Influence of public policies on the performance of Ideb in Pernambuco

Influência das políticas públicas no desempenho do Ideb em Pernambuco

Influencia de las políticas públicas en el desempeño del Ideb en Pernambuco

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Abstract

This article analyzes possible factors that drove the performance of Pernambuco in the evaluation of the Brazilian education system, a state that achieved first place in the ranking of the Basic Education Development Index for Secondary Education in 2015. A quantitative approach was adopted through multiple linear regression, which uses data from the Anísio Teixeira National Institute for Educational Studies and Research and investigates the variation of the performance indicator from the perspective of four axes of educational policies adopted in that state. The results found indicate that the axes of innovation and full-time education significantly explain the variation of the indicator, contrary to the axes of infrastructure and management, for which sufficient evidence was not found.

Keywords: Legislative Branch; Basic Education Development Index; National System of Basic Education Evaluation; school performance indicators; statistical analysis.

Resumo

Este artigo analisa possíveis fatores que impulsionaram o desempenho de Pernambuco na avaliação do sistema de ensino brasileiro, estado que alcançou a primeira colocação no *ranking* do Índice de Desenvolvimento da Educação Básica para o Ensino Médio em 2015. Adotou-se abordagem quantitativa por meio de regressão linear múltipla, que utiliza dados do Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira e investiga a variação do indicador de desempenho sob a perspectiva de quatro eixos de políticas educacionais adotadas naquele estado. Os resultados encontrados apontam que os eixos de inovação e educação integral explicam de forma significativa a variação do indicador, contrariamente aos eixos de infraestrutura e gestão, para os quais não foram encontradas evidências suficientes.

Palavras-chave: Poder Legislativo; Índice de Desenvolvimento da Educação Básica; Sistema Nacional de Avaliação da Educação Básica; indicadores de rendimento escolar; análise estatística.

Resumen

Este artículo analiza posibles factores que impulsaron el rendimiento de Pernambuco en la evaluación del sistema educativo brasileño, un estado que alcanzó el primer lugar en el *ranking* del Índice de Desarrollo de la Enseñanza Básica para la educación secundaria en 2015. Se adoptó un enfoque cuantitativo a través de la regresión lineal múltiple, que utiliza datos del Instituto Nacional de Estudios e Investigaciones Educativas Anísio Teixeira y examina la variación del indicador de rendimiento desde la perspectiva de cuatro ejes de políticas educativas adoptadas en ese estado. Los resultados encontrados indican que

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los ejes de innovación y educación integral explican de manera significativa la variación del indicador, a diferencia de los ejes de infraestructura y gestión, para los cuales no se encontraron evidencias suficientes.

Palabras clave: Poder Legislativo; Índice de Desarrollo de la Enseñanza Básica; Sistema Nacional de Evaluación de la Enseñanza Básica; indicadores de rendimiento escolar; análisis estadístico.

1 Introduction

Since 2007, the Brazilian education system has been assessed by the Basic Education Development Index (Índice de Desenvolvimento da Educação Básica – Ideb), published every two years, which was created by the Anísio Teixeira National Institute for Educational Studies and Research (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira – Inep) to measure the quality of national learning and to set targets for improving education. The Ideb is calculated from data on school approval obtained from the School Census, and the average performance in Mathematics and Portuguese in the Basic Education Assessment System (Sistema de Avaliação da Educação Básica – Saeb) (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022d).

The Ideb results have an impact on the decision-making process regarding public education policies and are used as a reference by managers to compare the success or failure of different practices adopted, as well as subsidizing future strategies (Almeida; Dalben; Freitas, 2013). The Ideb is also the tool for monitoring the quality targets of the Education Development Plan (Plano de Desenvolvimento da Educação – PDE), which has set a target of an average of 6 (six) for Brazil in 2022, a level corresponding to the educational systems of developed countries (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022d).

However, the proposal to reflect Brazilian educational quality in an index based on just two elements that culminate in an objective parameter, the grade, has been questioned as an evaluation model and as a method of inducing public policies. Figueiredo *et al.* (2018) point out inconsistencies in the indicator, concluding that: 1) the dissemination of the index does not take into account local efforts and does little to help build a school improvement policy; 2) the Ideb score is not associated with the concept of grade used in the school, where an average of six is considered low; and 3) the Ideb does not take into account endogenous and exogenous issues that influence the outcome of student performance.

In the same line of questioning, Chirinéa and Brandão (2015) argue that the two component elements of the Ideb do not take into account aspects such as the socioeconomic and cultural level of the students, teacher training, teacher appreciation, material and immaterial working conditions, school management, school infrastructure, and the respective inputs.

Therefore, reflecting on other possible explanatory factors for the variation in the Ideb, in addition to its original components, should be an essential requirement for proposing public policies and actions aimed at effectively improving the education system.

In this sense, it is worth highlighting the state of Pernambuco, which in 2007 was among the ten worst educational systems in the country, but gained national prominence in 2015 when it reached 1st place in the ranking of the Ideb in Secondary Education. Pernambuco's good performance is, according to research by the Instituto Unibanco (2019), the result of actions carried out over ten years in the context of four strategic axes: Innovation, Management, Full Time and Infrastructure.

Therefore, the aim of this study is to identify, based on the 2019 and 2021 Inep data, the school variables that have the potential to explain the variation in the Ideb in the state of Pernambuco. It also seeks to verify how these variables might fit into the four strategic axes that have guided educational policies in the state in recent times. In this way, it aims to find evidence that these policies were effective in the case in question, as well as contributing to the discussion on the (in)sufficiency of elements contained in the calculation of the Ideb, as a parameter for establishing the quality of Brazilian education.

