

Article

# Exploring the Relationship between Saber Pro Test Outcomes and Student Teacher Characteristics in Colombia: Recommendations for Improving Bachelor's Degree Education

Paola Sáenz-Castro <sup>1</sup>, Dimitrios Vlachopoulos <sup>2,\*</sup> and Sergi Fàbregues <sup>3</sup>

- <sup>1</sup> Proyecto Unidad Pedagógica de las Licenciaturas, Vicerrectoría Académica, Universidad del Cauca, Popayán 190003, Colombia; paolasaenz@unicauca.edu.co
- <sup>2</sup> Faculty of Digital Media & Creative Industries, Digital Society School, Amsterdam University of Applied Sciences, 1091 GM Amsterdam, The Netherlands
- <sup>3</sup> Department of Psychology and Education, Universitat Oberta de Catalunya, Rambla del Poblenou, 156, 08018 Barcelona, Spain; sfabreguesf@uoc.edu
- \* Correspondence: d.v.vlachopoulos@hva.nl

**Abstract:** This explanatory sequential mixed methods study explores the perceptions of academic and administrative managers responsible for teacher training at a public university in Colombia, as well as their views on improving such training after learning about the performance of teachers student teachers in the 2019 Saber Pro test, the differences in their test scores, and the relationships and statistical correlations between these outcomes and the students' personal, family, socioeconomic and academic characteristics. Our findings show significant differences in the student teachers' mean scores and performance when data are grouped according to personal, socioeconomic and academic conditions; a significant relationship between performance and student teacher characteristics; and correlations between critical reading scores and the other competencies assessed. Our data also highlight the lack of knowledge among academic and administrative managers about students' life circumstances and the diversity of factors that may impact their performance; the importance of correlational data; the difference between expected and true outcomes; the inequity under which students seem to pursue their education; the limitations in access to resources; the training required for teachers to be able to analyze quantitative data and use specific software; the impact of teachers' critical reading skills on student outcomes; the importance of data-driven decision-making; and the need for teachers to engage in quantitative research practices.

**Keywords:** standardized test; Saber Pro; student characteristics; mean score differences; correlations between competencies; academic performance; improvement



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## 1. Introduction

In what is commonly known as the Coleman Report, renowned sociologist James Coleman argued that sociodemographic factors could account for differences in students' scores and that school resources and teachers' education do not have a noticeable effect on student performance. Since the Coleman Report was published in 1966, researchers have debated the impact of education policies and the school system on student performance, in addition to other environmental and sociodemographic effects [1].

Improving the quality of education is an important factor for development, especially in Latin America, a part of the world with large student achievement gaps that are a reflection of substantial income inequalities [2]. Previous research has claimed that correlations exist between a district's level of development and student outcomes in Costa Rica; that a student's neighborhood has the greatest impact on educational performance; that the quality of services such as electricity and telecommunications is strongly related to student performance in Costa Rica; that information and communication technologies have

a positive effect on educational quality in Mexico; that individual and family variables are more closely linked to academic performance than school variables; and that social development has a positive effect on students' scores [2–6]. Other international studies [7] highlight the effect of professional community on student achievement, as well as the importance of student engagement [8–10] and quality management/culture [11]. Exploring the relationship between quality and equity in education and identifying factors that can reduce the impact of students' backgrounds on learning outcomes are important issues for research, policy development and teaching practices, especially when the focus is on enhancing educational quality [12].

Meanwhile, educational data mining (EDM) and learning analytics have the ability to influence current teaching and learning models. The primary goals of EDM include improving assessment techniques, reducing dropout rates, recommending resource materials based on prior learning, performing measurements, and ensuring students' self-actualization [13]. In this vein, the Colombian Institute for Educational Evaluation (<http://www.icfes.gov.co> accessed on 10 May 2020) has annually or biannually published the results of Saber Pro, a standardized test taken by Colombian higher education students, since 2006.

## 2. Literature Review

In order to draw an accurate picture of quality in education, we need a set of criteria that allows us to assess the procedures used to determine it [14,15]. In this regard, the analysis of standardized test results must overcome one of its greatest obstacles: the inability to delve into the reality of the individual, the student or the institution. Studies show that children living in extreme poverty, deprived of basic needs such as food, clothing or shelter, or lacking utilities such as electricity or internet access are more likely to perform poorly in school and drop out [16,17]. Knowing each item assessed on a standardized test and what it measures is as important to the practice of teaching as defending the idea that quality in education goes far beyond quantitative results [14].

With respect to data analysis, universities' digital culture involves the adoption and use of information and communication technologies, as well as the creation of methodologies and models based on these technologies [18]. In this data-driven landscape, teachers will serve as catalysts for learning success, as they will be capable of analyzing data to better comprehend their own teaching actions, the type of students in their classrooms, and the learning outcomes their students achieve [19,20].

Today, education-focused research is supported by advanced equipment and software that are able to apply statistical techniques to optimize the collection of valuable information from massive datasets [21]. This, in turn, makes it possible to come up with improvement actions and plans that account for the link between individual and family variables and student performance in Latin America [2] and the impact that sociodemographic factors have on learning outcomes. Data analysis could be used to bridge teaching pathways, with joint plans combining curricular proposals and economic resources mapped out to boost students' progress and encourage them to stay in school. This could help meet the need to lay down common objectives in different areas in order to make progress in complex contexts [22–25].

### 2.1. Quality in Education

In 1998, UNESCO defined quality in higher education as a multidimensional concept that should recognize and include functions or activities such as teaching and academic programs, research and scholarships, infrastructure, and the academic environment. According to the Colombian Ministry of National Education in 2009, educational quality meant ensuring that all students have opportunities to be productive and engage in lifelong learning. Then, in 2011, it was reworded to mean the creation of legitimate opportunities for progress. The National Accreditation Council (CNA) defines quality as the synthesis of

characteristics that allow a program or an institution to make judgments on the relative distance between how things are and how they should optimally be.

## 2.2. *What to Do with Standardized Tests in Education*

Research has shown that teachers, schools and countries that are effective in terms of quality tend to be effective in terms of equity as well [26]. However, standardized tests in higher education seem more focused on assessing education itself, rather than assessing for educational purposes. So, rethinking assessment methods could lead to changes in curricula [27]. Multilateral organizations are promoting education reform, and standardized tests offer the statistical indicators that these organizations are looking for in order to devise strategies that eventually become government policies in different countries [14,28–30]. When this type of test yields unfavorable results, government agencies deliver recommendations without a critical understanding of the solutions they are proposing, and they prioritize reproducing quantitative test data over exploring the implications for education [31–35]. In addition to the above problem, the Colombian law allows professionals from any area to be recognized as teachers at any level of education. As a result, the education system expects professionals who are unfamiliar with data analysis and data-driven decision-making to propose reform strategies that will have an impact on millions of children and adolescents. A change in this regard requires broad political and academic resolve, as well as strategies for qualifying teachers at all levels.

There has been considerable research into Saber Pro tests in recent years, and the consensus is that results-oriented courses are scarce [35–37] and that they depend on developments in other program cycles and on teachers themselves [38–40]. Previous research has called for updated pedagogical, methodological and didactic strategies in undergraduate education and for a critical look at how learning and teaching styles affect results [40,41]. Researchers have also suggested that statistical data analysis is key to improving educational quality [36,37,42–44] and that discussions are needed to assess educational quality [41,42].

