REVISTA AMBIENTE CONTÁBIL
Universidade Federal do Rio Grande do Norte
ISSN 2176-9036
Vol. 13, n. 1, Jan./Jun, 2021
Sítios: http://www.periodicos.ufrn.br/ambiente
http://www.atena.org.br/revista/ojs-2.2.3-06/index.php/Ambiente
Article received on 18 December 2019. Peer-reviewed on: 16 April 2020. Reformulated on: 17 May 2020. Reviewed by double blind review.

DOI: 10.21680/2176-9036.2021v13n1ID23629

An analysis of the efficiency of public expenditure on education in the Municipalities of the State of Amazonas from 2013 to 2017

Un análisis de la eficiencia del gasto público en educación en los municipios del estado de Amazonas de 2013 a 2017

Uma análise da eficiência dos gastos públicos com educação nos municípios do Estado do Amazonas no período de 2013 a 2017

Authors

Mayara Guimarães de Sousa
Graduated in Accounting Sciences, Federal University of Amazonas (UFAM). Address: Avenida Rodrigo Otávio Setor Norte, Bloco de Administração da Faculdade de Estudos Sociais, sala 07, Coroado I, 69067005 - Manaus, AM - Brasil. Phone: (92) 2121-1600. Identifiers (ID):
ORCID: https://orcid.org/0000-0002-0240-109X
E-mail: mayaguimaraess18@gmail.com

Carla Macedo Velloso dos Santos
PhD in Accounting Sciences from the Federal University of Rio de Janeiro (UFRJ). Adjunct Professor, Accounting Department, Federal University of Amazonas (UFAM). Address: Avenida Rodrigo Otávio Setor Norte, Bloco de Administração da Faculdade de Estudos Sociais, sala 07, Coroado I, 69067005 - Manaus, AM - Brasil. Phone: (92) 2121-1600. Identifiers (ID):
ORCID: https://orcid.org/0000-0003-1145-0130
Lattes: http://lattes.cnpq.br/8147056714245363
E-mail: carla.velloso.ufam@gmail.com

Adenes Teixeira Alves
Master in Accounting and Controllership from the Federal University of Amazonas (UFAM). PhD candidate in Biotechnology at the Federal University of Amazonas (UFAM). Adjunct Professor and Head of the Accounting Department of the Federal University of Amazonas (UFAM). Address: Avenida Rodrigo Otávio Setor Norte, Bloco de Administração da Faculdade de Estudos Sociais, sala 07, Coroado I, 69067005 - Manaus, AM - Brasil. Phone: (92) 2121-1600. Identifiers (ID):
ORCID: https://orcid.org/0000-0001-6802-1914
Lattes: http://lattes.cnpq.br/5323633054688660

E-mail: professoradenes@hotmail.com

Manoel Martins do Carmo Filho
PhD in Transport Engineering from the Federal University of Rio de Janeiro (UFRJ). Adjunct Professor, Accounting Department, Federal University of Amazonas - UFAM. Address: Avenida Rodrigo Otávio Setor Norte, Bloco de Administração da Faculdade de Estudos Sociais, sala 07, Coroado I, 69067005 - Manaus, AM - Brasil. Phone: (92) 2121-1600. Identifiers (ID):
ORCID: https://orcid.org/0000-0002-2587-5642
Lattes: http://lattes.cnpq.br/3780606901295400
E-mail: martins.manoel@gmail.com

Abstract

Purpose: This article aimed to evaluate the efficiency of public expenditure in the municipalities of the State of Amazonas with primary education in the years 2013 to 2017 by building a ranking of the efficiency of the municipalities relating the results obtained in IDEB by each city in the period, under the counterpart of the values of expenses paid for primary education, the average number of students enrolled in the period, average expenditure per student and GDP per capita of each municipality.

Methodology: We used Data Envelopment Analysis (DEA) technique to evaluate the 37 Amazonian municipalities' efficiency in the sample. The variables analyzed include municipal data on the Gross Domestic Product (GDP), number of inhabitants, number of students enrolled, spending on education, and IDEB notes for the period.

Results: The results showed that only eight municipalities (21.6%) were classified as efficient and that these municipalities were those with the worst starting conditions, in terms of average wealth and educational performance, and that made the lowest expenses per enrolled student, which reaffirms the finding of diminishing returns to scale in education. On the other hand, the least efficient municipalities were those with the best starting condition in terms of GDP per capita and which presented high expenditures per student, but which reached the worst performances in the 2017 IDEB.

Contributions of the Study: Considering the amounts spent by Amazonian municipalities on primary education, taking into account the size and performance in the IDEB of each city in the period under analysis, the research seeks to demonstrate the efficiency in the application of spending on primary education, providing useful and information for a more qualified and efficient allocation of public resources in education, providing improvements in the social aspects of the population aspects.

Keywords: Efficiency. Elementary School. Data Envelopment Analysis. Municipalities of Amazonas. IDEB.

Resumen

Objetivo: Este artículo tuvo como objetivo evaluar la eficiencia del gasto público en los municipios del estado de Amazonas con educación primaria en los años 2013 a 2017 mediante

la construcción de una clasificación de la eficiencia de los municipios en relación con los resultados obtenidos en Ideb por cada municipio en el período, bajo la contrapartida de los valores de los gastos pagados por la educación básica, el número promedio de estudiantes matriculados en el período, el gasto promedio por estudiante y el PIB per cápita de cada municipio.

Metodología: Para evaluar la eficiencia de los 37 municipios amazónicos en la muestra, se utilizó la técnica de Análisis de Envoltura de Datos (DEA). Las variables analizadas comprenden los datos municipales que se refieren al Producto Interno Bruto (PIB), el número de habitantes, el número de estudiantes matriculados, el gasto en educación y los puntajes de Ideb para el período.

Resultados: Los resultados mostraron que solo ocho municipios (21.6%) se clasificaron como eficientes, y que estos municipios eran los que tenían las peores condiciones iniciales, en términos de riqueza promedio y rendimiento educativo, y que representaban los gastos más bajos por estudiante matriculado, lo que reafirma el hallazgo de rendimientos decrecientes a escala en la educación. Los municipios menos eficientes, por otro lado, fueron aquellos con las mejores condiciones iniciales en términos de PIB per cápita y que presentaron altos gastos por estudiante, pero que alcanzaron los peores resultados en el Ideb 2017.

Contribuciones del Estudio: Teniendo en cuenta los montos gastados por los municipios amazónicos en educación básica, teniendo en cuenta el tamaño y el rendimiento en el Ideb de cada municipio en el período bajo análisis, la investigación busca demostrar la eficiencia en la aplicación del gasto en educación básica, proporcionando información útil y relevante para un asignación más calificada y eficiente de recursos públicos en educación, proporcionando mejoras en los aspectos sociales de la población.

Palabras clave: Eficiencia. Enseñanza fundamental. Análisis Envolvente de Datos. Municipios de Amazonas. IDEB.

Resumo

Objetivo: Este artigo teve como objetivo avaliar a eficiência dos gastos públicos dos municípios do Estado do Amazonas com o ensino fundamental nos anos de 2013 a 2017 por meio da construção de um *ranking* da eficiência dos municípios relacionando os resultados obtidos no Ideb por cada município no período, sob a contrapartida dos valores das despesas liquidadas com educação fundamental, média de alunos matriculados no período, gasto médio por aluno e PIB per capita de cada município.

Metodologia: Para avaliar a eficiência dos 37 municípios amazonenses da amostra, utilizou-se a técnica Análise Envoltória de Dados (DEA). As variáveis analisadas compreendem os dados municipais referentes ao Produto Interno Bruto (PIB), número de habitantes, número de estudantes matriculados, gasto com educação e as notas do Ideb para o período.

