide an explanation concerning the context in which students operate so as to stand out in their school performance.¹ This means that scholastic achievement must be understood from a broader point of view when it is combined with the perception of social inequality (Schmelkes, 1996).

In the same vein are found the direct variables that influence scholastic achievement: the relevance of learning, teaching practices in the classroom, the quality of teaching, the characteristics of the school and its director, the monitoring system and school dropouts. These variables make up the concept of "the effective school" (Schmelkes, 1996), i.e. those schools that are able to equip their students with all the necessary tools for better scholastic achievement, according to their specific contextual needs.

The concept of the effective school has to do with two more specific guidelines which favor both the study of the socioeconomic and cultural context, and the

infrastructure of the school. Neither of these two factors excludes the other. Both directly and indirectly are interrelated in influencing scholastic achievement.

It is evident that a study/analysis of what constitutes scholastic achievement and the factors that influence it should go beyond the test results for mathematics and Spanish, and should be linked with the students' socioeconomic and cultural context, as well as the schools' special conditions and human capital. Clearly, the phenomenon of excellence in education, in terms of its efficacy and equality is quite complex, and we cannot hope to cover it completely in this article.

Scholastic achievement is shaped by direct and indirect variables; this is what Cohen (2002) calls intra- and intersectionals, that is, the external and internal factors which influence the development of scholastic achievement to obtain a quality education. We should point out that we use this approach to conceptualize scholastic achievement, in accordance with what the Secretariat of Public Education (SEP, 2007) says in the virtual portal ENLACE:

“For the current administration, the theme of evaluation is of vital importance, not only because it addresses the criteria of transparency and accountability, but also because these criteria are an essential tool for detecting inequalities, explaining progress or limitations and for supporting planning processes and decision making.”

Indeed, basing our view of scholastic achievement on this makes decision-making in educational policy much more appropriate to its everyday practice. But that is where the model falters, since public policy considers homogenous realities rather than heterogeneous realities:

“The results of the SIMCE test (Measurement System on the Quality of Teaching) have emphasized that the policies for educational improvement have failed to increase significantly the achievement percentage in elementary education students. The limited impact achieved is due in large part to the discrepancy between the objectives sought, and the policies implemented to achieve them, which leads to the implementation of homogenous solutions for heterogeneous realities” (Franco *et al.*, 1991).

And while the SEP (in its virtual portal ENLACE) supports following existing educational criteria in terms of social inequality, in its current application there are still many disparities. An example of how this model of educational excellence and scholastic achievement can be problematical in practice is that of Mexico's northern frontier region, since the specificity of its economic, social and cultural context is very peculiar, due to its geographical position.

Up to this point, we have presented the factors that constitute scholastic achievement. However, we must remember that this concept is composed of a series of indicators, variables and factors. That is, if observed in a geometric manner, it is a circle encompassing the socioeconomic and cultural context, as well as the space in which the students receive their instruction. *It is not* that the content quality of the teaching is unimportant—indeed, it is crucial. *It is* that

because public elementary education in Mexico is in a state of crisis related to its dropout rates, the need for grade repetition, and failed grades,² it is even more important to get to the bottom of how these contents are to be taught for optimal achievement.

Cohen (2002, pp. 2-3) calls it *technologies*, or the "way of doing something", and says about it: "Unless the demand is homogeneous, there are as many technologies as a relevant target populations. Therefore educational policy should be analyzed beginning from different segments of the population." For this reason, the concept of scholastic achievement is holistic, or at least it should be.

It has already been stated here that scholastic achievement is intrinsically linked to the social fabric and the segments which compose it.³ This is because what we understand not only from a pedagogical point of view, which has more to do with the educational content, but from the social, economic and cultural point of view. This is the purpose of this essay: to reach an approach that speaks of scholastic achievement and everything that it influences to attain its optimal development.

To illustrate in practice what is presented here, let us consider the case of the northern frontier region of Mexico, in particular that of Ciudad Juarez. In doing so, we must take into account that this is one of the border regions of greatest economic activity, due to the expansion of the maquiladora industry, which characterizes it, and has controlled its urban development. That industry has made it the fifth largest economic area in the country, and the first in its state, according to the National Institute of Statistics, Geography and Informatics (INEGI, 2000, 2005).

This presentation is only an approximation of what in reality could be obtained by analyzing the educational context of the northern frontier region. In this case the idea is simply to lay on the table the state of scholastic achievement in elementary education in this area, and the difficulties facing the model of educational quality here.

1.3 The context of the Ciudad Juarez schools

1.3.1 Primary schools

FALTA UNA LÍNEA The mapping of these schools was developed by the Ciudad Juarez Municipal Institute of Planning (IMIP, 2005). Simply in terms of coverage, there is a homogeneous distribution for the urban district of the city, and there are problems detected in the southern part. According to Teresa Montero (as cited in Cervera, 2005), there is a 94.48% level of coverage in primary education.