## 2.3. *Political Action from Educational Data Mining and Learning Analytics*

The International Conference on Learning Analytics & Knowledge defines learning analytics as “the measurement, collection, analysis, and reporting of data about students and their contexts for the purpose of understanding and optimizing learning and the environments in which it occurs” [45]. Educational data mining (EDM), for its part, is an approach centered around developing methods for exploring unique data types to understand students and the environments in which they learn, so as to make lessons more effective. Although learning analytics are an essential part of online learning environments, teachers must also understand how to use data mining in education to make decisions based on otherwise unknown and potentially useful data patterns [46–48]. Bearing in mind that student success is a quality parameter of higher education institutions and that EDM techniques help to find relevant patterns and data, information about students’ life circumstances should be included to improve learning [49]. This is also called learning analytics [13] and is a source of political actions.

The importance of interpreting student data lies in establishing progress parameters, detecting problems in order to identify social connections, integrating pedagogy into data mining [50–52] and allowing for better decision-making [18,52]. Learning analytics can help to reduce educational achievement gaps [19,53,54]. Moreover, if they were to extend their interpretive scope beyond outcomes, scores and performance to account for students’ life circumstances as well, they could become a key tool for shedding light on and helping to close the invisible divide at different educational levels. Such analytics could lead to actions such as intervention, optimization, alerts and warnings, guidelines and pathways, and systemic improvements in planning or teaching [55]. Whatever the case may be, learning analytics face some important challenges, namely, assuring the quality and scope of the data gathered and the privacy and ethics of any analyses carried out thereon.

Educational institutions can restructure learning design processes based on analyses, meaning that teachers can incorporate feedback from these analyses into the future design of learning content and also customize content by including their personal understanding of a topic and previous experience [55]. In short, they can use analysis-derived information to make informed pedagogical decisions [56].

Currently, data analysis is not part of the required curriculum for undergraduate student teachers in Colombia, who therefore lack the necessary depth and rigor to use data to make education-related decisions. However, if students' socioeconomic level and teachers' subject knowledge are to be considered predictors of academic performance [57], this type of training has good reason to be enhanced.

This study is driven by our interest in acknowledging the characteristics of student teachers assessed in the 2019 Saber Pro standardized tests, and in offering insight to the academic and administrative managers responsible for teacher training in a Colombian public university into how these students' scores/performance statistically relate to their personal, family, socioeconomic and academic characteristics. This approach, which was new to some of our interviewees, opens the door to actions that promote change or improvements for the benefit of future education professionals. It is here where educational data mining and learning analytics surface as a source of political action.

#### *2.4. Learning Analytics and the Link between Higher Education and Other Educational Levels*

While increased attention has been given to higher education in Colombia, it is unfortunately not under any quality education plan involving continuous education for individuals. This is evidenced by the percentage of students dropping out of higher education, as well as by the direct relationship between these dropout rates and the competencies, knowledge and skills achieved by students at previous educational levels. Although efforts to improve national productivity are important, they will not be sufficient if student development is not considered a continuous process that seeks to strengthen cognitive development. Colombia has proposed bridging the gap between secondary and higher education, albeit from a perspective of coordination with the productive sector. This is at odds with the fact that curricular connections are meant to act as a two-way link between universities and their surrounding context, as well as between theory and practice. A curriculum whose design is based on competencies, active pedagogies and flexibility allows students to choose according to their interests and lays the foundation for new interinstitutional alliances that promote collaboration across any field, subject area, time of year, semester or credit system [58–61]. If connections between secondary and higher education facilitate progress in complex contexts and curricula become bridges for activity between universities and their surrounding context, administrative support will be more likely to focus on students' education [58,61].

The challenge is to optimize learning, satisfy political interests and exploit available data to descriptively, predictively or prescriptively analyze solutions [19,54]. In this way, it is possible to envision the bridging of teaching pathways as a process in which educators coordinate plans and programs, accounting for previous learning achievements and paving the way for students to make progress. Curricular proposals, learning pathways, pedagogical models, institutional agreements and economic resources would all come together in this scenario [22].

### **3. The Saber Pro Standardized Test in Colombia**

The purpose of the Colombian Institute for Educational Evaluation (ICFES) is to assess the quality of education at all levels through standardized external examinations. It is the Ministry of National Education (MEN) that determines what should be tested in these examinations (Law 1324 of 2009). The ICFES has worked on aligning the National System of Standardized External Evaluation, making it possible to compare results at different educational levels, since different examinations evaluate the same competencies, particularly general competencies, in some areas. Saber Pro is a requirement for students

to earn their bachelor's degree. It aims to verify that students have correctly developed the target competencies of their degree, to produce value-added indicators, and to track indicators that assess the quality of higher education programs and institutions.

#### *Exam Structure*

The Saber Pro test has a mandatory first sitting consisting of five modules that assess general competencies: critical reading (30 questions); quantitative reasoning (30 questions); citizenship skills (30 questions); written communication (1 question); and English (45 questions). Test takers may also opt for a second sitting made up of specific modules, which, in the case of teachers in training, are educating, teaching and evaluating. For the written communication module, the test poses an open-ended question or a topic, based on which students are asked to write an argumentative text. The other modules pose multiple choice questions with only one possible answer.

The ICFES website [62] provides an overview of the consolidated test results, including personal information (gender); geographic location (department, municipality and area of residence); academic data (cost of tuition and form of payment, semester in progress at the time of test submission); socioeconomic data (parents' level of education, parents' type of employment, socioeconomic stratum, access to the internet, television, a computer and other services, number of people with whom they share a bathroom, hours of work per week); information on the higher education institution (degree program); and results (scores and performance in the general and specific competencies assessed).

Based on data on residential properties from the DANE ("Statistics and data of Colombian government"), socioeconomic strata is a proxy measure of the economic and social development of the different areas of a municipality, as it classifies households according to their characteristics and living conditions. Socioeconomic strata range from one to six, with stratum one indicating lower living conditions and stratum six indicating higher living conditions.

#### **4. Objectives and Research Questions**

Learning analytics are a necessary tool for defining improvement strategies and actions. This holds true both for higher education institutions engaged in quality assessment (measured by means of standardized test results) and the teachers who assume the new role of analysts. Through our analysis, we hope to lay the groundwork for methods and techniques that will help decision makers find meaningful insights in the data gathered in the Saber Pro test.

This explanatory sequential mixed methods study seeks to provide academic and scientific communities in higher education with input on how to exploit the results of standardized tests, focusing on the relationship between student teacher characteristics and their scores and performance in the saber Pro test. In doing so, we aim to strengthen learning processes at all levels of education in Colombia by addressing the differences in subjects and contexts, identifying contextual needs and closing the gap between educational levels. We believe that the findings of our study may serve as a springboard for improving teacher training programs and higher education institutions, as well as for setting viable objectives to promote educational quality and equity. In pursuit of these goals, our study also explores the perceptions of academic and administrative managers responsible for teacher training at a public university, as well as their initial ideas for improving such training after learning about the performance of student teachers in the 2019 Saber Pro test, the differences in their test scores, and the relationships and statistical correlations between these outcomes and the student teachers personal, family, socioeconomic and academic characteristics.

Considering the possibilities for establishing interinstitutional alliances and thus fostering curricular engagement, the following research questions are addressed:

- What are the differences and relationships between student teachers' scores and performance on the 2019 Saber Pro test and their personal, sociodemographic, socioeconomic and academic characteristics? (RQ1);
- What are the views of academic and administrative managers of teacher training at a public university in Colombia regarding the quantitative results? (RQ2);
- In what ways do these academic and administrative managers believe those results can help bridge the gap between higher education and other educational levels? (RQ3).

