PANORAMA
ISSN: 1909-7433
ISSN: 2145-308X
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Politécnico Grancolombiano
Colombia

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PANORAMA, vol. 15, núm. 29, 2021
Politécnico Grancolombiano, Colombia
Disponible en: https://www.redalyc.org/articulo.oa?id=343967896018
DOI: https://doi.org/10.15765/pnrm.v15i29.1723

Artículos de investigación científica y tecnológica

DETERMINANTES DEL RENDIMIENTO ACADEMICO DE LA PRUEBA SABER 11 DURANTE EL PERIODO 2014-2019 EN COLOMBIA

ACADEMIC PERFORMANCE DETERMINANTS OF THE SABER 11 TEST IN THE 2014 - 2019 PERIOD IN COLOMBIA

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PANORAMA, vol. 15, núm. 29, 2021

Politécnico Grancolombiano, Colombia

Recepción: 19 Mayo 2021
Aprobación: 14 Julio 2021

DOI: https://doi.org/10.15765/pnrm.v15i29.1723

Redalyc: https://www.redalyc.org/articulo.oa?id=343967896018

Resumen: En este artículo se analizan los determinantes del rendimiento académico de la educación media teniendo en cuenta los resultados de la prueba saber 11 correspondiente al periodo 2014-2019. Se utilizó la base de datos suministrada por el Instituto Colombiano para la Evaluación de la Educación (ICFES), en donde se recoge información de los estudiantes que presentaron el examen Saber 11 para el periodo 2014-2019. La metodología utilizada se desarrolló mediante la aplicación de un modelo de combinación de corte transversal incluyendo variables que representan las características personales, familiares, socioeconómicas y del colegio de la población del modelo, los estudiantes que presentaron el examen. Los resultados muestran que la competencia del área de inglés es la que mayor explica el rendimiento de la prueba saber mostrando un mayor impacto dadas las características que se expusieron.

Palabras clave: ICFES, Academic performance, cross cut combination ICFES, Rendimiento Académico, Combinación de corte transversal.

Abstract: This article analyzes the academic performance determinants in secondary education, taking into account the results of the Saber 11 test in the 2014-2019 period. The database provided by the Colombian Institute for the Evaluation of Education (ICFES) was used, which collects information from students who took the test in that period. The methodology was developed by applying a cross-sectional combination model, including variables that represent personal, familial, socioeconomic and school characteristics of the model's population: students who took the test. Results show that the competence in the English area is the one that best explains performance in the Saber test, showing a higher impact given the characteristics exposed. Consequently, it is established that academic performance is defined by personal, familial, socioeconomic and school factors, and that a social and economic gap exists in the aforementioned performance.

ICFES, academic performance, cross-sectional combination model.
https://doi.org/10.15765/pnrm.v15i29.1723

Keywords: ICFES, academic performance, cross-sectional combination model..

Introduction

In recent decades, education has been considered one of society's pillars based on its power to transform the social sphere but also on its role to facilitate individual development; moreover, it is significant for nations' economic development. UNESCO expounds that the conceptualization of quality as a framework to understand, monitor and improve educational quality reveals education's importance as an agent of social transformation, it is the tool to achieve balance at cultural level, to get to know values and, since it is an essential part of humans construction of the self, it helps humans sustain social and economic wellbeing by fostering new work and lifestyle opportunities.

...Likewise, it is said that the bond between education and society is so strong that both influence each other on account of their capacity to strengthen skills, values, communication, mobility (pertaining to opportunities), personal prosperity and freedom. However, education as source of training is a reflection of citizens (society) and it helps manifest society's values and attitudes. It is worth mentioning that if education takes place in the context of sumptuous society or in a poverty-ridden one... (UNESCO, 2015, p.27)

In terms of individual development, transformations based on education must aim at new challenges, which, as asserted by Tedesco, need to incorporate the training of personality, impacting preparation and human development (Tedesco, 2003).

In this context, the impact of education on countries' economic growth and on social development potentiating cannot be ignored, theorists on economic growth now consider the productive aspects generated by knowledge (referred to as human capital) including it as a variable that determines economic growth, given that having an education opens possibilities to better positions and salaries, which in turn lead to a better quality of life. In that sense, Shapiro bases his study on research that shows that if productivity increases are the result of a better level of education, it contributes to an optimal quality of life of the population (Shapiro, 2006). It also promotes political and social participation, expanding the workforce as a consequence of economic growth.

In that regard, it is interesting to inquire into the levels of education that are measured through students' performance (as in Colombia), since from the point of view of public policy, its educational model makes decisions that are applied to students overall, yet results between students differ, a fact that makes it interesting to look into the factors that determine academic performance.

In turn, academic performance is understood as the way of evaluating the learning or knowledge acquired by a student within an academic context and as part of an education system (Moreno, 1998; Martinez, 2004). This way, academic achievement attained may be determined by factors that are external to the academia as an educational institution, to teachers and other students' intrinsic factors and origins (Rincon & Arias,

2017), therefore test results or evaluations may differ between students (Blackman, 2011).

