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Impacts on the efficiency of public expenditure in the fundamental education of São Paulo cities through the expenditure element categories

Impactos en la eficiencia del gasto público en educación básica en los municipios de São Paulo a través de las categorías del elemento de gasto

Impactos na eficiência do gasto público na educação fundamental dos municípios paulistas por meio das categorias do elemento da despesa

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Abstract

Purpose: This study aims to measure the impact of public spending on basic education in São Paulo cities on the efficiency of public educational expenditure.

Method: The calculation of the efficiency is based on the Data Envelopment Analysis (DEA), having as input the public expenditures in education in the years 2014 to 2017 and output the municipal score of Prova Brasil 2017. The measurement of the impact of public expenditures on efficiency is based on the technique of Multiple Linear Regression (MLR) by Ordinary Least Squares (OLS), having as explanatory variables educational expenses classified as wages, purchases, travel, interest and permanent materials, and variable response efficiency index of public expenditure.

Results: From the statistical models of MLR different regression coefficients were obtained, which estimate the change in the efficiency index of public expenditure when the expenditure is increased or withdrawn. The results expressed that there is a negative correlation between all categories of the expenditure element and the efficiency of public educational spending in the period from 2014 to 2017.

Contributions of the Study: This study, in a pioneering way, adopts the budget accounting classification of the categories of the element of the expense, thus approaching the study of the efficiency of the closest possible object to which the classification of the expenditure refers.

Keywords: Efficiency. Public Expenditure. Education. Element of expenditure.

Resumen

Objetivo: Este trabajo tiene como objetivo medir los impactos del gasto público en educación básica en los municipios de São Paulo sobre la eficiencia del gasto público educativo.

Método: El cálculo de la eficiencia se realiza a partir del Análisis Envolvente de Datos (DEA), utilizando el gasto público en educación de los años 2014 a 2017 como entrada y salida del puntaje municipal de Prova Brasil 2017. La medición del impacto del gasto público en la eficiencia se realiza mediante la técnica de Regresión Lineal Múltiple (RLM) por Mínimos Cuadrados Ordinarios (OLS), con los gastos educativos clasificados como salarios, compras, viajes, intereses y materiales permanentes como variables explicativas y variable de respuesta el índice de eficiencia del gasto público.

Resultados: A partir de los modelos estadísticos de RLM se obtuvieron diferentes coeficientes de regresión, que estiman el cambio en el índice de eficiencia del gasto público cuando los gastos aumentan o se retraen. Los resultados expresaron que existe una correlación negativa entre todas las categorías del elemento de gasto y la eficiencia del gasto público en educación en el período de 2014 a 2017.

Contribuciones del Estudio: Este trabajo pionero adopta la clasificación contable presupuestaria de las categorías del elemento de gasto, acercando así el estudio de la eficiencia del objeto al que se refiere la clasificación de gasto.

Palabras clave: Eficiencia. Gasto público. Educación. Elemento de gasto.

Resumo

Objetivo: Este trabalho tem como objetivo mensurar os impactos dos gastos públicos na educação fundamental dos municípios paulistas sobre a eficiência do gasto público educacional.

Método: O cálculo da eficiência se dá a partir da Análise Envoltória de Dados (DEA), tendo como *input* os gastos públicos em educação nos anos de 2014 à 2017 e *output* a nota municipal da Prova Brasil 2017. A mensuração do impacto dos gastos públicos sobre a eficiência se dá a partir da técnica de Regressão Linear Múltipla (RLM) por Mínimos Quadrados Ordinários (MQO), tendo como variáveis explicativas os gastos educacionais classificados em salários, compras, viagens, juros e materiais permanentes, e variável resposta o índice de eficiência do gasto público.

Resultados: A partir dos modelos estatísticos de RLM foram obtidos diferentes coeficientes de regressão, que estimam a mudança no índice de eficiência do gasto público quando os gastos são incrementados ou retraídos. Os resultados expressam que há correlação negativa entre todas as categorias do elemento da despesa e a eficiência do respectivo gasto público educacional no período de 2014 a 2017.

Contribuições do Estudo: De forma pioneira este trabalho adota a classificação contábil orçamentária das categorias do elemento da despesa, aproximando assim o estudo da eficiência do objeto mais próximo possível a que a classificação do gasto se refere.

Palavras-chave: Eficiência. Gasto Público. Educação. Elemento de despesa.

1 Introduction

Education, seen as a formal schooling, has been presented as the key to a country's economic and social development. Thus, Brazil, in recent decades, has made large investments in this sector, with policies that aim both to increase the education level of the population and to offer better quality education (Veloso, Pessôa, Henriques & Giambiagi, 2009; Todos Pela Educação [TPE], 2020).

Fundo de Manutenção e Desenvolvimento do Ensino Fundamental e de Valorização do Magistério (FUNDEF) and Fundo de Manutenção e Desenvolvimento da Educação Básica e de Valorização dos Profissionais da Educação (FUNDEB) are characterized as institutionalized efforts by the federal government to foster the development of the Basic education in the country. FUNDEF, created in 1996, gave priority to serving elementary school students, through the redistribution of resources from taxes applied by Cities and States. With its expiration in 2006, it was replaced by FUNDEB, which is a special fund for the financing of basic education (kindergarten, elementary and high school). It should be noted that in these two educational policies, which are among the largest and most significant since redemocratization, both in terms of structure and in terms of the resources they mobilize and the number of entities it affects (5,597 entities including cities and federative units), the basic education is the biggest target, and therefore decisive for the education of Brazilian population, as a state policy.