## 5. Research Methods

We used an explanatory sequential mixed methods design, based on an initial quantitative phase and a subsequent qualitative phase. In the quantitative phase, we aimed to find any statistically significant differences, relationships and correlations between the 2019 Saber Pro test outcomes and the student teachers' family, socioeconomic, personal and academic characteristics. Then, in the qualitative phase, we showed the results of our quantitative analyses to a sample of academic and administrative managers (Figure 1). We sought not only to gather their perceptions, but also to learn about their initial ideas for improving teacher training and fortifying the bridge between higher education and other educational levels in light of the quantitative results.

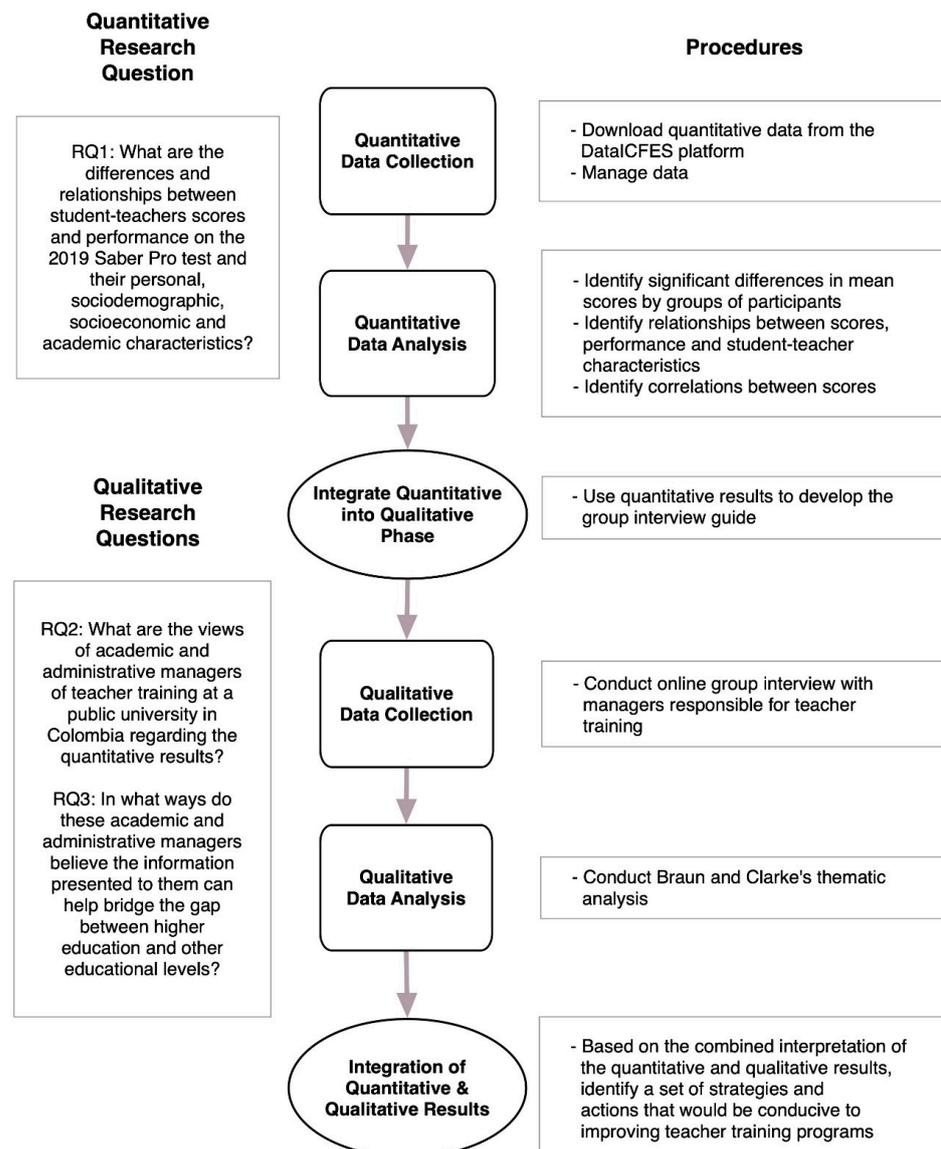


Figure 1. Explanatory mixed methods sequential design.

### 5.1. Quantitative Phase

Quantitative secondary data were taken from a public university in the southwest region of Colombia. The file containing the national results of the 2019 Saber Pro test ( $n = 187,469$ ) was downloaded, filtered by institution ( $n = 1763$ ) and academic program. As a result, our data analysis focused on the outcomes of 298 student teachers. The independent variables were: (1) personal characteristics (gender); (2) socioeconomic characteristics (area of residence, cost of tuition, form of payment, parents' level of education, parents' type of employment, socioeconomic stratum, services available, number of people with whom the bathroom is shared, hours of work per week, pay); and (3) academic characteristics (semester in progress, name of the academic program). The dependent variables were: (1) scores in general competencies; (2) performance in general competencies; (3) scores in specific competencies; and (4) performance in specific competencies. A description of the values of the variables used in this study is provided in Table A1.

JASP statistical software was used to analyze the data. Data were entered into the software and the variables were organized. Missing values and outliers were processed. Descriptive analyses were carried out, including frequency, central tendency values and variance. For significant mean difference, a Student's *t*-test was used for a factor and another Student's *t*-test was run for the independent samples and the ANOVA test factor. To select the appropriate test for comparing differences between two independent samples, we used the Shapiro–Wilk test to assess the normality of the variables. Based on these results, we used Student's *t*-test when the two samples had equal variances, Welch's test when the variances were unequal, and the Mann–Whitney test when the distribution was not normal. For the ANOVA analysis, we used Levene's test to assess the homogeneity of the variances between the groups. When the homogeneity assumption was not met, we used the Kruskal–Wallis test to assess the significance of differences across the participants' scores. Finally, to test the significance of the relationship between the qualitative variables, we ran a chi-squared test, and for the quantitative variables, we used the Pearson correlation coefficient, Spearman's rho or another test that was deemed relevant given the attributes of the variables to be related.

### 5.2. Qualitative Phase

Purposive sampling was used to bring together a group of individuals in charge of drawing up program and institutional improvement plans at the abovementioned public university in Colombia. The resulting sample was made up of a quality manager from the Central Curricular Committee, the academic vice president, the head of the Office of Accreditation and Quality, and eight coordinators of the following nine bachelor's degree student teacher programs: physical education, recreation and sport, art education, Spanish and literature, modern languages (English and French), Spanish and English, mathematics, music, and ethno-education. Since the work of these eight coordinators is evaluated by the head of each respective Department and not by the three managers attending the meeting, they could express their views openly and transparently.

Participants were recruited by the first author who coordinated an institutional project in which regular meetings were held with the bachelor's degree coordinators and the quality manager. In one of these meetings, a group interview was carried out using Google Meet, which also included the academic vice president of the university and the head of the Office of Accreditation and Quality. During the interview, the results from the first quantitative phase were presented to the participants, bearing in mind that students at this higher education institution sat the 2019 Saber Pro test. The aims of the interview were twofold: firstly, to examine participants' perceptions of the quantitative results; secondly, to explore their views on the utility of these results in driving actions to improve their degree programs and the institution as a whole, as well as in building bridges between higher education and other educational levels. The interview guide included the following two questions: (1) What results particularly caught your attention? (2) In light of the results presented, what strategic actions do you think could be included in program and

institutional improvement plans to strengthen ties between higher education and other educational levels?