Resultados: Os resultados mostraram que somente oito municípios (21,6%) foram classificados como eficientes e que esses municípios foram aqueles com as piores condições de partida, em termos de riqueza média e desempenho educacional, e que realizaram os menores gastos por aluno matriculado, o que reafirma a constatação de retornos decrescentes de escala em

educação. Já os municípios menos eficientes foram aqueles com a melhor condição de partida em termos de PIB per capita e que apresentaram elevados gastos por aluno, mas que alcançaram os piores desempenhos no Ideb de 2017.

Contribuições do Estudo: Considerando os valores gastos pelos municípios amazonenses com educação fundamental, levando em consideração o porte e o desempenho no Ideb de cada município no período em análise, a pesquisa procura demonstrar a eficiência na aplicação dos gastos com educação fundamental, fornecendo informações úteis e relevantes para uma alocação mais qualificada e eficiente dos recursos públicos em educação proporcionando melhorias nos aspectos sociais da população.

Palavras-chave: Eficiência. Ensino Fundamental. Análise Envoltória de Dados. Municípios do Amazonas. IDEB.

1 Introduction

To discuss public spending, discuss how the Brazilian State's budget revenue is being used, mostly obtained by the State's coercive power over society and applying these revenues in planned expenses through the budget (Mendonça, 2014).

Over time, society increasingly seeks to be aware of how public spending is intended, how the State manages public resources, and realize the effectiveness of return through the public services it enjoys.

However, there is a need to improve instruments and techniques for decision-making and evaluation of public policies so that greater efficiency and a more significant impact of public spending are possible. And among the essential services provided to citizens, education is a socially important asset for all (Batista, Alves, & Souza, 2015; Faria, Jannuzzi, & da Silva, 2008).

Mendonça (2014) states that education is one of the main bases for developing a community because it represents the most expressive means of promoting economic development and growth to combat regional and social inequalities.

The Brazilian Constitution (1998) guarantees, in article 6, the citizen's right to education and in article 208 establishes that the State must ensure "compulsory and free basic education from 4 (four) to 17 (seventeen) years of age" and "progressive universalization of free high school." The Law of Guidelines and Bases of Education (Law 9.394/96) determines that municipalities' responsibility is to promote early childhood education (daycare and preschool) and prioritize elementary school.

To evaluate basic education students, Brazil adopts the Basic Education Development Index (IDEB), which according to the Ministry of Education (2019), was created in 2007 by the National Institute of Educational Studies and Research Anísio Teixeira (Inep), to measure the quality of national learning and establish goals for improving education. It functions as a national indicator that enables monitoring the population's quality of education through concrete data.

In recent years, the results of IDEB show that there is a big difference in performances between regions of the country and even between municipalities of the same State, reflecting the regional inequalities of education. In this sense, some studies have been directed to evaluate the efficiency of public spending on education in municipalities of individual States of the

Federation (Faria et al., 2008; Gresele & Krukoski, 2018; Lourenço, Angotti, Nascimento, & Sauerbronn, 2017; Mendonça, 2014; Souza, Araújo, Silva, & Araújo, 2013; Will, Borgert, Flach, Farias, & Soares, 2012).

Wilbert and D´Abreu (2013) evaluated the efficiency of public spending on elementary education in the municipalities of Alagoas from 2007 to 2011. Savian and Bezerra (2013) evaluated the efficiency of public expenditure on education in the elementary school's initial grades in the municipalities of Paraná in the years 2005 and 2009, using as methodology the data envelopment analysis (DEA).

Souza et al. (2013) analyzed the efficiency of public spending on elementary school in the municipalities of Rio Grande do Norte in 2007 and 2009, also using the DEA. Similarly, Sousa, Magalhães, Nascimento, and Bernardes (2016) evaluated the efficiency and effectiveness of using public resources applied in elementary schools in Espírito Santo's municipalities. Lourenço et al. (2017) analyzed the technical efficiency of the 250 largest Brazilian cities.

However, no studies were noticed regarding the analysis of the efficiency of public expenditures of the elementary school in Amazonian municipalities using the IDEB as a reference parameter, a gap that the present study seeks to explore through the data envelopment analysis (DEA) technique.

Given the above, the following research question arises: Are public resources allocated to primary education by public administration in the municipalities of Amazonas being applied efficiently? Based on the problem, the present study aims to evaluate the efficiency of public spending in Amazonian municipalities with the elementary school in the years 2013 to 2017 through the construction of a ranking of the efficiency of the municipalities relating the results obtained in the IDEB by each city in the period, under the consideration of the values of expenses settled with elementary education, an average of students enrolled in the period, average expenditure per student and GDP per capita.

This is a significant theme for society in general since through the analysis of public spending, and one can promote awareness of the effectiveness of the investment made in a given sector and raise important points for the correct direction of applying public resources to meet the needs of the population.

It is expected that the results found can contribute to the comparability of previous analyses of finances destined to fundamental education in amazonian municipalities as well as to enrich the theory already existing in the area as a tool for evaluating public management and contributing to better optimization of the provision of public educational services.

2 Literature Review

To review this research's literature and theoretical support, we composed the theoretical framework of the following topics: Public expenditure; Efficiency of public spending and education, and previous studies.

2.1 Public expenditure

Public spending can be defined as one of the means of the action of the government. Through them, public managers manifest their preferences and priorities about the provision of public services to the population and the promotion of investments (Araújo, Monteiro, & Cavalcante, 2010; Mattei, Bezerra, & Mello, 2018).

In this sense, Silva (2007) points out that the study of public spending is related to the analysis points state intervention in countries' economy, essentially through obtaining the resources available in society and their relocation in public goods and services to meet government policies.

> However, all analysis of public spending should take into account that resources are limited and needs unlimited, with the government has the difficult mission of managing revenues and expenses in order to meet the needs of society in more dangerous areas or those that can produce satisfactory results and bring more significant benefits to this (Gonçalves, 2013, p.15).

Managing public revenue and expenditure should be, according to Kaplan (2004), something strategic in which priorities for action and direction of action should be established to achieve public policy objectives and goals. Public policies are put into practice through public spending. Therefore, decision-making should seek efficiency and optimization in the allocation of the expenditure to better serve society.

2.2 The efficiency of public spending and education

The search for efficiency is in maximizing results and, conversely, minimizing costs. The Brazilian Constitution (1988), in its article 37, establishes the guiding principles of the public administration of any of the Powers of the Union, the States, the Federal District, and the Municipalities, among which the principle of efficiency stands out.

Efficiency is defined as the ability to use the available resources and environmental conditions in the best possible way, aiming to obtain optimal performance in some dimension (Mariano & Rebelatto, 2010). And as in the private sector, in the public sector, the essence of efficiency is the same: to seek the most significant benefit for citizens at the lowest possible cost and to avoid waste (Souza et al., 2013).

Calculating public spending efficiency allows the State to visualize better how the relationship between the inputs being applied and the products being generated is better. This type of analysis is important because it demonstrates to society whether public resources allocated in public policies are being well managed, besides allowing greater transparency about public service management (Faria et al., 2008; Souza et al., 2013).

Still corroborating this perspective, Savian and Bezerra (2013) mention that efficiency boundaries are constructed to detect inefficiency in this type of evaluation. Thus, in the future, there will be a possibility of improving the performance of inefficient municipalities without the need to increase the number of resources used in this sector, but only by using them more efficiently.

Thus, Peña (2008) states that the efficiency of applying resources in the public sector directly contributes to the improvement of results since it demonstrates a sign of the efficiency of management actions and presents the management's performance of public administrators.

In Brazil, the legislation determines some actions within public administration's scope since public managers' administrative choices are often in the contraction of efficiency. It is an example for education articles 211 and 212 of the Federal Constitution of 1988, where they determine that Brazilian states must never spend less than 25% of the revenue resulting from taxes on the maintenance and development of education (Cury, 1998; Mendonça, 2014; Will et al., 2012).

According to Will et al. (2012, p. 3), the allocation of these minimum values reinforces public entities' financial commitment to education through "real budgetary links of revenues for the application of resources in developing and maintaining activities related to education".

