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RELATIONSHIP BETWEEN PUBLIC SPENDING AND EDUCATIONAL EFFICIENCY OF MUNICIPALITIES IN SANTA CATARINA

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ABSTRACT

High-quality public education plays a crucial role in mitigating socioeconomic disparities and promoting regional development. This study aims to analyze the relationship between public spending and the educational efficiency of municipalities in Santa Catarina. Using data from 2017 and 2019. this paper relies on the Basic Education Development Index (IDEB) as the main metric, analyzing a sample of 262 municipalities in Santa Catarina. Statistical methods, including Multiple Linear Regression and the TOPSIS multicriteria analysis technique, were employed to evaluate the efficiency of educational spending and rank the municipalities in terms of effectiveness. The results indicate that a higher GDP per capita does not necessarily correlate with superior educational performance, highlighting the complexity of factors influencing educational efficiency. Variables such as Average Spending and the Human Development Index (HDI) emerged as significant determinants of IDEB, underscoring their importance in improving municipal educational indicators. The conclusion of this study offers valuable insights for researchers and public managers, providing a basis for evaluating educational policy and supporting decisions aimed at optimizing the allocation of public resources to promote more efficient and equitable management of the educational system.

Keywords: Public Spending. Educational Efficiency. Public Education. IDEB.

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1 INTRODUCTION

Education plays a fundamental role in the development of both individuals and nations, being widely recognized as a significant driver of social mobility, contributing to the improvement of the socioeconomic status of society (Brown et al., 2013). The effective allocation of public resources, as observed by Souza et al. (2012), emerges as a pressing challenge on the sociopolitical agenda, as it seeks to comprehensively meet demands. In this context, the evaluation of the quality of these expenditures bewithes imperative, gaining prominence in discussions among public policy researchers.

As outlined by Zoghbi et al. (2009), the efficiency of public spending is characterized by the best results achieved relative to a given level of investment, with investments in education recognized as particularly propelling national growth withpared to other categories of government spending. Considering the interdependence between education levels and the socioeconomic development of a nation, as elucidated by Caleiro (2010), the strategic allocation of resources in the educational sphere emerges as an essential catalyst for socioeconomic progress. Thus, education emerges as a fundamental element for empowering individuals to improve their living conditions and, consequently, contribute to the development of the community in which they are embedded (Silva et al., 2013).

Municipal managers often seek to justify the poor performance of educational indicators by attributing it to the scarcity of available resources. However, counterarguments, such as those presented by Silva and Almeida (2012), contend that deficiencies in municipal public education are more broadly caused by inefficiencies in the allocation and application of these resources. Economic efficiency, as conceptualized in the literature, refers to the ability to maximize output gains with the minimum possible inputs, and it is the responsibility of public management, as a catalyst for local development, to ensure the appropriate use of these resources (Silva Filho et al., 2016). Nonetheless, efficient allocation proves to be a challenging task given the diversity of demands in each region, making it complex to establish priorities objectively. Nevertheless, it is crucial that the application of public resources is guided by the purpose of maximizing benefits for society.

The notion of efficiency and its applicability to education has been widely debated in the literature (Grosskopf et al., 2014). In recent decades, the evaluation of educational efficiency and productivity has sparked the interest of various researchers and professionals. Educational efficiency is intrinsically linked to the quality of teaching and the educational outcomes achieved with minimal resource expenditure (Johnes et al., 2017). In the national context, studies on public spending occupy a significant portion of research, especially in basic education, where the focus is on assessing the efficiency of public resource use (Savian & Bezerra, 2013; Sousa et al., 2016; Silva Filho et al., 2016; Begnini & Tosta, 2017; Moraes et al., 2017; Lourenço et al., 2017; Schuster & Zonatto, 2017; Queiroz et al., 2020; Bernardo et al., 2020; Kakihara et al., 2020; Vasconcelos et al., 2021; Sousa et al., 2021; Júnior & Cisne, 2023). These studies aim to identify the effectiveness of public spending on education, emphasizing the importance of qualitative application of resources, as larger investment volumes do not always translate into better educational quality indicators (Savian & Bezerra, 2013).

Indeed, the mentioned studies aimed to identify the effectiveness of resource allocation in the educational sector, enabling the measurement of public spending and the evaluation of the efficiency or inefficiency of the corresponding administrative units. The findings from these analyses have the potential to provide valuable information to decision-makers and public policy formulators. It is relevant to highlight that the measurement of public spending assumes a prominent role, as the prevailing perception among citizens is that public resources are generally poorly utilized (Zoghbi et al., 2011).

It is important to note that the results obtained so far do not fully encompass the breadth of

the topic under discussion, highlighting the need to analyze the relationship between public spending and educational efficiency. Public managers face the challenge of efficiently allocating available resources, given that demands vary significantly among different regions and municipalities. For public resources to be used in a way that maximizes benefits for society, it is necessary to implement management practices that prioritize efficiency and effectiveness in the application of these resources. Detailed analysis of expenditures and educational outcomes allows for the identification of municipalities that are making the best use of available resources, providing concrete data that can guide decision-making and the development of more effective public policies.