In addition to this Introduction, the article is organized into six more sections: the first

covers the history of Brazilian educational evaluation, presenting the motivations and initiatives of this process; the second addresses the issue of the effective use of evaluation results in the formulation of educational policies; the third provides an overview of the evolution of Ideb in the state of Pernambuco; the fourth describes the methodological approach of the research; the fifth presents the results and discussions; the sixth closes the article with the conclusions and final considerations.

2 The evaluation of Brazilian education

External and large-scale evaluations in Brazil began to be applied at the end of the 20th century, when the attribution of the State as responsible for the quality of education and for systematic evaluations that collected data for the improvement of educational policies in Brazil was strengthened. These initiatives were preceded by different projects and experiments carried out in previous decades (Perboni, 2016).

In 1990, Saeb was applied for the first time, with the aim of carrying out a diagnosis of Brazilian basic education and the factors that could interfere with student performance. From 1995 onwards, a School Census was set up, which began to be carried out annually, gathering information on enrollment, performance, and school characteristics. In 2005, the Saeb became two assessments: the National Basic Education Assessment (Avaliação Nacional da Educação Básica – Aneb), which maintained the sample characteristics used until then, and the National School Performance Assessment (Avaliação Nacional do Rendimento Escolar – Anresc), also known as *Prova Brasil*, which sought to assess for the first time in a census manner public school students in the 5th and 9th grades. In 2013, the National Literacy Assessment (Avaliação Nacional de Alfabetização – Ana) was created to measure the quality of literacy among students in the 2nd grade of Elementary School (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022b).

With the assessments and the School Census established, the Ideb was created in 2007, with the aim of bringing together, in a single indicator, the results of two concepts: the student pass rate and performance in the assessments. In 2017, the assessment of the 3rd grade of Secondary School in public schools became census-based. In 2019, the Aneb, Anresc and Ana assessments began to be identified by the name Saeb, and the assessment calendar was unified (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022d).

Although it was formally established in 2007, the Ideb is calculated using data from 2005 onwards; from then on, it is repeated every two years at the end of the three stages of basic education: the initial years of primary education (5th grade), the final years of primary education (9th grade) and secondary education (3rd grade). Its score varies from 0 to 10 and uses the calculation formula given by Equation 1, according to a technical note from Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (2009).

$$IDEB_{ji} = N_{ji} \times P_{ji} \tag{1}$$

where i is the year of the exam and the School Census; j is the teaching unit; N_{ji} corresponds to Saeb and is the average proficiency in Mathematics and Portuguese, standardized for an indicator between 0 and 10, of the students in the unit j, obtained in the i-th edition of the exam held at the end of the teaching stage; and P_{ji} is the performance indicator based on the pass rate for the stage of education of the students in the unit j.

In 2021, as a result of the covid-19 pandemic, the Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (2022e) clarified in an information note that the results for that year should be evaluated taking into account the changes in school activities that took place in the 2020-2021 period. Among the measures adopted is the recommendation to use the *continuum curricular*, which provides flexibility in school curricula to ensure the continuous development of learning. As a result, there was a significant increase in pass rates during this period:

> The public elementary school pass rate went from 91.7% in 2019 to 98.4% in the first year of the pandemic, in 2020 (variation by 6.7 p.p.), falling to 96.3% in 2021 (still 4.6 p.p. higher than in 2019). In the same network, for secondary education, the pass rate went from 84.7% in 2019 to 94.4%, falling to 89.8% in 2021. [...] the increase in pass rates is probably related to adjustments in the pass criteria and the adoption of the curriculum continuum, as these strategies were recommended and adopted by some schools (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022e, p. 3, our translation).

The increase in the pass rate may not necessarily mean an increase in the Ideb, as the educational challenges experienced during the pandemic, especially in 2020 and 2021, have had a negative impact on student performance in the assessments (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022e). However, the way the Ideb is calculated creates an incentive structure that favors student body approval policies, which can lead to the detriment of policies to effectively improve teaching since, as "educational authorities can have little influence on the results of standardized tests, they interfere in reducing failure and dropout rates" (Figueiredo *et al.*, 2016, p. 222, our translation), which may suggest the Saeb as a more reliable indicator of evaluation.

On the other hand, Saeb also has limitations, which, according to Padilha *et al.* (2012) are: 1) the calculation of the arithmetic mean, because it is influenced by extreme values, can be manipulated by allowing only the best prepared students to take the test and by inducing those with more difficulty to miss; 2) the score does not isolate the effectiveness of the school, as it includes the effects of the socioeconomic factor, which is one of the most preponderant in determining school performance, but which is not under the control of the educational authorities; and 3) the data does not inform the educational coverage of the networks, allowing, for example, a municipality to invest only in the part of the population with the best conditions, in order to boost its results.

Given the above, and considering the universality and standardization of the Saeb indicator, it is assumed to be the most appropriate source of data for the purposes of this study.

3   Evaluation as a driver of educational policies

The challenge remains of how to develop action based on the results of the evaluation, having highlighted the limitations of the indicators and the possible interpretative biases. Saeb was conceived with the aim of providing elements to support the formulation, reformulation, and monitoring of public policies, observing the regional differences in Basic Education that influence student performance (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2011). This would help create intervention programs tailored to the needs diagnosed and provide managers of the education system with useful information for the decision-making process.

However, this information is not automatically incorporated into the decision-making process. Almeida, Dalben and Freitas (2013) emphasize the importance of evaluations in the search for educational quality, but question their use in anchoring public policies, problematizing the influence of external factors in the composition of performance. Cotta (2014) points out that many factors hinder the effective use of evaluation results, either because of a lack of consensus among the players involved or because the cases in which the evaluation is simply ignored are much more frequent than those in which the evaluation fulfills its purpose.