The group interview was audio and video recorded and transcribed verbatim. Transcripts were uploaded into the qualitative data analysis software QDA Miner Lite v 2.0.8. We followed Braun and Clarke's [63] approach to thematic analysis, which consists of six phases: (1) familiarization with the data; (2) initial code generation; (3) search for topics; (4) review of topics; (5) designation of topics; and (6) preparation of the report. During this process, we repeatedly read the transcribed data in search of patterns, and then coded and qualified these patterns to form themes. Codes and issues were identified in the explicit or superficial meanings of the data, without looking at anything beyond what had been said when the participants mentioned something directly related to the questions posed. We have included extracts from our data below in order to substantiate the answers to our research questions. The coding and analysis of the qualitative data were made by the first author under the supervision of the second author. Any disagreements arising at this stage were discussed by the first and second author until a consensus was reached.

The interviews took place in May 2020. All participants gave their consent before being interviewed (Appendix A).

## 6. Results

### 6.1. Statistical Description of the Analyzed Data

Our study population had the following characteristics: 87.6% of the students were enrolled at the main campus; 93.6% studied on-site; 3% lived outside the department where the main campus is located and 21.5% lived in municipalities other than where the two campuses are located; 17.4% lived in rural areas; 85.5% paid less than USD 129 in tuition fees; 21.8% of the students' fathers did not finish elementary school and 20.7% finished their secondary school education (*bachillerato*); 25.1% of the students' mothers did not finish elementary school and 26.9% finished their secondary school education (*bachillerato*); 48.3% of students belonged to stratum 1 and 33.6% to stratum 2; 9.2% of students shared a bathroom with more than six other people; 18.1% of the fathers worked as farmers, fishermen or day laborers; 41.1% of the mothers were homemakers and neither worked nor studied; and 31% of the students worked between 11 and 20 h a week before registering for the exam.

As shown in Table 1, evaluating (Ev) and quantitative reasoning (QR) had the highest and lowest mean scores in our population, respectively. The population means exceeded the national means for all general competencies, with the exception of QR. Compared to the institution-wide means, only English (E) and written communication (WC) came out ahead.

**Table 1.** Mean scores in each competency assessed.

Competency Score	Population Mean	St Deviation	Std. Error of Mean	<i>p</i> -Value of Shapiro Wilk	Institutional Mean	Institutional Std. Deviation	National Mean	National Std. Deviation
Quantitative reasoning	138.557	27.349	1.584	0.037	159	33	147	32
Critical reading	155.926	25.438	1.474	0.092	161	28	149	31
Citizenship skills	141.195	29.58	1.716	0.004	151	33	140	33
English	157.351	32.566	1.893	0.005	155	30	152	32
Written communication	151.246	26.282	1.571	0.012	146	42	144	38
Educating	153.087	30.979	1.795	0.001				
Teaching	161.338	28.926	1.676	<0.001				
Evaluating	164.432	27.705	1.605	<0.001				

Note: The institutional and national average of the competencies Educating, Evaluating and Teaching is not included since not all students of the institution nor all students in the country present these modules.

Table 2 shows a breakdown of student performance in these general competencies. A large proportion of students fell into performance levels 1 and 2. Specifically, 71.4% were at level 1 or 2 for QR; 67.1% for citizenship skills (CS); 55.8% for WC; and 51.4% for critical reading (CR). With respect to the specific competencies, 75.9% of the students fell

into levels 2 or 3 for evaluating (Ev), 71.8% for teaching (T) and 67.8% for educating (Ed). However, we should also point out that almost a fourth of the students (24.8%) were in level 1 for Ed. Institutional regulations require students to be at level A2 in English (E) and national regulations require them to graduate at level B1 or higher if they have a foreign language focus. However, 62.3% of the students in our population were at level A2 or below and only 37.7% were at level B1 or above.

**Table 2.** Percentage of students by performance level.

Competency	Sample	Percentage of Students by Performance Level				
		1	2	3	4	
Quantitative reasoning (QR)	297 *	32.3%	39.1%	28.6%		
Critical reading (CR)	298	12.8%	38.6%	45.6%	3.0%	
Citizenship skills (CS)	298	32.2%	34.9%	31.9%	1.0%	
Written communication (WC)	280 *	7.9%	47.9%	31.4%	12.9%	
Educating (Ed)	298	24.8%	24.5%	43.3%	7.4%	
Teaching (T)	298	14.4%	28.2%	43.6%	13.8%	
Evaluating (Ev)	298	11.4%	25.2%	50.7%	12.8%	
English (E)	Sample	0	A1	A2	B1	B2
	297 *	17.2%	21.9%	23.2%	26.6%	11.1%

Note: \* The student missing from the total population did not take the module and was excluded from the analysis. English is the only module to have five levels of performance, following the Common European Framework of Reference for Languages. The "0" means that the student did not take the test or that their knowledge did not reach level A1.

### 6.2. Statistically Significant Differences in Mean Scores When Students Were Grouped by Their Characteristics (RQ1)

Tables 3 and 4 show statistically significant differences in mean scores when students were grouped by characteristics. A significant difference was found when grouping students according to gender (QR, Ev); if they pay the tuition with credit (CS, E); if the tuition is paid by parents (CR); according to some services the student has, such as internet (CR, E), a pc or laptop (E), a washing machine (E), or a tv (E); the cost of tuition (QR, E, WC, T, Ed, Ev); semester in progress (QR, E, WC, T, Ed, Ev); degree program (all skills evaluated); municipality of residence (E, T); father's level of education (CR, E); mother's level of education (T, Ev); socioeconomic stratum (E); mother's type of employment (Ed).

**Table 3.** Independent samples' *t*-tests.

Competency Score	Gender	Pay Tuition with Credit	Parents Pay Tuition	Internet	Available Services			Mode On-Site or Online
					Pc or Laptop	Washing Machine	Tv	
Quantitative reasoning (QR)	<0.001 (S)							<0.001 (W)
Critical reading (CR)			0.044 (S)	0.010 (S)				0.003 (S)
Citizenship skills (CS)		0.024 (MW)						
English (E)		0.003 (MW)		<0.001 (W)	0.012 (MW)	<0.001 (MW)	0.009 (MW)	<0.001 (W)
Written communication (WC)								
Educating (Ed)								
Teaching (T)								
Evaluating (Ev)	0.048 (S)							

Note: S: Student. MW: Mann-Whitney. W: Welch. A p value that is less than or equal to 0.05 denotes a statistically significant difference. Significant differences between mean scores when students are grouped by gender, enrollment data, available services and mode of instruction.

Table 4. ANOVA tests.

Competency	SE	<i>p</i> -Value of Shapiro-Wilk	Cost of Tuition		Semester in Progress		Degree Program		Municipality of Residence		Father's Educational Level		Mother's Level of Education		Socioeconomic Stratum		Mother's Type of Employment	
			<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F
Quantitative reasoning	1.579	0.039	0.004 *	4.320	<0.001 *	7.045	<0.001 *	8.521										
Critical reading	1.469	0.097					<0.001	5.184			0.049	1.829						
Citizenship skills	1.711	0.005					0.006 *	2.581										
English	1.886	0.005	<0.001 *	21.086	0.010 *	3.387	<0.001 *	43.046	<0.001 *	11.25	0.005 *	2.597			0.018 *	2.749		
Written communication	1.565	0.014	0.046 *	3.146	0.004 *	4.503	0.034 *	1.846										
Teaching	1.586	0.001	0.005 *	5.639	0.015 *	3.975	0.002 *	2.894	0.032 *	3.363			0.049 *	2.097				
Educating	1.789	0.005	0.003 *	6.027	0.009 *	3.661	0.013 *	2.551									0.011 *	2.356
Evaluating	1.494	0.010	0.001 *	6.224	0.014 *	3.252	0.021 *	2.197					0.026 *	2.116				

Note: A *p* value that is less than or equal to 0.05 denotes a statistically significant difference. Significant differences between mean scores when students are grouped by cost of tuition, semester in progress, degree program, municipality of residence, father's or mother's level of education, socioeconomic stratum and mother's type of employment. \* The Kruskal–Wallis test was used for non-parametric data.