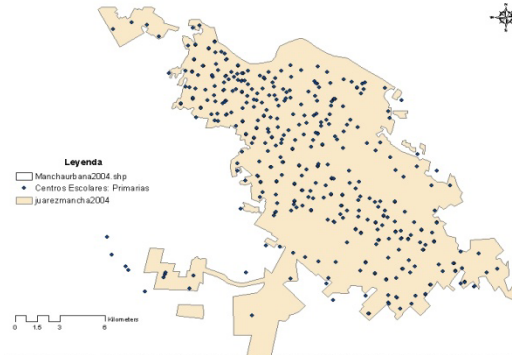


Figure 1. Distribution of primary schools in, school year 2005.
Source: Montero (cited in Cervera, 2005)

1.3.2 Junior high schools

The IMIP database reports a total of 119 schools of junior high level. The geospatial distribution of junior high schools covers about 70% of the city. The remaining 30% without coverage is plainly in the southern area of the city, as shown in Figure 2.

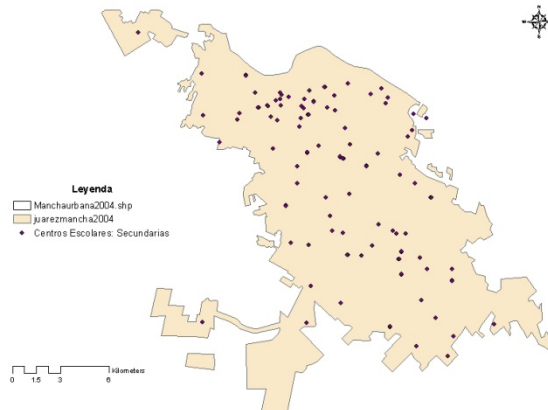


Figure 2. Distribution of junior high schools in Ciudad Juárez, school year 2005
Source: Montero (as cited in Cervera, 2005)

1.4 Overview of ENLACE in the Municipality of Juárez

The ENLACE database is composed of 21 variables, and is based on results of the first stage of the examination, initially applied to students in third, fourth, fifth and sixth grades of primary school, and third grade of junior high school. Students are tested in Mathematics and Spanish, from which subjects come all the questions asked in the examination. It yields information about the achievement of each student in the areas tested, his/her grade level and site, and the number of questions answered correctly on the test. The database can also find information

about the school she/he attends, such as the key, the name, the shift (morning, afternoon or evening); the school zone; the municipality and its location; as well as the level (primary or junior high school) and the modality (general, indigenous, private and technical) to which it belongs.

1.5 Scholastic centers by zone

According to the database, 248,610 primary and junior high school students were examined in the specified subjects in the whole of the state of Chihuahua. Of that total, 92,121 students (37.1%) belong to the Municipality of Juarez, which is divided into six zones. Ciudad Juarez is the one that represents the vast majority (99.4%), with 91,524 students (see Table I). This is the town addressed by this article.

Table I. Name of the zone in which the school is located

Zone	Students tested	Percentage
Alfredo B. Bonfil (Lomas de Poleo)	105	0.1
El Millon	64	0.1
Juarez	91,524	99.4
Loma Blanca	174	0.2
Samalayuca	160	0.2
San Agustin	94	0.1
Total	92,121	100

Source: Database ENLACE, processed in statistical package in El Colegio de la Frontera Norte (COLEF)

1.5.1 Level and scholastic modality

Of the total number of students tested, the majority (92.8%, or 85,505 students) belong to the primary level, while for the junior high school level, 6,616 were tested. Primary schools were classified in the modalities of general, indigenous and private; while the junior high schools were in general, private and technological modalities. Table II and Figure 1 illustrate the distribution of students in schools by level and modality.

Table II. Distribution of students according to level and scholastic modality

Level	Modality of the school				Total
	General	Indigenous	Private	Technological	
Primary	80,294 (87.2%)	31 (0.0%)	5,180 (5.6%)	0	85,505 (92.8%)
Junior High School	3,540 (3.8%)	0	956 (1.0%)	2,120 (2.3%)	6,616 (7.20%)
Total	83,834 (91%)	31 (0.0%)	6,136 (6.7%)	2,120 (2.3%)	92,121 (100%)

Source: ENLACE database, processed in statistics package COLEF

As previously mentioned, most of the students are in the primary level. Of these, a large part belong to the general modality (87.2%), followed by the private modality, and finally—with very few cases—the indigenous modality. There were no cases of technical primary schools.

Most students of secondary level also belong to the general modality, followed by the technical modality, and thirdly, the private. There were no cases of indigenous junior high schools.

1.5.2 Level, modality and zone

This section describes the distribution of students tested according to the level and type of school, and according to the zone within the Municipality of Juarez. Table III shows the distribution of students tested.