For Boullosa *et al.* (2021), the evaluation of public policies in Brazil has created a multifaceted field of knowledge and practices in terms of its objectives, interests, and the different actors that make it up — evaluators, demanders, funders, evaluated. For these authors, the managerialist, quantitativist, and objectivist logics linked to this field have been marked by little reflexivity and have been dispersed in terms of their purposes and applications.

In a more objective analysis, without discussing the limiting aspects of the indicator and large-scale evaluation, but exploring the potential of Ideb as a government management

tool, the Institute for Applied Economic Research (Instituto de Pesquisa Econômica Aplicada – Ipea) concluded that, although the results of recent years point to an improvement in Primary Education, the targets set out in the National Education Plan (Plano Nacional de Educação – PNE) have not been achieved, in addition to the fact that regional and local inequalities remain very large and show no tendency to decrease (Araújo; Codes; Uderman, 2019). In this sense, these authors propose that the federal government should play a leading role in setting up a strategic management body for the PNE, capable of coordinating the federal entities responsible for education in their territories and achieving greater convergence in state trajectories, with a view to improving performance.

Regardless of the centralized coordination of the PNE and the limitations of the indicator, the Ideb has served as a guide for inducing public policies in states such as Ceará, Rondônia, Acre, and Tocantins, which have outperformed Rio Grande do Sul, Distrito Federal, Rio de Janeiro, and Mato Grosso. The states of Goiás and Pernambuco also stood out in the evaluation, showing the two biggest increases in the Ideb for Secondary Education (Araújo; Codes; Uderman, 2019, p. 16).

In general, these examples are associated with well-planned educational policies focused on results, combining teacher training, efficient management, continuous monitoring, and community involvement, elements which, in principle, have led to significant improvements in the quality of education in those states. However, measuring the impact of these initiatives on educational performance solely on the basis of the variation in the Ideb may not be a sufficient condition for assessing the actual effectiveness of the actions.

Therefore, in order to better understand the relationship between the education evaluation process and the cycle of public policies practiced, the following sections present and discuss the possible factors that have raised Pernambuco to first place in the Ideb.

4 The evolution of Ideb in Pernambuco

Secondary Education in the state school system of Pernambuco (PE) has stood out for the improvement in its indices and the speed with which results have been achieved, which is why it was selected as the focus of this study.

In the first year the Ideb, in 2005, PE was among the ten worst in the Federation, but a decade later, in 2015, it came first, along with São Paulo. Figure 1 shows the state's consistent rise in the Ideb, surpassing the national average in 2011, and in the Saeb, surpassing the average national performance in 2013.

The PE state administration attributes this growth to the success of public policies implemented since 2007, grouped into the following areas: management, teacher selection, infrastructure, full-time teaching, pedagogical experiences, PE on Campus, Win the World Program, State Public Library, Pernambuco Conservatory of Music and special projects (Pernambuco, 2018). The Instituto Unibanco (2019) compiles these initiatives into four axes, as shown in Figure 2: Infrastructure, Innovation, Full-Time Education, and Management by Results (or just Management).

The effectiveness of the policy axes illustrated in Figure 2 has been widely explored in the literature. Santana (2015) found that the increase in the number of classrooms, a characteristic of the Infrastructure axis, which reflects the size of the school, contributes negatively to the score in standardized evaluations. With regard to the Full-Time axis, the same author found a positive and significant linear regression coefficient for the number of years in which a given school offers this type of education, suggesting that there is a gradual positive impact as the full shift offer is consolidated. However, the variable with the highest coefficient in the author's analysis was the number of employees in the school's management team, indicating the preponderance of impact of a factor possibly linked to the Management axis.

Also, Mello Neto et al. (2017) identified full-time education and management by results as the central elements for improving educational performance. However, these authors have reservations regarding the adoption of full-time education as being responsible for Pernambuco's

Figure 1 – Evolution of the Ideb and Saeb in Secondary Education in the state of PE
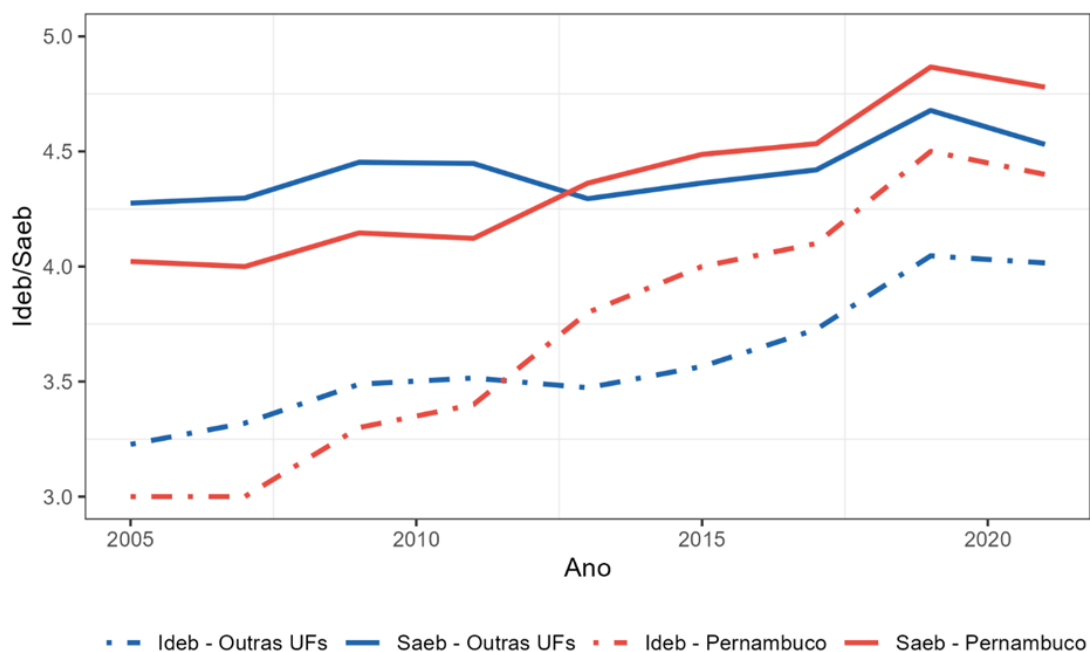
progress in high school assessments. This is because, despite the fact that full-day schools have better results, there is a barrier to poorer students or those who have to work staying in these schools; therefore, the higher performance could be mostly explained by the higher socioeconomic level of the student body. Management by results, on the other hand, induces the Pernambuco education system to concentrate its efforts on the subjects of Mathematics and Portuguese, so that external evaluations cease to be a means of measuring quality and become an end in themselves, neglecting aspects of education related to citizenship, human rights, work and entry into higher education.