Based on the above, the following research question was addressed: **what is the relationship between public spending and educational efficiency in the municipalities of Santa Catarina?** This study aimed to examine and discuss aspects related to the quality of public resource allocation and educational performance in the municipalities of Santa Catarina. Beyond quantifying expenditures, it is crucial to compare these expenditures among municipalities to identify those demonstrating greater efficiency in their use. In this context, the article seeks to develop a comprehensive evaluation and, consequently, establish a ranking of the municipalities of Santa Catarina regarding the efficiency of public resource application in the educational sector.

The existence of inequality and inefficacy in the distribution of resources across various sectors, such as education, health, and housing, reflects the disparities in the socioeconomic development of regions, directly impacting the quality of life of the population (Silva et al., 2012). Monitoring and analyzing educational expenditures, both by researchers and society, is crucial because inadequate allocation in these areas can result in increased schooling without a corresponding advance in human capital, which is essential for the socioeconomic progress of a nation (Savian & Bezerra, 2013). In this context, understanding the practices adopted by efficient municipalities can help less efficient ones improve their management and allocation of public resources.

The research significantly contributes to the academic literature by exploring the relationship between public spending and educational efficiency in the municipalities of Santa Catarina. By employing advanced statistical methods, the study offers a robust and detailed analysis of the allocation of public resources in education. Furthermore, the investigation broadens the theoretical understanding of economic efficiency in the educational context, highlighting the importance of maximizing educational outcomes with the least possible expenditure of resources. This theoretical focus is essential for developing new approaches and models that can be applied in future studies, contributing to the evolution of theories on efficiency and quality in the public sector.

In practical terms, the study provides a detailed assessment of the efficiency of public spending in education, allowing for the identification of municipalities that make the best use of available resources. This type of analysis is fundamental for public managers, as it provides concrete and comparable data that can guide decision-making. The information obtained can be used to develop more effective public policies, strategically directing investments to areas with greater needs or potential for improvement. Additionally, by establishing a ranking of municipal efficiency, the research offers a benchmark that other regions can use to evaluate and enhance their educational management practices.

From a social perspective, the research underscores the importance of education as a driver of socioeconomic development. By focusing on the efficiency of public spending, the study addresses the crucial issue of how to improve the quality of education without necessarily increasing financial investments. This is particularly relevant in contexts of limited resources, where optimizing fund allocation can result in significant improvements in quality of life and educational opportunities for the population. Furthermore, by highlighting inequalities in resource

distribution, the research contributes to a broader debate on social justice and equity in access to quality education.

2 THEORETICAL FOUNDATION

The primary purpose of public administration is the efficient allocation of public resources, derived from taxes, to benefit social welfare and guarantee the fundamental rights established in the Federal Constitution of 1988. such as the rights to life, education, health, security, and leisure. In this context, education assumes a prominent role, recognized as essential for national development (Almeida & Gasparine, 2013). The importance of education is further emphasized by Zoghbi et al. (2009), who highlight its contribution to human, social, and economic progress.

Considering the significant impact that education has on society through the enhancement of human capital, it is imperative that resources are allocated effectively, aiming to maximize benefits for the community (Souza et al., 2012). In this context, Diniz and Corrar (2011) argue that improving public educational institutions can accelerate the pace of economic growth, emphasizing the importance of ensuring efficiency in the allocation of public resources in the educational sector.

It is important to highlight that the resources available to meet this demand are limited, which necessitates more efficient public management in the allocation of these resources, aiming for the fair and equitable satisfaction of the population's needs (Diniz et al., 2012). The discussion on the efficiency of public resource allocation, besides meeting legal requirements, encourages managers to adopt responsible fiscal management practices, prioritizing the quality of services offered without disregarding the costs involved (Diniz et al., 2012).

To measure the quality of education and monitor the fulfillment of the School Development Plan (PDE), a system for evaluating Brazilian education was established, comprising large-scale assessments such as Prova Brasil and SAEB, culminating in the Basic Education Development Index (IDEB) (INEP, 2015). The IDEB, as an educational indicator, plays a fundamental role in the formulation, reformulation, and monitoring of public policies, providing society with evidence of governmental initiatives in the education sector (INEP, 2015). Considering that public educational policies encompass all actions taken or omitted by the government, both in the educational sphere and in other areas, the IDEB emerges as an indicator capable of revealing and overseeing the efficiency and effectiveness of public administration interventions concerning basic education.

After a review of the international literature, several reasons were identified that support the importance of analyzing and measuring the efficiency of public spending. Zoghbi et al. (2011) argue that such quantifications can assist governmental decision-makers, highlighting the relevance of efficiency evaluation through quantitative models, given the general perception that public resources are not always efficiently employed by the population. In a study on the efficiency of municipal public spending on early elementary education in Paraná between 2005 and 2009. Savian and Bezerra (2013) found that most municipalities in Paraná demonstrated inefficiency in educational investments, indicating the need for a review of resource allocation by public management.

By examining the efficiency and effectiveness of public resources allocated to elementary education in the municipalities of Espírito Santo, Souza (2016) observed that average spending per student was not a determining factor in achieving IDEB goals, especially in more economically developed regions where municipalities demonstrated lower efficiency. Schuster and Zonatto (2017) support these findings by identifying that the most efficient municipalities tended to spend less, were smaller in size, and had lower economic activity.