Table III. Distribution of students tested by level, modality and zone

Zone, level and modality	Students tested	Percentage
Alfredo B. Bonfil, Primary general	105	0.1
El Millon, general primary	64	0.1
Juarez, technical junior high	2,120	2.3
Juarez, private primary	5,180	5.6
Juarez, private junior high	956	1.0
Juarez, indigenous primary	31	0.0
Juarez, general primary	79,697	86.5
Juarez, general junior high school	3,540	3.8
Loma Blanca, general primary	174	0.2
Samalayuca, general primary	160	0.2
San Agustin, general primary	94	0.1
Totals	92,121	100.00

Source: ENLACE database, processed in statistics package COLEF

In Table I we can see at a glance that the heaviest zone was Juarez, with 91,524 students tested (99.4%). This majority can be explained in relation to what was stated in the section referring to the Secretariat of Public Education's virtual portal enlace (SEP, 2007), in the section on researchers, communications media and society: "Excluding Oaxaca and Michoacán, states where there were special circumstances as a result of teachers' movements, the coverage of the application was 97% of primary schools and 90% of junior high schools."

This coverage explains the fact that the great majority are concentrated in the Juarez zone. The breakdown in Table III allows us to see that, both as a municipality and within the Juarez zone, a large majority of the students tested are concentrated in the primary level and in the general modality (86.5%). This is followed in importance by the private primary level (5.6%) and the general junior high school level (3.8%).

1.5.3 The student's level in Spanish and Mathematics

In addition to the distribution of the students surveyed, according to the level, modality and zone, it was possible to break down the achievement distribution for both subjects, classified in the following categories: 1) *insufficient*, students who do not possess the knowledge and skills necessary to continue their learning, 2) *elementary*, students who master a minimum of the cognitive skills of the grade evaluated, 3) *good*, students who master most of the content and cognitive abilities and 4) *excellent* students who master all the content and cognitive skills evaluated. Table IV breaks down the field of Spanish, and Table V does the same for Mathematics.

Table IV. Student's achievement level in Spanish

Zone, level and modality	Insufficient	Elementary	Good	Excellent	Total
Alfredo B. Bonfil, general primary	38 (0%)	61 (0.1%)	6 (0%)		105 (0.1%)
El Millon, general primary	29 (0%)	33 (0%)	2 (0%)		64 (0.1%)
Juarez, technical junior high	1,316 (1.4%)	683 (0.7%)	115 (0.1%)	6 (0%)	2,120 (2.3%)
Juarez, private primary	622 (0.7%)	2,196 (2.4%)	1,927 (2.1%)	435 (0.5%)	5,180 (5.6%)
Juarez, private junior high	414 (0.4%)	364 (0.4%)	167 (0.2%)	11 (0%)	956 (1.0%)
Juarez, indigenous primary	6 (0%)	13 (0%)	12 (0%)		31 (0%)
Juarez, general primary	18,899 (20.5%)	44,650 (48.5%)	14,932 (16.2%)	1,216 (1.3%)	79,697 (86.5%)
Juarez, general junior high	2,506 (2.7%)	915 (1.0%)	118 (1.0%)	1 (0%)	3,540 (3.8%)
Loma Blanca, general primary	19 (0%)	98 (0.1%)	46 (0%)	11 (0%)	174 (0.2%)
Samalayuca, general primary	75 (0.1%)	81 (0.1%)	3 (0%)	1 (0%)	160 (0.2%)
San Agustín, general primary	55 (0.1%)	37 (0%)	2 (0%)		94 (0.1%)
Total	23,979 (26.1%)	49,131 (53.3%)	17,330 (18.8%)	1,681 (1.8%)	92,121 (100.0%)

Source: ENLACE database, processed in statistic package in COLEF

Table V. Student's achievement level in Mathematics

Zone, level and modality	Insufficient	Elementary	Good	Excellent	Total
Alfredo B. Bonfil, general primary	42 (0%)	60 (0.1%)	2 (0%)	1 (0%)	105 (0.1%)
El Millon, general primary	34 (0%)	29 (0%)	1 (0%)		64 (0.1%)
Juarez, technical junior high	1,478 (1.6%)	597 (0.6%)	40 (0.1%)	5 (0%)	2,120 (2.3%)
Juarez, private primary	527 (0.6%)	2,642 (2.9%)	1,612 (1.7%)	399 (0.4%)	5,180 (5.6%)
Juarez, private junior high	479 (0.5%)	393 (0.4%)	73 (0.1%)	11 (0%)	956 (1.0%)
Juarez, indigenous primary	3 (0%)	20 (0%)	8 (0%)		31 (0%)
Juarez, general primary	17,673 (19.2%)	48,883 (53.1%)	11,863 (12.9%)	1,278 (1.4%)	79,697 (86.5%)
Juarez, general junior high	2,768 (3%)	725 (0.8%)	46 (1.0%)	1 (0%)	3,540 (3.8%)
Loma Blanca, general primary	24 (0%)	96 (0.1%)	44 (0%)	10 (0%)	174 (0.2%)
Samalayuca, general primary	57 (0.1%)	99 (0.1%)	4 (0%)		160 (0.2%)
San Agustin, general primary	56 (0.1%)	18 (0%)	20 (0%)		94 (0.1%)
Total	23,141 (25.10%)	53,562 (58.1%)	13,713 (14.9%)	1,705 (1.9%)	92,121 (100.0%)

Source: ENLACE database, processed in statistic package in COLEF

These tables do not specify the percentage distribution within each zone in particular. Although in general terms the analysis calls attention to Juarez, it is interesting to look more closely at the situation in other zones, rural and/or marginalized, without forgetting that in the Juarez zone too, these characteristics are shown in the interior of some of its boroughs.