In this sense, Santos and Silva (2019), despite agreeing with the positive effect of the full-day shift on the evaluation scores of Pernambuco's high school, criticizes the narrowing of the curriculum caused by the one-dimensional search for evaluation indexes. What's more, these authors reveal, on the basis of statements obtained in interviews, that there is data falsification, a consequence of the constant pressure to improve indices, which involves accountability, either through reward or sanction.

When comparing full and single shifts, Silva and Sousa (2016) found significant differences not only in educational indices, but also in access to other levels of education and in students' training for citizenship. These authors believe that longer formal and informal daily contact (*e.g.* lunch) with teachers creates a stimulating learning environment for students, a benefit that translates into lower levels of failure and dropping out of school.

In relation to the Innovation axis, Marcelino (2015) criticizes the philosophy behind the continuing training carried out in Pernambuco because it is focused on performance in external assessments, ignoring and discarding the particular interests, experiences and needs of the teachers and the local context in which they work. For this author, the managerialist profile of these training courses does not serve the student's needs and does not guarantee their full development as learners. Continuing education along these lines would serve more in obtaining results in order to justify management policies.

Still, on the Innovation axis, Lasalvia (2017) identified positive impacts in the adoption

Figure 2 – Axes of public educational policies in the state of Pernambuco

Axis	Actions
INFRASTRUCTURE (improving the physical conditions of schools)	Construction of 18 state technical schools.
	Reconstruction of 27 state and municipal schools.
	Completion of 14 education-related projects in the state.
	Win the World Program aims to promote English and Spanish language proficiency among students, as well as offer international exchange opportunities to the best students, with expenses paid by the state government.
INNOVATION (more attractive school and improved teaching)	Win the World Program aims to promote English and Spanish language proficiency among students, as well as offer international exchange opportunities to the best students, with expenses paid by the state government.
	Program for Access to Higher Education, with the aim of preparing students for the entrance exams and providing financial support to low-income students who pass at public universities.
	Teacher training through continuing education, with special attention to schools with the worst results in the indicators.
	Systematic offer of innovative experiences and inclusion of technology in classrooms.
	The Good Vision Project (Law No. 14.511/2011), which offers ophthalmic assessment and prescription glasses for students, teachers and staff.
	Semear Project, to encourage youth protagonism through workshops and debates.
FULL-TIME (increasing the supply of full-time education)	Full-time Education Program, created by Complementary Law No. 125/2008, with 410 full-time schools in 2018.
MANAGING FOR RESULTS (setting targets and monitoring results)	Agreement on Goals, through an annual meeting between the Department of Education and regional managers, to discuss results and set goals, in addition to debating the specific demands of schools.
	School Management Award, to recognize good practices and improvements in management processes, encouraging an exchange of experience between managers.
	Pact for Education, with the aim of monitoring educational quality through indicators, pass and dropout rates, student and teacher attendance, and family participation.
	Program to Strengthen School Management, with the aim of stimulating cost reduction and using the resources saved to pay teachers, seeking greater efficiency in management.
	Seminar on Good Practices of the Pact for Education in Pernambuco, a meeting between school managers and regional managers to seek integration and exchange successful experiences.

Source: Own elaboration (2023) based on Pernambuco (2018) and Instituto Unibanco (2019)

of digital technologies and tools in Pernambuco schools, especially as they make students and teachers more stimulated and encourage the diversity of teaching materials and the formation of a network for sharing new practices. However, they point out that there are still challenges related to infrastructure, such as connection speed and maintenance of computers, and to the training of teachers to include technology in the educational process.

When discussing the Management by Results axis, especially on spending efficiency, Carvalho (2016) suggests that the regional education departments with the best results in standardized tests in Secondary Education are not the most efficient in the application of resources, both human and financial. It is therefore possible that the policies adopted, although effective, need to be improved if they are to be efficient

It can, therefore, be seen that the analyses and perceptions of educational public policies do not converge on a consensus, which is possibly due to the inability to represent all the explanatory dimensions of educational quality in a single indicator, such as the Ideb or the Saeb. Nor is it possible to establish a direct relationship or cause and effect between these policies and the results measured for these indicators, which may seem to be implied in government management reports such as that of the state of Pernambuco. In this sense, the following sections present the study methods and discuss the results found in order to verify possible evidence that the policies adopted in PE have contributed to the evolution of Ideb in that state.

