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Analysis of the efficiency of municipalities from the Brazilian State of Sergipe: a comparison of the results in Brazil's evaluation of its basic education system and investments on education

Análisis de la eficiencia de los municipios sergipanos: comparación entre los puntajes de prova Brasil y los recursos para la educación

Análise da eficiência dos municípios sergipanos: comparação entre notas da prova Brasil e recursos destinados à educação

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Abstract

Objective: To identify the efficiency of municipalities in the Brazilian State of Sergipe in promoting satisfactory education levels from the resources aimed at this sector.

Method: A qualitative research was used with the application of Data Envelopment Analysis as a technique for measuring the performance of the municipalities assessed. Municipal expenditure on education and financial resources received from the Brazilian fund FNDE were selected as input variables. The results of municipalities in the Brazilian national exam of *Prova Brasil*, for students in basic education, were used as outputs variables.

Results: The results indicate that higher expenditure in education does not necessarily ensure high educational performance, as municipalities with tighter budgets can reach better results in the sector analysed. Following the targets set in the current analysis, municipalities deemed inefficient were suggested to maintain or even reduce the resources applied on education, while also increasing the scores obtained in *Prova Brasil*.

Contributions to the study: The present study can be considered a reference tool for municipal authorities to establish strategies aiming towards the efficiency in the consumption of resources, while also delivering better services to the community. In addition, this study plays a supporting role to society, in helping them understand the performance of their municipality in *Prova Brasil*, thus creating subsidies to request greater transparency from local authorities.

Keyword: Municipal Expenditure. Education. Investments. Brazilian National Exam.

Resumen

Objetivo: Identificar el nivel de eficiencia de los municipios de Sergipe en la promoción de buenos índices educativos con los recursos destinados a este sector.

Metodologia: Se realizó una investigación con metodología cuantitativa aplicando el Análisis de Envoltura de Datos como técnica para medir el desempeño de las ciudades investigadas, seleccionando como variables de entrada los gastos municipales con educación y los recursos recibidos del FNDE. Las variables de salida fueron los puntajes de Prova Brasil en los grados de la escuela primaria.

Resultados: Los resultados señalaron el hecho de que gastar más no garantiza un buen desempeño educativo, ya que los municipios con presupuestos más pequeños pueden lograr mejores resultados en el sector discutido. Con los objetivos establecidos por el análisis, la propuesta de municipios ineficientes era mantener o incluso disminuirlos los recursos, pero, al mismo tiempo, siempre aumentar los puntajes en Prova Brasil.

Contribuciones del Estudio: El estudio puede considerarse una herramienta de consulta para que los administradores municipales diseñen estrategias para la eficiencia de los recursos y la entrega de mejores servicios a la comunidad. Además, respalda la comprensión de la sociedad sobre el desempeño de su localidad y, por lo tanto, tiene subsidios para exigir una mayor transparencia de las autoridades.

Palabras clave: Educación. Gasto municipal. Inversiones. Prueba de Brasil.

Resumo

Objetivo: Identificar o nível de eficiência dos municípios sergipanos em promover bons índices educacionais com os recursos destinados a este setor.

Método: Realizou-se uma pesquisa com metodologia quantitativa aplicando a Análise Envoltória de Dados como técnica para mensuração do desempenho das cidades investigadas. Selecionou-se como variáveis de *input* as despesas municipais com educação e os recursos recebidos do FNDE. As variáveis de *output* foram as notas do Prova Brasil nas séries do ensino fundamental.

Resultados: Os resultados apontaram para o fato de que gastar mais não garante um bom desempenho educacional, pois municípios com orçamentos mais enxutos conseguem alcançar melhores resultados no setor discutido. Com os alvos traçados pela análise, a proposta para os

municípios ineficientes foi manter ou até diminuir os recursos, mas, ao mesmo tempo, sempre elevar as notas no Prova Brasil.

Contribuições do estudo: O estudo pode ser considerado uma ferramenta de consulta para que os gestores municipais tracem estratégias visando a eficiência no consumo de recursos e também a entrega de melhores serviços à comunidade. Adicionalmente, serve de apoio para que a sociedade perceba como tem sido o desempenho de sua localidade e assim ter subsídios para cobrar das autoridades uma maior transparência.

Palavras-chave: Despesa Municipal. Educação. Investimentos. Prova Brasil.

1 Introduction

Throughout its history, Brazil has adopted different approaches on education. Brazilian Constitutions have emphasized the changes and approaches adopted in each period of time with regards to national education. The Brazilian Federal Supreme Court (2008) outlined that seven constitutions have been in fact established throughout Brazilian history. According to Article 24, IX, the Brazilian Union, as well as its States, the Federal District and its Municipalities, are responsible for laying out the legislation on this subject.

Gratuity is also a right ensured by the current Constitution in place (art. 206, IV), in which free and basic education is targeted towards those aged between 4 and 17 years old, being also provided to those outside of this age group (art. 208, I). The National Plan has been established for achieving substantial results towards eradicating illiteracy, as well as universal school attendance, career training and an improvement of the overall quality of Brazilian education (art. 214), etc. Moreover, the National Plan establishes that the Brazilian Union shall invest a minimum of 18% of tax revenues on education, with this figure being set at 25% for States, the Federal District and Municipalities (art. 212).

It can be noted that during certain periods of time, there has been a specific concern for directing minimum resources towards education, with the understanding of the State as a funding entity of this sector. Besides these constitutional provisions, the Brazilian Fund for Maintenance and Development of Elementary Education (FUNDEF) was established in 1996 through Law no. 9.424. In 2007, with the establishment of Law no. 11.494 (2007), FUNDEF was replaced by the National Fund for the Development of Basic Education (FUNDEB). In both instruments, the basic goal has been of distributing resources for education. The first national funding instrument focused solely on elementary education, while the second targets basic education as a whole, thus, with a wider scope.