One noticeable feature is the presence of the indigenous primary level and modality, found only in Juarez—although in a very small percentage—but not in any of the other zones,

Table IV shows in a general way that a slight majority (53.3%) of the students tested reached an '*elementary*' level of achievement in Spanish, followed by a little more than a quarter (26.1%) whose level was '*insufficient*'. After these comes just under a fifth of the students (18.8%), who arrived at a level of '*good*', and finally, a fraction (1.8%) who attained a level of '*excellent*'.

Table V gives an overall view of the school zone of the students tested in Mathematics. Although the percentages differ, the performance displayed in this field is similar to that of Spanish. The majority (58.1%) achieved an '*elementary*' level with a slight increase of 5% as compared to Spanish. These were followed by a quarter of the students (25.10%) who obtained an '*insufficient*' level. About

one-sixth (14.9%) reached the level of 'good', and a tiny fraction (1.9%) attained the level of 'excellent'.

ENLACE's previously-mentioned coverage gives us the idea that the proportion of schools is close to reality—for example, that there are more general primary schools than private ones. This observation may give direction to a refinement in approach for each type of school. At first glance, in the subject of Spanish in the Juarez zone, we can see that there were more students with an 'excellent' level in the general primary schools than in the private ones (1216 vs. 435), but that in the interior of each, the result can be inverted. Of 79,697 students of general primary schools, 1.50% attained an 'excellent' level, whereas 5180 students from private primary schools (8.39%) earned an 'excellent' rating. One interpretation could be that 1.5 of every 100 general primary school students were 'excellent', and that 8.39 of every 100 private primary school students were 'excellent'.

1.5.4 Correct answers and the level of achievement

In percentage terms, for the two subjects, 55.70% obtained an 'elementary' level of use, followed by nearly 17% who got a qualification of 'good'. These two levels (elementary and good) form the great majority, which is close to 73%. However, we must take into account that in the section on the website on consulting ENLACE, the SEP portal, under the heading of "Researchers, media and society", it is made clear that the grade reflects an underlying scale, based on the Theory of Response to Item (TRI), in which the grade depends not only on the number of correct answers, but on the degree of difficulty of these."

This means that, just as in the distribution of students according to the level achieved, in terms of the number of correct answers the specific weight of the questions should be taken into account, so that medium-low values in relation to the total number of correct answers actually shows that 55.70% are between *elementary* and *good*.

1.5.5 Level obtained by subject and grade: value of mode

Based on the type of variables that represent the level achieved by the students tested in two subjects (*insufficient*, *elementary*, *good* or *excellent*), the measure of central tendency appropriate for describing these is the mode. According to Hopkins, Hopkins and Glass (1997, p. 407), mode "is the observation that occurs with more frequency, the value most common or popular." The determination of the mode implies exercising the values of the frequencies obtained from the crosses of variables that are shown in Tables VI and VII, but was also reflected in Tables IV and V.

Table VI. Level obtained in Spanish by school grade (mode)

Grade	Level obtained in Spanish (Greatest frequency equals the mode)				Total
	Insufficient	Elementary	Good	Excellent	
3rd Primary	4675 (5.07%)	10425 (11.32%)	6814 (7.4%)	538 (0.58%)	22452 (24.37%)
4th Primary	4868 (5.28%)	12411 (13.47%)	3533 (3.84%)	558 (0.61%)	21370 (23.19%)
5th Primary	4529 (4.9%)	12372 (13.43%)	3484 (3.78%)	266 (0.29%)	20651 (22.41%)
6th Primary	5671 (6.15%)	11961 (13%)	3099 (3.36%)	301 (0.33%)	21032 (22.83%)
3rd Junior high	4236 (4.6%)	1962 (2.13%)	400 (0.43%)	18 (0.019%)	6616 (7.18%)
Total	23979 (26.02%)	49131 (53.33%)	17330 (18.81%)	1681 (1.82%)	92121 (100%)

Source: ENLACE database, processed in statistics package COLEF

Table VII. Level obtained in Mathematics by school grade (mode)