5 Method

This work consists of a case study with a quantitative approach, using the statistical resource of multiple linear regression, which investigates the extent to which the variation in the Ideb for Secondary Education in the state of PE can be explained by variables associated with the four axes of educational policies presented in Figure 2. For the reasons already explained about the possibility that the way the Ideb is calculated encourages automatic approval of the student body regardless of how well the students perform (Figueiredo *et al.*, 2016), the scope of the study was limited to analyzing the component of the Ideb referring to the averages achieved in Mathematics and Portuguese. Therefore, this is the construction of a multiple regression model whose dependent variable is the standardized Saeb score.

To determine the independent or explanatory variables, we used the School Census database (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022a), which collects data on school infrastructure and management; the National Basic Education Assessment System (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022f), which assesses student learning in Mathematics and Portuguese; and other educational indicators calculated by Inep, such as teaching effort, regularity of teaching staff and the school's socioeconomic level (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2015, 2022c). The specialized literature suggests that there is an influence on the Saeb score of issues related to school infrastructure, school management, the length of time students stay at school, and the socioeconomic level of the students (Silva; Silva; Lima, 2020; Soares; Soares; Santos, 2020). The databases used contain around 400 variables that describe the characteristics of the school environment.

The time frame established focuses on the years 2019 and 2021, which corresponds to a database containing 1,371 observations referring to 735 schools, with 694 observations referring to 2019 and 677 to 2021. This decision stemmed from the fact that, until 2015, Saeb in Secondary Education was calculated on a sample basis, and the state Education Department knew which schools would be assessed. There are reports that tutoring classes would be offered selectively in the schools chosen to try to increase the assessment score (Figueiredo *et al.*, 2016). For this reason, only the census evaluations, which began to take place in 2017 (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2022b) are considered. However, the data for 2017 was discarded from the analysis, as the School Census database is incomplete for that year compared to subsequent years, with almost half of the variables unavailable.

In the selection stage of the independent variables, those related to Early Childhood

Education were excluded, and those possibly associated with the educational policies contained in the four axes defined by Instituto Unibanco (2019) were considered in order to check how much these axes, or the variations in these variables, really explain the variation in Saeb in the state of PE. A variable indicating the socioeconomic level of the schools was also added, because even though it does not fall within these four axes, it is pointed out as a relevant indicator (Mello Neto *et al.*, 2017).

An initial linear regression model was adjusted in order to discard the variables whose coefficients were not statistically significant, considering a confidence level of at least 95%. Also used to discard variables was the coefficient of determination metric (R^2), which indicates, on a scale of 0 to 100% and for a given set of variables, how satisfactorily the model fits the data. This variable selection process is known as backward selection (backward elimination process), according to Lilja and Linse (2022), and is useful for selecting variables with explanatory potential in very large databases with many candidate predictor variables (Lattin; Carroll; Green, 2011). At the end of this process, the scope was reduced to just over 20 independent variables.

Based on this reduced set, several simulations were carried out in the search for a model that offered a balance between the coefficient of determination and the number of independent variables used. The range of 10% to 50% was taken as a parameter for values of R^2, which are considered typical values for social sciences (Lattin; Carroll; Green, 2011). At the end of this process, nine of the most relevant variables were identified to explain the Saeb standardized score, shown in Figure 3.

Figure 3 – Relevant variables for explaining the standardized Saeb score in Pernambuco

Variable	Description
Year of evaluation	Categorical variable indicating the year of the Saeb assessment.
Socioeconomic index	Indicator of the school's socioeconomic level. This index is calculated by Inep on the basis of a questionnaire administered to students at each school*.
Percentage of full-time enrollment	Variable were derived by dividing two variables from the School Census, namely the number of full-time Secondary School enrollments and the total number of Secondary School enrollments. Variable of the "Full-time schools" axis.
Number of computers per student	Variable were derived by dividing the variables total computers in the school and total Secondary School enrollment in the school, both from the School Census. Variable of the "Innovation" axis.
Percentage of air-conditioned rooms	Variable were derived from dividing the number of air-conditioned classrooms used by the total number of classrooms used, both from the School Census. Variable from the "Infrastructure" axis.
Number of psychologists per student	Variable were represented by the ratio between the number of psychologists working in the school and the number of Secondary School enrollments. Variable of the "Management" axis.
Teaching regularity index	Indicator that represents teacher turnover in a given school**. It is calculated based on the number of years a teacher has been at a given school. Variable of the "Management" axis.
Student union	Categorical variable indicating whether or not there is a student union. Variable of the "Management" axis.
Covered sports court	Categorical variable indicating whether or not the school has an indoor sports court. Variable from the "Infrastructure" axis.

Source: Own elaboration (2023)
Notes:
* The two central elements used to calculate the 2019 socioeconomic index are: a) the schooling of the students' parents; and b) the students' ownership of goods and services. For more details, see Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (2021).
** See Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (2015) for more information on the teacher regularity index.

Based on these variables and the multiple regression analysis, two models were proposed: the first, using all the relevant variables found; the second, more partial, containing only the year and the three variables with the greatest influence.

The database and scripts with the construction steps described in this section are available[1] in a public repository (Fernandes *et al.*, 2023).

6 Results and discussions

Figure 4 illustrates the relationship between the relevant variables found and the Saeb score. Density graphs were used to represent the distribution of Saeb scores according to categorical variables. In addition, the relationship between the Saeb score and the continuous variables was illustrated with scatter plots. It can be seen that there is some level of association between the variables in Figure 3 and the Saeb score.