According to the Programme for International Student Assessment (PISA), which evaluates skills in reading, mathematics and sciences of students aged 15, Colombian students' academic performance was below the mean of other OECD members, as follows: 412 points in reading, 391 points in mathematics and 413 points in sciences; the score for reading was lower than that of 2015. Among the academic performance determinants, it was found that Colombia's economic conditions accounted for 14% of the variation in reading performance, a figure that is higher than the OECD's mean (12%) (OECD, 2019). Also, it was found that at least 10% of Colombia's underprivileged students were able to reach a score in the top four of reading performance, compared with the mean of 11% of all OECD members. In terms of gender, women had a higher score in reading of 10 points compared with men, closing the gap in comparison with participant countries; as opposed to the scores of mathematics and science, where men surpassed women, evincing one of the largest gaps in countries that participated in the test (OECD, 2019).

The aforementioned illustrates the country's education situation and its contrasts with other countries, in this case OECD members, revealing a negative outlook for the reach of the country's education.

In the same context, the 2019 management report of the Ministry of National Education (MEN) explains the existence of challenges at educational level pertaining to the acknowledgement of students' particularities, proving the existence of certain traits or factors that affect academic performance, therefore, challenges must be faced to guarantee inclusive educational environments to service the populations' academic needs, taking the different factors that affect academic performance into account. Moreover, school motivation, which is where skills and instruments are managed to achieve class objectives, is also part of the discussion.

According to the aforementioned, the MEN evinced that aspects such as familial characteristics influence education, finding that only 19% of the students with mothers who completed primary education made it to secondary level; in terms of the origin, students stay in school an average of 6 years when they are in rural areas, and 9.7 years when they are in urban areas, showing an existing gap between regions (MEN, 2019).

Consequently, the bases of the National Planning Plan (Plan Nacional de Planeacion, in Spanish) illustrate that the net coverage of preschool is of 55.26%, with 59.02% in the urban areas and 46.92% in the rural areas, showing that the rural area is the one with the least coverage aside from lack of representation in the total educational coverage (Departamento Nacional de Planeacion - DNP, 2018).

According to the aforementioned, this article intends to analyze the academic performance determinants of seniors (grade 11th) in the country. Academic performance in Colombia is measured using the Saber 11 test, applied by ICFES (Instituto Colombiano para la Evaluación de la

Educacion), which includes personal, familial, socioeconomic and school variables to explain academic performance, using the data of eleventh graders who took the test between the years of 2014 and 2019.

This document is divided in five sections, including this introduction. The second section presents the theoretical reference. Methodological aspects are defined in the third one. The fourth section introduces the results of the empirical analysis, and the fifth offers a discussion.

Theoretical Reference

Background

Academic performance may depend on several factors that might be related between themselves or not; per Montes and Matiz (2010-2011), performance circulates based on five characteristics grouped in traits such as personal, familial, academic, economic and institutional categories, measured with quantitative and qualitative approaches. Moreover, the analysis of school performance by Correa (2004) considers the association between familial, school and personal characteristics.

Personal Characteristics

Some authors whose research considers personal aspects assume them as individual factors that determine academic performance, including Coleman (1966), who studied the effect of student's characteristics on academic performance in the United States; his studies found that familial background and economic conditions have a greater effect on academic performance. In Barcelona, according to Albalate, Fageda and Perdiguero, an empirical analysis estimating academic score determinants found that amount of hours of study, attendance and prior knowledge are significant, proving that these affect academic performance to successfully implement learning evaluation in the European Higher Education Area (EHEA). As for Gallegos and Campos (2019) in the case of Chile, an analysis based on a cross-sectional combination model found that personal characteristics have a more positive, significant and superior effect than social and institutional characteristics. At national level, Cerquera, Giraldo and Cordoba applied a multinomial logistic model with ICFES's information, determining the factors that affect academic performance, the main finding indicates that students' personal characteristics influence academic performance.

Familial Characteristics

Internationally, Rodriguez and Guzman (2019) conducted a study on academic performance and familial factors of risk, they analyzed the relationship at familial and socioeconomic levels and found that great influence is exercised by familial contexts, thus affecting academic performance. Chaparro, Gonzalez and Caso (2016) undertook an

identification of secondary students' profiles with variables such as familial characteristics, socioeconomic level, among others; the study was based on two groups of students with specific characteristics, and it concluded that familial variables allow to configure student profiles that are associated with academic performance. Nationally, Gaviria and Barrientos (2001) studied the effects of family environment in the quality of education in Bogota, results show that familial characteristics such as parents' education are associated with academic performance, thus affecting academic performance, and in turn, quality of life and opportunities. On the other hand, Chica and Galvis (2009) undertook an analysis based on ICFES's results of the areas of mathematics and language applying a logit model in which familial characteristics such as income and parents' school level have a solid impact on students' academic performance.

SocioeconomicCharacteristics

Studies by sociologists and by researchers focusing on social inequalities, and, in this case, on academic performance throughout students' school levels, have found socioeconomic characteristics to be extremely relevant; therefore and to contrast the aforementioned, a review of the international context led to Tejedor and Caride (1988), whose study conducted an external valuation of teaching reforms at secondary level (*nivel medio*, in Spanish) in Spain, finding that students with greater academic performance are in high socioeconomic level and their parents' study level is higher and mothers' is average; students with the lowest performance have parents with incomplete and inferior studies.