Grade	Level obtained in Mathematics (Greatest frequency equals the mode)				Total
	Insufficient	Elementary	Good	Excellent	
3rd Primary	4840 (5.25%)	12502 (13.57%)	4623 (5.02%)	487 (0.53%)	22452 (24.37%)
4th Primary	4167 (4.52%)	13244 (14.38%)	3438 (3.73%)	521 (0.57%)	21370 (23.20%)
5th Primary	4540 (4.93%)	12678 (13.76%)	3013 (3.27%)	420 (0.46%)	20651 (22.42%)
6th Primary	4869 (5.29%)	13423 (14.57%)	2480 (2.69%)	260 (0.28%)	21032 (22.83%)
3rd Junior high	4725 (5.13%)	1715 (1.86%)	159 (0.17%)	17 (0.02%)	6616 (7.18%)
Total	23141 (25.12%)	53562 (58.14%)	13713 (14.89%)	1705 (1.85%)	92121 (100%)

Source: ENLACE database, processed in statistics package COLEF

Table VI describes the frequencies of the level achieved by students of different grades in the subject of Spanish. In each grade frequency is the largest mode (max) marked in bold and italics. For the 92,121 students tested in the Municipality of Juárez, the overall mode is '*elementary*'. In each level it is the same for all four grades of primary school, while for the third grade of junior high school, the mode falls to the level '*insufficient*' in Spanish.

The situation in the field of Spanish is almost replicated in Mathematics (see Table VII). All of the students show that the mode is the *Elementary* level. In the primary school grades the mode is the *Elementary* level, but in the third grade of junior high school, the mode is *Insufficient*.

The data show a troubling situation regarding the majority of students placing in the level '*Elementary*' in both subjects. However, it is even more troubling that at the junior high school level the result should have fallen to the level of '*Insufficient*'. While the junior high school level comprises a minority of students (7.18%), compared to the Primary level (also see Table 4), the fact is that in that grade the majority (5.13% of the 7.18% represented) attain a level of '*Insufficient*'.

1.6 Depiction of the ENLACE results in digital cartography

One of the contributions of this ENLACE analysis was the creation of a database of a relational type, in an environment of geographic information systems in the ArcView platform. A connection was possible between the original database and the mapping of schools created by IMIP for the school year 2004-2005, using the key called 'school key', standardized by the SEP, and contained in the database ENLACE delivered to FoxPro for this project.

The base was made up of the geographical location with coordinates X, Y for each school within the urban area of Ciudad Juarez, and having a direct connection with each attribute or variable of the ENLACE database. Thus, for each school there are 21 original variables registered for the achievement examination. This evaluation of ENLACE will provide the user not only with the potential of a database of shared data, similar to FoxPro, but will also make available the opportunity to access the information in a digital mapping format for the urban area of Ciudad Juarez, both for the scholastic centers inside the urban area itself, and also for the other schools in its municipality.

The distribution in the space of the ENLACE results allows us to observe and establish empirical evidence for the variable achievement in the city's urban area. It also helps to infer possible relationship between the socioeconomic conditions in the city and their relationship with indicators of basic infrastructures, in addition to establishing possible connections between the results and the presence or absence of libraries. This empirical evidence will permit or support in the preparation of hypothetical approaches between the dependent variable determined by achievement and other potential factors that explain their behavior.

With the goal of helping to explain the spatial distribution between the phenomena of achievement the results were compared with two important indicators: 1) the socio-spatial hierarchy and 2) the infrastructure deficit.

II. Methodology

This research was conducted with 100% of the universe of primary school students in third, fourth, fifth and sixth grades, as well as students from the ninth grade (equivalent to the third level of junior high school). The base for the Municipality of Juarez consists of 92,121 students. In the first stage, a comprehensive descriptive analysis of the database for Ciudad Juarez was made using the SPSS software, including a description of the main parameters which ENLACE contains. This section would explore the possibility of establishing a model where the dependent variable would be *achievement*, and of exploring whether other independent variables could be included.

Second, by means of a code for a school, the enlace database was georeferenced with the scholastic mapping developed by the Ciudad Juarez IMIP. Given the spatial environment defined for this project, it will be possible to correlate data from ENLACE with variables that summarize the principal socio-economic characteristics of Ciudad Juarez, such as socio-spatial hierarchy, poverty, welfare and infrastructural deficit.

Finally, the potential of the ENLACE base is described and linked with public policies, which, in terms of education, exist to aid in detecting and resolving problems of education in Ciudad Juarez in terms of the coverage of education services, and in terms of the principal problems of poverty and well-being in the city.

III. Results

The ENLACE database is made up of 21 variables that show information on a total of 92,121 students, all belonging to the municipality of Juarez, and representing 37.1% of the universe of students tested in the state of Chihuahua. Only 1.6% of the students go to schools located in rural areas of the municipality. Therefore, the results analyzed in Juarez can have great statistical weight and representation for the state of Chihuahua, but only as compared with other urban areas, given the characteristics of the Municipality of Juarez.