This association is confirmed by Table 1, which shows the composition of the proposed models. The coefficients of both multiple linear regression models are shown with their respective *p*-values in brackets, and all are statistically different from zero at a significance level of 95%. Year was used as a categorical variable in order to capture the possible variation resulting from specific evaluation conditions from year to year.

Table 1 – Proposed models: the first, with all the relevant variables found; the second, with the year and the three most influential variables

| Variable	Coefficients of Model 1 (p-value)	Coefficients of Model 2 (p-value)
Intercept	0.87 ($p < 10^{-7}$)	1.19 ($p < 10^{-13}$)
Year of evaluation	-0.07 ($p < 10^{-2}$)	-0.07 ($p < 10^{-2}$)
Socioeconomic index	0.78 ($p < 10^{-15}$)	0.72 ($p < 10^{-15}$)
Percentage of full-time enrollment	0.53 ($p < 10^{-15}$)	0.61 ($p < 10^{-15}$)
Number of computers per student	2.52 ($p < 10^{-14}$)	3.05 ($p < 10^{-15}$)
Percentage of air-conditioned rooms	0.18 ($p < 10^{-14}$)	
Number of psychologists per student	76.07 ($p < 10^{-5}$)	
Teaching regularity index	0.14 ($p < 10^{-6}$)	
Student union	0.16 ($p < 10^{-9}$)	
Covered sports court	0.07 ($p < 10^{-2}$)	
R^2 of the model	52.62%	47.32%

Source: Own elaboration (2023)

Table 2 and Figure 5 clarify the similarities and differences between the models proposed, presenting summaries of their estimates for the Saeb scores in schools, as well as for the score in schools in Pernambuco. The interquartile range of both models is similar to the range of school grades, and so is the minimum value. The main difference between the models and the observed values is the difficulty estimating scores higher than 6. While there are 47 observations in the database in this situation, Model 1 and Model 2 estimated, respectively, only 9 and 6 records with scores above 6.

Figure 5 also shows that the two highest score estimates for Model 1 are 7.68 and 6.32, i.e. there is a gap of 1.36 points with no estimate, which may indicate that the model is adjusting to the extreme values of the observation set.

What differentiates the two models is the presence of five additional variables in Model 1: percentage of air-conditioned classrooms, number of psychologists per student, teacher regularity index, student council and indoor sports court. According to the proposed models, these five variables have low predictive power, which is confirmed by the reduction of only 5.3 percentage points in the value of R^2 in Model 2 compared to Model 1. In other words, around 47% of the

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1 See https://github.com/Cefor/E-Legis/blob/main/2024%20-%20n.%2041/artigo%2002.

Figure 4 – Relevant variables and their relationship with the Saeb score
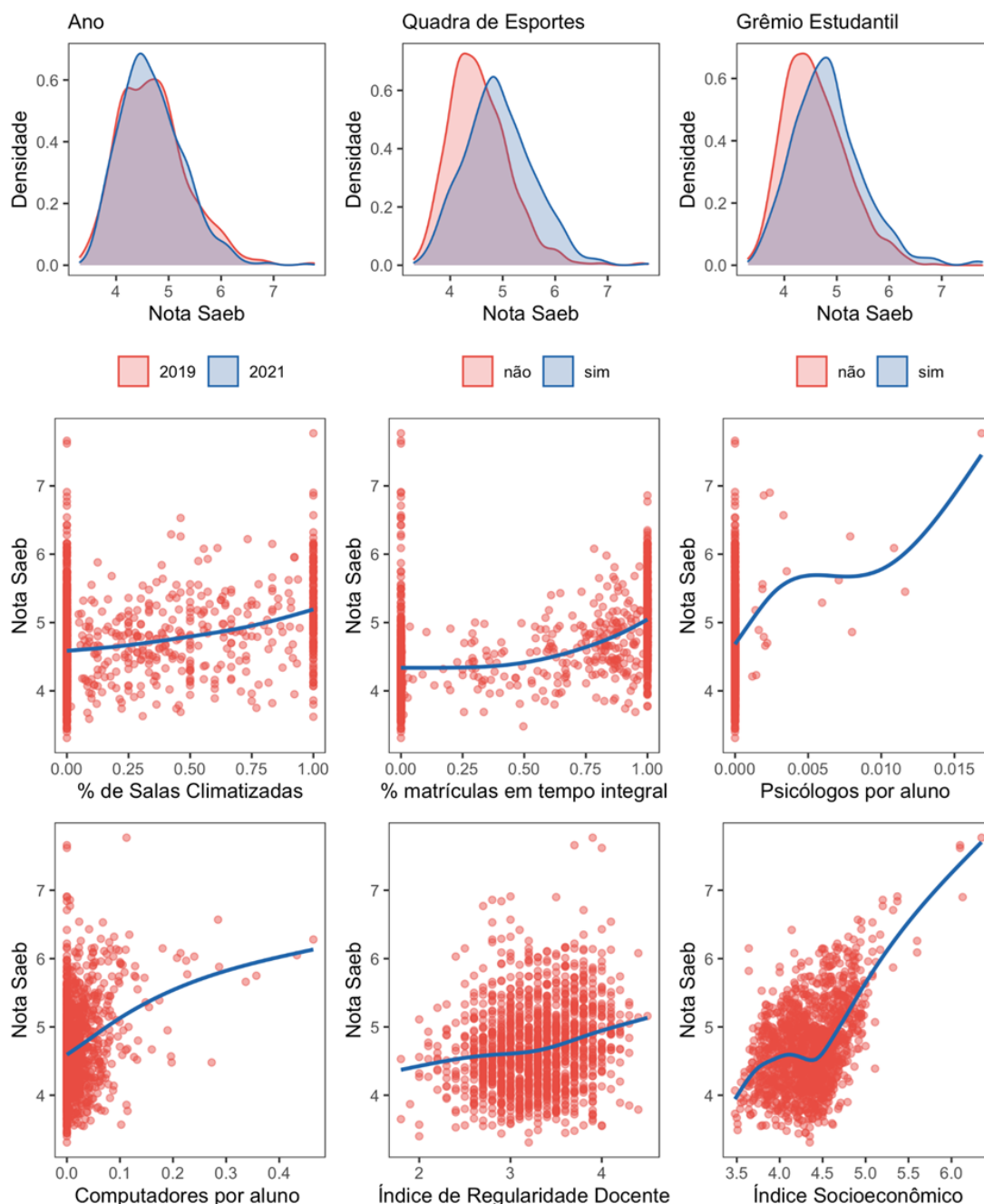
Table 2 – Summary of the distribution of Saeb scores in the state of Pernambuco and their estimates made by the proposed models