Other resources, such as the National Textbook Programme, specific funding allocated towards school meals, the Programme of School Roadmaps, among others, are funded through the National Education Development Fund (FNDE), established through Law no. 5.537 (1968), connected with the Brazilian Ministry of Education (MEC).

Therefore, it is important to point out that in 2015 the Brazilian National Congress enacted Constitutional Amendment no. 95 (2016), which was submitted to constitutional voting through the Proposal for Constitutional Amendment (PEC) no. 241/2016, better known in the country as “expenditure PEC”. This legislative tool limited public expenditure in several areas for the next 20 years. More specifically, for education, the legislation ensures that the Union

shall maintain investments of 18% of its tax revenues to the sector, together with the resources from the National Fund for the Development of Basic Education (FUNDEB). From 2018, such resources shall follow adjustments for inflation, such as in the other areas of the government (Agência Câmara Notícias, 2016).

However, despite ensuring investments, some critics have pointed out that there will necessarily be a reduction in resources allocated to this sector, having argued that it will allegedly lead to damaging results in terms of the quality of education, as well as to growth in social inequality (Alesi, 2016). Therefore, there have been stark concerns regarding this possible decrease in public spending on education, as if a greater expenditure on education would lead to greater levels of education. According to Sales and Sousa (2016), for instance, the resources aimed towards education, especially those within the scope of FUNDEB, have been insufficient to ensure high-quality education. The authors point out that the amount of investments is still below that required to deliver the quality of education expected by the population.

On the other hand, the study carried out by Marlow (2000); Borges, Bontempo, Wander and Najberg. (2013); Maza-Ávila; Quesada Ibargüen and Vergara-Schmalbach (2013); Gouveia and Polena (2015); Monteiro (2015); Oliveira and Lemes (2016); Santos; Carvalho and Barbosa (2016) point in the opposite direction, having presented, in different contexts, that greater investments in education do not necessarily ensure better quality of education.

Therefore, there is a growing need to better understand the reality of Brazilian regions and States regarding the efficient use of educational resources, aiming at improving the quality of education. Consequently, the following question may be raised: **What is the efficiency of municipalities in the Brazilian State of Sergipe in promoting a good level of education based on the resources directed towards the education sector?** The Brazilian State of Sergipe was selected due to its bad indicators on education, with the State being considered one of the worst in Brazil in this regard (Rios, 2018). Thus, it is important to understand how the use of resources granted by municipal councils and those received by the FNDE fund are being employed, aimed at reaching higher levels of education.

With this in mind, the present research has the overall objective of identifying the level of efficiency of municipalities from the State of Sergipe in promoting good levels of education by using the financial resources granted to this sector. The grades in the Brazilian national exam *Prova Brasil* were used as a learning indicator, which evaluates the quality of learning of Portuguese and Mathematics among students from Year 5 and Year 9 of the Brazilian education system, specifically aimed at students from public schools. This indicator is even more appropriate in the present work, as it does not contain data from private institutions, which, in theory, do not receive any public funding.

Based on the initial literature review, it is understood that those municipalities with higher investments in education do not necessarily present better indicators, strengthening the concept of efficiency, which imply reaching satisfactory results by using less resources. Therefore, the present research will be useful to outline the investments made in education and its relationship with the quality of education in one of the most underprivileged States of Brazil. In addition, this work is carried out under the argument that more research focused on the State of Sergipe should be carried out. At the same time, this work is aligned with the recent discussions on public expenditure which took place in Brazil.

The results of the study can be a reflection to public administrators, whose aim must be of reaching high levels of efficiency in the use of public resources and a better provision of services to the community. The findings will also be relevant for the population in itself, by helping them understand how public administrators have been managing public education, thus,

providing greater transparency to society, aiming at a greater understanding of the importance of supervising governmental actions and finances.

2 Literature Review

2.1 Investment in Education

The education sector is crucial for the development of a nation. Therefore, Messeder (2012) highlights the thriving need of creating governmental projects which enable better financing tools for this sector. Since the Brazilian Constitution of 1934, specific public taxes have been allocated towards financing the education sector. Such prerogative was withdrawn in the Constitution of 1937, though strengthened in the Constitution of 1946 (Sales & Sousa, 2016). Following the same trend, the current Brazilian Federal Constitution (1988) establishes a minimum of 18% of national tax revenues to be allocated to education, while 25% of these revenues are to be invested in education by the Brazilian States, the Federal District and municipalities.

However, according to Davies (2006), such binding provisions are a matter of concern. The fact that a minimum percentage is established creates a perspective on public authorities that this amount can be both considered a minimum and a cap investment. Thus, the author argues that public administrators have the wrong impression of how much is actually necessary to be invested in order to develop high quality education.

Accordingly, a basic understanding on creating budget reserves, or funds, is necessary for the given sector. At first, the Brazilian Fund for Maintenance and Development of Elementary Education (FUNDEF) was created. However, through Constitutional Amendment no. 53 from 6th December 2006, FUNDEF was replaced by the National Fund for the Development of Basic Education and Basic Education Professionals (FUNDEB), aimed at rectifying the flaws from the previous programme in terms of eliminating the remaining periods of basic education. It is also important to point out that while FUNDEF was only restricted to elementary education, FUNDEB englobes all spheres of education which comprise nursery and childcare until secondary education, while also raising the amount of resources aimed towards education (Silveira *et al.*, 2017).