6.3. Statistically Significant Relationships between Students' Performance and Characteristics, and Correlations between the Scores Achieved

Table 5 displays the significant relationships between categories. Among the competencies assessed, E is associated with the greatest number of student characteristics, while degree program is the characteristic that is associated with the greatest number of competencies. Table 6 shows the correlation between the scores achieved for the competencies assessed.

**Table 5.** Significant relationships between students' characteristics and their performance in the competences assessed.

Characteristic	P in QR	P in CR	P in CS	P in WC	P in E	P in Ed	P in T	P in Ev
Degree program	<0.001	<0.001	0.046	0.023	<0.001	0.046	0.019	
Mode of instruction	0.008		0.025		<0.001			
Father's level of education	<0.001				0.048			
Gender	0.011		0.013				0.037	
Hours worked per week					0.030			
Internet					<0.001			
Mother's level of education								0.030
Municipality of residence					0.011			
Oven	0.016							
No. of people with share the bathroom		0.019						
Socioeconomic stratum	<0.001							
Tuition paid in credit			0.003		0.031			
Semester in progress	<0.001			0.002		0.024	<0.001	<0.001
Cost of tuition	<0.001				<0.001		0.019	
TV	0.046			0.013				
Video game console	<0.001							
Washing machine					<0.001	0.030	0.039	

Note: P is performance; QR is quantitative reasoning; CR is critical reading; CS is citizen skills; WC is written communication; E is English; Ed is educating; Ev is evaluating; and T is teaching. A *p* value that is less than or equal to 0.05 denotes a statistically significant difference.

**Table 6.** Correlations between scores.

		<i>p</i> -Value for Shapiro-Wilk	Pearson		Spearman		
			<i>r</i>	<i>p</i>	<i>rho</i>	<i>p</i>	
Quantitative reasoning score	Critical reading score	0.034			0.269	***	<0.001
Quantitative reasoning score	Citizenship skills score	0.084	0.155	**	0.008		
Quantitative reasoning score	English score	0.049			0.042		0.470
Quantitative reasoning score	Written communication score	0.189	0.147	*	0.014		
Quantitative reasoning score	Educating score	0.679	0.293	***	<0.001		
Quantitative reasoning score	Teaching score	0.599	0.290	***	<0.001		
Quantitative reasoning score	Evaluating score	0.253	0.313	***	<0.001		
Critical reading score	Citizenship skills score	0.582	0.514	***	<0.001		
Critical reading score	English score	0.279	0.298	***	<0.001		
Critical reading score	Written communication score	0.285	0.120	*	0.046		
Critical reading score	Educating score	0.039			0.410	***	<0.001
Critical reading score	Teaching score	0.133	0.465	***	<0.001		
Critical reading score	Evaluating score	0.037			0.436	***	<0.001
Citizenship skills score	English score	0.318	308	***	<0.001		
Citizenship skills score	Written communication score	0.429	0.051		0.392		
Citizenship skills score	Educating score	0.015			0.383	***	<0.001
Citizenship skills score	Teaching score	0.002			0.279	***	<0.001
Citizenship skills score	Evaluating score	0.544	0.404	***	<0.001		
English score	Written communication score	0.371	0.209	***	<0.001		
English score	Educating score	0.118	0.047		0.424		
English score	Teaching score	0.680	0.061		0.299		
English score	Evaluating score	0.540	0.109		0.064		
Written communication score	Educating score	0.110	0.087		0.146		
Written communication score	Teaching score	0.193	0.084		0.163		
Written communication score	Evaluating score	0.970	0.024		692		
Educating score	Teaching score	0.004			0.481	***	<0.001
Educating score	Evaluating score	<0.001			0.656	***	<0.001
Teaching score	Evaluating score	0.044			0.635	***	<0.001

Note: The greater the number of asterisks, the greater the strength of the correlation: \* *p* < 0.05; \*\* *p* < 0.01; and \*\*\* *p* < 0.001.

#### *6.4. Perceptions of the Academic and Administrative Managers of Teacher Training Regarding Our Data Analysis of the 2019 Saber Pro Test Results, and Their Initial Ideas for Improvement (RQ2)*

For the qualitative phase of our explanatory mixed methods sequential design, we held a group interview with managers responsible for teacher training, as explained in the methods section. After being apprised of the results from the first quantitative phase, the participants expressed a general lack of knowledge about the diversity of factors affecting students' test outcomes ("as far as how well we know our students (...) this is revealing a very great lack of knowledge", P2). They noted the impact of family and socioeconomic characteristics on these outcomes ("the sociocultural and socioeconomic part showing how students' living and material conditions differ, that's where you can see how these conditions affect students' learning and academic performance", P2). When describing the potential reasons leading to these outcomes, participants pointed out a number of factors including the services available to students ("with internet and TV, you have greater opportunities for interaction", P11); the time spent on extracurricular activities such as work ("if their work is more in line with their professional aspirations, we can be more efficient and attain better results than if their work is far removed from what they have to do in their university studies", P11); the inequality with which students pursue their education ("students who belong to high strata achieved better results, while those belonging to low strata face difficulties", P4); and the limitations in access to resources ("in private universities, students receive a latest-generation mobile phone with all the apps they need, which keeps them from facing connectivity problems. We have to look at where to find the money to try and sort out these material issues that have an impact on learning", P2).

Teachers should be trained to analyze quantitative data and use specific software, especially if the higher education institutions they work for ask them for numerical data to support documents presented in program quality accreditation processes ("these reports, and the conditions under which [institutional] bodies request them, are more in line with this [data-driven] mindset", P1). This approach would provide crucial insights into the positive correlations between students' scores in CR and the other competencies assessed. Likewise, it would help explain the differences between expected and actual outcomes, as well foster data analysis-based decision-making. "It is not common to find such analyses, despite how important they are for decision-making" said one participant (P11). Indeed, they are essential for devising program improvement plans, defending decisions, identifying weaknesses, designing strategies and engaging experts ("I'm particularly struck by the use of mechanisms such as statistical analysis software to establish these relationships and links with information that we don't normally take into account", P1).

Teachers' critical reading skills may have an impact on student outcomes, which "leads us to think about how well we handle reading in our teaching practices, and not just any reading, but critical reading" (P11). Accordingly, teachers should be given the means to understand the aims and features of the Saber Pro test, as well as the requirements and conditions for taking it, "even if we teachers need to undergo training in critical reading in order to adequately guide our students" (P7).

Teachers must engage in quantitative research practices ("we're from the field of humanities, so it's very special for us to see this type of statistical analysis of the tests because it's objective, which is not something we consider very much as people with a more human-centered way of thinking", P7). Given how the institution handles standardized test results and the general lack of knowledge of the relationship between quantitative analysis and the humanities, the data given to the participants was "another vantage point from which to look at the tests, because what we had been doing was examining percentages and percentiles to review performance and think about how to improve our classes" (P6). Setting up interdisciplinary research projects "raises the likelihood that other colleagues will join in, allowing us to take advantage of all this information that we don't know exists but could prove extremely useful in decision-making" (P11). It would pave the way for universities to further analyze data from the Saber tests; to characterize student profiles ("it's a fundamental aspect upon which the university should develop research

processes so that we can get a more accurate and detailed picture of our students' living conditions", P2); to explore the impact of emotional factors and classroom activities on the outcomes achieved ("we stick to the academic and cognitive side of teaching and neglect the emotional part", P1); to examine the student–teacher relationship and its impact on student outcomes ("I still maintain that people are who they are regardless of their conditions. I believe that there are pedagogical encounters that inspire and challenge students to transcend their careers", P12); and to test the relationships between Saber 11 and Saber Pro test scores ("a comparative analysis of the results of the Saber 11 and Saber Pro tests would be vital, as it would show us how the students have improved in the various competencies after going through the program", P7).