Fuchs and Wößmann (2004) found that there is positive reciprocity between academic performance of school students (elementary level) and socioeconomic situations, particularly in Colombia. Likewise, in terms of the socioeconomic aspect, Alvarenga, Osegueda and Zepeda (2014, p.71) conclude that:

A peculiarity of homes with inappropriate economic level is that they drive interfamilial tensions that affect students' concentration, attention and motivation. Moreover, fathers and mothers with inadequate economic levels use ineffective strategies to encourage their children, even if they value education and want their children to have a suitable academic performance, they scarcely interact with their children in activities related to learning strategies; this absent interaction affects the experience of some students in this economic level, a main indicator of their capacity to learn.

Zambrano (2016), who conducted a critical analysis of the national test to access higher education in Ecuador, affirms that top students' academic performance was the result having access to private education.

Lastly, at national level, Cerquera, Cano and Gomez (2016) found that resources provided by parents (access to computers and the Internet) have a considerable impact on students' academic performance, especially in regions of Colombia with greater economic development; in terms of access to the Internet, they found greater impact on performance in

less developed regions, they added that despite the fact that Colombia develops programs to benefit Internet access, such as "*Computadores para educar*", it is necessary to create free and universal policies to access the Internet, since these would greatly benefit students' educational performance.

School'sCharacteristics

Two categories are taken into account pertaining to the characteristics of the educational facilities: public and private. Private education, fulfilled with private funds, has good resource management and usually achieves high performance. However, in recent years, education in the country has had to overcome bad resource management to attain good academic performance results. There are still evident differences in quality between the official and the private sectors.

Internationally, Di Gresia, Porto and Ripani (2002) have presented evidence in terms of how students in private schools in Argentina sustain better academic performance in higher education compared with students in public education.

Regarding the location of the educational institution, rural areas show academic underperformance due to the lack of development compared with cities, which have more access to quality. Research by Hernandez (2017) about Mexico, concludes that inequality in quality of education in rural and urban areas is driven by educational institutions' infrastructure and ideology. Nationally, Tovar and Diaz (2016) studied the causes that determine performance of public school students versus private schools, using official information of 2014 ICFES's Saber 11 test. They applied the Oaxaca-Blinder wage decomposition, which states that "the existing difference in wages or salaries between two groups is the result of two components. The first is the difference between observable explicative variables of the two groups, and the second is the difference between non-observable characteristics" (Otero, 2012, p.34), along with estimates of the educational production function, according to the methodology proposed by Heckman, which helps to correct the selection bias. The results of Tovar and Diaz's research showed school gaps between private and public centers; for private schools in Colombia and its main five cities, it was demonstrated that these gaps are present in all of the competences assessed in the Saber 11 test , except in the city of Cali, where results favored public schools.

Meanwhile, Viana and Pint (2018) analyzed the efficiency of eleventh graders in urban and rural schools in the department of Santander, Colombia, in the Saber 11 test. They applied the DEA method (Data Envelopment Analysis) and disaggregated the two parts (students/ school) in order to observe attributable characteristics. Subsequently, they studied students' performance to define individual efficiencies, they proceeded to do the same in every school with the goal of defining the total efficiency. The sample was of 25,990 observations (students enrolled in all of the schools in Santander who took the test in 2016): 15,461 students enrolled in 340 public urban schools, and 3,316 students enrolled in public rural schools. Results concluded that students in rural

schools are 7% less efficient than students in urban schools; it also concluded that the school is largely accountable for this fact.

Finally, teachers are among the determinant factors of academic performance. In that sense, in international literature, Sanders and Rivers (1996) determine that teachers' characteristics and behaviors remarkably affect students' academic performance. An unproductive teacher makes student's learning wane. Noticeably, establishing if teachers' behaviors and characteristics are efficient or inefficient can be complicated, the ideal information to do this is lacking, especially in developing countries; regardless, studies that support the effect of teacher's characteristics on academic performance are scant.

Theoretical Framework

The theoretical formalization of this analysis is inspired by the work on the functions of educational production by Hanushek* in 1986, in which he classified the input of educational production as familial input (characteristics, parents' education, family income and size); input that evinces peer-effect as aggregated indicators of socio-demographic characteristics of other students in the school; school input such as teachers' characteristics (education, experience and gender), school's characteristics (class size, facilities and administrative expenditure), and local context factors (average expenditure level) (Hanushek, 1986).

The model of the production function is adjusted to the specific characteristics of this analysis. The model shows the following specification:

$$R_i^t = f(F_i^t, P_i^t, C_i^t, S_i^t)$$

Where,

i = i-th student
t = Period of time
R_i^t = Academic performance in time
F_i^t = Familial characteristics vector in time
P_i^t =Persnal characteristics vector in time
C_i^t =School characteristics vector in time
S_i^t =Socioeconomic characteristics vector in time

Method

Since this research's objective is to identify determinants associated with students' academic performance, ICFES's database was used to collect information of students who took the Saber 11 test in the 2014-2019 period (overall score, average score per evaluated subject, amount of official and non-official schools, etc.), this database comprises a set of variables regarding personal, socioeconomic, familial and school characteristics of the students who took the test. As for ICFES, it provides

information about the educational quality and its evaluation system at national level.