The ENLACE database shows that it was applied to a total of 409 primary and junior high schools, while the IMIP cartographic database for the 2004-2005 school year shows a total of 485 primary schools and 119 junior high schools, for a total of 604 schools. Therefore, we can assume that the test was applied to 67.71% of the schools in Juarez.

3.1. Findings for the Spanish examination

Figure 3 shows the results of the Spanish test data set for primary and junior high schools. The results are expressed in levels of *Insufficient*, *Elementary*, *Good* and

Excellent. To help in understanding the spatial distribution of these results, there are two overlapping ellipsoids illustrating the geographical distribution of the results grouped by levels 1 and 2, *Insufficient* and *Elementary*, and levels 3 and 4, levels *Good* and *Excellent*. There is a spatial pattern in the results grouped in *Good* and *Excellent* on the north side of the city, and a distribution of the results 1 and 2, which form an ellipsoid aligned with the western sector of Ciudad Juarez.

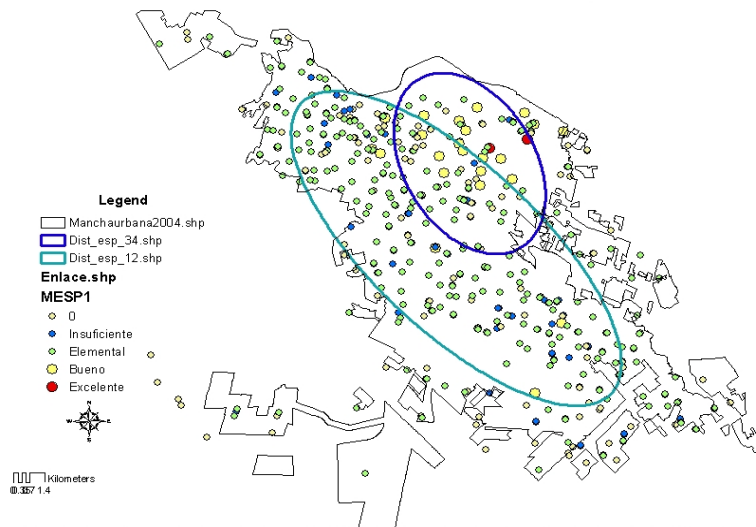


Figure 3. Results of ENLACE in Ciudad Juarez: 2005-2006 school year.
Mode of the results of the Spanish test

In general, the evaluation for Ciudad Juarez is represented with a modal value (the most frequent result) in the category *Elementary* and, according to the SEP definition, at this level a large percentage (53.33 %, or 49,131 students) of primary and junior high school students tested would be considered students who master a minimum of cognitive abilities in the grade assessed. A total of 23,979 students (representing 26.02% of the total number of students) was found to be at level *Insufficient*. There were 17,330 (18.81%) at the level of *Good*, and only 1681 *Excellent* students (1.82%).

The result or mode value *Elementary* is the only level distributed evenly throughout the urban area. The results *Insufficient*, *Good* and *Excellent* exhibited a spatial pattern of grouping for parts of the city.

It is notable that the bulk of the results *Good* and *Excellent* tend to occur in schools in the sector having better socio-economic conditions and infrastructure, and, coincidentally covers many of the schools in the private sector. It is also significant that the results *Good* are found in sectors that have great coverage of basic services such as drinking water, sewer service and energy, summarized in the determined indicator as *deficit of infrastructure* (See Figure 4).

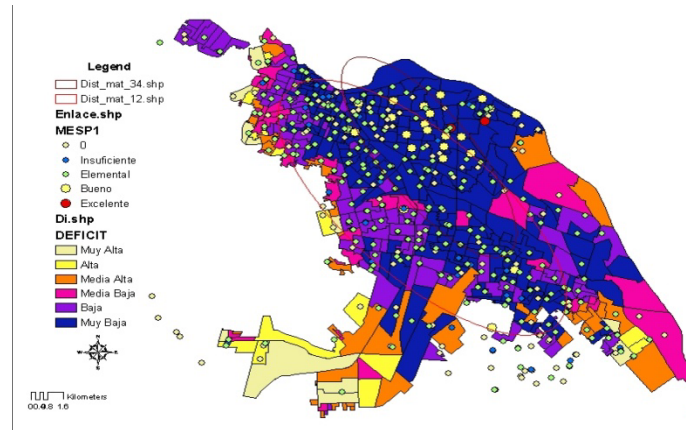


Figure 4. ENLACE results in Ciudad Juarez: school year 2005-2006. Mode of results for Spanish examination vs. deficit of infrastructure

It is also noteworthy that the results *Good* and *Excellent* are located in the city's sectors of high socio-spatial hierarchy (high socioeconomic status)(see Figure 5).