It is also important to highlight that the resources allocated to FUNDEB are granted through the National Education Development Fund (FNDE), under the authority of the National Education and Culture Ministry, under Law no. 5.537 (1968). Davies (2006) has also stressed that such funds have not tackled the issue underlying the allocation of satisfactory resources to promote improvements in education. According to the author, such funds solely regard a transfer of resources which had already been allocated to the sector, with a minimal contribution from the Federal government. At the same time, the allocation of these resources favours larger municipalities to the detriment of smaller ones.

The Brazilian Federal Constitution (1998) outlines the share of resources connected to the maintenance of the FUNDEB fund, as presented in Table 1, which is complemented by the directive of Article 212 for Federal entities, on raising funds aimed towards education.

Table 1

Summary of the respective investment shares aimed towards Education

National Entity	Percentage	Product Collected	Article from Constitution
National level	18%	Tax Revenues	Art. 212
States	25%	Tax Revenues	Art. 212
	20%	Tax on inheritance and properties of any nature	Art. 155
		Tax on the movement of Goods and services	
		Property Tax on Motor Vehicles	
		State Participation Fund	Art. 159
		Share of Taxes on Industrialised Products transferred by the Union	
		Share of withholding income tax transferred by the Union	Art. 157
Municipalities	25%	Tax Revenues	Art. 212
	20%	Share of Rural Territorial Tax revenues transferred to the Union	Art. 158
		Share of Property Tax revenues on Motor Vehicles transferred to the Union	
		Share of Tax revenues on the movement of Goods and services transferred by the municipalities	
		Participation Fund of the Municipalities	Art. 159

Source: *Adapted from the Brazilian Federal Constitution (1988).*

Moreover, Law no. 11.494 of 2007 establishes a percentage contribution from the Union, the State and municipalities to the Fund. Besides, in case tax revenue at a State level is not sufficient to supply the annual student cost, the Union shall supply an additional minimum contribution of 10% of the amount of contributions from the States, the Federal District and municipalities (article 4 and 6 of Law no. 11.494 of 2007). It is also worth pointing out that, according to Mendes (2012), such additional contribution helps to close the gaps between States, providing a higher share of resources to more underprivileged locations.

2.2 Assessment of Basic Education in Brazil

In Brazil, basic education includes the first school years divided into three stages: preschool, for children up to five years old; elementary education, for children aged 6 and 14-

year-old teenagers; and secondary education, for teenagers aged between 15 and 17 years old (Ministério da Educação, 2017).

The assessment of such stages of education in Brazil is carried out by the Basic Education Evaluation System (SAEB), which comprises different exams that provide a diagnosis on the status of education in the country. The system specifically seeks to verify which factors can lead to a better or worse performance of the student. The evaluation consists of three components: the Evaluation of National School Performance (Anresc); the National Basic Education Evaluation (Aneb) and the National Literacy Evaluation (ANA). Such tools are measured in a scale from 0 to 9 for Portuguese and from 0 to 12 for Mathematics.

The average scores in Saeb, together with the data on the school census, which carries out a statistical survey, outlining the status of education in Brazil, constitute the Brazilian Basic Education Development Index (Ideb). It is also worth pointing out that since 2019, all three forms of evaluation, Anresc, Aneb and ANA, have been separately withdrawn, being only identified under the term Saeb, with its national exam *Prova Brasil* (INEP).

Following this brief description of the forms of evaluation adopted by the Brazilian government, it is necessary to draw some comments regarding the efficiency and effectiveness of these forms of evaluation in school routine. Accordingly, Juchum and Gabriel (2009) argue that the success of students in national examination *Prova Brasil* lies on how up to date the teachers are with the procedures to be employed. Nevertheless, in their study, the authors understood that most teachers interviewed did not even know about the evaluation tool.

It also important to emphasize that the socioeconomic, educational and cultural profile of the country, besides the characteristics regarding school organisation can be conditioning factors for the good or bad performance in these national and State exams (Santos Filho, 2017). Moraes and Jelinek (2017) also stress that the continuous training of teachers, classroom didactics and the exchange of experience between teachers themselves can also have a positive effect on the performance of students in exams such as *Prova Brasil*. The authors still highlight that the difficulties faced in the public education sector cannot be seen as a discouraging factor, which justifies the low grades obtained in this national examination, as the involvement of the entire school community can break these obstacles and help reach good results.

In addition, it is also important to stress that despite the relevant information contained in these evaluation exams, it is possible that over time, the characterisation of high-quality education might be simplified (Silva, 2010). Casassus (2009) also argues that these large-scale examinations can lead to greater focus of the teacher only on the exam, without a focus on education for life. This would prevent the student from carrying out a critical reflection, building a wide knowledge perspective; thus, they would only be able to choose between pre-established options, on what is more adequate.

However, as pointed out by Schneider (2010), besides the difficulties and deficiencies of these evaluations, they do not in fact characterise the quality of education, instead, only presenting indications. Thus, despite not being indicative of fire (lack of quality), they can give indications of smoke, of where there are problems (Schneider, 2010, p.63).

2.3 Previous Studies

Some studies, both at a national and international context, have sought an analysis between public expenditure and the quality of education. As pointed out in Table 2, the main findings indicate that higher levels of investment alone do not ensure a better quality of education. Consequently, previous researches highlight a concept of efficiency which is not only linked to higher expenditure, but of spending public resources correctly and coherently.

The works presented herein were extracted from Capes journals, in the period of November 2018, whose objectives were more closely aligned with those of the present study.