2.3 Previous Studies

Given the relevance of the theme worldwide, De Witte and López-Torres (2017) conducted a systematic review of the international literature on efficiency in education between 1977 and 2015, summarizing the inputs and outputs used as the methodologies applied in the 223 articles in the sample. According to the research findings, data envelopment analysis (DEA) was the primary empirical approach to measure efficiency in education.

The authors also identified that the standard input used in the literature refers to the expenses with education, being observed in about 50% of the articles in the sample. Of these, the following works stand out: Agasisti (2014), focusing on the educational institutions of the countries of the European Union; Aristovnik and Obadić (2014) in the educational system of Slovenia and Croatia; Blackburn, Brennan, and Ruggiero (2014) in Australian primary and secondary schools; Brennan, Haelermans and Ruggiero (2014), in dutch schools; Johnson and Ruggiero (2014), in Ohio/USA school districts; and Mayston (2014), in the economics departments of the University of the United Kingdom.

In Brazil, many studies were developed focusing on the analysis of the efficiency of public spending on education in various scenarios of the country, where many of them used the data envelopment analysis (DEA), likewise the present research.

In their study, Wilbert and D'Abreu (2013) aimed to identify the most efficient and least efficient cities in the years 2007 to 2011, about the expenditure on elementary education using the technique of data envelopment analysis. They identified that the efficient municipalities in the period studied were those with the worst starting conditions, in terms of average wealth and educational level, and that spent little per student enrolled and that the least efficient municipalities, with an index lower than 0.65, were those with the best starting condition in terms of GDP per capita and who had high expenses per student, but who achieved the worst performances in IDEB 2011.

Souza et al. (2013), when analyzing the efficiency of public spending in the municipalities of the State of Rio Grande do Norte with the elementary school in the years 2007 and 2009 through the data envelopment analysis, they concluded that among the 145 municipalities surveyed, only 19 (13.10%) were efficient in 2007 and 12 (8.28%) in 2009. When comparing the efficiency scores of the 145 municipalities, it was observed that 98 of them (67.59%) decreased their scores, 35 (24.14%) increased their efficiency level results, and 12 cities (8.28%) remained with their equal efficiency scores in 2007 and 2009.

Savian and Bezerra (2013) evaluated the efficiency of public spending on education in the initial grades of the elementary school in the municipalities of Paraná in the years 2005 and 2009 using the DEA as a method and from the analysis found that the cities with the best economic performance are not necessarily the most efficient. There was also a reduction in the number of efficient municipalities between 2005 and 2009. As for spending on education in elementary school's initial years, most cities in Paraná presented moderate efficiency.

Lourenço et al. (2017), also through the use of the DEA, sought to analyze the technical efficiency of the 250 largest municipalities in terms of students enrolled in elementary school in urban and rural classes considering the IDEB under the consideration of expenses settled,

average expenses per student and MHDI of the municipalities in the dimensions education and income, and discuss aspects related to the quality of public spending on education.

The results showed that only 5.2% of the municipalities in the sample were efficient. Among the cities with the highest efficiency level, the least developed regions of Brazil (North and Northeast) stood out but were not necessarily those with the highest scores in IDEB. However, of the municipalities analyzed, only five were from the State of Amazonas. None of them were among the 15 towns with the highest technical efficiency level, demonstrating the importance of studies in the region.

Begnini and Tosta (2017), to evaluate the efficiency of spending on elementary education in Brazilian states, in 2011, through the data envelopment analysis (DEA), concluded that only 25.92% of Brazilian states had efficient expenditures, especially the State of Amazonas as the most efficient and the State of Piauí as the most inefficient. Therefore, the reality shows a need for review in management practices in most states, aiming at a continuous improvement in education results.

In the studies mentioned above and among others existing, there was the option to use the method of data envelopment analysis (DEA) in a way that justifies the choice in the present study of the method that is widely used when it comes to analyzing the efficiency of the applicability of public resources.

3 Methodological Procedures

This section finds the methodological procedures used to prepare this research, described in the following topics: a typology of the study; population and sample; the method - data envelopment analysis; the analysis strategy; and the comparison of CCR and BCC methods.

3.1 Research typology

From the point of view of its objectives, the research is defined as descriptive, which, according to Prodanov & Freitas (2006), refers to the researcher's facts' record and description without interfering with them. It aims to describe the characteristics of a given population or phenomenon or establish relationships between variables.

As for the technical procedures for obtaining the elaboration data, the research is characterized as bibliographic and documentary research since it will use previous materials already published on the subject researched for broad knowledge and information. The collection of data on public expenditures on fundamental education in the budget balance sheets to confront and understand the scenario of spending on education and its efficiency in the period made available by the government in its means of dissemination.

Gil (1999) highlights the main difference between these types of research the nature of the sources of both kinds of research. While bibliographic research is fundamentally used by several authors' contributions on a given subject, documentary research is based on materials that have not yet received an analytical treatment or re-elaborated according to the research objectives.

From the point of view of the problem approach, the research is characterized as quantitative since the analysis of raw data and its relationships as variables of the study will occur by the nonparametric method of data envelopment analysis.

3.2 Population and sample

The research population refers to the State of Amazonas (AM) municipalities, which has 62 cities. For the research analysis, the municipalities that had made available the amounts of expenses settled with elementary education related to the research analysis period were part of the sample.

Thus, in the first analysis, called "simplest," of the 62 municipalities of the State of Amazonas, 18 cities were excluded or by the absence of data related to their expenses with elementary education in the National Treasury or for not having the grades in IDEB for not meeting the requirements to have the performance calculated, making a total of 44 municipalities analyzed.

In the complete analysis and the previous approach, some data were not available for all 62 municipalities in the State from 2013 to 2017. Therefore, the municipalities with incomplete information were removed from the sample, leaving 37 cities to make up the efficiency analysis.

3.3 The Method - Data Envelopment Analysis (Data Processing)

Measuring the efficiency of a production unit, according to Duarte (2003), involves inputs or inputs (materials, information and consumers) that are used to transform or be transformed into outputs or outputs of goods and services. This production system, responsible for changing a set of inputs into a set of outputs, is known as decision-making units (DMU).

For the present study, data envelopment analysis (DEA) is used as a tool to measure the efficiency of Amazonian municipalities with spending on the elementary education function in the period evaluated, where it will assign each DMU an efficiency score for its performance ranging from 0 to 1, or between 0 and 100%, where efficient units receive a value equal to 1 or 100%.

> The goal of the DEA is to compare a certain number of DMUs performing similar tasks that differ in the number of user inputs and outputs produced. There are basically two classic DEA models: the Constant Return Scale (CRS) model, also known as CCR (Charnes, Cooper & Rhodes, 1978), and the Variable Return Scale (VRS) or BCC (Banker, Charnes & Cooper, 1984) model. The first model considers constant scale returns; the second assumes variable scale returns and no proportionality between inputs and outputs. (Meza, Neto, Mello, & Gomes, 2005, p. 494).

For the definition of the most appropriate approach model to be used in the analysis of efficiency with fundamental education in the present study, we chose to make a first analysis, called "simplest", where we observed the behavior of total expenditure on per capita elementary education in 2017 compared to the result in IDEB for the 4th and 8th grade of the same year.

Another aspect of classification of the analysis model by the DEA is the orientation to inputs or outputs. The input-based DEA approach aims to maximize a linear combination of the quantities of the various products. For an output-based system, it is sought to reduce the amounts of inputs, that is, to minimize a linear combination of the quantities of the various inputs (Coelli, Rao, O'Donnell, & Battese, 2005; Macedo & Almeida, 2009).

3.4 The analysis strategy

This study aims to evaluate the efficiency of public spending in amazonian municipalities with elementary school in the years 2013 to 2017 by constructing a ranking of

the efficiency of cities. For this, it was relevant to analyze the differences between the constant scale returns (CCR) and variable (BCC) method described in the next topic. Data envelopment analysis was performed through the computer program called Integrated Decision Support System (SIAD) - SIAD V3.0, proposed by Meza et al. (2005). The DEA models used were the CCR and BCC, both oriented to output.