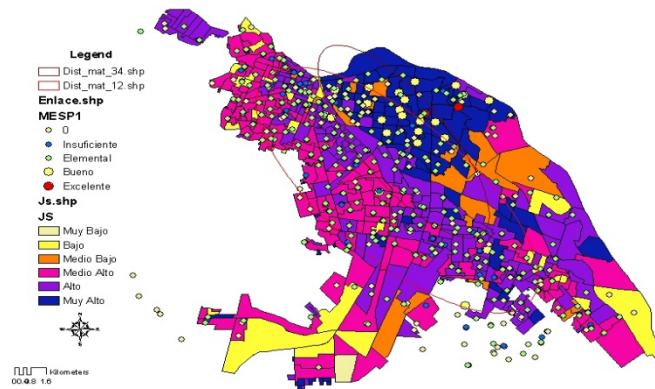


Figure 5. ENLACE results in Ciudad Juarez: school year 2005-2006. Mode of results for Spanish examination vs. socio-spatial hierarchy

Results of *Insufficient* are found in the marginalized sectors of Ciudad Juarez area, and are principally localized in the western and southern sectors, and in the schools outside the urban area. In these regions are found many of the cases showing *Elementary*-level results as well.

It is striking that at the junior high school level, the modal value falls to the level of *Insufficient*. However, it should be noted that third-level junior-high students account for only 7.18% of the total number tested.

3.2 Findings for the Mathematics examination

Figure 6 shows the distribution of the results of the mode for the Mathematics examination in the urban area of the city. It has a general distribution similar to that of the Spanish test, with a spatial pattern less concentrated—that is, a bit more scattered.

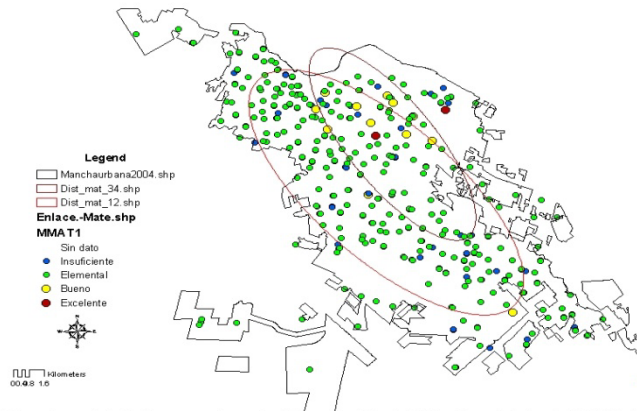


Figure 6. ENLACE results in Ciudad Juarez: school year 2005-2006.
Mode of results for the Mathematics examination

Figures 7 and 8 show a relationship in the urban space between the results *Good* and *Excellent* in areas of high-level hierarchy and with great coverage of basic services. In the same way, the results *Insufficient* and *Elementary* are closely related to areas with low socioeconomic levels.

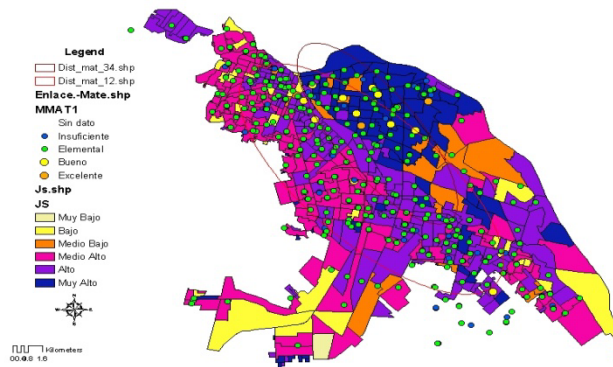


Figure 7. ENLACE results in Ciudad Juarez: school year 2005-2006.
Mode of results for Mathematics examination vs. socio-spatial hierarchy

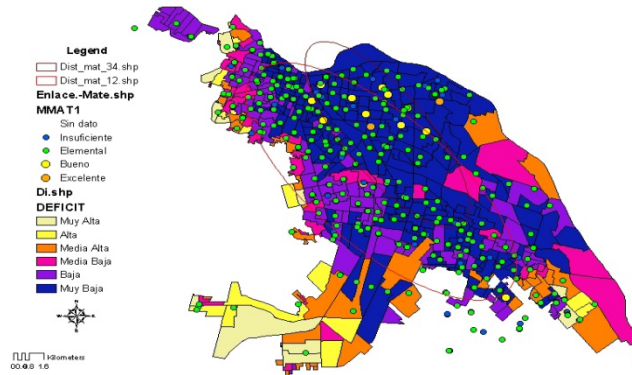


Figure 8. ENLACE results in Ciudad Juárez: school year 2005-2006.
Mode of results for Mathematics examination vs. infrastructure

On the whole, the evaluation for Ciudad Juárez is represented with a modal value (the most frequent result) falling into the category considered as *Elementary*, and according to the definition of the SEP, at this level a large percentage (58.14 %, or 53,562 students) of primary or junior high school students tested are those who master only a minimum of this subject's cognitive skills. Found at the level *Insufficient* were a total of 23,141 students (representing 25.12% of the total number). At the level of *Good*, there were 13,713 (14.89%), and in the category of *Excellent*, only 1705 (1.85%).