In numerical terms, the prioritization of basic education over the past few years is expressed in the amount of resources allocated to this stage of education in proportion to GDP, which went from 3.7% in 2000 to 4.9% in 2012 (growth from 32 %), proportion that remained until 2015 (TPE, 2020). In the case of the State of São Paulo, the total distribution of FUNDEB to schools in the state (R $ 16 billion) and municipal (R $ 16.4 billion) network reached over R$ 32.47 billion in 2016 (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira [INEP], 2018c). However, in order to obtain a quality education, the simple application of resources is not enough, it is necessary that these resources are used efficiently.

There are many factors correlated to the level of efficiency of public spending on education, one of which is the value of public spending (Moraes, 2018). Another aspect is the dimension of the object of the expenditure, that is, in which educational resource the money is applied. The functional classification of public expenditure in Brazil requires the indication of the Expense Element as one of the class levels (Ministry of Planning, Budget and Management [MPOG], 2018). The accounting record of budgetary execution with the indication of this public expenditure classification code opens the possibility of assessing whether the object of the expenditure influences the level of efficiency of the expenditure.

So, the objective of this research is to analyze how the element categories of expenditure on spending on basic education in the cities of São Paulo, except the state capital, impact on the efficiency of public spending in these cities. The exclusion of the capital is justified because this unit is not under the jurisdiction of Tribunal de Contas Estadual (TCE) of São Paulo, which is the responsible to supply the data used in this research, thus imposing operational limits for its inclusion. However, 99.84% of the cities in the state are part of this study, so the exclusion of the capital does not impose significant losses on the results, due to the prevalence of the aggregate effects on the individual to obtain the results.

In this study, efficiency is measured and assessed based on the ratio of average spending per student in the years 2014 to 2017 - a period that constitutes a medium-term spending cycle, and therefore enough to produce effects on educational policy - and the

performance of these students in Prova Brasil, in 2017. The study identifies the statistical correlation between the level of efficiency of spending on basic education in the municipal systems of São Paulo and the values of spending on the elementary education subfunction disaggregated into categories of the expenditure element in budget accounting of the same public entities. These categories are salaries, purchases, trips, interest and permanent materials. The study presents the data with the breakdown of spending and the quality of basic education by categories of cities in São Paulo - the Brazilian state with the largest population and GDP - by population ranges.

The analyzes of this study contribute to the discussion of educational public policies management in Brazil highlighting the category of expenditure elements on spending on basic education in São Paulo cities, as innovation in this type. Before it, studies that analyze public spending on education and its efficiency consider global spending or average spending per student, without identifying the fraction by expenditure and thus without providing significant subsidies to deeply understand the reasons and causal mechanisms of the relationship between public spending and its efficiency (Moraes, 2018).

In addition to this introduction, this study consists of four more sections. The second presents the literature review, highlighting the main studies in the thematic area in which this one is inserted. The third section presents the methodological choices with their respective justifications. The fourth presents the analysis and discussion of the results. The fifth is the conclusion, and finally there are the references.

2 Literature Review

2.1 Public spending efficiency

According to Sherman and Zhu (2006, p. 51), efficiency can be understood simply as "the reason for the exit to the entrance", so that "the more production per unit of input, relatively the greater efficiency". Measuring the efficiency of education spending is based on the relationship established between inputs and outputs. The inputs are the necessary resources to the educational service to be possible to be provided, which are more significantly the resources spent on education, while the outputs are the results that can be obtained from these expenditures.

Therefore, the efficiency of the State assessed through public spending does not occur with the greatest expenditure of financial resources, but with the best expenditure, that is, it is not a question of "how much" is spent, but of "how" it is spent. One public administration may spend more resources than another and still not obtain the best results, which indicates that this administration is less efficient than the other (Faria, Jannuzzi & Silva, 2008). Thus, the literature presents empirical studies that indicate that "higher public spending has not resulted in better quality in education, as IDEB spending and grades do not have a positive relationship" (Lourenço, Angotti, Nascimento & Sauerbronn, 2017, p. 97), since the quality of public spending is not directly linked to its amount, total or per student enrolled in the network, thus not necessarily being efficient.

Through the need to make better use of public resources and the responsibility of governments to improve public management, the Federal Constitution of 1988, in Article 37 (Federal Constitution, 1988), establishes efficiency as one of the principles of public administration. Therefore, the optimization of the State's capacity for action is not only a guideline for public administration, but also a legal obligation that must be fulfilled. With this, the measurement of the efficiency of public spending is an important object of study

capable of shedding light on public management about its practices, aiming at the achievement of the desired state of social well-being.

There are areas of activity in the public sector that are considered fundamental for the development of a country. Education is among them, since, in the long run, it tends to give returns to society through its multiplier effect, which implies consequences for several other sectors of social life. Then, the measurement of efficiency in education has a specific weight, as it is one of the dimensions by which education expenditure can be assessed. The calculation of efficiency in education can be done by several approaches, as long as student performance is considered as the output of the educational system. An effective and comprehensive way to measure the output of the educational system is by using the results of Índice de Desempenho da Educação Básica (IDEB) (INEP, 2018d) or Prova Brasil (INEP, 2018a). The inputs that have been most used in published studies are: spending on education, school structure, students' socioeconomic profile, family and school structure (Moraes, 2018).

The debate about the influence of public spending on the results of education has taken on an increasing proportion, because of the need for public management to improve its results and the limits of the State, which, dealing with a limited capacity of resources, should increase the their productivity and thus “do more with the same”, or even “do more with less” in periods of economic recession.

2.2 Previous Studies

The lack of correlation between public spending and student performance can be seen in the study by Flores (2016), which analyzes the efficiency of European public spending. In this study, the author concluded that countries like Norway and Sweden do not obtain the performance of students reflected by the expenses that these countries make in education, since they have many resources for this sector and the results are not equivalent to these investments. According to the author, there are still European countries that spend less on education than these two countries and obtain better levels of performance, and, therefore, are considered more efficient. However, it should be considered that the amount of spending is a factor that influences the conditions for efficiency to be achieved, so that administrative units that have more resources have more conditions to be efficient, since they may have part of their results linked to gains in scale, but on the other hand, there is also a need to consider that the relationship between spending and performance is not linear, since the effects of spending on performance tend to decrease as the two variables rise .