After the database was organized, each variable was determined through descriptive statistics; subsequently the suggested econometric model was developed, this cross-sectional combination model enables following-up on different variables in time. In this specific case, the model was applied to the five subjects evaluated in the Saber 11 test, these models were estimated using the STATA 15 statistic software.

The methodology of this work is quantitative because it deals with the topic of academic performance determinants, which need to be established with quantitative data and software. As per Hernandez, researchers following the quantitative approach use their designs to analyze the suggested problem with certainty in order to provide evidence in terms of the research's guidelines, in this case, to prove the variables that determine academic performance. Initially, non-experimental design will be applied in the quantitative approach so that the researcher can intentionally operate the set of independent variables (theoretical causes-background), in order to analyze the effects of manipulating variables' results (theoretical effects-consequents) within a control situation, said variables are specified in the model.

Particularly, a correlation-causes cross-sectional design will be used to predict the behavior of one or more variables based on the others, after causality is established (Hernandez, Fernandez, & Baptista, 2010).

The research process selected individuals who have taken the test in the 2014-2019 period, considering students who took the Saber 11 test in each year's second semester; moreover, it is important to highlight that only students with information related to the studied characteristics were taken into account, the total sample amounted to 3,247,429 observations.

Results

Descriptive Statistics

Statistical analysis was used to characterize the studied sample and determine students' average performance in the test based on students' overall characteristics (including personal, familial, socioeconomic and school characteristics).

Table 1 shows the averages per evaluated subject of the total evaluated students in period 2, which has a favorable variation in the years of the study 2014-2019, illustrating that the amount of students who take the Saber 11 test decreases and increases in a certain way; also, it is observed that the trend is not maintained because of factors aside from education, which include some external elements that affect students' development: family income, region where they live, personal relationships and other social factors.

Categories' variables are considered binary variables that take values of 0 and 1, depending on the analysis.

Period	Students	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies	Global Score
2014-2	542,569	50.03	50.04	50.04	50.03	49.97	**250.1**
2015-2	541,354	50.14	50.37	49.73	50.08	49.81	**249.87**
2016-2	545,744	50.8	51.97	52.6	52.61	50.55	**258.32**
2017-2	541,439	50.12	49.57	53.23	51.28	50.27	**255.49**
2018-2	538,818	50.34	50.72	52.66	49.66	48.31	**251.39**
2019-2	537,505	50.72	48.52	52.24	48.34	46.31	**246.68**
TOTAL	**3,247,429**	**50.36**	**50.2**	**51.75**	**50.34**	**49.21**	**251.99**

Table 1

Averages per areas and overall score of evaluated students (2014 – 2019)

Source: compiled by the authors based on ICFES's database, 2014-2019

Econometric Model

According to the model explained in the methodology, the score per competence is assumed as a dependent variable, it takes values of 0 to 100 according to the test's qualifying scale. It is important to take into account that starting in period 2 of 2014, ICFES updated the evaluated competences, switching from seven to five competences; likewise, the overall score's qualifying scale used to be measured from 1 to 100 possible points and it was also changed to a scale of 1 to 500 possible points.

The cross-sectional combination model was applied with the purpose of knowing the determinants associated with academic performance of the Saber 11 test for each of the evaluated subjects, considering the characteristics obtained from ICFES's database for the 2014-2019 period. The explanatory variable for each model is each subject's average, and the independent variables are grouped in four per the individual's personal, familial, socioeconomic and school characteristics..

Table 2 presents the academic performance determinants per subject in the Saber 11 test; it shows five models, one for mathematics, one for English, one for critical reading, one for natural sciences and one for social and citizen studies, including the effect of each variable included in the characteristics and its values. The inclusion of all of the variables gives more accuracy to the model.

	Mathematics	English	Critical Reading	Natural Sciences	Citizen and Social Studies
Variables	***Coefficient***	***Coefficient***	***Coefficient***	***Coefficient***	***Coefficient***
Personal Characteristics					
Gender M	3.207***	0.945***	0.182***	2.034***	1.185***
Ethnicity	-3.904***	-2.442***	-2.972***	-3.273***	-3.395***
Has a job	-1.522***	-2.407***	-0.966***	-1.833***	-2.167***
Familial Characteristics Father's education					
Elementary	0.139***	--	-0.040***	0.099***	--
Secondary	0.506***	0.547***	0.494***	0.435***	0.445***
Higher – incomplete	2.191***	2.261***	2.085***	1.795***	2.155***
Higher – compete	2.729***	3.198***	2.383***	2.429***	2.587***
Postgraduate	6.742***	8.162***	5.158***	5.892***	6.198***
Mother's education					
Elementary	0.873***	0.427***	0.521***	0.802***	0.610***
Secondary	1.758***	1.194***	1.307***	1.491***	1.210***
Higher – incomplete	3.392***	2.787***	2.960***	2.862***	2.927***
Higher – compete	4.082***	3.838***	3.257***	3.573***	3.516***
Postgraduate	7.448***	8.086***	5.561***	6.592***	6.756***
Father's occupation					
Employed	-0.635***	-0.223***	-0.755***	-0.049**	-0.040*
Independent	-0.409***	--	-0.974***	0.185***	0.283***
Homemaker	-2.514***	-2.035***	-1.556***	-1.935***	-2.197***