The results of the Mathematics examination in urban Ciudad Juárez are spatially very similar to those of the Spanish examination, as well as demonstrating a high spatial correlation with indicators of socio-spatial hierarchy and the deficit of basic infrastructure.

Conspicuous is the fact that at the junior high school level, the modal value obtained in Mathematics falls into the category of *Insufficient*. It should be noted that the third-level junior-high students constitute only 7.18% of the universe tested.

Other findings indicate that in both examinations, in terms of the modal value, we can almost dispense with the classification *Excellent*, since it occurs in only two schools in the northern sector of the city (see Figures 3 and 6). However, in absolute terms, 1681 students (1.82% of the totality) attained the category of *Excellent* in English, and 1705 (1.85%) did so in Mathematics.

3.3 Libraries vs. results

An important variable for achievement is represented by the presence or absence of libraries. It should be noted that this variable is not included among those which make up the ENLACE database.

Taking advantage of digital cartography for libraries, we overlaid this layer (the map of libraries) with the previous results of English and Mathematics, and found the following results: the urban area of Ciudad Juarez has a very low proportion of libraries in relation to the number of schools. The Figure 9 map shows how the ellipsoid showing the geographical distribution of libraries takes in 100% of the results for levels *Good* and *Excellent* in the field of Spanish, and does almost the same with the results for the mathematics test.

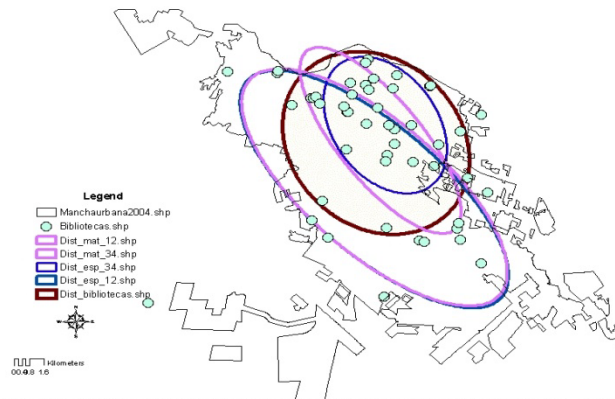


Figure 9. ENLACE results in Ciudad Juarez: school year 2005-2006.
Geographic distribution of results for Spanish and Mathematics vs. libraries

It is easy to see how the ellipsoids showing the levels *Insufficient* and *Elementary* match almost perfectly the geographical distribution of the two subjects (English and Mathematics).

3.4 Potential of ENLACE

As a measuring instrument, ENLACE, aside from measuring a variable so important as student achievement, provides a very important potential for analysis of the education sector. Furthermore, it offers possibilities of action for identifying and improving the conditions of the students, teachers, and schools. It also provides an opportunity to identify areas or sections of the city having real problems in school infrastructure, and which directly affects the performance of learners.

It has an outstanding potential in the field of scientific research, with information which provides empirical evidence, and which allows the designing of hypothetical approaches to the phenomenon of the equation, or to its contextualization, using the social reality of a city's urban environment.

3.5 Final considerations and conclusions

The ENLACE was analyzed for the specific case of Ciudad Juárez. It was concluded that ENLACE is an excellent instrument of measurement for the educational quality of primary-school students of third to sixth levels, and for third-level students of junior high school.

The findings for the spatial distribution of the results show a high correlation between these and the spatial distribution of the socio-economic variables of the city. This coincides with what was explained in the theoretical framework, which gives significant weight to these variables and their impact on student achievement. Also, the findings show a direct relationship between the results *Good* and the existence of libraries, and by contrast, with their absence.

Judging by the methodology used for designing questions, the pilot program, application, management and systematization of the results, control of copying, etc., we can establish that the results of ENLACE are of a proven statistical excellence. The above reaffirms the congruency of the results with a portion of the city's social reality.

The SEP has created a properly-systematized database using the ENLACE results. This has allowed a rapid connection in an environment of geographic information systems. The databases on Fox Pro, and the one designed in this project using ArcView are prepared to receive the results of the ENLACE recently applied in the school year 2006-2007.

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¹ And Cohen (2002), explains how to build the indicator of context and how it relates to the efficiency of resource allocation, in what it called the cost-impact of the social capital of education, to raise the efficiency and efficiency of educational quality and thus, scholastic.

² Consult survey link: <http://enlace.sep.gob.mx/default.asp>

³ The National Institute for the Evaluation of Education (INEE, 2007) emphasizes this when it states how the indicators for evaluating education in basic education in Mexico should be created:

“One of the main problems in the interpretation of results in terms of educational research, is the interpretation of statistical information and the usability of it, when it requires context information and indicators to identify objectively the setbacks, progress and adjustments made in the types, levels and modalities of elementary and high school education in the national education system.”