Silva Filho et al. (2016) conducted an evaluation of the efficiency in the allocation of public spending on education in the Army Military Colleges. The results revealed that in 2009. seven

colleges (58.34%) were classified as efficient, while in 2011 only four units (30%) maintained such efficiency. It is worth noting that the colleges with the highest resource allocations were not necessarily the most efficient, indicating the need for more effective management by those responsible. In line with these findings, Begnini and Tosta (2017) indicated that only 25.92% of Brazilian states demonstrated efficient spending, while 74.08% showed inefficient results, suggesting the need for improvements in the management of employed resources.

Moraes et al. (2017) identified in their study that certain municipalities, despite higher investments, did not achieve significant results, while smaller municipalities demonstrated better performance, characterizing a more efficient use of municipal resources in elementary education. Lourenço et al. (2017) analyzed the technical efficiency of the 250 largest Brazilian municipalities in terms of elementary school enrollments, using the DEA analysis technique. The results indicated that only 13 municipalities achieved 100% efficiency, being classified as efficient. These findings highlight the urgent need to improve the application of public resources.

Queiroz et al. (2020) observed the stagnation of educational performance in Brazil in recent years, as evidenced by the results of PISA (Programme for International Student Assessment) and IDEB. Even considering variations in variables and socioeconomic context, the average efficiency of schools showed little improvement from 2007 to 2015. highlighting the overall lack of progress in the efficiency of primary schools during this period. Thus, the studies emphasize the urgent need to improve the application of public resources, noting that more efficient municipalities tend to spend less, are often smaller, and that the volume of resources is not directly proportional to efficiency. Effective management can lead to superior results even with limited resources.

The study conducted by Bernardo et al. (2020) analyzed and quantified the quality of education in Brazilian municipalities through the General Quality Index of Municipal Education (IQGEM), emphasizing the positive impact of investments in school infrastructure and social aspects. The results indicate that such investments play a crucial role in improving the quality of education, revealing a positive correlation with the IQGEM. Vasconcelos et al. (2021) support this conclusion by demonstrating that school infrastructure has a significant impact on educational quality, using the IDEB to show that the lack of adequate infrastructure reduces the effectiveness of the resources applied.

De Sousa et al. (2021) examined the efficiency of public spending on education in Amazonas and found that municipalities with better initial conditions showed lower efficiency. Kakihara et al. (2020) identified variables such as rural population, class size, and teacher qualifications that affect the efficiency of educational resources, highlighting the need for effective educational management to improve resource utilization and, consequently, the quality of education. Finally, Júnior and Cisne (2023) evaluated the relationship between public spending and IDEB results in Ceará, finding a strong connection between spending policies and educational performance. The authors emphasized that changes in the volume of public spending on education explain the variations in the IDEB performance index, highlighting the importance of well-directed policies and the potential positive impact of long-term investments.

3 METHODOLOGY

Given the scope of the study, which aims to analyze the relationship between public spending and educational efficiency in the municipalities of Santa Catarina, a descriptive approach is adopted for the objectives, a documentary approach for the procedures, and a quantitative approach for problem-solving. The quantitative approach aims to measure the collected data through the acquisition of information, numerical data analysis, and the use of statistical tests (Hair et al., 2009). The descriptive approach, as described by Hair et al. (2009), is employed to examine the characteristics of events or research activities in a structured manner. Regarding the

documentary research, according to Martins and Theóphilo (2007), it refers to the use of data sources and auxiliary information derived from various documents.

The target population of the study consists of the 295 municipalities in Santa Catarina. However, after excluding municipalities that did not have the necessary information for the analysis, the sample totaled 262 municipalities. Considering that IDEB is an index published every two years, the analysis is based on data from the years 2017 and 2019. The selected time interval is justified by the limited availability of data. Expanding the research to earlier periods would result in the exclusion of a substantial portion of the sample due to the inaccessibility of the required data. Thus, this research includes 524 observations. Table 1 presents the description of the variables addressed in the study.

Table 1
Description of Variables

Dependent Variable	**Description**	**Information Basis**
Average IDEB Score (IDEBMed)	Average IDEB for Municipalities: Calculated as (IDEB 4th Grade + IDEB 8th Grade) / 2	National Institute for Educational Studies and Research Anísio Teixeira (INEP) Website
Independent Variable	**Description**	**Information Basis**
GastMed (gasto médio por aluno)	Result of the Division Per Student Spending: Total Expenditure / Enrolled Students	Average expenditure per student enrolled in each municipality (of municipal withpetence)
Control Variables	**Description**	**Information Basis**
HDI	Human Development Index	IBGE
GDP *per capita*	Gross Domestic Product *per capita*	IBGE

Source: Prepared by the authors
Legend: GastMed (Average Spending per Student) will henceforth be referred to as GM; GDP per Capita (Gross Domestic Product per Capita) will henceforth be referred to as GDP.