#### *6.5. Perceptions of the Academic and Administrative Managers of Teacher Training on How the Information Presented Might Contribute to Bridging Higher Education and Other Educational Levels, and Their Initial Ideas for Improvement in This Regard (RQ3)*

Participants pointed out that communication between educational levels was poor ("there is a gap between secondary education and higher education, which makes students leave high school and take a very complex leap to university; these are two completely different ways of teaching and learning", P2). This study makes it possible to work jointly with other levels ("by teaming up with elementary and secondary education we can offer up our support and knowledge of the test, because English is tested in Saber Pro and English is tested in Saber 11", P4), or to plan, execute and evaluate strategies built around the development of competencies assessed on the Saber tests at various levels ("this should be discussed with the teachers in charge of elementary and secondary education. There is a path there, an action, so that we don't do it endogenously but rather by engaging with the other educational levels", P3). It also makes it possible to collect and systematize data from the test, as well as about students' life circumstances and the use of training scenarios ("there is a high percentage of students who are working (...) What can be done there in relation to graduates or with culture and well-being? To the extent that their work is more in line with their professional aspirations (...) we can be more efficient and obtain better results than if their work is far removed from their schoolwork, from the academic work they have to do at university", P11). In order to improve the practical training that university students receive in school at other educational levels, "one possible way to bridge the gap is through internships, setting up projects along those lines" (P9). The training that university teachers can give to teachers at other levels, discussing these subjects, can lead to actions and transformation ("once we as university teachers feel that we are competent and well trained, we can support that close link that should exist between universities and elementary and secondary schools, and also provide training support; then we can establish that link", P4). Schools should consider the academic community and the characteristics of higher education ("it seems to me that the university should establish a relationship with schools in such a way that they can better prepare final-year students, giving them a better understanding of what university is, what it's like and what academic processes take place at this level of education", P2).

## **7. Discussion**

Using an explanatory sequential mixed methods design, this study explores the perceptions of academic and administrative managers responsible for teacher training at a public university, as well as their initial ideas for improving such training after learning about the performance of student teachers in the 2019 Saber Pro test, the differences in their test scores, and the relationships and statistical correlations between these outcomes and the students' personal, family, socioeconomic and academic characteristics.

As mentioned above, learning analytics can help to reduce educational achievement gaps [19,54]. Thus, following Patil and Gupta [13], who claim that information about students' life circumstances can shed light on and help improve learning and learning environments, we set out to analyze the 2019 results of the Saber Pro standardized test taken by all bachelor's degree students in Colombia in relation to the characteristics of the

students who took it. Taking into account that education-focused research is now supported by software that optimizes the collection of valuable information from massive datasets [21], that universities' digital culture involves the adoption and creation of models of the information and communication technologies they possess [18], and that understanding each item assessed on a standardized test and what it measures is as important to the practice of teaching as defending the idea that quality in education goes far beyond quantitative results [14], we began by statistically describing the characteristics of the 298 bachelor's degree students from a public university in Colombia who sat the Saber Pro test in 2019.

*What are the differences and relationships between student teachers' scores and performance on the 2019 Saber Pro test and their personal, sociodemographic, socioeconomic and academic characteristics? (RQ1).* We identified statistically significant differences in the mean scores in the assessed competencies by grouping students according to their personal, family, socioeconomic and academic characteristics (RQ1). Our findings coincide with the claim that individual and family variables are linked to student performance in Latin American contexts [2]. Specifically, we identified significant mean score differences when students were grouped by gender, the father's or mother's level of education, and the mother's type of employment, besides the mode of instruction. Our interviewees' perceptions of the results emphasized the general lack of knowledge about what students who sit the Saber Pro test are going through in their lives, about the diversity of factors that may affect their scores and performance, and about the impact that some family and socioeconomic characteristics have on their outcomes. Identifying these factors is important for research, policy making and teaching, especially when the focus is on boosting quality [7]. It is also vital when development hinges on improving the quality of education, which is especially true for Latin America, a part of the world with large student achievement gaps that are a reflection of substantial income inequalities [2]. These claims are borne out by the statistical differences we uncovered when grouping students by stratum, by cost of enrollment, and by the services available to them (e.g., internet, computer, washing machine and TV). Our findings also support the idea that students' sociocultural, socioeconomic and living conditions affect their learning and academic performance.

In addition to finding a significant difference in mean scores in English when grouping students by stratum, we also identified a statistically significant relationship between stratum and student performance in QR. This coincides with the claim that there are correlations between a district's level of development and student results [3]; these comments are relevant because, for instance, seven of the nine degree programs we analyzed do not have foreign language on their study plans. It also bears out the findings of Vivas Pacheco et al. [4], who discovered a close link between the quality of Colombian students' local environment and the educational outcomes they are able to achieve. In particular, these authors claimed that a student's neighborhood has the greatest impact on educational performance. Our study found that students belonging to high socioeconomic strata achieved better outcomes, while those belonging to low socioeconomic strata seemed to struggle more. Giménez and Castro Aristizábal [5] emphasize the importance of seeking a level of infrastructure that covers basic housing needs such as electricity and telecommunications, arguing that the quality of these services is strongly related to student performance in Costa Rica. Similarly, Jiménez et al. [6] found that information and communication technologies (ICTs) have a positive effect on economic growth, innovation and high educational quality in Mexico. Studies show that children living in extreme poverty, deprived of basic needs such as food, clothing or shelter, or lacking utilities such as electricity or internet access, are more likely to perform poorly in school and drop out [16,17]. In this vein, we found a statistically significant relationship between having certain services (e.g., internet, an oven, a TV, a video game console or a washing machine) and students' performance in QR, E, WC, Ed and T. One of our participants stated that access to the internet or television gives rise to opportunities for interaction. In line with this, Gimenez et al., [2] shed light on the interaction between academic performance and social development, a scarcely explored

relationship due to a lack of data availability. These authors conclude that individual and family variables are more closely linked to academic performance than school variables, and that social development has a positive effect on scores. Our data point to a statistically significant relationship between student performance and the student's degree program, mode of instruction and semester in progress (school variables), as well as between student performance and the student's gender and the mother's and father's level of education (personal and family variables). Altogether, we found more statistically significant relationships between school variables and students' performance in the assessed competencies, thus contradicting Coleman [1].

Finally, we identified correlations between students' scores in the assessed competencies. The positive correlation between the CR scores and the scores in the other assessed competences caught our interviewees' attention, as success on the test appears to depend largely on knowing how to read critically.