Tabela 2

Summary of previous studies on the relationship between public expenditure and the quality of education

Authors	Objective	Main Results
Marlow (2000)	To examine how the structure of the public school system influences both public expenditure on education and the performance of students in the American State of California.	Higher spending on education tends to cause a positive effect on reading, although such impact is weak under a statistical point of view. Regarding mathematics and writing, the effect of the spending on education presents a negative effect.
Borge, Bontempo, Wander and Najberg (2013)	To assess and compare the quality of public expenditure on education and health in the microregions of the Brazilian State of Goiás.	The microregion of Quirinópolis, despite showing the highest public investments in 2009, showed no gains in terms of wellbeing. On the other hand, the microregion of Iporá presented the lowest level of investments, though still obtaining better returns in terms of the levels of wellbeing. Therefore, it can be concluded that higher spending is not directly linked with better results
Maza-Ávila, Quesada-Ibargüen and Vergara-Schamalbach (2013)	To analyse the efficiency and development of the quality of education in Colombian municipalities.	In general, the municipalities analysed showed to be inefficient; that is, they do not make adequate use of the resources transferred, aimed at a better quality of education. Little more than 8% of the sample presented a good performance in the period analysed (2007-2010).
Gouveia and Polena (2015)	Combining indicators of economic, social and educational development to discuss the quality of education offers in the Brazilian cities of Aracaju and Ilha das Flores (Sergipe), Belo Horizonte and Cataguases (Minas Gerais) and Curitiba and Marmeleiro (Paraná).	Small municipalities, with less schools, tend to present a better performance in the maintenance of school infrastructure. As for larger cities, in order to have greater access to education, a more complex and costly contribution of resources is often necessary.
Monteiro (2015)	To analyse the relationship between public expenditure in education and education performance in municipalities from the Brazilian State of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul	The increase in the level of investment can even provide higher school attendance and lower school dropouts, besides closing the gap between age and school year. On the other hand, a higher expenditure on education does not ensure a better learning process.

Oliveira and Lemes (2016)	To analyse and discuss the relationship between cost per students of elementary education and the quality of education using the IDEB index in 38 municipalities of the region of Barretos and the central region of the State of São Paulo.	Both regions analysed have similar GDP per capita, although the region of Barretos spends more on education. Nevertheless, an increase in public expenditure leads to a reduction on the IDEB index, though the opposite would be preferable. The Central region of Brazil spends less on education per student, although a growth in the IDEB index can be observed, with an above-average indicator compared with the region of Barretos.
Santos, Carvalho and Barbosa (2016)	To analyse the efficiency of municipal expenditure on elementary education in 21 municipalities of the Brazilian region of Seridó Potiguar, in the State of Rio Grande do Norte.	The simple employment of financial resources was deemed insufficient to lead to greater levels of efficiency, as the study verified the existence of efficient municipalities when employing lower public resources, while inefficient municipalities would have above-average investments.

Source: *Search on Capes jornals in November 2018.*

Thus, it can be observed that none of the abovementioned studies verified the efficiency of education expenditure for generating good level of education in the Brazilian State of Sergipe. Nevertheless, as Sergipe is a State whose education system requires considerable improvements, it is relevant to investigate the subject of good performance of the public school sector. The methodology used to reach the objectives proposed is summarised in the section below.

3 Methodology

3.1 Research Characterisation

The present research adopted a positivist approach, having verified and refined theories through numerical measurements, being based on the objective observation of reality (Creswell, 2007). A deductive method was adopted because, as explained by Coelho and Silva (2007), a conceptual structure based on the literature was verified without seeking to generalise, before actually verifying aspects individually. The deductive method was adopted, despite its lack of popularity in social sciences. Nevertheless, as stated by Gil (2008), despite the fact that the social sciences do not tend to adopt a deductive approach, its use helps to remove a speculative posture, thus prioritizing the observation of certain phenomena. Still, according to the author, with the progress of positivism, the deductive method gained prominence even within the social sciences. A strictly quantitative method was adopted for analysing the variables selected and for explaining the factors related to the research, which requires the use of statistical tools to be carried out (Silva & Menezes, 2005).

The State of Sergipe consists of 75 municipalities, grouped into eight territories and considered the smallest State in Brazil, with a population of 2,288,116 inhabitants, of which 70% live in urban areas (Governo de Sergipe, 2018). Nevertheless, for the present study, eight municipalities were excluded due to lack of the data required. Therefore, the research sample, which represents an extracted share of a universe or population (Marconi & Lakatos, 2003) consisted of 67 municipalities.

3.2 Data Envelopment Analysis

3.2.1 General Aspects of Data Envelopment Analysis

Data Envelopment Analysis (DEA) was developed by Edward Rhodes, following the specific need of measuring the efficiency of educational programmes implemented by the United States government in assisting underprivileged children, under the scope of his PhD thesis supervised by William W. Cooper, having created a model for estimating the performance of the institutions investigated (Nova & Santos, 2008).

Thus, DEA used linear programming to estimate the limit to which efficiency is able to incorporate the various inputs (inflows, resources, raw material) and outputs (outflows or products) for calculating the efficiency of Decision-Making Units – DMUs (Gomes; Mangabeira & Mello; 2005). Therefore, it is necessary to determine the resources inherent to each DMU and which products can be obtained based on the available raw material. The DMUs achieve better results when existing inputs are considered efficient.

There are basically two models used to perform DEA. The Constant Returns to Scale (CRS) model infers that outflows are always constant, though not all organisations operate under such scenario. With this in mind, it became necessary to create a model able variable returns to scale, the Variable Returns to Scale (VRS) model (Souza, Scatena; & Kehrig; 2016). This model enables the analysis of DMUs with distinct scales (Nova & Santos, 2008).