Therefore, the allocation of resources to achieve the highest possible level of efficiency is a major difficulty for public management, since administrations have limitations to achieve satisfactory levels of efficiency. Analyzing the efficiency of Rio Grande do Norte, Dantas, Costa and da Silva (2016) observed that less than 10% of the cities achieved a satisfactory level of efficiency. Lourenço et al (2017) also concluded that only 5.2% of Brazilian cities with more students enrolled in elementary school can be classified as efficient. Sherer, Araújo and Serafim (2016) demonstrated, in the study on Brazilian states, that 23 of the 27 federative units had low levels of efficiency in spending on education. This demonstrates the limitations of governments to make better use of their resources and offer society the best result of their contribution to maintain their social citizenship.

Wilbert and D'Abreu (2013) observed that the cities in Alagoas that have the best efficiency of public spending in the years 2007, 2009 and 2011 were those that had the worst preconditions in terms of educational level and wealth, while the least efficient were those with better conditions, thus reinforcing the argument previously expressed that cities with

high levels of expenditure and level of school performance have greater difficulties in increasing their level of efficiency. Then, Sousa, Santos, Alves and Carmo (2021) observe that from 2013 to 2017 only 21% of the cities in Amazonas were efficient, being also the group of cities with the worst preconditions to raise the level of school results, while less efficient cities had better conditions. Finally, Galvão (2021) notes that in Sergipe cities, in 2017, there is no relationship between a higher level of educational spending and higher school performance.

Despite the virtue and contributions of the studies presented so far, it is noteworthy that all of them use the total average expenditure to measure the efficiency of public educational expenditure, without expressing, however, what are the causal mechanisms or the elements of the expenditure that contribute to explain these levels of efficiency. From this gap, this study uses the expenditure on basic education in São Paulo cities, except the capital, through the expenditure element of basic education, so that there is a new opportunity to measure its impacts on efficiency and justify which aspects of these expenditures are responsible for improving the optimization of resources.
So, the expense element:

"... its purpose is to identify objects of expenditure, such as fixed wages and benefits, interest, daily allowances, consumables, third-party services provided in any form, social subsidies, studies and installations, equipment and permanent material, aid, amortization and others that the public administration uses to achieve its ends (Portaria Interministerial 163 de 04/05/2001, 2001, p. 3).

According to Manual de Contabilidade Aplicada ao Setor Público (MCASP), made available by Secretaria do Tesouro Nacional (STN), the classification of public expenditure in this category level may make use of numeric codes with up to 8 digits, which, the last two include "The optional split of the element" (STN, 2017, p. 75).

For the purposes of the present study, the mentioned expenditure element codes, according to the law, were grouped into five categories that represent, in summary, the following public spending on basic education:

A. Expenses related to own staff including expenses with Regime Geral de Previdência Social (RGPS);

B. Daily expenses and other expenses with trips and stays;

C. Financial expenses such as interest and debt repayments;

D. Spending on miscellaneous material and hiring outsourced personnel, whether individuals or corporate services;

E. Expenses with permanent materials and studies, as long as they are durable;

The methodological procedures of the study are described in the following section.

3 Methodological Procedures

In terms of monitoring and evaluation, Antico and Jannuzzi (2014) point out the relevance of verifying the results indicators from effort indicators and resources allocated to measure the efficiency of programs. In this context, the methodology based on the use of Data Envelopment Analysis, or DEA of the English acronym of *Data Envelopment Analysis*, gained prominence in academic research and has been used by a wide range of researchers to assess the efficiency in the use of public and private resources. (Moraes, 2018). Data

Envelopment Analysis is a non-parametric technique developed to determine the efficiency of productive units called DMU (*Decision Making Unit*).

According to Casado and Souza (2007) the basic assumption of the DEA is that, if a given DMU "1" is capable of producing Y (1) units of product, using X (1) units of inputs, then other DMU's could also do the even if they are operating efficiently. Similarly, if a DMU "2" is capable of producing Y (2) units of product, using X (2) of inputs, then other DMU's might be able to carry out the same production scheme. If DMU's "1" and "2" are efficient, they could be combined to form a composite DMU, that is, one which uses a combination of inputs to produce a combination of products. Since this composite DMU does not necessarily exist, it is called a virtual DMU. The DEA analysis consists of finding the best virtual DMU for each DMU in the sample. If the virtual DMU is better than the original DMU, or because it produces more with the same amount of inputs, or produces the same amount using less inputs, the original DMU will be inefficient (Casado & Souza, 2007). The results of the application of DEA allow to identify the units with good practices in the management of the resources, indicating references for those that need corrections (Antico & Jannuzzi, 2014).

To measure the efficiency of municipal spending on basic education, this study used IBGE municipal code to identify cities and as an association reference between variables, so this code is the model DMU. As *input* the average total expenditure per student was used, obtained by adding the total average expenditure per student for the years 2014 to 2017 for each city. These years (2014 to 2017) correspond to a teaching cycle and was chosen for analysis because it is the closest to the available data when they were obtained. It was excluded from this average and adds the amounts of interest payments and financial amortization of loans and financing, since its values are mostly zero. As output, the averages of Prova Brasil 2017 grades of each city were used, which consists of the Portuguese and Mathematics test averages carried out by the students in the initial and final years of elementary school, released by INEP (2018d). If the city has only one of the stages of elementary education, then the average of Prova Brasil corresponds only to this stage. This variable aims to measure the students' performance in the academic exercise with responses to a standardized test of items on the indicated contents. In this regard, the cities in which students answered more questions from Prova Brasil are more efficient, given the amount of budgetary expenditure committed in the fiscal years 2014 to 2017. The aggregation of four years in a spending cycle is justified by the medium term results that they have in relation to educational results.