The average IDEB score calculated from the results of the 4th and 8th grades is an essential measure for evaluating the quality of education at different stages of elementary education. This average is important because it allows for a broader and comparative analysis of educational performance over time, capturing both progress and deficiencies at various phases of student development. Firstly, considering the 4th-grade results provides an initial view of the impact of educational policies and pedagogical practices in the early years of schooling, a critical period for acquiring fundamental skills in reading, writing, and mathematics. These formative years establish the foundation upon which subsequent learning is built. A good performance at this stage indicates that students are acquiring the basic competencies necessary for future academic success.

On the other hand, the 8th-grade results reflect the continuity of the educational process and the effectiveness of teaching strategies applied in the intermediate years of elementary education. At this stage, students should consolidate and expand their knowledge and skills, preparing for the challenges of high school. Evaluating performance at this level allows for the identification of whether initial improvements are sustained over time or if there is a decline in achievement that needs to be addressed.

By calculating the average IDEB score from the results of the 4th and 8th grades, we can obtain a more representative measure of the educational quality offered by schools and educational networks. This average provides a balanced perspective that considers both the initial gains and the sustainability of these gains over time. Additionally, it facilitates the identification of critical moments in the students' educational journey, allowing for the implementation of specific and targeted interventions to ensure consistent quality education at all stages of elementary education.

After data collection, based on the variables presented in Table 1. it was possible to begin the analysis through descriptive statistics, correlation, and subsequently, multiple linear regression to address the research objective, as per Equation 1.

$$IDEB = \beta_0 + \beta_1 GM + \beta_2 IDH + \beta_3 PIB + \varepsilon$$

(Equation 1)

To conduct an efficiency analysis of the municipalities in Santa Catarina, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was used to classify each municipality according to its performance. The TOPSIS technique, according to Tzeng and Huang (2011), is a multicriteria decision analysis model that classifies data based on its distance from the best (closest to the ideal solution) and the worst (farthest from the ideal solution) performance within the presented sample. Therefore, the result from TOPSIS is a number between 0 and 1. where the closer to 1. the better. In the context of this study, municipalities with results closer to 1 show better performance among the analyzed data. For better understanding, the steps for TOPSIS according to Tzeng and Huang (2011) are outlined below, starting with the decision matrix:

$$D = \begin{bmatrix} d_{11} & \cdots & d_{1m} \\ \vdots & \ddots & \vdots \\ d_{n1} & \cdots & d_{nm} \end{bmatrix} \quad \text{(Equation 2)}$$

The second step involves standardizing the data, and the third step determines the positive ideal solution (A+) and the negative ideal solution (A-) for each variable in the research.

$$A^+ = (p_1^+, p_2^+, \ldots, p_m^+) \text{ where } p_j^+ = \{Max_i p_{ij}, j \in J_1;\ Min_i p_{ij}, j \in J_2\} \quad \text{(Equation 3)}$$

$$A^- = (p_1^-,\ p_2^-, \ldots, p_m^-) \text{ where } p_j^- = \{Min_i p_{ij}, j \in J_1;\ Max_i p_{ij}, j \in J_2\} \quad \text{(Equation 4)}$$

The distances of each variable from the positive ideal solution and the negative ideal solution are calculated, determining d_i^+ e d_i^- for each municipality [1].

$$d_i^+ = \sqrt{\sum_{j=1}^{n} w_j \left(p_j^+ - p_{ij}\right)^2} \text{ with i} = 1\ldots., \text{m} \quad \text{(Equation 5)}$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} w_j \left(p_j^- - p_{ij}\right)^2} \text{ with i=1}\ldots, \text{ m} \quad \text{(Equation 6)}$$

Given this, the coefficient of proximity for each variable is determined, yielding the final score for each alternative.

$$\xi_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad \text{(Equation 7)}$$

The process concludes with the development of the final ranking, considering the classification of the calculated indicators from highest to lowest.

Therefore, the standardized variables of IDEB, Average Spending per Student, HDI, and GDP per capita were added, and the TOPSIS analysis results allowed for the classification of municipalities according to their performance. Thus, two rankings (for 2017 and 2019) were

[1] The weight structure was disregarded within the TOPSIS model.

generated, where the top position was assigned to the municipality that demonstrated performance closest to the positive ideal (optimal solution) and farthest from the negative ideal (inferior solution) (Bulgurcu, 2012).

4 ANALYSIS AND DISCUSSION OF RESULTS

This section is dedicated to presenting and analyzing the results obtained. Initially, the descriptive statistics of the variables relevant to the research are presented. Following that, the correlation matrix, the results of the multiple linear regressions, and finally, the ranking obtained through the TOPSIS method, as established in the research scope, are displayed. Table 2 presents the descriptive analysis of the variables related to the municipalities of Santa Catarina.

Table 2
Descriptive Statistics of the Variables

Descriptive Statistics					
Municipalities of Santa Catarina					
	Average	Standard deviation	25th Percentile	Median	75th Percentile
IDEB	6.022	0.702	5.5	6	6.5
GM	9.126	0.266	8.949	9.12	9.289
GDP	10.383	0.379	10.129	10.376	10.615
HDI	0.734	0.039	0.707	0.737	0.761

Legend: IDEB. Basic Education Development Index; GM. Average Expenditure; GDP. Gross Domestic Product; HDI. Human Development Index.
Source: Research data.