*What are the views of academic and administrative managers of teacher training at a public university in Colombia regarding the quantitative results? (RQ2).* It is vital that we explore the relationship between the Saber Pro test and the indicators used to track the quality of university degree programs. Indeed, as stated by Rosero and Montenegro [63], educational quality implies developing an organizational culture oriented towards assessment and continuous improvement and innovation, which in turn implies deploying strategies that promote teaching, research and social outreach. This study supports the idea that testing in higher education can focus on assessment for educational purposes, so rethinking assessment methods could lead to changes in curricula [27]. Proof of this lies in the proposals made by our interviewees after being apprised of our data analysis. They underlined the importance of harnessing data analysis to make and defend decisions, map out plans to improve academic programs, identify weaknesses and design improvement strategies. This is directly related to the role that teachers acquire as catalysts for learning success, as they will be capable of analyzing data to better comprehend their own teaching actions, the type of students in their classrooms, and the learning outcomes their students achieve [19,20].

Siemens [55] proposed a learning analytics model (LAM) cycle that includes action. Actions resulting from this analysis can be systemic improvements in planning or teaching. This study contributed to shaping an initial decision-making proposal based on analyzed data. Decision-making also hinges on the need to devise strategies to improve student retention. Education systems have made limited use of available data to improve teaching, learning and student success, although there is a special interest in analysis as a solution to challenges such as student retention and support [46,55]. Educational institutions can restructure learning design processes based on analyses, meaning that teachers can incorporate feedback from these analyses into the future design of learning content and also customize content by including their personal understanding of a topic and previous experience [55]. In short, they can use analysis-derived information to make informed pedagogical decisions [58] and significantly improve student learning [27].

*In what ways do these academic and administrative managers believe those results can help bridge the gap between higher education and other educational levels? (RQ3).* First of all, the fact that a significant difference was found when grouping the results of the students according to the modality of education they receive (face-to-face or distance education) feeds the dialogue about how the institutional conditions and teacher preparation may be related to student learning outcomes in addition to the relationship reported by Coleman [1] between student socioeconomic conditions and outcomes. Research has shown that teachers, schools and countries that are effective in terms of quality tend to be effective in terms of equity as well [26]. Teaching should be adapted to suit students' interests and, above all, to account for their social and cultural environment and individual differences [64]. In this regard, curricular connections are meant to act as a two-way link between universities and their surrounding context, as well as between theory and practice. A curriculum whose design is based on competencies, active pedagogies and flexibility allows students

to choose according to their interests and aspirations. It also lays the foundation for new interinstitutional alliances that promote collaboration across any field, subject area, time of year, semester or credit system [58,59,61]. Our interviewees suggested the possibility of working together with other educational levels to develop the competencies assessed on the various Saber tests. This coincides with the challenge of optimizing learning, satisfying political interests and exploiting available data to descriptively, predictively or prescriptively analyze solutions. [19,54]. This proposal is in line with the claim that data analysis can be used to bridge teaching pathways, with joint plans and programs mapped out to lay down common objectives in different areas in order to make progress in complex contexts [22–25]. This bridging process has various administrative implications, including overseeing labor practices, socio-occupational guidance, labor intermediation and higher education funding [58,61]. In this regard, the interviewees suggested having teachers in training face different work scenarios in their practical activities.

The challenge is to optimize learning, satisfy political interests and exploit available data to descriptively, predictively or prescriptively analyze solutions [19,54]. In line with this, our interviewees suggested fortifying the bridge between higher education and other educational levels by teaming up to develop the competencies assessed on the various Saber tests. This allows teachers to incorporate the feedback they receive in the future design of the learning content and also personalize the content, including their personal understanding of a topic and previous experience [55]. Furthermore, they can use information derived from the analysis to make informed decisions [56], such as systematizing Saber test data and student details gathered during their first enrollment; having university students carry out their practical training in nursery, elementary and secondary schools, with an eye to strengthening students' competencies at those levels; encouraging university professors to take on a leadership role in training teachers from other educational levels; designing opportunities for reflection and action where nursery, elementary and secondary school teachers come together; or raising awareness among secondary school students about the higher education experience.

The use of tools driven by learning analytics enables educational institutions to gain an insightful understanding of their processes and governance. Such tools can also be used in tandem with data and information systems for the educational system and quality assurance [65]. In this data-driven landscape, teachers will serve as catalysts for learning success, as they will be capable of analyzing data to better comprehend their own teaching actions, the type of students they have in their classrooms, and the learning outcomes their students achieve [19,20]. According to our interviewees, quantitative data analysis is not a frequent practice among prospective and practicing teachers in the Colombian educational system, even though higher education institutions request numerical data from teachers to support the documents they present as part of their programs' quality accreditation processes. For this reason, the interviewees expressed the need to train teachers to analyze quantitative data and use specific software. This is in line with current literature [57], which confirms that if students' socioeconomic level and teachers' subject knowledge are to be considered predictors of academic performance, this type of training has good reason to be enhanced.

Although the 1966 Coleman Report argued that differences in students' scores could be explained by sociodemographic factors and that school resources and teachers' education do not have a notable effect on student performance, our interviewees raised questions about the influence of teachers' critical reading skills on student outcomes, and before this the OECD affirmed that in most PISA-participating countries and economies the relationship between teachers' participation in professional development activities and students' performance in reading is weak [8]. These statements support the need for debate about the impact that educational policies and the school system have on student performance, in addition to environmental and sociodemographic effects [1]. Although this is not an objective of our study, it is pertinent to highlight here that the OECD in its PISA 2018 results report affirms that teachers are perhaps the most important of the school resources that are

needed to boost students' learning, because improving the quality and equity of education is more likely if teachers are adequately qualified and able to support their students' needs. However, in Colombia, Georgia, Mexico and the United Arab Emirates, less than half of teachers in schools attended by 15-year-olds were fully certified [8].

The above matters were brought up by our interviewees after we showed them the results of our statistical analysis of data from students who took the 2019 Saber Pro test. In addition to these topics, they were also asked questions about the possibility of developing research projects to further analyze data from tests taken at different educational levels; to characterize student profiles; to explore the impact of emotional factors and classroom activities on the outcomes achieved; to examine the student–teacher relationship and its impact on students' outcomes; and to test the relationships between Saber 11 and Saber Pro test scores.

## 8. Study Contributions, Conclusions and Recommendations

This study makes a significant contribution to the otherwise limited exploration of the relationship between students' academic performance and their individual, family and school variables, owing to problems of data availability [2]. It also helps to fill the research gap on the Saber Pro test and on analyzing test outcomes to drive improvement actions [36,37,41,42,44,66–68]. In this regard, we statistically analyze data to provide insights into how to improve education quality [36,37,42–44].

Our study gave participants the chance to make proposals on topics that could be addressed in future research, such as analyzing results from previous years; reviewing the impact of classroom activities on test results; investigating the level of student willingness to take the test or the reasons for academic success in those who do not have the best socio-economic or family conditions; reviewing the impact of the student–teacher relationship and teaching practices on test results; exploring institutional recognition of student characteristics; working with other areas of knowledge and designing pedagogical, educational and didactic strategies alongside other bachelor's degree programs; comparatively analyzing the results of the Saber Pro and Saber 11 tests (added value); analyzing results to make decisions; looking into the characteristics and backgrounds of the students starting the degree programs; and reviewing the behavior of correlations in previous years.

Our study set out to perform a statistical analysis of the data from the 2019 Saber Pro standardized test in relation to the students' personal, family, socioeconomic and academic characteristics, in order to devise strategies and actions for improving the academic programs and the institution as a whole. This could have a positive effect on the quality of education. Indeed, by means of a descriptive statistical analysis and an exploration of the relationships between the data, our research signifies a first step in helping the academic and scientific community of higher education to consider the results of standardized tests—relating students' test results and performance with their characteristics—in order to improve teaching and learning processes at all levels of education in the country, taking into account the differences between students and their individual life circumstances, identifying context-based needs and closing the current gap between higher education and other educational levels, as well as paving the way for future research. We hope that our findings will lay the foundation for analyzing standardized test data for the purpose of improving teacher training programs and higher education institutions, and that they will provide insightful input for setting feasible goals with respect to the promotion of quality and equity.