It is also necessary to understand that both models must follow a certain guidance, with the models being either guided by the inputs or outputs. Mello, Meza, Gomes Serapião and Lins (2003) explained that DEA must be guided by the inputs when aiming to minimise these, while maintaining the outputs constant. The guidance by outputs, according to the same authors, must be adopted when the objective is to maximise the outputs while maintaining the value of inputs. In sum, the latter seeks to increase the results so that the same level of resources is used.

Regarding the sample in itself, an appropriate size is required for the analysis. One criterion widely used to define the number of DMUs that constitute a research was developed by Fitzsimmons and Fitzsimmons (2000), which establishes that the number of to be studied should be of at least twice the sum of the inputs and outputs.

3.2.2 Variables Selection

In order to reach the goal set out in this study, of determining the efficiency of municipalities from the State of Sergipe in educational terms and taking into account the resources made available for this area, municipal expenditure per student and the amount of resources received by the FNDE fund per student were considered as input variables. The output variables selected included the grades of the municipalities in *Prova Brasil* in the subjects of Portuguese and Mathematics in Years 5 and 9 of the Brazilian elementary education.

The data was collected on the website of the Brazilian National Institute of Educational Studies and Research (INEP), under the section results, for the output variables and to establish the total number of students enrolled in elementary education. The year of 2017 was selected for the study as it was the most recent year with complete data availability at the time of carrying out the present research. The input variables were retrieved from the Accounting and Tax Information System of the Brazilian Public Sector (SINCOFI), from where the annual financial statements of municipalities can be obtained. This database was selected as data from each municipality could be obtained in a single database, which would otherwise require to access the website of each municipality to obtain the data. This procedure would require longer periods

of time, which could also reduce the size of the sample as some municipalities do not have such an online platform available. Table 3 summarises the variables adopted in the present work.

Table 3
Summary of the variables

Group	Variable	Acronym	Concept
INPUTS	Municipal expenditure on education per student	DEPMUN	Amount invested by the municipality on basic education (up until Year 9) in 2017 divided by the total number of students enrolled in elementary education
	Revenues from the FNDE fund	FNDE	Amount of resources received by FNDE from the municipality in 2017, divided by the total number of students enrolled in elementary education.
OUTPUTS	Score obtained in Mathematics in Year 5	MAT5	Average score obtained by the municipality in Mathematics in the Brazilian national examination under Saeb in 2017, referring to Year 5
	Score obtained in Mathematics in Year 9	MAT9	Average score obtained by the municipality in Mathematics in the Brazilian national examination under Saeb in 2017, referring to Year 9
	Score obtained in Portuguese in Year 5	PORT5	Average score obtained by the municipality in Portuguese in the Brazilian national examination under Saeb in 2017, referring to Year 5
	Score obtained in Portuguese in Year 9	PORT9	Average score obtained by the municipality in Portuguese in the Brazilian national examination under Saeb in 2017, referring to Year 9

Source: *Author's own compilation*.

It is also worth mentioning that based on the number of variables, it is possible to determine a minimum sample size, according to the criterion established by Fitzsimmons and Fitzsimmons (2000), which sets that a sample size should be of at least twice the sum of inputs and outputs. Therefore, for the present study and taking into account the 6 variables selected, the minimum sample size should be of at 12 components, which has been fulfilled in the present research.

3.2.3 Data Envelopment Analysis Model

As previously discussed, DEA enables to develop two classic models: CRS and VRS. Under the scope of the present research, the VRS model was adopted, which enables the variables return to scale, without requiring constant returns, as is the case of the other model. Moreover, the VRS model enables the analysis of DMUs of different scales, which constitutes the reality of this study, as various municipalities were analysed, which, despite the similar variables and objectives selected, are of different scales under different points of view: financial, structural, populational, educational, etc.

Regarding the model's guidance, it can either be in terms of inputs or outputs, as previously pointed out. In the present work, the model was guided by outputs, as this enables to establish the highest grade to be obtained in *Prova Brasil*, without necessarily requiring higher expenditure.

It is also important to highlight a complementary analysis which can be carried out using DEA, determining the composite border, which, according to Silveira, Meza and Mello (2011), is calculated based on the so-called reverse border, representing a pessimist analysis of the performance of a DMU. This analysis allows to rank the performance of decision-making units, as many units can be considered efficient at the standard border, though, based on the composite border principle, it is possible to identify which in fact had the best performance.

$$Composite\ Efficiency = \frac{Standard\ Efficiency + (1 - reverse\ efficiency)}{2}$$

Thus, it is possible to identify which DMU had the best behaviour when compared to the remaining components of the sample. It is important to highlight that DEA was carried out in software SIAD v3.

4 Results

4.1 Description of the Sample

At first, an analysis of the characteristics of the sample studied was carried out to enable a better understanding of their dimensions. It was verified that the average score obtained in Portuguese in Year 5 (PORT5) was of 176.60, with the municipality of Graccho Cardoso having achieved the highest score. On the other hand, the lowest score was obtained by the municipality of Brejo Grande. Regarding Mathematics, in the same school year (MAT5), the average score was of 188.29, with the municipality of Amparo do São Francisco obtaining the best score, while the municipality of Brejo Grande remained in last position in the ranking.

As for Year 9, the average score of municipalities in Portuguese was of 233.64, with the municipality of Cedro de São João obtaining the best score, while the lowest score was obtained in the municipality of Arauá. It is important to highlight that in this case, Graccho Cardoso, which obtained the best score in Portuguese in Year 5, was 39th in the ranking of municipalities studied for Year 9. Brejo Grande, which obtained the lowest scores in Portuguese in Year 5, was 61st in the ranking. Thus, also an unsatisfactory performance in the sample.