Regarding the calculation of efficiency from DEA, it is worth mentioning there are two types of model for it, which are the variable return scale (VRS) and the constant return scale (constant return scale) - CRS). The first assumes a differentiation in the dimensioning of the relations between input and output, so that these relations are not necessarily proportional in their entirety, while the second does not presuppose a differentiation in the dimensioning of the possible returns. In this study the two models were used in order to make comparisons.

For the measurement of efficiency, a relevant step refers to the selection of variables (indicators or proxies) to be used to compose the model, including the inputs (input variables) and the outputs (output variables). The selected variables have a strong impact on the calculated efficiency indicator and, consequently, on the research result, with influence on the entire object of the study (Geys, Heinemann & Kalb, 2010).

The selection of variables, as well as the methodological model of the DEA, took place through a theoretical basis of all the available knowledge about the respective area (Moraes, 2018). This is justified because the efficiency results must reflect the inputs applied to the educational policy, as well as elements that reflect the socioeconomic context of the

students in the network. For the products, the selection obeys the same criterion as well as other studies and regulations that describe what is expected by the educational policy results (Mainardes, 2006).

The amount of budgetary expenditures made by São Paulo cities was obtained from Tribunal de Contas do Estado de São Paulo´s transparency website ([TCESP], 2018) and was updated by Índice de Preços ao Consumidor Amplo (IPCA) to mitigate the effect of the inflation in each of the years up to 2017 (IBGE, 2018).

The impact measurement or the association level of public spending on basic education through the categories of the expenditure element on the efficiency index of São Paulo cities took place through the technique of Multiple Linear Regression of Ordinary Least Squares, which consists of the estimate of parameters to measure the effect of one variable on others. So, from a given number of observations it is possible to obtain a certain behavior from these that will provide us with estimates of a behavior pattern, so that each observation will be associated with an estimate created from this pattern.

The variable choice to be used in the proposed regression model is not restricted to their relevance. There is a set of criteria and statistical properties of Ordinary Least Squares (OLS) that must be taken into account in order to obtain unbiased estimates of population parameters (Wooldridge, 2017).

The first hypothesis of the Multiple Linear Regression (HRLM 1) postulates that the model must be linear in the parameters, this condition is satisfied due to the possibilities offered by the statistical software used to carry out the analyzes, which is Stata 14. The second hypothesis (HRLM 2) is of random sampling, which in this study is satisfied by the use of all universe units with which we are studying, which are São Paulo cities. Thus, it was verified through the visual test of the histogram that the dependent variables have a normal distribution, typical of random samples.

The third hypothesis (HRLM 3) is of non-perfect collinearity, which demands that independent variables are not constant and that they do not have an exact development. The verification of this hypothesis was done by the multicollinearity test, which attested the absence of this condition for all models built. The fourth hypothesis is the zero conditional average (HRLM 4), which requires that there is no correlation between any independent variable and the error term. This hypothesis was fulfilled through the endogeneity test, which confirmed the absence of a correlation between the independent variables and the error term.

Under RLM 1 to RLM 4, the estimators are not biased towards population parameters (Wooldridge, 2017). To these four hypotheses is added a fifth one, so the estimators are the best linear and unbiased. The fifth hypothesis is of homoscedasticity (HRLM 5), which postulates that the error term has the same variance for any value of the independent variables, that is, the error is distributed evenly. To test this hypothesis, the Breusch-Pagan test (Wooldridge, 2017, p. 303) was performed, both for models built from the dependent variable that adopts the DEA's VRS model, and for CRS models. For the VRS models it was verified through the test that the models are homoscedastic, since the test indicates there is no statistical significance to reject the null hypothesis of the test, which postulates there is a constant variance. For the models that adopt the CRS orientation, the tests indicated heteroscedasticity, since there is statistical significance to reject the null hypothesis. To overcome the problem of heteroscedasticity of models built with the CRS variable, robust errors were adopted for these models.

For the construction of the regression models, the efficiency variable of the basic education expenditures of the cities was used as a response one, which varies from zero to 100, where 100 indicates the maximum efficiency level of the cities. As explanatory

variables, the average of average expenditures sum per student for each of the expenditure element categories from the years 2014 to 2017 was used, so that each of the models has four explanatory variables corresponding to each expenditure category. In addition to it, were built models which use the expense log as an explanatory variable, which is justified because there is a possibility that the relationship between expenditure and efficiency is not linear.

The measurement of the explanatory capacity of the Linear Regression models is done through R2 (*r-square*), which is the proportion of the response variable variability explained by the explanatory variables. Thus, the more relevant variables are added to the regression model, there is a greater tendency to increase R2 due to the increase in the explanatory capacity of the model (Wooldridge, 2017).

4 Results and Analysis

4.1 Descriptive analysis of spending on basic education in São Paulo cities and grades from Prova Brasil by population ranges

This section explores descriptively the behavior and the dimension of the spending variables, the scores of Prova Brasil and the efficiency index of São Paulo cities. Regarding the variety of cities, which to a large extent are linked to their sizes, we opted to segregate them from the population ranges of IBGE, so we can abstract more explanatory descriptions about the analysis. The population ranges, the number of cities, inhabitants and the number of students enrolled in 2017 corresponding to these ranges are shown in Table 1 below.