In order to improve teacher training based on the data published by the ICFES, which discloses students' Saber Pro test results and their personal, family, socioeconomic and academic characteristics, we make the following recommendations:

- Defend the idea that the quality of education goes beyond quantitative results.
- Promote processes and procedures that account for the characteristics of students entering the degree programs, including their personal, family, socioeconomic and academic situations.

- Engage bachelor's degree teaching staff in quantitative research processes.
- Encourage students and teaching staff to learn and use statistical analysis software and qualitative analysis software.
- Speak with the academic members of the program or institution to shape improvement actions or strategies based on data-analysis-driven decision-making.
- Come up with ways for bachelor's degree teaching staff to become familiar with the competencies assessed on the Saber Pro test.
- Analyze the relationships between Saber 5, 7, 9 and 11 test data and the results of the Saber Pro test.
- Nurture teachers' and students' critical reading skills (texts, charts and images).
- Develop research projects on this topic, enlisting the help of colleagues working at different educational levels, undergraduate and postgraduate students, members of research groups, and graduates of the program.

### 9. Study Limitations

Studies related to the Saber Pro test in recent years have underlined the scarcity of research addressing the test results [35–37]. In this study, we examined the results of the Saber Pro test taken in 2019 by 258 bachelor's degree students from a specific public university, and there is a wealth of data available on different programs and universities and from different years, so the amount of data to be analyzed is still immense. Likewise, students' varying characteristics make each group and context different. The teacher training processes are different in every program or institution. The sample from the qualitative phase of the study is rather small compared to the number of teacher education programs in Colombia. So, the data cannot be generalized to draw conclusions about the entire population of bachelor's degree student teachers or all public higher education institutions. The interview data clearly depend on the conversations between the participants and the first author; therefore, a second interview to those summoned to the presentation of results would have been enriching and would have enriched the perceptions and the actions proposed for the strengthening of the programs that train teachers. However, time was an important limitation within the new dynamics of online communication generated by the pandemic.

**Author Contributions:** Conceptualization, P.S.-C. and D.V.; methodology, P.S.-C. and D.V.; validation, P.S.-C., S.F. and D.V.; formal analysis, P.S.-C.; investigation, P.S.-C.; data curation, P.S.-C. and D.V.; writing—original draft preparation, P.S.-C.; writing—review and editing, D.V. and S.F.; supervision, D.V. and S.F. All authors have read and agreed to the published version of the manuscript.

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**Informed Consent Statement:** See Appendix A.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to identity protection/confidentiality reasons.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

### PARTICIPANT CONSENT FORM

Participant Name \_\_\_\_\_ Date \_\_\_\_\_ Signature \_\_\_\_\_

**Title of Research Project:** Exploring the Relationship between Saber Pro Test Outcomes and Student Teacher Characteristics in Colombia: Recommendations for Improving Bachelor's Degree Education

**Researcher:** Paola Sáenz-Castro

1. I confirm that I have read and have understood the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my rights being affected. In addition, should I not wish to answer any particular question or questions, I am free to decline.
3. I understand that, under the Data Protection Act, I can at any time ask for access to the information I provide and I can also request the destruction of that information if I wish.
4. I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any publications.
5. I understand and agree that once I submit my data it will become anonymized, however I can ask to withdraw my data at any time.

To indicate that you consent to take part in this research please sign the consent form below. I consent to take part in the research titled: "Exploring the Relationship between Saber Pro Test Outcomes and Student Teacher Characteristics in Colombia: Recommendations for Improving Bachelor's Degree Education"

**Figure A1.** Participant Informed Consent Template.

**Table A1.** Variables used in the study.

Independent Variables			
Variable Grouping	Descriptor	Variable	Value
Personal	Personal details	Gender	F—Female M—Male
Socioeconomic	Contact details	Department of residence Municipality of residence Area of residence	Text Text Rural area Municipal capital
Socioeconomic	Academic details	Cost of tuition for the last semester taken (without considering discounts or grants)	No tuition paid Less than USD 130 Between USD 130 and USD 260 Between USD 260 and USD 648 Between USD 648 and USD 1037 Between USD 1037 and USD 1426 Between USD 1426 and USD 1815 More than USD 1815
Socioeconomic		Tuition is covered by a grant Tuition is paid in credit Tuition is paid by the student's parents Tuition is paid out of pocket by the student	No Yes

Table A1. Cont.

Independent Variables			
Variable Grouping	Descriptor	Variable	Value
Academic		Semester the student is currently enrolled on	1st
			2nd
			3rd
			4th
			5th
			6th
			7th
			8th
			9th
			10th
			11th
			12th or subsequent
Socioeconomic	Socioeconomic details	Father's highest level of education Mothers' highest level of education	No schooling completed
			Elementary school not completed
			Elementary school completed
			Secondary school ( <i>bachillerato</i> ) not completed
			Secondary school ( <i>bachillerato</i> ) completed
			Technical or technological training not completed
			Technical or technological training completed
			Vocational training not completed
			Vocational training completed
			Postgraduate studies
			Doesn't know
Socioeconomic		Job performed by the student's father for most of the previous year Job performed by the student's mother for most of the previous year	Farmer, fisherman or day laborer
			Large business owner, director or manager
			Small business owner (few or no employees; e.g., a shop or stationary store)
			Machine operator or drives a vehicle (e.g., a taxi driver or chauffeur)
			Salesman or customer service representative
			Administrative auxiliary (e.g., a secretary or assistant)
			Cleaner, maintenance worker, security guard or construction worker
			Qualified worker (e.g., a doctor, lawyer or engineer)
			Housemaker, unemployed or studying
			Self-employed (e.g., plumber, electrician).
			Pensioner
			Doesn't know
			N/A
Socioeconomic		Socioeconomic stratum of the student's home according to the electricity bill	Stratum 1
			Stratum 2
			Stratum 3
			Stratum 4
			Stratum 5
			Stratum 6
			Lives in a rural area where there is no socioeconomic stratification
			No stratum

Table A1. Cont.

Independent Variables			
Variable Grouping	Descriptor	Variable	Value
Socioeconomic		Internet service or connection available TV Computer Washing machine Microwave, electric or gas oven Owns a car Owns a motorcycle Owns a video game console	Yes No
Socioeconomic		No. of people with whom the household bathroom is shared	1 2 3 or 4 5 or 6 More than 6 No one
Socioeconomic		No. of hours worked per week prior to completing the test registration form	0 Less than 10 h Between 11 and 20 h Between 21 and 30 h More than 30 h
Socioeconomic		Payment received for work	No Yes, in cash Yes, in kind Yes, in cash and kind
Academic	Information from the higher education institution	Name of the student's degree program	Text
Dependent Variables			
Variable Grouping	Descriptor	Variable	Value
Scores in general competencies	General test scores	Score in quantitative reasoning Score in critical reading Score in citizenship skills Score in English Score in written communication	Number–Range [0, 300]
Performance in general competencies	Performance on the general tests	Performance level in quantitative reasoning Performance level in critical reading Performance level in citizenship skills Performance level in English Performance level in written communication	Number–Range [1, 4]
Scores in specific competencies	Specific test scores	Teaching Evaluating Educating	Number–Range [0, 300]
Performance in specific competencies	Performance on the specific tests	Teaching Evaluating Educating	Number–Range [1, 6]

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