	Mathematics	English	Critical Reading	Natural Sciences	Citizen and Social Studies
Variables	***Coefficient***	***Coefficient***	***Coefficient***	***Coefficient***	***Coefficient***
Pensioner	-0.319***	0.538***	-0.268***	0.332***	0.630***
Other	-0.178***	-0.621***	0.090***	--	-0.160***
Mother's occupation					
Employed	-0.160***	0.118***	0.070***	0.191***	0.424***
Freelancer	-0.304***	0.306***	-0.714***	0.359***	0.682***
Homemaker	-0.479***	-0.099***	-0.723***	0.067***	0.242***
Pensioner	-1.374***	-0.156**	-1.134***	-0.626***	--
Other	-1.474***	-0.904***	-1.337***	-0.812***	-0.677***
Socioeconomic Characteristics					
Mid SEL	0.813***	2.221***	0.982***	0.730***	0.899***
High SEL	1.064***	5.389***	0.903***	0.480***	0.746***
More than four people	-0.598***	-0.876***	-0.873***	-0.644***	-0.978***
More than three rooms	-0.884***	-0.546***	-0.656***	-0.721***	-0.681***
Access to the Internet	1.142***	1.464***	1.410***	0.915***	1.031***
TV service	--	--	0.155***	--	-0.299***
Has a computer	1.422***	1.438***	1.039***	1.378***	1.656***
School Characteristics					
Type of school					
Technical	-0.193***	-0.663***	-0.331***	-0.224***	-0.386***
Academic/Technical	0.500***	--	0.326***	0.198***	0.325***
School's Education					
All-male	0.215***	-0.249***	-0.479***	0.174***	--
Co-education	-3.485***	-3.967***	-2.628***	-3.077***	-3.160***
Official school	-0.262***	-1.922***	-0.336***	-0.322***	-0.698***
Urban area	2.135***	1.492***	1.902***	1.394***	1.753***
Session					
AM	-2.313***	-2.330***	-1.612***	-1.834***	-1.650***
PM	-3.062***	-2.714***	-2.120***	-2.360***	-2.174***
PM/Saturday	-9.406***	-7.387***	-7.033***	-7.980***	-7.153***
Bilingual school	--	1.014***	-0.378***	-0.113**	-0.250***
Constant	52.626***	54.9444***	54.681***	52.491***	51.955***
R2	0.256	0.306	0.23	0.242	0.213

Table 2

Academic Performance Determinants per Subject

Source: compiled by the authors. Significance level (* at 10%, ** t 5% and *** t 1%).

The five cross-sectional combination models show that most of the explanatory variables are significant in each level at 10% and 5%. In terms of the student's personal characteristics, it can also be seen that men get in average 3.20 points more in mathematics than women; likewise in other subjects, male students get an average of 0.94 points more in English, 0.18 points more in critical reading, 2.03 points more in natural sciences and 1.18 points more in social and citizen studies than female students. Also, a student who is part of a minority ethnicity has an average of 3.90 points less in mathematics than a student who is not, this difference is of 2.44 points less in English, 2.97 points less in critical reading, 3.27 points less for natural sciences and of 3.39 points less in social and citizen studies. A negative effect is present in all subjects for these type of students.

On the other hand, for the five subjects it was found that if a student has a job, his/her average goes down compared with a student who does not have a job; this difference is larger in social and citizen studies, where it is 2.16 points less; the difference in English is of 2.40 points less, in natural sciences it is of 1.83 points less, in mathematics it is of 1.52 points less and

in critical reading it is of 0.96 points less compared with a student who does not have a job. In terms of the student's familial characteristics, it was identified that the more educated the family is, the greater the student's average in each subject; in mathematics, if the father has incomplete elementary, secondary and higher education, complete higher education and postgraduate studies, then the student's average is 0.13, 0.50, 2.19, 2.72 and 6.74 points higher, respectively, than students whose father does not have an education at all; comparatively, the mother's education has a greater effect on the student's score: a student whose mother has postgraduate education has an average of 7.44 points more than a student whose mother does not have an education at all. This effect is also present in critical reading, natural sciences and social and citizen studies, but in English, the effect of a father's postgraduate education is a bit higher than the mother's. In mathematics, if the parents are employed, independent, homemaker, pensioner or other, the effect is negative compared with parents who are entrepreneurs; yet for the other four subjects, if the mother is employed, the effect on the score is higher compared with students whose mother is an entrepreneur. Regarding socioeconomic characteristics, students in the mid SEL have an average in mathematics that is 0.81 points lower than students in low SEL, in English they get an average of 2.22 points more than students in low SEL, in critical reading, natural sciences and social and citizen studies, they get an average of 0.98, 0.73 and 0.89 points more than students in low SEL, respectively. Likewise, if the student is in high SEL the effect is greater in English, with an average of 5.38 points more than students in low SEL, the effect in other subjects is also positive.

Other socioeconomic characteristics such as the number of people and number of rooms in the household, showed that there is less effect in the five subjects when there are four people in a student's household compared with a home made up of 1-4 people; similarly as if a house has more than three bedrooms, the effect is less compared with a student who lives in a 1-3 bedroom house.