Table 1
Population, cities and students enrolled in the municipal elementary school system

Population range	Cities	Inhabitants	% Partial	% Accumulated	Students	% Partial	% Accumulated
1	145	483.040	1,46	1,46	31.223	1,72	1,72
2	123	884.547	2,68	4,14	61.711	3,39	5,11
3	120	1.739.985	5,27	9,41	126.472	6,95	12,06
4	120	3.843.160	11,65	21,06	237.337	13,05	25,11
5	59	4.127.393	12,51	33,57	257.249	14,15	39,26
6	37	5.069.127	15,37	48,94	311.195	17,11	56,37
7	40	16.805.555	50,94	100	745.817	41,01	100
Total	644	32.987.946	100		1.818.535	100	

Source: Adapted from IBGE.
Note: population range: 1- up to 5,000 inhabitants; 2 - from 5001 and 10,000; 3 - from 10,001 and 20,000; 4 - from 20,001 and 50,000; 5 - from 50,001 and 100,000; 6 - from 100,001 and 200,000; 7 - above 200,000 inhabitants.

From Table 1 it is possible to extract that the range with the largest number of cities is the one with 145 cities from 644 in the state, which corresponds to 22.5% of these; while the range with the lowest number of cities is 6 with 37 cities, corresponding to 5.7% of the total. From another perspective, line 7, which has 40 cities, has a number of inhabitants

corresponding to almost 51% of the total inhabitants from 644 cities, therefore the 40 cities with more than 200 thousand inhabitants have a larger population than the 604 cities with less than 200 thousand inhabitants. In a proportion of ten percentage points less than the population, group 7 had 41% of students enrolled in 2017 (enrollment reference period), while the sum of the other groups corresponds to 59% of students enrolled and the lowest proportion is 1, with only 1.72% of the enrollments.

Table 2 shows the total expenditure on basic education per year and the population range in São Paulo cities from 2008 to 2017.

Table 2

Total spending per year and population range

Fx. Pop.\year	8	9	10	11	12	13	14	15	16	17	Total
1	343	348	383	411	451	445	461	420	424	414	4.100
2	536	561	606	639	642	663	688	637	618	608	6.198
3	969	1.030	1.140	1.230	1.310	1.290	1.240	1.200	1.170	1.150	11.729
4	1.900	1.910	2.080	2.290	2.420	2.410	2.520	2.380	2.380	2.310	22.600
5	2.080	2.110	2.260	2.410	2.610	2.580	2.680	2.560	2.660	2.480	24.430
6	2.410	2.540	2.670	3.000	3.190	3.270	3.240	3.190	3.050	2.800	29.360
7	5.920	6.470	6.800	7.310	7.340	7.440	7.370	6.870	6.960	6.580	69.060
Total	14.158	14.969	15.939	17.290	17.963	18.098	18.199	17.257	17.262	16.342	167.477

Note: Population range: Similar of Table 1. Values in millions of reais.
Source: *adapted from TCESP (2018).*

From the proportion ratios established in tables 1 and 2, it is possible to conclude that while in line 7, with the largest population per city, has 23.88 times more students enrolled than line 1, which has the lowest population per city, the expenditure total of line 7 is on average 16.1 times higher than the expenses of line 1 from 2014 and 2017, so the average spending on students is higher in line 1 than in 7.

Figure 1 shows the behavior of the average expenditure per student from each of the categories of expenditure element in the cities of line 1, those with up to 5,000 inhabitants.

Figure 1 Average expenditure per student per category of expenditure element in cities with up to 5,000 inhabitants / range 1
Source: *adapted from TCESP (2018).*

It can be seen in Figure 1 that most of the expenses are with the Salary category. This is due to the fact that labor is the main input needed for the development of education, in addition to being a fixed current expense. Figure 1 also shows that this category showed growth from 2008 to 2014 and some stability until 2017, reflecting the fiscal crisis that inhibited potential remuneration improvements to municipal civil servants. The Trip and Interest categories have very low amounts, close to zero.

The category of the expenditure element purchases represents the expenses spent on municipal purchases linked to basic education, such as materials for school use, uniforms, food and similar things. The average expenditure on this category for the years 2008 to 2017 was R$ 5,600 per student. Purchasing expenditures have declined since 2014, evidence that the adjustments to fiscal expenditures due to the decrease in the available budget allowance were due to the reduction of expenditures with this category.

Finally, for these cities, expenditures on permanent materials are only higher than expenditures on trips and interests, presenting an average of 1,100 reais per student from the years 2015 and 2017. These expenditures correspond to expenditures on equipping the network, such as construction and instruments with a useful life of over one year.

Figure 2 shows the behavior of public spending by category of the expenditure element in cities with more than 200 thousand inhabitants.