Description	Saeb Scores	Model 1 estimates	Model 2 estimates
Minimum	3.31	3.56	3.67
First quartile	4.23	4.35	4.37
Median	4.63	4.68	4.69
Average	4.70	4.70	4.70
Third quartile	5.06	5.01	5.02
Maximum	7.77	7.68	6.74

Source: Own elaboration (2023)

Figure 5 – Box diagram for the Saeb score in Pernambuco and the estimates made by the proposed models
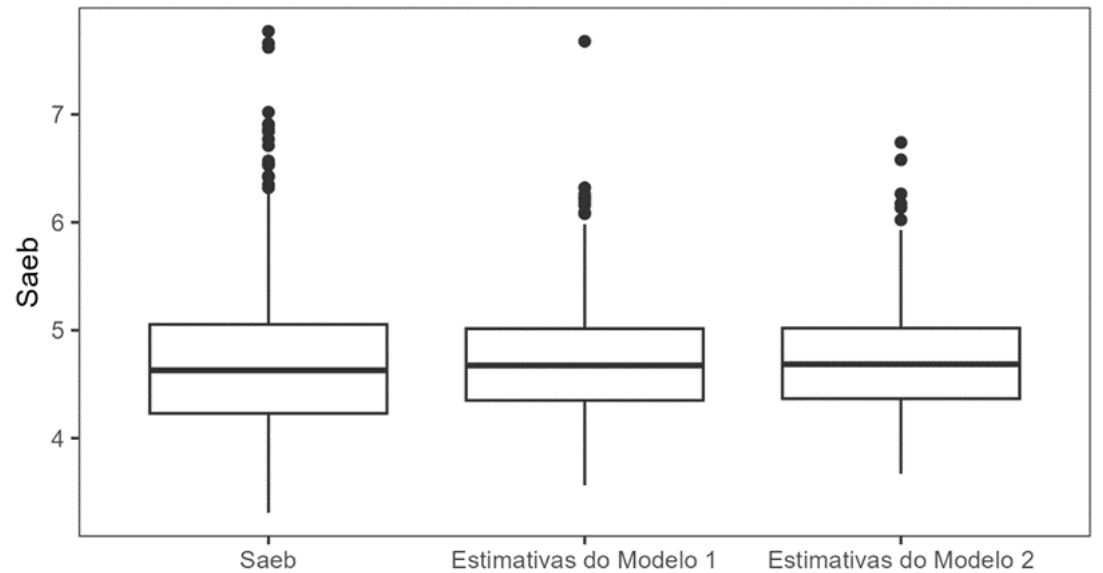
Source: Own elaboration (2023)
Notes:
Estimativas do Modelo 1: Estimates of Model 1
Estimativas do Modelo 2: Estimates of Model 2

variation in the Saeb score can be explained by just three variables: the socioeconomic level of the students, the percentage of full-time classes and the number of computers per student[2]. The addition of the other five variables explains only a small percentage of the variation in Saeb scores in the last two assessments in Pernambuco, indicating that these variables may only be serving to overfit the model to the data (overfitting[3]).

This can be exemplified by the variable number of psychologists per student. Figure 4 reveals the absence of psychologists in the vast majority of schools. In fact, there are only 21 observations of schools with psychologists, while 1,350 observations are of schools without any psychologists[4]. Thus, although this variable individually estimates a variation of up to 1.28 points in the Saeb score, and considering the range of variability of the score in schools without psychologists, it is possible that this variable is acting to adjust a small set of estimates to the data.

Thus, although there is evidence of an association between these variables and the Saeb score, further studies are needed to identify the actual relevance of this association. Considering these results, we proceed to discuss the results through the prism of the specialized literature presented above, notably the influence of the four axes of action of the state of Pernambuco on student performance.

With regard to the axis that develops Full-time Education, both proposed models are consistent with the hypothesis that a higher proportion of full-time enrollment is substantially associated with better Saeb scores, which corroborates the results found by Santana (2015), Mello Neto *et al.* (2017) and Santos and Silva (2019). One explanation for this is that more time students spend with the teacher and with other classmates allows for more learning opportunities, increasing their performance and being able to cover more content compared to the single shift (Silva; Sousa, 2016).

However, Mello Neto *et al.* (2017) warn that full-time schools may concentrate students from more advantaged backgrounds, which would explain their better performance. It is important to note, however, that Models 1 and 2 already incorporate data on the socioeconomic factor, and even so, Full-Time Education has a statistically significant positive effect on the scores, which confirms the contribution of this variable in explaining the variation in the Saeb. In addition, as shown in Figure 3, the socioeconomic level is calculated by school, but uses the characteristics of the students enrolled (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2021).