When considering the scores in Mathematics in Year 9, the average score obtained was of 233.4, with the municipality of Cedro de São João having also obtained the highest score, while the lowest was found in the municipality of Feira Nova. As previously discussed, in Year 5, the best performance in mathematics was found in Amparo de São Francisco, with this municipality ranking 10th in the overall evaluation. On the other hand, Brejo Grande, which obtained the worst performance in the previous analysis, ranked 58th in this verification, one of the last positions among all municipalities studied.

Regarding municipal expenditure on education per student, in 2017, the average amount spent by municipalities was of R$ 8,212.92. The municipality of Campo do Brito obtained the highest score in this variable. Moreover, this municipality obtained the 13th best score in Portuguese in Year 5 and 23rd best in Year 9 for the same subject. In mathematics, the municipality ranked 18th in Year 5 and 15th in Year 9.

However, it can be observed that the municipality of Telha presented the highest municipal expenditure on education per student, while ranking 26th in the scores obtained in Portuguese in Year 5 and 15th in Mathematics in the same school year. In Year 9, the

municipality ranked 24th for Portuguese and 35th for Mathematics. These results are higher than the other municipalities which spent more resources on education, but which obtained lower grades *Prova Brasil*, which is the case of Arauá, Brejo Grande, Laranjeiras, Pedrinhas and Pacatuba.

As for the resources received by the FNDE fund per student, the average amount received by the municipalities analysed was of R$ 474.75. It was verified that the municipality of Campo do Brito was again the city with the highest amount of resources. On the other hand, the municipality of Cristinápolis received less resources from this fund, while having better indicators than the municipality of Pedrinhas, for instance, with the 5th highest amount of resources from FNDER per student.

With the aspects pointed out, it can be inferred that higher expenditure on education does not ensure a higher quality of education of municipalities. At the same time, it is not essential for the performance in *Prova Brasil*. This is connected to the concept of efficiency pointed out in the present work, i.e. reaching positive results while spending fewer financial resources. However, to confirm such assumption, DEA was employed to consolidate such comments.

4.2 Efficiency Level of Municipalities

In terms of efficiency, among the parameters established in the present work, the average score of municipalities in the State of Sergipe was of 0.9319. It is important to point out that this high value is not necessarily an indication of a good situation of municipalities, as DEA only analyses the sample by comparing it with itself. Dantas and Boente (2012) argue that one of the restrictions of DEA is that it can consider a DMU under a bad situation as being efficient, though, when compared with other samples, a less unfavourable situation is observed.

Accordingly, if the municipalities of the State of Sergipe were compared with municipalities from other regions, the results could be quite distinct. Consequently, it is important to highlight that the municipalities considered herein in as efficient can still be below an excellent education level, as they are only regarded as having a good performance when compared with the sample analysed. Nevertheless, such scenario does not invalidate the results, but it sheds light on the constant need of developing researches in this subject.

The cities considered as efficient represented 11.94% of the sample. When analysing the composite border, it could be observed that the municipality of Amaparo de São Francisco obtained the best performance. When regarding the resources available, this municipality ranked 21st in terms of the highest expenditure on education per student and 38th in terms of the resources received by FNDE per student, thus, it was not part of the municipalities with the highest investments. Nevertheless, this municipality still obtained the best score in Portuguese in Year 5 and the 14th best in Year 9. It also achieved the highest score in Mathematics in Year 5 and the 10th best in Year 9.

This finding is in agreement with the results found by Borges, Bontempo, Wander and Najberg (2013) in the State of Goiás, where regions with the lowest amount of investments presented better indicators in both education and health. Oliveira and Lemes (2016) also verified that higher expenditure levels do not ensure a better quality of education in the municipalities of the Brazilian State of São Paulo. Even in international studies, such as the one carried out by Marlow (2000), it was concluded that higher levels of spending do not ensure a better quality of education. Figure 1 shows the ranking of the most efficient municipalities studied in the present work.