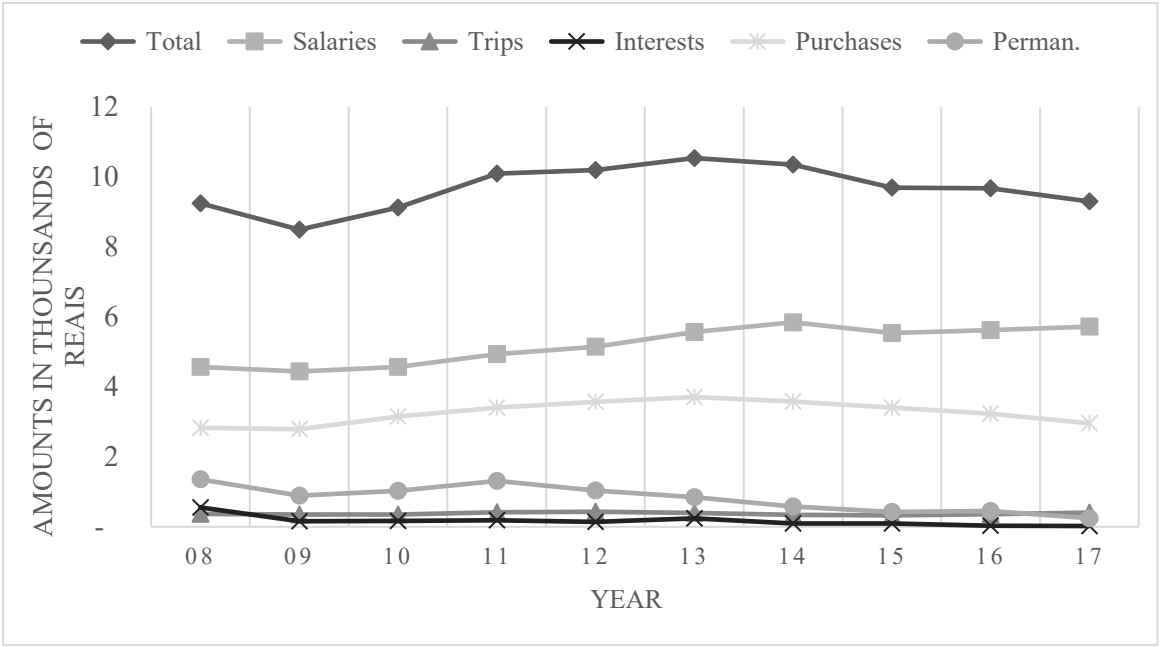

Figure 2 Average expenditure per student by category of expenditure element of cities with more than 200 thousand inhabitants / Range 7
Source: *Adapted from the TCESP transparency portal (2018).*

Despite the distinction in the amounts spent in relation to cities with up to 5,000 inhabitants, and differences in the growth and fall in the amounts spent according to the years, it is possible to observe the same sequence of categories for higher amounts spent in relation to Figure 1. The distribution of total spending between the categories serves an increasing sequence among them, so that all the groups spend mostly on the category of wages, followed by purchases, permanent expenses, travel and interest. This relationship demonstrates an expenditure profile among the different groups of cities, however the difference among them is in the absolute amount spent with each category, which will impact on the efficiency levels found. For this reason, the graphs and tables of the other ranges of cities will be removed from the study, given the similarity with those shown here.

Figure 3 below shows the behavior of Prova Brasil average, by population range

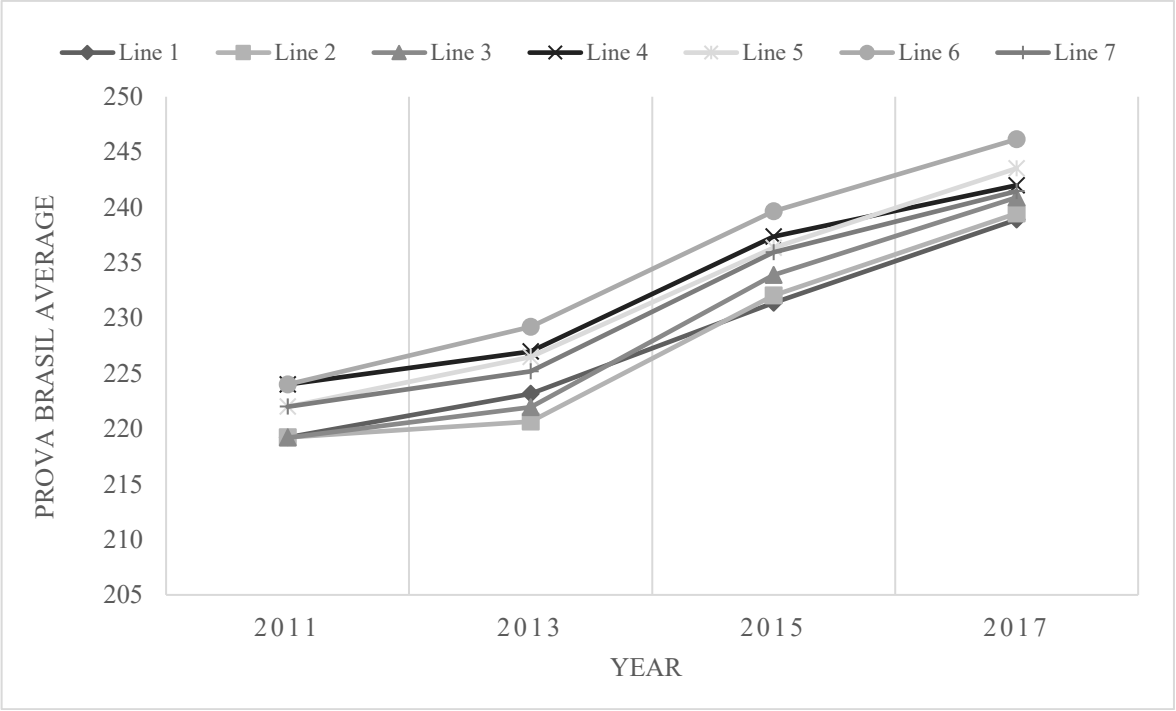

Figure 3 Prova Brasil averages by population ranges
Source: *Adapted from INEP.*

It is observed that the averages of Prova Brasil for all ranges of cities are increasing in all years. The population range that has the highest averages in all years is 6, where the average ranges from 224.01 in 2011 to 246.16 in 2017, and is also the one with the highest growth and amplitude of 22.15 points among the first and the last year of the grades. The range that shows the lowest growth in the average of the grades is 1, 19.65 and ranging from 219.25 to 238.9 from 2011 to 2017, respectively.

Finally, Table 3 presents the results by population range of the efficiency indexes obtained from DEA. It is observed that in general terms the proportions of the results obtained from the CRS model are significantly lower than those of the VRS model, but this is justified by the different calculation mechanisms that are behind each of the models. Analyzing CRS model, its average is 36.29 for the total number of cities, ranging from 5.96 to 100, with the group of cities with the highest average being 3, followed by 7 and 4. In VRS model, it is observed that the total average is 83.74, ranging from 62.21 to 100, with the range with the highest average 6, followed by 4 and 7.