On the other hand, technology plays an significant role in academic performance. If a student has access to the Internet, the average in mathematics is of 1.14 points, in English of 1.46 points, in critical reading of 1.41 points, in natural sciences of 0.91 points and in social and citizen studies the average is 1.03 points more than a student who lacks access to the Internet. Whereas if the student has access to television, the average in critical reading is 0.15 points more compared with a student who does not have access to TV, in social and citizen studies the average is 0.29 points less compared with a student without this service, also, in mathematics, English and social studies, coefficients are not statistically significant. When students have a computer at home, the average in mathematics is of 1.42 points, in English is of 1.43 points, in critical reading is of 1.03 points, in natural sciences is of 1.37 points and in social and citizen studies is of 1.65 points more compared with students who do not own a computer. As for the school's facilities, technical schools have a lesser effect compared with academic schools, this negative effect is observable

in the five subjects of the study and even more so in English, in which the average is of 0.66 points less than academic schools. Whereas for technical and academic schools the effect is positive in almost every subject, except in mathematics, in which the coefficient is not statistically significant.

On the other hand, in terms of the school's gender, if students come from all-male schools there is greater effect in mathematics and natural sciences compared with all-female schools; in English and critical reading, the effect on scores is better; for social and citizen studies the coefficient is not statistically significant, therefore empirical evidence is lacking in terms of the effect of an all-male school on the score of social and citizen studies. Likewise, if students come from co-ed schools, the effect in the five subjects is below that for all-female schools, English shows the greatest difference with 3.96 points less. Regarding enrollment in public or official schools, the effect is below that of private schools; it was also found that students in public schools get an average of 0.26 in math, in English of 1.92, in critical reading of 0.33, in natural sciences of 0.32 and in social and citizen studies of 0.69 points less compared with students enrolled in private schools. Pertaining to location, schools in urban areas have a greater effect than schools in rural areas; in that sense, a student gets an average in mathematics of 2.13 points, in English of 1.49 points, in critical reading of 1.90 points, in natural sciences of 1.39 points and in social and citizen studies of 1.75 points more compared with a student who comes from a school in a rural area.

In terms of the morning school session, students get an average in mathematics of 2.31 points less, in the afternoon session, students get an average in mathematics of 3.06 points less and in the night or Saturday session, students get an average in mathematics of 9.40 points less than schools with full or daily session. Likewise, it was found that students in the morning session get an average of 2.33 points less in English than those in the afternoon session, 2.71 points less than those in the night or Saturday session, 7.38 points less than a school with full or daily session. This effect is the same for critical reading, natural sciences, and social and citizen studies. If students are enrolled in bilingual schools, they get an average of 1.01 points more in English than a student in a non-bilingual school; yet this effect is negative in the other subjects, in critical reading the average is of 0.37, in natural sciences it is of 0.11, in social and citizen studies it is of 0.25 points less and in mathematics it is not statistically significant.

In terms of the R-squared measure of goodness of fit, the cross-sectional combination model for mathematics indicates that the variation of the set of explanatory variables accounts for 25.62% of the performance in mathematics. In English, the R-squared indicates that the variation of the set of explanatory variables accounts for 30.69% of the performance in English. In critical reading, the R-squared was of 0.2300, for natural sciences it was of 0.2422 and for social and citizen studies it was of 0.2139.

Table 3 illustrates the effect in time, it considers each subject as dependent variable and includes each of the binary variables of temporality to see its effect in time; it can be seen that the average per

subject has changed in time. For 2014, the average in mathematics was of 52.30 points, in English of 55.05 points, in critical reading of 52.56 points, in natural sciences of 52.49 points, and in social and citizen studies of 53.17 points.

Subject	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies
Variables	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
2015	0.104431***	0.33551***	-0.31751***	0.03726**	-0.15798***
2016	0.73005***	1.92253***	2.52537***	2.53169***	0.54473***
2017	0.13049***	-0.39070***	3.25304***	1.27500***	0.32839***
2018	0.30173***	0.73878***	2.65473***	-0.38658***	-1.6734993***
2019	0.59154***	-1.62685***	2.14840***	-1.79047***	-3.76919***
Constant	52.2970***	55.0500***	52.5588***	52.4868***	53.1744***

Table 3

Effect in Time

Source: compiled by the authors. Significance level (* at 10%, ** at 5% and *** at 1%)

In 2015, the average in mathematics was of 52.40 points, in English of 55.39 points, in critical reading of 52.24 points, in natural sciences of 52.52 points and in social and citizen studies of 53.02 points. For 2016, the average in mathematics was of 53.03 points, in English of 56.97 points, in critical reading of 55.08 points, in natural sciences of 55.02 points and in social and citizen studies of 53.72 points. In 2017, the average in mathematics was of 52.43 points, in English of 54.66 points, in critical reading of 55.81 points, in natural sciences of 53.76 points and in social and citizen studies of 53.50 points. In 2018, the average in mathematics was of 52.60 points, in English of 55.79 points, in critical reading of 55.21 points, in natural sciences of 52.10 points and in social and citizen studies of 51.50 points. In 2019, the average in mathematics was of 52.89 points, in English of 53.42 points, in critical reading of 54.71 points, in natural sciences of 50.70 points and in social and citizen studies of 49.41 points.