As evidenced by Table 2, there is minimal variation among the percentiles of the analyzed variables. This pattern is attributed to the standardization of the variables, resulting in moderate standard deviations and a balanced distribution.

However, it is important to highlight that there are population disparities among municipalities in the years analyzed. Additionally, there are noticeable differences in public spending on education and municipal economic development, as assessed through GDP and Average Expenditure. These municipal and regional disparities significantly contribute to the large inequalities identified (Savian & Bezerra, 2013) and could influence the efficiency of educational indicators if there is inadequate allocation of public resources.

Table 3 presents both the Pearson correlation matrix in the lower triangular matrix and the Spearman correlation matrix in the upper triangular matrix.

Table 3
Pearson and Spearman Correlation

Variable	IDEB	GM	GDP	HDI
IDEB	1	0.274**	0.062	0.128**
GM	0.265**	1	0.071	-0.098**
GDP	0.072	0.118**	1	0.462**
HDI	0.149**	-0.090**	0.424**	1

Legend: IDEB. Basic Education Development Index; GM. Average Expenditures; GDP. Gross Domestic Product *per capita*; HDI. Human Development Index. Significance Levels: p<0.05. * p<0.01.
Source: Research data.

The analysis of the Pearson correlation matrix, which relates elements based on their variance and covariance, indicates a positive and significant association between IDEB and the variables Average Spending and HDI. This preliminary analysis suggests that these variables play a crucial role in enhancing the educational indices of municipalities in Santa Catarina. Regarding

Spearman's correlation, which is based on the ranks of elements, the results support the validity of the variables, although they show that the relationship between GDP and Average Spending is not significant. Moreover, the variable GDP *per capita* did not prove significant in any of the models, indicating that the GDP *per capita* of municipalities does not have a significant influence on improving IDEB results. This aligns with the conclusions of Queiroz et al. (2020), which did not identify a clear relationship between the GDP *per capita* of regions.

Table 4 presents the results of the analysis of the relationship between IDEB, Average Spending, GDP *per capita*, and HDI. It is important to highlight that tests for residual autocorrelation and multicollinearity among the variables were conducted, which did not reveal any issues, as indicated in Table 4 by the Durbin-Watson test (for residual autocorrelation) and VIF (for multicollinearity among the variables). These tests were carried out as an additional measure, even though no statistical indications suggesting the presence of these problems were observed.

When analyzing Panel A of Table 4, it is observed that the model was statistically significant, demonstrating that the explanatory power of the Average Spending variable in relation to IDEB was 6.88%. Additionally, the Average Spending variable showed statistical significance and the obtained sign was as expected. In Panel B, it is noted that the model also proved to be statistically significant, with the explanatory power of the variables in relation to IDEB increasing to 9.72% after the inclusion of control variables. Generally, it is evident that the variables included in the model are relevant for explaining the relationship between public spending and educational efficiency in the municipalities of Santa Catarina, with only GDP per capita not being statistically significant.

Table 4

Results of the Relationship Between Public Spending and Educational Efficiency

Variables	Dependent Variable: IDEB		
	Coefficient	Statistics *t*.	VIF
Panel A -			
Constant	-0.352	0.728	
GM	0.698	0.000***	NSA
Model Significance		0.000***	
R^2		7.05	
Adjusted R^2		6.88	
DW		2.008	
N		524	
Panel B -			
Constant	-2.568	0.043	
GM	0.757	0.000***	1.04
GDP	-0.081	0.343	1.26
HDI	3.433	0.000***	1.25
Model Significance		0.000***	
R^2		10.23	
Adjusted R^2		9.72	
DW		1.982	
N		524	

Legend: Research data. NSA. Not Applicable; IDEB. Basic Education Development Index; GM. Average Expenditures; GDP. Gross Domestic Product per capita; HDI. Human Development Index. VIF = Variance Inflation Factor; DW = Durbin-Watson; N = number of observations. Significance levels: * p<0.10; ** p<0.05; *** p<0.01.

The control variable GDP did not show significance. Previous studies, such as those by Savian and Bezerra (2013), emphasize that a high GDP *per capita* in a municipality does not always translate into an efficient allocation of public resources in education. The regression analysis results support the findings of Souza et al. (2016) and Schuster and Zonatto (2017), who

demonstrated that municipalities in economically more developed regions tend to show lower efficiency. This highlights that greater availability of resources does not necessarily result in higher efficiency, underscoring the importance of more effective management of these resources.

Finally, aiming to construct a ranking of efficiency for the municipalities in Santa Catarina regarding the allocation of public resources in education, the TOPSIS technique was employed to classify the municipalities based on their performance and obtain the corresponding efficiency scores. Therefore, the data presented in Table 5 reflect the 10 most efficient municipalities (with scores closest to 1) and the 10 least efficient municipalities (with scores furthest from 1) among the 262 analyzed municipalities in Santa Catarina, using the TOPSIS method based on the years 2017 and 2019.