The analysis of the efficiency of education, called simple, was carried out to evaluate the approach of efficiency analysis considering constant scale returns (CCR) and variable scale returns (BCC). From this analysis, the behavior of the variables was observed for the definition of the model and the model used for the "complete analysis" was defined. In this simpler analysis, the amounts of total expenditure on per capita elementary education in the municipalities and the IDEB grades were compared for 2017.

According to the Ministry of Education, the Basic Education Development Index (IDEB) is a performance indicator calculated based on the combination of two factors that interfere in the quality of education, which are the flow indicators that demonstrates the approval, disapproval and dropout rates and the performance indicators in standardized exams such as Prova Brasil and SAEB, performed every two years at the end of a given stage of basic education.

The Brazil Test and the National Basic Evaluation System (SAEB) are applied in the 4th and 8th grades (fifth and ninth years) of elementary school and the 3rd year of high school with an application of Portuguese Language tests, Mathematics and socioeconomic questionnaires (Paz & Raphae, 2012).

The amounts of expenditure on each municipality's fundamental education for each year of the research in question, amounts settled, was obtained in the Siconfi- Accounting and Fiscal Information System of the Brazilian Public Sector made available by the National Treasury (Ministry of Finance, 2019). The number of inhabitants of the municipalities was removed from the values of the 2017 population estimates published by IBGE (2019).

The outputs (results) of the municipalities in the IDEB in 2017 for the 4th and 8th grade of elementary school of municipal schools, published by INEP (2019) were used as outputs (results)

In the complete analysis approach, we use the expenses with elementary education, amounts settled, accumulated for the period from 2013 to 2017 weighted by the number of students enrolled in high school.

The number of students enrolled in elementary school was obtained from the INEP portal (2019). Values were obtained for each year that the research involves so that the average number of students was calculated for the period in question that was later used in the weighting with the values of education expenditure accumulated in the period, thus obtaining an average expenditure with education per student used as one of the inputs.

As control variables, we used the values related to GDP per capita in 2013, obtained at IBGE (2019), and the IDEB of the 4th grade of 2013, obtained from the INEP portal (2019).

The GDP per capita of 2013 was adopted as a control variable to act regulating the effect on elementary education level so that one municipality is more economically active than the other. Savian and Bezerra (2013) and Wilbert and D´Abreu (2013) also used the variable of GDP per capita in their studies for the same purpose.

The IDEB variable of the 4th grade of 2013 was used to control the effect on education, because a given municipality had a better or worse educational starting point.

As a result, variable(output), the IDEB note of the 8th grade of 2017 is used. It is justified in the understanding that, starting from the analysis of 2013, after the four years, the students analyzed in the 4th grade will be in the 8th grade if they have not been disapproved.

3.5 Comparison of CCR and BCC methods

To test and establish the best adequacy of the efficiency analysis considering the constant returns of scale (CCR) in contrast to the approach with variable scale returns (BCC), an analysis called "simple" was performed considering the total per capita expenditure with elementary education of 2017 as input and the IDEB scores of the 4th and 8th grades as output for the same year, similarly as in the research by Wilbert and D'Abreu (2013).

It was observed in the approach in the CCR model a negative correlation between per capita expenditure with education and the efficiency index obtained, which suggests a decreasing return. The more the amount invested in education increases, the return of grades in IDEB is lower and lower (Appendix, Figure 4).

Analyzing the results obtained by the BCC model approach, there is no correlation between per capita expenditure with education and the efficiency index. There are municipalities with more or less efficient rates for the same levels of per capita expenditure on education (Appendix, Figure 5).

Therefore, it is concluded by adopting variable scale returns (BCC) to analyze this study.

4 Results and Analyses

In 2013, the average GDP per capita of the municipalities in the sample was R$ 10,606.78, according to Table 1, with most municipalities with GDP per capita lower than the average. By way of comparison, in the same year, the GDP per capita of Brazil was R$ 26,657.57 (IBGE). There is a large dispersion of GDP per capita, which corresponds to 89% of the average. The municipality with the highest GDP per capita was Coari and the lowest was Nova Olinda do Norte.

Table 1

Descriptive statistic "Complete Analysis"

Statistics	Variables				
	GDP *per capita* 2013	**Enrolled Students** [(a)]	IDEB **4th grade 2013**	IDEB **8th grade 2017**	**Spend-per student** [(b)]
Average	10.606,78	9.033,9	3,99	3,77	R$ 24,362.39
Median	7.473,00	4290,6	4	3,7	R$ 23,861.94
Maximum	56.055,00	163.508,40	5	4,9	R$ 38,325.03
Minimum	4.667,00	1200,8	3,1	2,5	R$ 19,802.43
Standard Deviation	9.473,70	26.294,52	0,48	0,55	R$ 3,748.48

Observations: (a) Average of students enrolled in elementary school for the years 2013 to 2017;
(b) Expenditure on accumulated elementary education from 2013 to 2017, divided by the average number of students enrolled.

Source: *Own elaboration based on data from the National Treasury (Ministry of Finance), the Ministry of Education and the Brazilian Institute of Geography and Statistics (IBGE).*

The average number of students enrolled in elementary school during the 5 years of the research was 9,033.9 students. The dispersion represents approximately 291% of the average value, reflecting large differences between municipalities. It is also observed that most cities have the number of students enrolled lower than the average because the median value is lower than the average, as well as in the research by Wilbert and D'Abreu (2013). The municipality with the highest average of students enrolled in elementary school in the period was the capital Manaus and the one with the lowest number was Itapiranga.

Also, in Table 1, it is observed that the IDEB of the 4th grade of 2013 presented an average higher than the IDEB of the 8th grade of 2017. This fact draws attention, since it assumes that students enrolled in 4th grade in 2013, if they had not been disapproved, would be in the 8th grade of 2017. The same phenomenon was observed in the studies by Wilbert and D'Abreu (2013) and Silva, Souza, Borges, Araújo and Silva (2015). For the 4th grade IDEB, in 2013, Presidente Figueiredo was the municipality with the highest score, while Tonantins presented the lowest. For the IDEB of the 8th grade in 2017, Boca do Acre showed the highest score and Envira the lowest.

As for the expenditure per student, this is the sum of expenses settled with elementary education, divided by the average number of students enrolled in the period. Therefore, the average expenditure of R$ 24,362.39 represents what was spent accumulated from 2013 to 2017 for each student enrolled. Thus, R$ 4,872.48 per year was spent for each student enrolled in elementary school. The dispersion of the amounts paid per student corresponds to approximately 15% of the average value, a percentage that contrasts with the dispersion found for GDP per capita, which reveals that the municipalities in the sample are more similar in terms of spending on elementary school per student enrolled and unequal to each other about GDP per capita.

The main results will then be presented in the efficiency analysis. The data used in the analysis and the efficiency indices for each municipality can be observed in Table 4 in the appendix.

According to the observation in Figure 1, it is verified that for spending on elementary education per student close to the average, there are municipalities with low, medium and high efficiency rates. And the cities with the lowest efficiency rates have the values with spending very close to or above the average value.