Table 4 presents the effect of gender in time, the variable's interaction is taken with the regularity to specify the effect between individuals and time, it can be seen that for the base year (2014), the effect of the male gender is positive in mathematics, English, natural sciences and social and citizen studies, while it is negative in critical reading. Likewise, it is concluded that the difference between a male and a female student has been sustained in time only in mathematics and natural sciences, whereas the difference in English, critical reading and social and citizen studies has been sustained in some years.

Subject	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies
Variables	***Coeff.***	***Coeff.***	***Coeff.***	***Coeff.***	***Coeff.***
Gender	2.3959***	0.6012***	-1.7511***	1.8194***	1.6408***
2015	0.6914***	0.2330***	0.0774***	--	--
2016	1.2990***	1.9966***	2.8557***	2.0062***	0.6945***
2017	0.8538***	-0.2387***	3.4042***	1.2312***	0.7822***
2018	0.6684***	1.1877***	2.9225***	-0.4072***	-0.9837***
2019	1.3765***	-1.2249***	2.5024***	-1.6290***	-3.3717***

Table 4

Effect in Time of Gender

Source: compiled by the authors. Significance level (* at 10%, ** at 5% and *** at 1%).

Subject	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies
Variables	***Coeff.***	***Coeff.***	***Coeff.***	***Coeff.***	***Coeff.***
Part of an Ethnicity	-0.579***	-0.293***	-1.884***	-0.628***	0.315***
2015	-3.517***	-0.804***	-2.414***	-3.093***	-3.358***
2016	-3.599***	-0.976***	--	-1.000***	-3.011***
2017	-4.351***	-2.772***	-0.471***	-1.918***	-2.663***
2018	-4.103***	-2.319***	-1.431***	-3.844***	-5.069***
2019	-3.604***	-5.262***	-1.894***	-5.196***	-6.955***

Table 5

Effect in Time of Being Part of an Ethnicity

Source: compiled by the authors. Significance level (* at 10%, ** at 5% and *** at 1%)

Table 5 shows the effect in time of being part of a minority ethnicity; for the base year (2014), the difference of being in a minority ethnicity is negative in all of the subjects. In conclusion, the difference of a student being in a minority ethnicity compared with one who is not has been sustained in time in the subjects.

Table 6 introduces the effect in time of having a job, the variables are specified in their base levels to evince the effect of each one and disregard a possible correlation between variables; for the base year (2014), the difference for employed students is negative in mathematics, English, critical reading and natural sciences, and positive for social and citizen studies. Likewise, it is concluded that the difference between students who work and those who do not has been sustained in time in mathematics, English, critical reading, and social and citizen studies, but not for natural sciences.

Subject	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies
Variables	***Coeff.***	***Coeff.***	***Coeff.***	***Coeff.***	***Coeff.***
Employed	-0.643***	-0.647***	-2.402***	-1.116***	0.126***
2015	-0.576***	--	--	-0.168***	-0.908***
2016	-0.229***	0.500***	2.372***	2.081***	-0.184***
2017	-1.328***	-2.138***	2.197***	0.517***	-0.798***
2018	-1.216***	-1.037***	1.640***	-1.310***	-2.829***
2019	-0.628***	-3.784***	1.021***	-2.626***	-5.037***

Table 6

Effect in Time of Having a Job

Source: compiled by the authors. Significance level (* at 10%, ** at 5% and *** at 1%).

Subject	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies
Variables	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
Con Internet	0.523***	0.548***	0.131***	0.700***	1.505***
2015	0.610***	0.626***	-0.833***	--	0.194***
2016	1.188***	2.783***	2.015***	2.397***	0.999***
2017	0.432***	0.468***	2.380***	1.166***	0.792***
2018	0.542***	1.819***	1.930***	-0.260***	-0.945***
2019	0.817***	-0.160***	1.470**	-1.588***	-3.027***

Table 7

Effect in Time of Having Access to the Internet at Home

Source: compiled by the authors. Significance level (* at 10%, ** at 5% and *** at 1%).

Table 7 shows the effect in time of having access to the Internet at home; for the base year (2014), the difference is positive in mathematics, English, critical reading and natural sciences, and social and citizen studies. Likewise, the difference between students with access to the Internet compared with a student without access has been sustained in time in mathematics and English, but not in natural sciences, critical reading, and social and citizen studies; the latter was sustained until 2018.

Table 8 addresses the effect in time of having a computer at home; for the base year (2014), the difference between having a computer is positive in mathematics, English, natural sciences, and social and citizen studies, and negative in critical reading. The difference between students with a computer at home and those who do not have one has been sustained in time in mathematics, English and natural sciences, but not for critical reading, in social and citizen studies it was sustained until 2018.

Subject	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies
Variables	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
Has a PC	0.888***	0.578***	0.191***	1,.055***	2.034***
2015	0.521***	0.537***	-0.718***	0.046**	0.138***
2016	1.138***	2.641***	2.116***	2.432***	0.865***
2017	0.370***	0.425***	2.510***	1.180***	0.655***
2018	0.476***	1.735***	1.997***	-0.314***	-1.148***
2019	0.787***	0.140***	1.572***	-1.610***	-3.168***

Table 8

Effect in Time of Having a Computer at Home

Source: compiled by the authors. Significance level (* at 10%, ** at 5% and *** at 1%).