A preliminary analysis of Table 5 reveals distinct results in the efficiency ranking of Santa Catarina municipalities regarding the allocation of public resources in education between 2017 and 2019. Notably, only four municipalities remained among the top 10 most efficient: São João do Oeste, Peritiba, Presidente Castello Branco, and Seara, with a special emphasis on Seara, which maintained its 4th position. These municipalities demonstrate consistency in education quality, with minimal variations in the TOPSIS index. This stability suggests effective educational practices and well-implemented policies that sustain high performance over the years. Arabutã and Santa Rosa de Lima showed remarkable improvements, rising to the top positions in 2019. This rise can be attributed to recent changes in educational policies, increased investments, or enhancements in school infrastructure and teacher training.

Among the 10 least efficient municipalities, four maintained their low positions with nearly unchanged or worsening indices, including Ponte Alta, Ponte Serrada, São Joaquim, and Bom Jardim da Serra. The persistence in these low rankings suggests a need for a critical review of educational strategies and local policies, as well as increased support and resources directed towards these municipalities.

A comparative analysis of the average GDP *per capita* for the state in 2017 (R$ 32,150.45) and 2019 (R$ 36,292.97), alongside municipalities like Treze Tílias (with GDP *per capita* of R$ 81,495.35), São João do Oeste (R$ 42,910.29), Arabutã (R$ 40,781.33), Peritiba (R$ 29,306.57), Santiago do Sul (R$ 24,541.27), and Santa Rosa de Lima (R$ 26,842.89), reveals that regardless of their GDP *per capita* relative to the state average, these municipalities demonstrated high efficiency. Consequently, the analysis from Table 5 suggests that smaller municipalities, despite having lower GDP *per capita* values, exhibit more efficient spending in education. This pattern implies that smaller municipalities might have more effective management, corroborating previous findings in public sector performance studies, such as those by Zoghbi et al. (2011) and Moraes et al. (2017).

Table 5

Ranking of Santa Catarina Municipalities Based on the TOPSIS Technique

Municipalities of Santa Catarina					
Ranking 2017	TOPSIS	Municipality	Ranking 2019	TOPSIS	Municipality
Panel A – *Top 10* Rankings					
1º	0.74	São João do Oeste	1º	0.77	Arabutã
2º	0.74	Peritiba	2º	0.77	São João do Oeste
3º	0.73	Presidente Castello Branco	3º	0.75	Peritiba
4º	0.73	Seara	4º	0.74	Seara
5º	0.73	Treze Tílias	5º	0.74	Santa Rosa de Lima
6º	0.71	Santiago do Sul	6º	0.74	Presidente Castello Branco
7º	0.71	Águas Frias	7º	0.73	Alto Bela Vista
8º	0.70	Xavantina	8º	0.73	Lajeado Grande
9º	0.70	Luzerna	9º	0.72	Lacerdópolis
10º	0.70	Rio do Oeste	10º	0.72	Iporã do Oeste
Panel B – Bottom 10 Rankings					

253º	0.25	Ponte Alta	253º	0.32	Três Barras
254º	0.25	Monte Carlo	254º	0.32	Balneário Arroio do Silva
255º	0.25	Santa Rosa do Sul	255º	0.31	Pouso Redondo
256º	0.24	Ponte Serrada	256º	0.31	Ponte Alta
257º	0.21	Santa Cecília	257º	0.31	Biguaçu
258º	0.20	Calmon	258º	0.31	Camboriú
259º	0.19	São Joaquim	259º	0.27	Bom Jardim da Serra
260º	0.19	Bom Jardim da Serra	260º	0.22	São Joaquim
261º	0.15	Campo Belo do Sul	261º	0.21	Ponte Serrada
262º	0.15	São José do Cerrito	262º	0.18	Passo de Torres

Source: Research data.

When comparing the average state GDP *per capita* for the years 2017 (R$ 32,150.45) and 2019 (R$ 36,292.97) with the values of the bottom 10 municipalities in each year, including Três Barras (with GDP per capita of R$ 59,705.74), São Joaquim (R$ 33,206.44), Biguaçu (R$ 32,288.10), and Camboriú (R$ 20,293.69), it is observed that these municipalities fluctuate around the state average. These results highlight that municipalities with better economic performance are not necessarily the most efficient, corroborating previous findings.

Therefore, the study's results highlight the urgent need for improvements in resource management by public officials. It is emphasized that a municipality's efficiency cannot be assessed solely based on the volume of available resources. As demonstrated, smaller municipalities with more limited resources often show higher efficiency, indicating a more effective allocation of these resources and, consequently, achieving better results.

As a complementary analysis, the different regions of Santa Catarina were investigated. Thus, Table 6 presents the results of the relationship between IDEB, Average Expenditures, GDP *per capita*, and HDI by regions of Santa Catarina. It is worth noting that tests were conducted to check for residual autocorrelation and multicollinearity among the variables, which did not reveal any problems, as shown in Table 6 by the Durbin-Watson tests (for residual autocorrelation) and VIF (for multicollinearity among the variables).