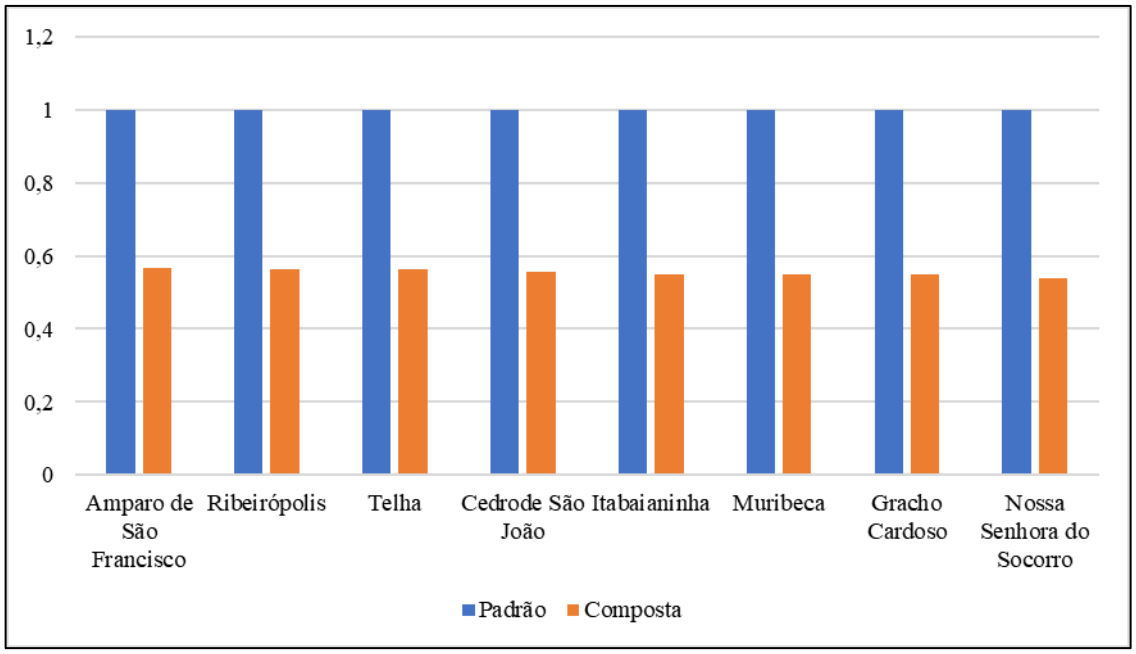

Figure 1 – *Efficient Municipalities.*
Source: *Data from the research.*

On the other hand, the municipality of Arauá was considered the least efficient among the municipalities studied, although with higher amounts of investments, ranking 18th in terms of municipal expenditure on education per student and 13th in terms of financial resources received from FNDE per student. Nevertheless, the results achieved in *Prova Brasil* were not compatible with the investments made on education. Moreover, Santos, Carvalho & Barbosa (2016) verified that municipalities from the Brazilian State of Rio Grande do Norte invested above-average amounts, though being considered inefficient with regards to education levels. As observed, such result is also found in the State of Sergipe. Figure 2 outlines the results of the ten municipalities with the lowest performance levels in DEA.

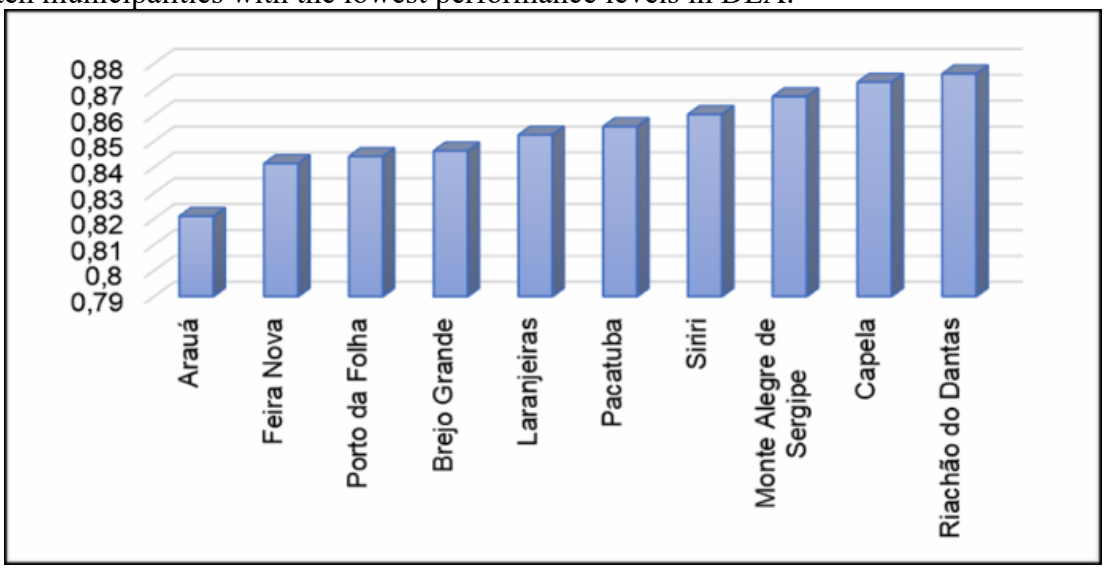

Figure 2 – *The most inefficient Municipalities.*
Source: *Data from the research.*

However, it understood that one of the unique properties of DEA is of enabling to set the route for better levels of performance. Therefore, in order to provide appropriate feedback

to municipal authorities regarding the results to be reach aiming at improving the levels of performance, a target analysis was carried out, as discussed in the following section.

4.3 Target Analysis

With this analysis, the assumption that higher investments, or higher financial resources available, alone do not ensure better results in education was consolidated. If such prerogative is considered true, municipalities can be deemed inefficient, as resources cannot be saved. Therefore, DEA set specific targets for inefficient municipalities to become more efficient, thus, achieving better grades in *Prova Brasil*. Consequently, it is important to emphasize that this work does not expect to defend a random lower investment on education, but yes discuss how these could better allocated in order to reach better public goals by saving more resources. As recommended by Mendes (2011), it is important that government costs do not exceed the benefits which they provide.

In some cases, cities would not need to spend fewer financial resources, as the same municipal expenditure on education per student and the same investment received from FNDE would ensure a good performance. However, municipalities should achieve higher scores in *Prova Brasil*. It was also observed that the resources allocated to education in the most inefficient cities was above the average than of most municipalities considered efficient within the context of the present study. It is also worth pointing out that Brazil spends, on average, more than developed countries on education, though it stands at one of the worst positions in international performance rankings (Oliveira, 2018). Nevertheless, some argue that despite the high levels of spending, in terms of cost per student, the national investment is low when considering the number of students enrolled (Cafardo, 2018). All these views need to be widely discussed to improve levels of education in Brazil, as it is pointless to spend more if no benefits can be observed.