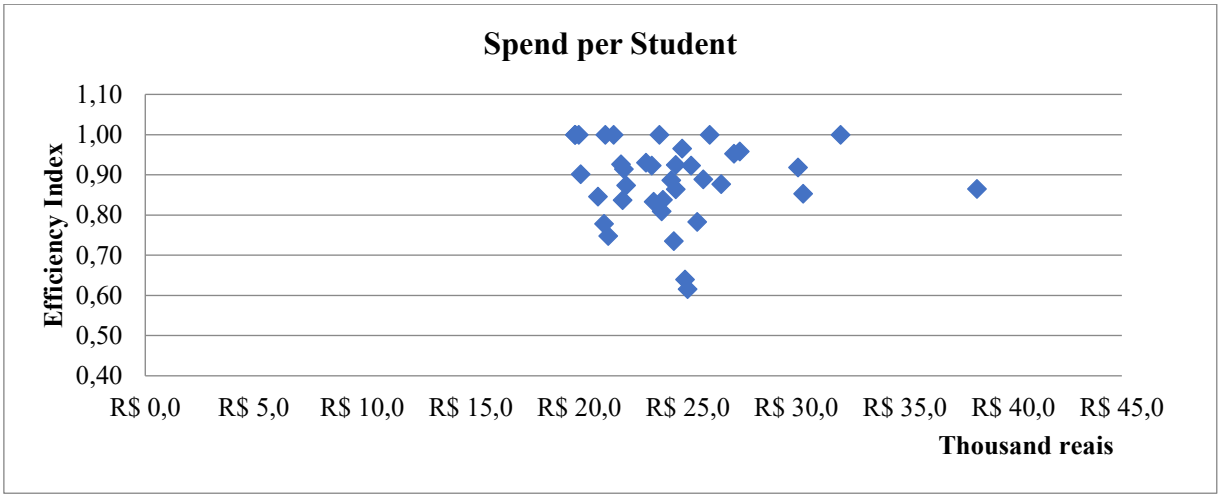

Figure 1 *Relationship between spend per student and efficiency index*
Source: *Elaborated by the authors.*

Concerning the GDP per capita of 2013 and the efficiency index, it is observed in Figure 2 that for low values of GDP per capita, there are varied rates of efficiency, concentrating a large part of the municipalities. There is also a slight trend in reducing efficiency according to the increase in GDP per capita.

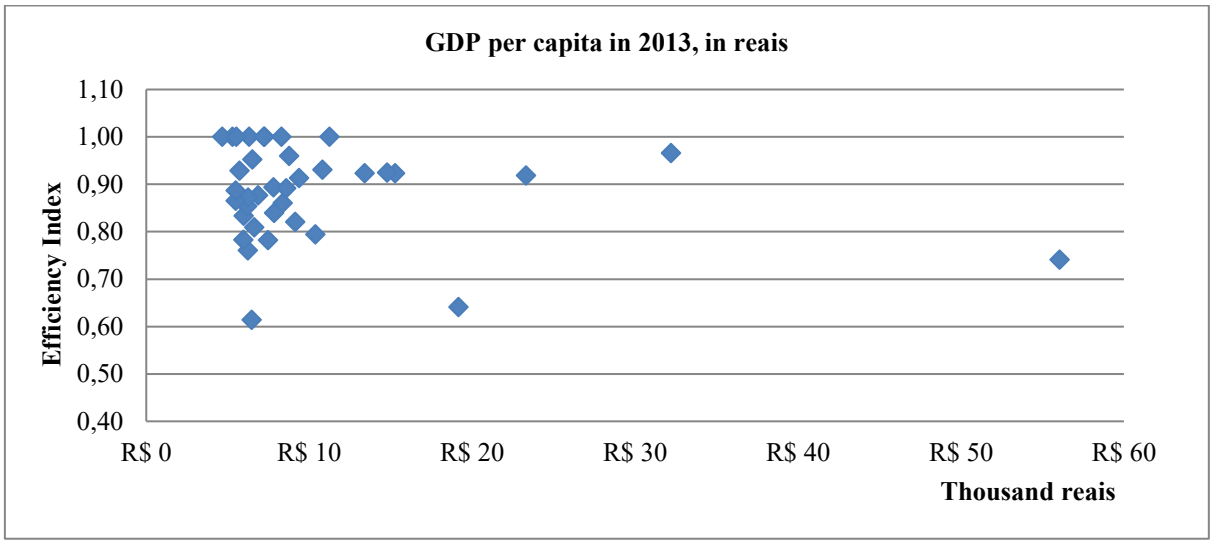

Figure 2 *Ratio of GDP per capita 2013 to the efficiency index*
Source: *Elaborated by the authors.*

Observing Figure 3 with the performance obtained in the IDEB by the 4th grade of 2013 about the efficiency index obtained by the municipalities, it is not possible to establish a clear trend since several levels of efficiency were found for different starting points.

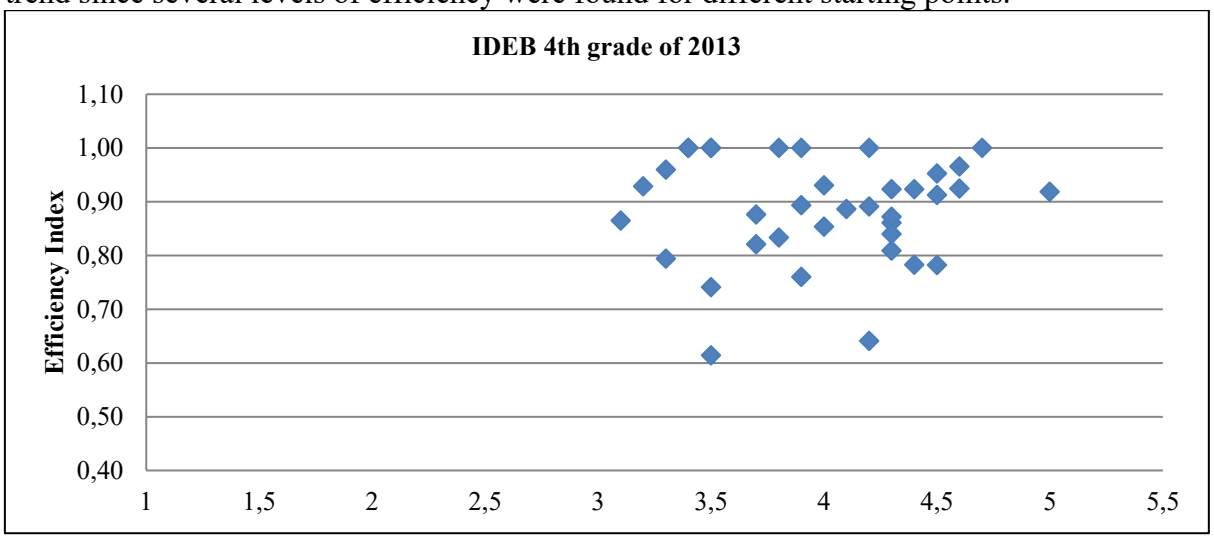

Figure 3 *Relationship between IDEB 4th grade of 2013 and efficiency index*
Source: *Elaborated by the authors.*

Next, Table 2 and 3 will be demonstrated with the classification of municipalities regarding efficiency.

Table 2
Efficient municipalities (Index =1)

Municipality	GDP *per capita* (ranking)[to]	IDEB 4th Series 2013 (ranking)[b]	IDEB 8th Series 2017 (ranking)[c]	Expenditure per student (ranking)[d]
Anamã	7252 (20th)	3.5 (13th)	4.5 (3rd)	32,042.59 (2nd)
Benjamin Constant	6307 (26th)	3.4 (14th)	3.5 (12th)	21,580.62 (31st)
Boca do Acre	7216 (21st)	4.7 (2nd)	4.9 (1st)	21,337.84 (29th)
Maraã	5291 (36th)	3.5 (13th)	3.1 (15th)	19,802.43 (37th)
Nova Olinda do Norte	4667 (37th)	3.9 (10th)	3.5 (12th)	23,692.36 (21st)
Novo Airão	5540 (33rd)	3.8 (11th)	3.6 (11th)	19,981.94 (35th)
Rio Preto da Eva	11249 (8th)	3.4 (14th)	4.2 (6th)	26.013,02 (8th)
Tapauá	8301 (16th)	4.2 (7th)	4.1 (7th)	19,810.12 (36th)

Observations: a) *GDP per capita* 2013, evaluated in 37 positions (municipalities), from highest to lowest; b) IDEB 4th Grade of 2013 evaluated in 17 positions, from the best score to worst; c) IDEB 8th Grade 2017 evaluated in 17 positions, from the best score to the worst; d) Expenditure on elementary education per enrolled student evaluated in 37 positions, from highest to lowest.