As shown in Table 6, the different regions of Santa Catarina were individually investigated. In a preliminary analysis, it was observed that only the models for the South, West, and Serrana regions presented statistically significant results, with the explanatory power of the models ranging between 14.34% and 25.98%. This clearly indicates that IDEB performance is subject to influences beyond the variables analyzed. The regions that did not demonstrate significance in the models were reported; however, conclusions based on non-significant models are not viable. Nonetheless, this finding reveals a certain disparity in the variation between independent and dependent variables (ANOVA), possibly driven by the diversity in the economic structure of some municipalities, especially in Jaraguá do Sul and Joinville.

Table 6

Results of Regression between Public Spending and Educational Efficiency by Santa Catarina Region

Variables	Dependent Variable: IDEB					
	South Region	Greater Florianópolis Region	North Region	West Region	Serrana region	Vale do Itajaí Region
	Coef. (Est. *t*)	Coef. (Est. *t*)	Coef. (Est. *t*)	Coef. (Est. *t*)	Coef. (Est. *t*)	Coef. (Est. *t*)
Constant	-8.300 (0.008)	4.423 (0.357)	4.609 (0.336)	-0.844 (0.772)	-4.843 (0.285)	4.499 (0.101)
GM	0.504 (0.057*)	0.449 (0.277)	0.192 (0.710)	0.712 (0.007***)	0.816 (0.007***)	0.358 (0.201)
GDP	0.644 (0.007***)	0.095 (0.729)	-0.231 (0.361)	-0.287 (0.182)	0.150 (0.653)	-0.016 (0.930)

HDI	3.845 (0.191)	-4.729 (0.102)	2.781 (0.273)	4.849 (0.018**)	1.754 (0.513)	-2.191 (0.244)
VIF	[1.05; 1.51]	[1.04 ;1.49]	[1.06; 1.24]	[1.01;1.39]	[1.06; 1.12]	[1.07 ;1.33]
Significância do modelo	0.000***	0.167	0.637	0.003***	0.049**	0.406
R^2	25.98	13.66	3.75	14.34	15.55	3.30
R^2 Ajustado	22.98	6.04	-2.82	11.36	10.04	0.00
DW	1.43	1.58	2.11	2.34	2.03	2.04
N	78	38	48	90	50	90

Legend: Research Data. IDEB: Basic Education Development Index; GM: Average Spending; GDP: Gross Domestic Product; HDI: Human Development Index; VIF = Variance Inflation Factor; DW = Durbin-Watson; N = number of observations. Significance levels: * p<0.10. ** p<0.05. *** p<0.01.

Overall, when analyzing the regions individually, it is observed that the Southern, Western, and Serrana regions of Santa Catarina show a significant relationship between IDEB and Average Spending. The sign found is consistent with expectations: higher investment in education leads to better results, indicating that average spending and human development are important for educational performance. Additionally, it is noted that HDI in the Serrana region reflects the expected pattern, where a higher HDI is associated with better IDEB results, suggesting that higher municipal development indices can translate into more positive educational outcomes. Finally, the GDP variable in the Southern region showed a significant and positive result, indicating that financial and economic investment appears to have a positive impact on educational performance.

The comparative analysis reveals that the impact of variables on educational performance (IDEB) varies significantly between the regions of Santa Catarina. This variability underscores the need for region-specific approaches in educational policies. Therefore, based on the study's results, it can be inferred that there are differences between regions, highlighting the necessity for managers and policymakers to identify ways to enhance the efficiency of public resource allocation and improve regional educational indices. Thus, the results highlight a crucial factor for managers to consider in formulating educational public policies: regional characteristics, as they can have a substantial influence on the outcomes of public resource allocation.

In line with the observations of this study, the research by Bernardo et al. (2020) quantified and assessed the quality of education in Brazilian municipalities through the Municipal General Education Quality Index (IQGEM), highlighting the positive influence of investments in school infrastructure and social aspects. The findings confirm that such investments are crucial for improving the quality of education, showing a positive correlation with IQGEM. Vasconcelos et al. (2021) reinforce this conclusion by demonstrating that school infrastructure significantly impacts educational quality (IDEB), indicating that inadequate infrastructure reduces the efficiency of applied resources, which aligns with the findings of this study.

Sousa et al. (2021) assessed the efficiency of public spending on education in Amazonas and found that municipalities with better initial conditions showed lower efficiency. Kakihara et al. (2020) identified variables such as rural population, student-teacher ratios, and teacher qualifications that affect the efficiency of educational resources. These findings support the conclusion about the need for efficient educational management to improve resource allocation and, consequently, the quality of education. Additionally, these studies complement the analysis on the necessity of strategic and efficient investments, indicating that merely increasing spending does not guarantee better educational quality.

Júnior and Cisne (2023) assessed the correlation between public spending and IDEB results in Ceará, finding a strong relationship between spending policies and educational performance. The authors demonstrated that changes in the volume of educational public spending account for variations in the IDEB performance index, highlighting the importance of well-targeted policies and the potential positive impact of long-term investments. The findings of these studies converge on identifying critical factors for educational quality, such as investments in school infrastructure,

efficient resource management, and social aspects. However, a common emphasis is placed on the need for efficient management and well-planned strategies to ensure that public investments lead to significant improvements in education quality.