Table 9

Effect in Time of Having TV Service at Home

Source: compiled by the authors. Significance level (at 10%, ** at 5% and *** at 1%).*

Table 9 shows the effect in time of having TV service at home, one year was considered for comparison purposes and to establish an analysis that includes the behavior of variables for each year in the period. For the base year (2014), the difference between having TV service at home is negative in mathematics, English, critical reading and natural sciences, and positive in social and citizen studies. Equally, it is concluded that the difference between a student having TV service at home compared with one who

does not, has not been sustained in time in mathematics, English, critical reading, natural sciences and social and citizen studies.

Subject	Mathematics	English	Critical Reading	Natural Sciences	Social and Citizen Studies
Variables	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
TV Service	-0.376***	-0.465***	-1.168***	-0.308***	0.376***
2015	0294***	0.423***	-0.636***	--	--
2016	0.846***	2.237***	2.146***	2.393***	0.650***
2017	0.222***	--	2.618***	1.354***	0.517***
2018	0.303***	1.170***	2.033***	-0.313***	-1.476***
2019	0.545***	-1.053***	1.513***	-1.696***	-3.597***

Table 9
Effect in Time of Having TV Service at Home
Source: compiled by the authors. Significance level (* at 10%, ** at 5% and *** at 1%).

Discussion and Conclusion

Based on students' personal characteristics, it can be concluded that there is a difference in gender, in which men get a higher scores than women in all of the subjects, the difference is larger in mathematics and natural sciences; this can be compared with OECD's results referring to an existing gender gap in the aforementioned subjects. In terms of students being part of a minority ethnicity, it was found that they score less than students who are not; this is also evinced in academic performance attained in the five subjects, revealing social inequality in the levels of quality of education for the country's minority populations. The effect on academic performance of students being employed is negative in the five subjects; also, this effect is more noticeable in English and social and citizen studies due to the fact that students must split their time between school and on the job, taking away dedication time to the academia.

In terms of the students' familial characteristics, parents' education drives an effect on academic performance; mostly in English and mathematics; the mother's education generates greater score than the father's education. These results resemble those by Gaviria and Barrientos in 2001, who revealed that educational level significantly influences children's education. On the other hand, parents' occupations affect students' performance in the subjects, depending on the type of occupation; in mathematics, both parents' occupation affect scores less than if they are entrepreneurs; yet in the other subjects, this difference varies depending on the occupation, if the father deals with house chores, the impact is larger compared with the mother's; this effect is negative in the subjects' score, but if the mother deals with house chores it is positive only in natural sciences and social and citizen studies, to a lesser extent.

Based on students' socioeconomic characteristics, it was found that the SEL has a positive effect on academic performance, affecting the score in English more than any other subject's score. Conversely, the effect on academic performance of the number of people and rooms in the household decreases as the number of people and rooms in the household increases.

On the other hand, students with access to the Internet and a computer get higher scores compared with those who do not have access to these tools. The effect of students having TV service is larger in critical reading, whereas it is smaller in social and citizen studies, in mathematics, English and natural sciences this variable is not statistically significant. These results show that the country's socioeconomic conditions influence academic performance, as asserted by Tejedor and Caribe and Fuchs and Wößmann in the literature.

Concerning the schools' characteristics, this variable was found to have less effect on academic performance for students enrolled in technical schools compared with students enrolled in academic schools. If the school is co-ed, the effect is negative in all of the subjects compared with an all-female school. In terms of public schools, the effect on academic performance is below that of private schools, this difference is more evident in English. The effect on academic performance of schools located in urban areas is greater than in rural areas, this effect is higher in mathematics.

In terms of the school session variable, it drives a negative effect on academic performance in all of the sessions compared with the full or daily session; this difference is similar in the five subjects, the impact is greater if students are enrolled in night or Saturday sessions. Similarly, students in bilingual schools have a positive effect in English, yet the effect is negative in the other subjects, except for mathematics, which is not statistically significant. The aforementioned reveals that the country's quality of education is not the same for all of the students, although the same public policy applies, differences in schools affect students' training, and ultimately, their academic performance.

As to the effect in time of academic performance, the average has risen only in mathematics, and the average has varied throughout the years in the other subjects. On the other hand, the difference between being a male student or a student with a job has been sustained only in mathematics; for students who are part of a minority ethnicity, the difference has been sustained in time. Variables such as access to the Internet and a computer have had their difference sustained in mathematics and English, for the other subjects, the difference has varied; the difference of having TV service has also varied in time.

To conclude, academic performance is defined by personal, familial, socioeconomic and school factors, furthermore, there is a social and economic gap affecting performance. Moreover, the results of this research may be used as bases for further studies pertaining to the educational outlook in Colombia and as grounds for new policies that counteract persistent educational difficulties and the population's social and economic gap.

Further research is recommended to extend the scope to higher education in order to evince if the school's characteristics have the same impact when becoming part of higher education, or to conduct specific analyses of the characteristics undertaken in this work aimed at including

policies that allow to bridge the existing gaps and to deal with them properly.

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