Source: *Prepared by the* authors based on data from the National *Treasury (Ministry of Finance), the National Institute of Educational Studies and Research (INEP) and the Brazilian Institute of Geography and Statistics (IBGE).*

Table 2 presents the eight municipalities that were considered efficient, that is, they obtained the efficiency index equal to 1. It is observed that about *GDP per capita,* these municipalities are mostly those that have values below average (R$10,606.78). It is emphasized that two of the cities with efficiency equal to 1 occupy the last two positions in the GDP per *capita* ranking. In addition, as well as in the research es by Wilbert and D'Abreu (2013) and Lourenço et al. (2017), where the capitals were not pointed out as efficient, the capital Manaus is not among the municipalities highlighted by efficiency.

Regarding the result variable, IDEB 8th grade of 2017, it is observed that two efficient municipalities have high scores (1st and 3rd position), two with median grades (6th and 7th position) and four municipalities presented low scores (11th position onwards). Therefore, we perceive a balance of efficient municipalities because half obtained IDEB grades 8th grade in 2017 above average (3.77) and another half below.

For the variable spent on elementary school per enrolled student, 6 six municipalities (75%) values considered low (below the average of R$24,362.39). Only two municipalities have higher expenses per student, with Anamã in 2nd position and Rio Preto da Eva in 8th position. Therefore, it is possible to perceive a pattern, even if close, for municipalities classified as *efficient: low GDP per capita* in 2013, low starting scores in 2013 and low amounts spent per student in the period from 2013 to 2017.

Table 3
Less efficient municipalities (Index <0.77)

Municipality	Efficiency Index (BCC)	GDP *per capita* (ranking)[to]	IDEB 4th Series 2013 (ranking)[b]	IDEB 8th Series 2017 (ranking)[c]	Expenditure per student (ranking)[d]
Beruri	0,75	6,229 (28th)	3.9 (10th)	3 (16th)	21,394.15 (31st)
Coari	0,74	56,055 (1st)	3.5 (13th)	3 (16th)	24,578.35 (20th)
Codajás	0,64	19,159 (4th)	4.2 (7th)	3 (16th)	24,881.75 (19th)
Envira	0,62	6,474 (25th)	3.5 (13th)	2.5 (17th)	25,782.02 (11th)

Observations: a) *GDP per capita* 2013, evaluated in 37 positions (municipalities), from highest to lowest; b) IDEB 4th Grade of 2013 evaluated in 17 positions, from best score to worst; c) IDEB 8th Grade 2017 evaluated in 17 positions, from the best score to the worst; d) Expenditure on elementary education per enrolled student evaluated in 37 positions, from highest to lowest.

Source: *Prepared by the* authors based on data from the National *Treasury (Ministry of Finance), the National Institute of Educational Studies and Research (INEP) and the Brazilian Institute of Geography and Statistics (IBGE).*

Table 3 lists the last four municipalities with the lowest efficiency rates. Observing the *GDP per capita* of 2013 of these municipalities, we observed that they fall within the two poles of the ranking, with two of the municipalities among the first positions and the other two in the positions below the ranking. A fact that draws attention is the municipality with the highest GDP per *capita* in the State, Coari, with a value of R$ 56,055.00, being among the inefficient.

Regarding the IDEB of the 4th grade of 2013, the least efficient municipalities present median grades, except for the municipality of Codajás that occupies the 7th place. On the other hand, the least efficient municipalities have the lowest values for the result variable, the IDEB 8th grade of 2017.

As for the expenditure per student, the less efficient municipalities present values that occupy median to final positions. Relating to the average expenditure, the least efficient municipalities spend on average (R$ 23,890.56) more than efficient municipalities (R$ 23,016.12).

Therefore, it is concluded, roughly, that the least efficient municipalities are the ones that obtained low performance scores in the IDEB 8th grade of 2017. Also, they are those who had a fall in the grade in relation to the IDEB 4th grade of 2013.

There is not necessarily a pattern of municipalities less efficient in terms of spending per student and *GDP per capita,* because there are municipalities that figure within the two extremes of the ranking of these variables.

It is noteworthy that municipalities' classification as efficient or less efficient is related to the set of municipalities and variables of the present study since this is the relative efficiency model. In addition, the results obtained in this research indicate that other factors may be linked to the performance of municipalities regarding efficiency in elementary school, as well as the studies by Wilbert and D'Abreu (2013), Lourenço et al. (2017) and Gresele and Krukoski (2018) pointed to their respective samples.

5 Final considerations

The study in question aimed to evaluate the efficiency of public spending in the municipalities of the State of Amazonas with elementary school in the years 2013 to 2017 by

constructing a *ranking of the efficiency* of the municipalities using the method of data envelopment analysis (DEA).

Of the 62 municipalities that make up the sample, only 37 were analyzed, due to the unavailability of the information related to them, corresponding to a limitation of the study. Therefore, the importance of transparency of accounting information regarding education expenses for effective *accountability* is initially emphasized, which is the main instrument of social control by citizens.

From the simple initial study, the approach with variable returns proved to be more appropriate for use in the research, reflecting that municipal spending on elementary education is associated with decreasing scale returns.

Analyzing the efficiency, the DEA/BCC model shows that 8 municipalities achieved maximum efficiency in the allocation of resources, staying at the efficiency frontier with scores equal to 1 (one), being: Anamã, Benjamin Constant, Boca do Acre, Maraã, Nova Olinda do Norte, Novo Airão, Rio Preto da Eva and Tapauá.

As for municipalities considered efficient, it is possible to perceive a pattern, even if close, for municipalities classified as *efficient: low GDP per capita* in 2013, low starting scores in 2013 and low amounts spent per student in the period from 2013 to 2017. Therefore, the efficient municipalities in the period were those with the worst starting conditions, in terms of average wealth and educational performance, and who spent little per enrolled student, which reaffirms the finding of decreasing returns of scale in education.

As for the less efficient municipalities, with an index lower than 0.77, they obtained low-performance scores in the IDEB 8th grade of 2017 and those who had a fall in the score in relation to the IDEB 4th grade of 2013. There are also two municipalities with the best starting conditions in terms of GDP *per capita*.

Therefore, it is concluded that the municipalities studied should improve the management of public spending, investing not only in education, but mainly in actions that aim to improve the socioeconomic conditions of their citizens, minimizing inequalities of opportunities.

The research has limitations in the number of municipalities surveyed, since 25 cities could not participate in the study. The composition of the municipalities, in their entirety, would positively influence the results achieved since the results found in this research are restricted to the sample understood and make it impossible to generalize the results achieved.

In this study, all possible inputs and products were not taken into account, however, from the variables used and considered the most relevant, what can be concluded is that there are more efficient or less efficient municipalities among themselves. It is suggested, therefore, those future studies include all municipalities of Amazonas, *with inputs* and *outputs* that can reach all cities in the analysis of data. As well as researching factors and variables that can influence the high efficiency and low efficiency of the studied municipalities.

References

Agasisti, T. (2014). The Efficiency of Public Spending on Education: An empirical comparison of EU countries. *European Journal of Education*, 49(4), 543–557. https://doi.org/10.1111/ejed.12069

Araújo, J. A. de, Monteiro, V. B., & Cavalcante, C. A. (2010). Influência dos gastos públicos no crescimento econômico dos Municípios do Ceará. In F. J. Carvalho, Eveline Barbosa

Silva; Oliveira, J. Lima; Trompieri Neto, Nicolino; Medeiros, C. Nascimento; Sousa (Ed.), *Economia do Ceará em Debate 2010* (pp. 176–200).