5 FINAL CONSIDERATIONS

It is understood that investment in education represents a crucial means for driving economic growth, making the expansion and precise allocation of resources to basic education imperative. Due to its capacity to foster citizenship, influence the well-being of the population, and generate development at both local and national levels, education demands attention from government officials and policymakers. The purpose of this research was to analyze the relationship between public spending and educational efficiency in municipalities in Santa Catarina, as well as to discuss its results. The following are some conclusions drawn from this investigation.

As practical and social contributions, the results of this study have the potential to provide fundamental insights for decision-making by public managers, offering a deeper understanding of the importance of effective allocation of public resources, especially in the educational sector. Strategic and well-informed allocation can have a direct impact on poverty alleviation, violence reduction, and income disparity reduction, thereby promoting sustainable socioeconomic development.

The research findings, including the analysis of the efficiency ranking of municipalities in Santa Catarina for the years 2017 and 2019, suggest that, in general, smaller municipalities with more limited resources demonstrated higher efficiency compared to their larger counterparts. This observation highlights that higher volumes of available resources do not always translate into better public indicators, underscoring the crucial importance of efficient management and the careful allocation of resources. In this context, the quality of public resource allocation emerges as a prominent topic in public sector performance research, offering the potential to generate substantial and beneficial social, political, and economic impacts for society.

Another relevant finding is that GDP *per capita* does not necessarily correlate with a high level of efficiency in education. Conversely, the variables Average Expenditure and HDI proved significant in relation to IDEB, suggesting that these factors play a crucial role in improving the educational indicators of municipalities in Santa Catarina. Additionally, it is important to highlight that the comparative analysis between the regions of Santa Catarina reveals significant variability in the impact of the variables on educational performance (IDEB). This variability underscores the need for regionally tailored approaches in educational policies and the inclusion of a broader range of variables to fully capture the determinants of educational performance.

The analysis of IDEB and the efficiency in the use of public resources has profound implications for long-term socioeconomic development. By understanding the practices adopted by the most efficient municipalities, it is possible to promote more qualified and targeted management, optimizing the application of resources and improving educational outcomes. Thus, the discussion on the efficient allocation of resources in education is not merely a matter of financial management but an essential long-term strategy for sustainable and equitable societal development.

In summary, the study on the relationship between public spending and educational efficiency in municipalities of Santa Catarina offers valuable contributions on several fronts: (i) Enrichment of Literature: The findings enhance the literature on economic efficiency and educational quality with new analytical approaches; (ii) Practical Tools for Policymakers: The results provide useful data and tools for public managers and policymakers; (iii) Promotion of Equity and Social Justice: The study stimulates debate on equity and social justice, while

suggesting pathways to improve education and, consequently, the socioeconomic development of the studied regions.

These contributions underscore the importance of continuing research in this area, encouraging more efficient and informed public management that can lead to significant advancements in education and social well-being.

It is important to highlight that this conclusion cannot be generalized, emphasizing that the evaluation of educational indicators is not a straightforward task and requires careful analysis. These results point to the need for a review of management practices in many municipalities in Santa Catarina, with the aim of continuously improving educational indices in Brazil. Proper application of public resources by public management will result in higher quality education offered to the population, contributing to the reduction of social inequalities. Therefore, these findings contribute to the literature by addressing the theme of educational efficiency, enabling reflections on adopting measures to reduce inequality and inefficiency in the allocation of public resources.

As a limitation, it should be noted that this study did not encompass all possible variables that could influence educational efficiency and municipal development. Additionally, the results may vary depending on the statistical model adopted and its respective constraints. The sample was limited to the municipalities in Santa Catarina that provided the necessary information for analysis, and a larger sample could have yielded more robust results. However, based on the variables considered in this study, it is possible to identify municipalities that are more efficient compared to others. It is also important to consider the potential endogeneity between the independent and dependent variables in the model, as increases in spending, HDI, and GDP may influence IDEB, and vice versa, creating a cycle of growth. However, a more in-depth analysis of this aspect is beyond the scope of this article.

For future research, it is suggested to analyze the quality of public resource allocation in relation to other public services, not only education, which was the focus of this study, as all public policies are crucial for local development. Additionally, future studies in the public sector may include variables not tested in this study, such as teacher continuing education rates, school infrastructure, socioeconomic indicators like average family income, unemployment rates, parental education levels, and expenditures on health, basic sanitation, regional characteristics, and infrastructure.

This work does not aim to exhaust the discussions on public spending efficiency. However, it is hoped that it can serve as a tool for reflection on the quality of public sector management and draw attention to a more efficient allocation of public resources in education, with the goal of improving the social aspects of the population.

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CONFLICT OF INTEREST

The authors assert that there is no conflict of interest related to this submitted work.

AUTHOR CONTRIBUTIONS

Roles	1st author	2nd author	3rd author
Conceptualization	♦	♦	♦
Data curation	♦	♦	♦
Formal analysis	♦	♦	♦
Funding acquisition			
Investigation	♦	♦	♦
Methodology	♦	♦	♦
Project administration	♦	♦	♦
Resources	♦	♦	♦
Software	♦	♦	♦
Supervision	♦	♦	♦
Validation	♦	♦	♦
Visualization	♦	♦	♦
Writing – original draft	♦	♦	♦
Writing – review & editing	♦	♦	♦