Although there is not a completely proportional relationship between the population groups and the level of efficiency of the respective groups of cities, it is observed that for both models the cities in lines 1 and 2, those with up to 20 thousand inhabitants, are the ones who have the lowest averages and the lowest minimum values in relation to the other groups. This may indicate the existence of a population threshold under which the conditions for obtaining efficiency are limited, so that above this threshold, the population characteristics start having less weight on the efficiency levels.

Figures 4 and 5 below show CRS and VRS efficiency indexes of the georeferenced São Paulo cities.

Table 3
Efficiency index of São Paulo cities by population range

		1	2	3	4	5	6	7	Total
CRS	average	28,18	36,56	39,84	39,10	37,13	38,99	39,56	36,29
	minimum	11,81	14,29	14,41	15,60	5,96	19,81	17,55	5,96
	maximum	54,18	62,36	70,57	65,20	54,54	87,52	100	100
	standard deviation	8,01	9,95	9,78	11,04	9,29	12,11	13,67	10,99
	N	130	114	117	117	58	37	40	613
VRS	average	82,47	83,07	83,80	84,52	84,36	85,88	84,41	83,74
	minimum	65,21	65,79	73,01	70,22	94,69	74,51	73,20	65,21
	maximum	96,06	99,47	100	100	76,14	98,71	100	100
	standard deviation	5,00	5,72	5,27	5,09	4,21	6,02	4,87	5,26
	N	130	114	117	117	58	37	40	613

Note: Population range: similar of Table 1. Amounts range from 0 to 100.
Source: *research data.*

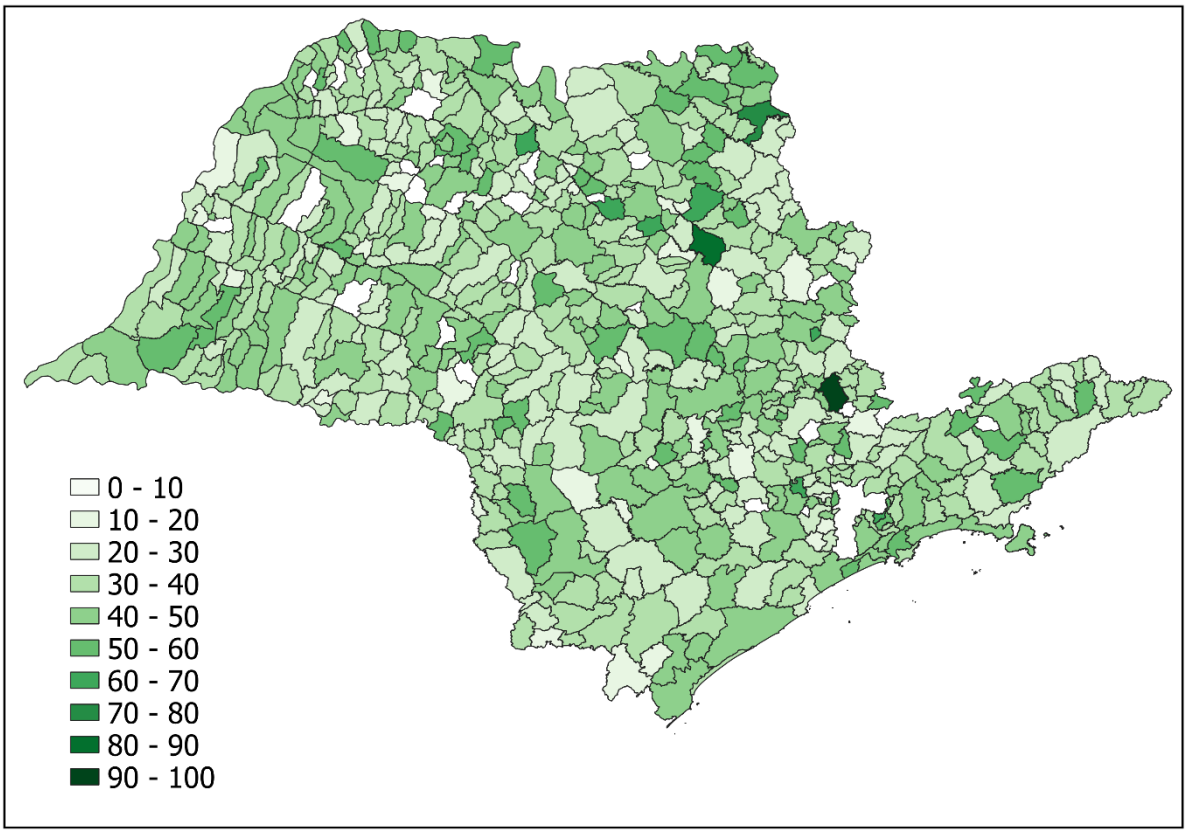

Figure 4 Map of São Paulo cities according to CRS efficiency index from 2014 to 2017
Source: *research data.*