Aristovnik, A., & Obadić, A. (2014). Measuring relative efficiency of secondary education in selected EU and OECD countries: the case of Slovenia and Croatia. *Technological and Economic Development of Economy*, 20(3), 419–433. https://doi.org/10.3846/20294913.2014.880085

Batista, T. M., Alves, A. T., & Souza, O. M. De. (2015). Análise Dos Gastos Públicos Em Educação No Município De Manaus Nos Anos De 2011 a 2013. *Veredas Favip-Revista Eletrônica de Ciências*, 8(1), 31–46.

Begnini, S., & Tosta, H. T. (2017). A eficiência dos gastos públicos com a educação fundamental no Brasil: uma aplicação da análise envoltória de dados (DEA). *Revista Economia & Gestão*, 17(46), 43-59.

Blackburn, V., Brennan, S., & Ruggiero, J. (2014). Measuring efficiency in australian Schools: A preliminary analysis. *Socio-Economic Planning Sciences*, 48(1), 4–9. https://doi.org/10.1016/j.seps.2013.08.002

Constituição da República Federativa do Brasil de 1988. (1998). Brasília. Recuperado em 10 novembro 2019, de http://www.planalto.gov.br/CCIVIL_03/Constituicao/Constitui%C3%A7ao.htm

Brennan, S., Haelermans, C., & Ruggiero, J. (2014). Nonparametric estimation of education productivity incorporating nondiscretionary inputs with an application to Dutch schools. *European Journal of Operational Research*, 234(3), 809–818. https://doi.org/10.1016/j.ejor.2013.10.030

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An Introduction to Efficiency Analysis*. (2a ed.). Nova Iorque: Springer.

Cury, C. R. J. (1998). O ensino médio no Brasil: histórico e perspectivas. *Educação Em Revista*, (27), 73–84.

De Witte, K., & López-Torres, L. (2017). Efficiency in education: A review of literature and a way forward. *Journal of the Operational Research Society*, 68(4), 339–363. https://doi.org/10.1057/jors.2015.92

Duarte, J. C. (2003). *Marketing de relacionamento: uma estratégia para a fidelidade do cliente numa agência bancária*. Dissertação de mestrado, Universidade Federal de Santa Catarina, Florianópolis, SC, Brasil.

Faria, F. P., Jannuzzi, P. de M., & da Silva, S. J. (2008). Eficiência dos gastos municipais em saúde e educação: Uma investigação através da análise envoltória no estado do Rio de Janeiro. *Revista de Administração Publica*, 42(1), 155–177. https://doi.org/10.1590/s0034-76122008000100008

Gil, A., & Métodos, C. (1999). *Técnicas de pesquisa social*. São Paulo: Atlas.

Gonçalves, E. D. A. (2013). *Gastos públicos com a educação superior: evolução dos gastos federais com a universidade de Brasília entre 2003 e 2010*. Dissertação de mestrado, Universidade de Brasília, Brasília, Brasil.

Gresele, W. D., & Krukoski, F. Â. (2018). Eficiência dos gastos municipais em educação no Paraná. *Revista Pensamento Contemporâneo Em Administração*, 12(4), 56–74. https://doi.org/10.12712/rpca.v12i4.27149

Instituto Nacional de Estudos e Pesquisas Educacionais. *Sistema de Consulta a Matrícula do Censo Escolar - 1997/2014*. Recuperado em 18 setembro, 2019, de http://matricula.educacenso.inep.gov.br.

Johnson, A. L., & Ruggiero, J. (2014). Nonparametric measurement of productivity and efficiency in education. *Annals of Operations Research*, 221(1), 197–210. https://doi.org/10.1007/s10479-011-0880-9.

Kaplan, R. S. (2004). *Kaplan e Norton na Prática*. Rio de Janeiro: Campus.

Lourenço, R. L., Angotti, M., Nascimento, J. C. H. B. do, & Sauerbronn, F. F. (2017). Eficiência do gasto público com ensino fundamental: uma análise dos 250 maiores municípios brasileiros. *Revista Contabilidade Vista e Revista*, 28(1), 89–116.

Macedo, M. A. D. S., & de Almeida, K. (2009). Análise do desempenho organizacional no agronegócio brasileiro: aplicando à agroindústria de papel e celulose. *Revista de Educação e Pesquisa em Contabilidade (REPeC), 3*(1), 25-45. https://doi.org/10.17524/repec.v3i1.39.

Mariano, E. B., & Rebelatto, D. A. do N. (2010). Sistematização do processo de escolha dos modelos e perspectivas da Análise Envoltória de Dados por meio de um sistema especialista. *XXX Encontro Nacional de Engenharia de Produção*, (October), 1–14. https://doi.org/10.13140/2.1.1236.0645

Mattei, T. F., Bezerra, F. M., & Mello, G. R. de. (2018). Despesas públicas e o nível de desenvolvimento humano dos estados brasileiros: uma análise do IDHM 2000 e 2010. *RACE - Revista de Administração, Contabilidade e Economia*, 17(1), 29–54. https://doi.org/10.18593/race.v17i1.10296

Mayston, D. J. (2014). Effectiveness analysis of quality achievements for university Departments of Economics. *Applied Economics*, 46(31), 3788–3797. https://doi.org/10.1080/00036846.2014.939373.

Mendonça, R. L. (2014). *Gestão Pública E Eficiência Nos Gastos Com Educação: Evidências A Partir Do Estado Do Pará*. Dissertação de mestrado, Universidade da Amazônia, Belém, PA, Brasil. https://doi.org/10.4324/9781315853178

Meza, L. A., Neto, L. B., Mello, J. C. C. B. S. de, & Gomes, E. G. (2005). ISYDS- Integrated System for Decision Support (SIAD - Sistema Integrado de Apoio a Decisão): a software package for data envelopment analysis model. *Pesquisa Operacional*, 25(3), 493–503. https://doi.org/10.1590/s0101-74382005000300011

Paz, F. M. Da, & Raphae, H. S. (2012). Contribuições Para O Debate Sobre a Escola Pública: O Índice De Desenvolvimento Da Educação Básica (IDEB). *Colloquium Humanarum*, 9(2), 55–65. https://doi.org/10.5747/ch.2012.v09.n2.h125

Peña, C. R. (2008). Um modelo de avaliação da eficiência da administração pública através do método análise envoltória de dados (DEA). *Revista de Administração Contemporânea, 12*(1), 83-106. Recuperado em 30 de outubro de 2018 de http://dx.doi.org/10.1590/S1415-65552008000100005.

Prodanov, C. C., & Freitas, E. C. D. (2006). *Metodologia do trabalho científico [recurso eletrônico]: métodos e técnicas da pesquisa e do trabalho acadêmico*. Novo Hamburgo: FEEVALE.

Savian, M. P. G., & Bezerra, F. M. (2013). Análise de eficiência dos gastos públicos com educação no ensino fundamental no estado do Paraná. *Economia & Região, 1*(1), 26-47. Recuperado em 20 agosto, 2019 de http://dx.doi.org/10.5433/2317-627X.2013v1n1p26.

Silva, M. C. da, Souza, F. J. V. de, Borges, E. F., Araújo, A. O., & Silva, J. D. G. da. (2015). Avaliação da função educação nos municípios de São Paulo, Rio de Janeiro e Belo Horizonte: mudança ou inércia social? *ConTexto*, 15(29), 17–29.

Silva, R. (2007). *Evolução e dinâmica dos gastos do governo federal brasileiro no período 1995-2005*. Dissertação de mestrado, Programa Multiinstitucional e Inter-Regional de Pós-graduação em Ciências Contábeis, UnB/UFPB/UFPE/UFRN, Brasília, Brasil.

Sousa, W. D.; Magalhães, M. A.; Nascimento, J. C. H. B.; Bernardes, J. R. (2016). Análise dos Gastos na Alocação dos Recursos Públicos Destinados ao Ensino Fundamental dos Municípios do Espírito Santo. *Gestão Org: Revista Eletrônica de Gestão Organizacional, 14(*2), 381-392. Recuperado em 27 setembro, 2019 de http://www.revista.ufpe.br/gestaoorg.