Lopes (2018) highlights that Brazil spends 62% more than what would be necessary to ensure the same results of today, which is an indication of inefficiency. In addition, higher expenditure does not reflect in better quality levels, in proportional levels. Such situation is a matter of great concern, given the various requests by the population and some political entities for more money to be invested on education. Table 4 summarises the percentage increase and decrease that municipalities with the lowest performance rates should seek in order to reach appropriate efficiency levels.

Table 4

Percentage increase and decrease per variable for reaching better targets in municipalities with the lowest performance rates.

DMU	DEPMUN	FNDE	PORT5	MAT5	PORT9	MAT9
Arauá	↓ 23.00%	0.00%	↑ 23.86%	↑ 21.55%	↑ 22.16%	↑ 21.55%
Monte Alegre	0.0%	↓ 7.50%	↑ 15.48%	↑ 13.54%	↑ 13.54%	↑ 14.14%
Porto da Folha	↓ 27.57%	0.00%	↑ 20.41%	↑ 18.27%	↑ 20.51%	↑ 18.27%
Laranjeiras	↓ 44.93%	0.00%	↑ 17.22%	↑ 17.22%	↑ 20.18%	↑ 17.22%
Siriri	↓ 20.59%	↓ 0.00%	↑ 16.89%	↑ 15.76%	↑ 21.60%	↑ 15.76%
Riachão do Dantas	↓ 22.98%	0.00%	↑ 14.07%	↑ 14.01%	↑ 15.71%	↑ 14.01%
Brejo Grande	↓18.52%	0.00%	↑ 18.80%	↑ 17.88%	↑ 21.29%	↑17.88%
Capela	0.00%	↓20.35%	↑ 14.51%	↑ 15.92%	↑ 14.51%	↑ 15.06%
Pacatuba	↓ 16.30%	↓ 0.00%	↑ 16.84%	↑ 16.84%	↑ 21.63%	↑ 16.84%
Feira Nova	0.0%	↓8.79%	↑ 24.53%	↑ 21.21%	↑ 21.21%	↑ 28.57%

Source: *Data from the research.*

The results presented herein point towards the fact that spending more does not ensure a good educational performance, as municipalities with tighter budgets have managed to reach better results in the education sector. Nevertheless, it is important to point out that the present work does not randomly defend spending fewer financial resources in this sector, which is of extreme importance to the nation. Nonetheless, it brings a reflection on whether the solution for such issues in Brazilian education could in fact be solved with higher costs or whether other measures would need to be taken and considered.

5 Conclusion

The objective of the present study was to identify the level of efficiency of municipalities of the State of Sergipe in promoting good quality of education with the investments made. Therefore, a quantitative research was carried out, applying Data Envelopment Analysis as a method for measuring the performance of the cities investigated.

Under the scope of the present work, the municipality of Amparo de São Francisco achieved the best performance in the sample analysed, though it did not invest the highest amount of resources, despite obtaining higher results in the *Prova Brasil* national examination when compared to other municipalities with superior expenditure on education. This point consolidates the concept of efficiency, in which better results can be achieved by saving financial resources.

On the other hand, the municipality of Arauá ranked last among the municipalities studied in terms of efficiency levels, though it spent higher amounts on education, as observed in the variables investigated. At the same time, this municipality obtained the lowest scores in *Prova Brasil*. Such results indicate that spending more does not necessarily ensure a better educational performance, as municipalities with tighter budgets managed to achieve better results in the sector under discussion. Thus, this can be illustrated as an example of inefficiency: higher expenditure though with unsatisfactory returns.

However, not only deficiencies can be pointed out, being also relevant to set targets so that these municipalities can improve their performance rates. Therefore, DEA set specific targets for those municipalities considered inefficient. Accordingly, it was possible to verify that the suggestions tended to aim towards reducing the levels of investment, or maintaining the same amounts practised, while always promoting an increase in the scores obtained in *Prova Brasil.* Thus, it is important that inefficient municipalities understand that better results are achieved by those with similar or even less investments, while maintaining satisfactory performance levels on education.

Consequently, the objective of the present study was then achieved, having widened the discussion on the efficiency of public expenditure. The present study can also serve as a reference so that municipal administrators of the locations considered herein can set strategies aiming at reaching higher efficiency in the consumption of resources, while also delivering better services to the community. It also serves as support so that society can understand how their hometown performed, providing subsidies to request more transparency and responsibility from local authorities.

However, despite the contributions, some limitations to the present research can be pointed out, which is a common remark of any scientific work. One of the limitations to be pointed out concern the fact that larger DEA samples tend to present a higher number of DMUs considered as efficient. Another point to be reinforced lies on the fact that a municipality which was considered efficient in the present study cannot be considered so in an effective manner, as its performance is only estimated based on a comparison with the components of the sample. Therefore, a municipality considered inefficient in the present study can still be considered

efficient under more unfavourable circumstances. Thus, the results of the present work can only be seen as a closed reality for the State of Sergipe, taking into account the data selected, and not generalised for other regions – another restriction of DEA.

With this in mind, and in order to complement this work and continue the discussion on the subject, future researches in other States of the Brazilian Northeast, or even in all other regions, are recommended so that the different realities can be better compared. Moreover, an analysis which enables to estimate future scores in *Prova Brasil* can be carried out, enabling to estimate future scores in this Brazilian national examination based on the investments made. It is also relevant to verify the temporal progress of the efficiency of these municipalities. Another suggestion regard verifying other factors which can affect educational performance, because, as discussed in the present work, higher expenditure alone does not ensure good performance rates in education. Therefore, other researches should be carried out based on the motivation of teachers, on family-school relationships, diet and paediatric health, school infrastructure, household income, among other social aspects that can somehow impact on the performance of children and teenagers at school.

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