The number of computers per pupil, understood as the school's capacity for innovation through the use of technology in the classroom, also showed a considerable positive and statistically significant association with pupils' grades, according to both models. A school that has approximately one computer for every two students, the maximum value recorded in the sample analyzed, performs up to 1.4 points better than a school that has no computers. This positive relationship is in line with the study by Lasalvia (2017), which suggests positive impacts from the adoption of digital technologies and tools in PE schools. In this sense, digital teaching platforms and access to good quality teaching materials on the Internet are having a positive impact on student performance. Although Models 1 and 2 provide robust evidence of the association between the number of computers and scores, it is not possible to say that all the actions implemented in the innovation axis of Figure 2 are associated with an increase in Saeb scores. In addition, the variable's coefficient decreases as new variables are introduced (Model 1), suggesting that part of the variation explained by the number of computers per student is

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2 Although these variables explain the variation in Saeb scores, the regression analysis is not sufficient to identify a causal relationship between these three indicators and the improvement in Saeb scores.

3 Whenever a new variable is used to define a regression model, the output of this model will better fit the data used in its training, tending towards a perfect fit of the data. However, this is not a desirable situation, since adding meaningless variables does not help to understand the phenomenon being studied. Thus, a compromise is sought between a parsimonious model, in which few variables can explain a significant part of the variance in the data, and a model that is overfitted to the data, in which the independent variables only serve to fine-tune the prediction to the data (Lattin; Carroll; Green, 2011).

4 The average Saeb score in schools with at least one psychologist is 5.63 points (standard deviation of 0.98 point), and in those without any psychologists, it is 4.68 points (standard deviation of 0.61 point).

actually explained by a set of other variables associated with this relationship and absent from the model.

Although Santana (2015) found a negative association between the number of classrooms and school performance, in this study, the two variables in Model 1 that represent the infrastructure axis — the existence of a sports court and the proportion of air-conditioned classrooms — showed a positive association with Saeb scores. However, the explanatory power of these two variables is quite weak, suggesting that infrastructure aspects have little or no relevance in explaining variations in PE performance. In particular, there is no evidence in the data used that the *Quadra Viva* Program, mentioned in Figure 2, is associated with better performance in the sample analyzed.

Finally, with regard to the variables related to school management, the associations found were also relatively weak. The existence of a student council explains an increase of only 0.16 points in the Saeb score. On the other hand, a school with one psychologist for every 100 students has, on average, a 0.76 higher score than a school without psychologists. In addition, schools with less teacher turnover also seem to score modestly higher. These indications are in line with those pointed out by Santana (2015), who concludes that good management is positively associated with PE scores. However, while the author states that management is the factor that most contributes to explaining the performance of schools in PE, this study finds a weak association between the variables of the management axis and Saeb scores.

Thus, given the methodological options used in this study and the variables included in each axis, there is evidence that the full-time and innovation axes have a significant impact on Saeb scores, while the management and infrastructure axes do not show robust evidence in this regard.

In general, in relation to the debate on the adequacy of Ideb as a catalyst for public policies (Chirinéa; Brandão, 2015; Figueiredo *et al.*, 2018), this study finds evidence of a strong association between the Saeb and factors not included in the calculation of the Ideb, such as the socioeconomic level of students and the proportion of full-time enrollment, suggesting that the Ideb should always be considered in conjunction with other indicators of the educational reality of each school.

7 Conclusions and final considerations

This study analyzed the data from the Saeb assessments for Secondary Education in the state of Pernambuco, in 2019 and 2021, with a view to verifying whether the public policies adopted in the area of education can justify, to some extent, the accelerated improvement in the state's Ideb performance. Possible associations between Saeb scores and variables related to innovation, school infrastructure, school management, students' socioeconomic status, and full-time study were investigated.

The results show that three variables predominate in explaining the variation in Saeb scores in the sample considered. The first of these is the socioeconomic level of the school, which is widely documented in the literature. The second, related to the innovation axis, is the number of computers per student. Finally, the third is the proportion of full-time enrollments, which represents the full-time education axis. Thus, substantial evidence was found that the innovation and comprehensive education axes explain the variation in scores between schools in Pernambuco in the sample analyzed. As for the infrastructure and management axes, there is not enough evidence to characterize an association.

It is important to note that the linear associations found do not necessarily have a causal relationship with the score, but only indicate the explanatory potential of the score and the possible effectiveness of the public policies adopted. On the other hand, the fact that a variable shows little association with the Saeb score in Pernambuco in 2019 and 2021 does not necessarily mean that this variable is not significant from the point of view of these policies. For example, a certain action or characteristic implemented uniformly in schools, or until its effect is saturated, would not have the influence reflected in the variation in grades. A non-linear

association between characteristics and Saeb scores may not be adequately captured. In addition, unlike the 2019 assessment, the 2021 assessment took place in the midst of the transformations resulting from covid-19, a period in which variables identified as influential in 2019 could have their effect reduced due to the pandemic scenario. There is still the possibility that other variables not available (hidden or unknown) in the databases investigated have a significant impact on grade variation and that the associations identified in this study are nothing more than spurious relationships, in which the data analyzed seems to offer some meaning that, in practice, is non-existent.

In any case, in the context of the above, the four strategic axes of action developed in the state of Pernambuco seem to account for no more than 50% of the variation in Saeb scores. This shows the need for closer ties between evaluation methods and objectives and decision-making in the formulation of public policies, revealing that there is still much to be explored in the educational field in that state and throughout Brazil.

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