Souza, F. J. V., de Araújo, F. R., da Silva, M. C., & Araújo, A. O. (2013). Análise da Eficiência dos Gastos Públicos em Educação Nos Municípios do Estado do Rio Grande do Norte. *Revista de Administração e Contabilidade da FAT*, 5(3), 04-21. Recuperado em 15 agosto, 2019 de http://www.reacfat.com.br/index.php/reac/article/view/70.

Wilbert, M. D., & D'Abreu, E. C. C. F. (2013). Eficiência dos gastos públicos na educação: análise dos municípios do estado de alagoas. *Advances in Scientific and Applied Accounting, 6*(3), 348-372. Recuperado em 15 agosto, 2019 de http://asaa.anpcont.org.br/index.php/asaa/article/view/136/94

Will, A. R., Borgert, A., Flach, L., Farias, S., & Soares, S. V. (2012). Os Gastos com Educação nos Estados Brasileiros: uma Análise da Qualidade das Despesas Públicas. *Encontro De Administração Pública E Governo - Anpad*, 1–16.

Appendix

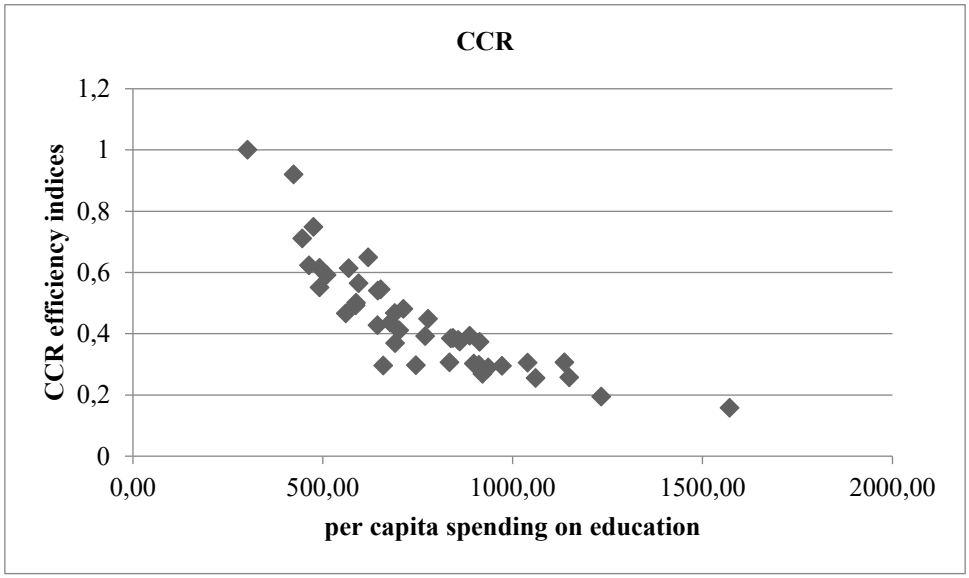

Figure 4 *CCR efficiency indices versus per capita spending on education*
Source: *Elaborated by the authors.*

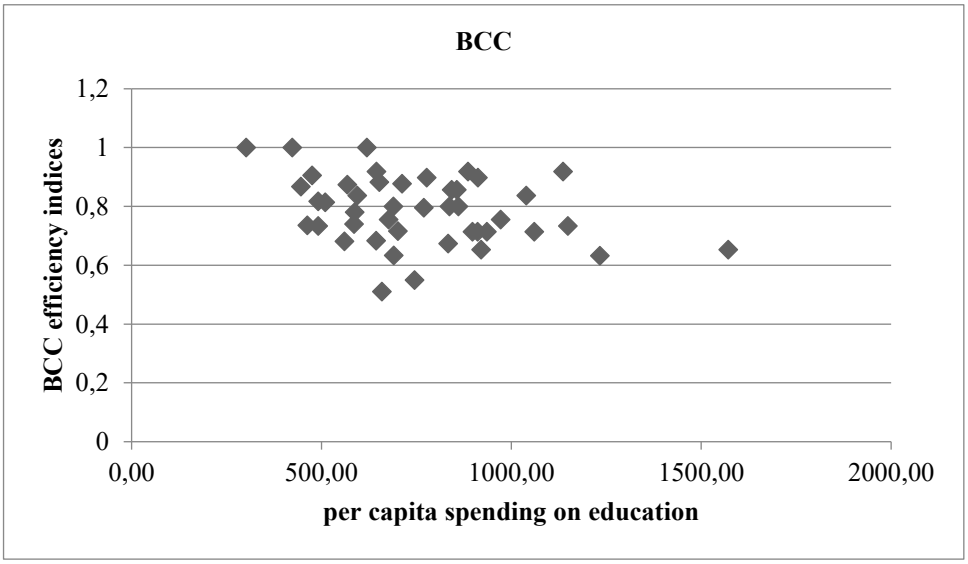

Figure 5 *BCC efficiency indices versus per capita spending on education*
Source: *Elaborated by the authors.*

Table 4
Data used in the analysis

Municipality	Expenditure/Student (accumulated from 2013 to 2017, in R$)	GDP *per capita* 2013, in R$	IDEB 4th series of 2013	IDEB 8th series of 2017	BCC Efficiency Index
Alvarães	23.861,94	5992,00	3,8	3,5	0,84
Amaturá	21.931,38	5736,00	3,2	3,5	0,93
Anamã	32.042,59	7252,00	3,5	4,5	1,00
Anori	24.450,13	8385,00	4,3	4,1	0,86
Barreirinha	23.436,67	6625,00	4,3	3,7	0,83
Benjamin Constant	21.205,85	6307,00	3,4	3,5	1,00
Beruri	21.337,84	6229,00	3,9	3	0,75
Boca do Acre	21.580,62	7216,00	4,7	4,9	1,00
Borba	30.321,58	6205,00	4	3,7	0,85
Careiro da Várzea	27.400,33	8772,00	3,3	3,9	0,96
Coari	24.352,27	56055,00	3,5	3	0,74
Codajás	24.879,05	19159,00	4,2	3	0,64
Envira	24.993,06	6474,00	3,5	2,5	0,62
Humaitá	21.141,52	7473,00	4,5	3,6	0,78
Iranduba	23.073,66	10818,00	4	4,1	0,93
Itacoatiara	23.338,44	15281,00	4,4	4,4	0,92
Itapiranga	20.867,08	7850,00	4,3	3,7	0,85
Jutaí	23.793,82	10373,00	3,3	3,2	0,81
Lábrea	22.000,64	9151,00	3,7	3,3	0,84
Manacapuru	25.161,98	13399,00	4,3	3,8	0,92
Manaquiri	26.536,94	6870,00	3,7	3,8	0,88
Manaus	24.741,44	32202,00	4,6	4,7	0,97
Manicoré	20.066,62	7811,00	3,9	3,8	0,90
Maraã	19.802,43	5291,00	3,5	3,1	1,00
Maués	22.164,69	6260,00	4,3	3,8	0,87
Nhamundá	27.128,97	6515,00	4,5	4,3	0,95
Nova Olinda do Norte	23.692,36	4667,00	3,9	3,5	1,00
Novo Airão	19.981,94	5540,00	3,8	3,6	1,00
Novo Aripuanã	25.439,68	5969,00	4,4	3,3	0,78
Presidente Figueiredo	30.085,98	23310,00	5	4,5	0,92
Rio Preto da Eva	26.013,02	11249,00	3,4	4,2	1,00
Silves	22.055,71	9382,00	4,5	4,4	0,91
Tapauá	19.810,12	8301,00	4,2	4,1	1,00
Tefé	25.714,26	8588,00	4,2	4,2	0,89
Tonantins	38.325,03	5485,00	3,1	3,2	0,86
Urucará	24.441,41	14776,00	4,6	4,5	0,92
Urucurituba	24.237,25	5483,00	4,1	3,5	0,89

Source: *Elaborated by the authors.*