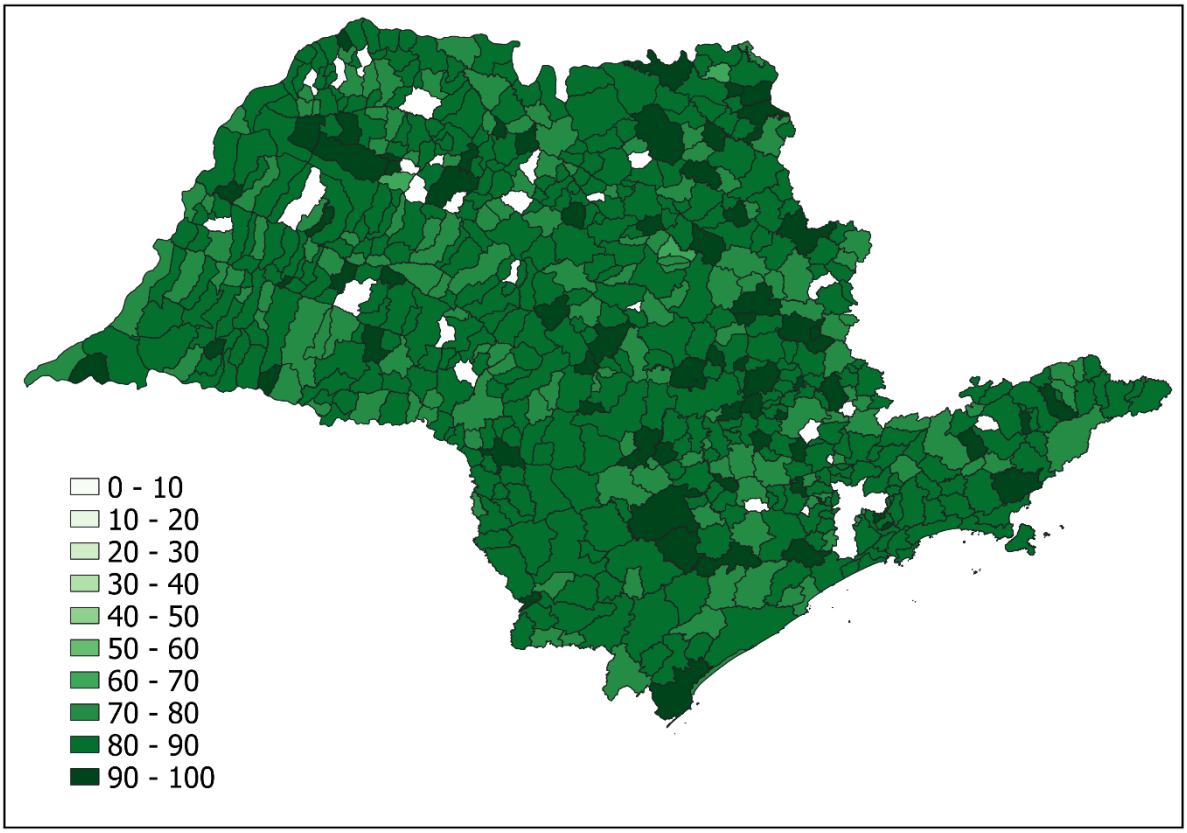

Figure 5 Map of São Paulo cities according to the VRS efficiency index in the cycle from 2014 to 2017
Source: *research data.*

4.2 Explanatory analysis of the correlation between the categories of the expenditure element and the efficiency of public educational spending

The technique of Multiple Linear Regression through Ordinary Least Squares measures the impacts of the spending of each of the categories of the element of expenditure on the efficiency of São Paulo cities. So, it is possible to capture the effect of each type of expenditure on the efficiency of municipal spending on basic education, thus making it possible to determine which categories of expenditure most contribute to the increase or decrease in efficiency in the cities.

The estimated coefficients for each of the explanatory variables are the impacts caused by the increase of one unit of expenditure in the respective category in the cycle considered. In cases where the logarithm of explanatory variables was used, which is justified by the fact that the relationship between spending (explanatory variables) and the efficiency of spending (response variable) is exponential, since the higher the level of spending, the lower it will be its impact on the efficiency ratio proportionally, then the estimated coefficients of the explanatory variables represent the impact of the percentage variation of the explanatory variable on the response variable (Wooldridge, 2017), keeping everything more constant (ceteris paribus), so, the measured impact takes place on the increment or extraction of the expenses already realized that are considered in this study. The constant, on the other hand, indicates the estimated value of the response variable if the other explanatory variables are null.

The result of the estimated coefficients, number of model observations (N) and the r-square (R2), for each of the multiple linear regression models are outlined in Table 3 below.

Table 4
Multiple Linear Regression Model Results

	CRS		*VRS*	
	without log in the independent variables	with log in the independent variables	without log in the independent variables	without log in the independent variables
Salary	-0,0021865*** (0,0004416)	-19,20406*** (1,758867)	-0,0000827 (0,000092)	-0,9591912 (0,6055857)
Trips and Stays	-0,0029487*** (0,0004639)	-0,1509612* (0,0847895)	-0,0000522 (0,0005248)	0,0698551 (0,0797001)
Purchases	-0,0025426*** (0,0002906)	-9,05007*** (1,651567)	-0,0006299*** (0,0001324)	-2,241717*** (0,3817428)
Permanents	-0,0025411*** (0,0003605)	-1,290022*** (0,2476121)	-0,0002309 (0,0003128)	-0,1166227 (0,1909559)
Population in 2017	$5{,}08.10^{-06}$* ($2{,}63.10^{-06}$)	0,2845446** (0,1414904)	$2{,}78.10^{-06}$ ($1{,}98.10^{-06}$)	0,3400405** (0,1496307)
Constant	61,64321*** (3,482525)	280,207*** (16,38409)	86,84978*** (2,55566)	107,763*** (6,099486)
R^2	70,73%	83,99%	5,46%	8,20%
N	613	613	613	613

Note: *in none of the models was the variable "average of the Brazil 2013 Test" used with log. Statistical significance level: *** <1%; ** <5%; * <10 *.*
Source: *research data.*

The estimated coefficients of the regression models in table 4 indicate the direction and the dimension of the correlation between the independent variables and the level of efficiency of public expenditure, both for the efficiency measured by CRS and VRS methods, and adopting or not the log in the independent variables. It is also observed that there is variation in the level of statistical significance for the different variables and models, however, as we are working with the sample universe of observations, this can be neglected based on the consideration that these results apply only to São Paulo cities, only the models with high statistical significance are those that have the greatest generalization capacity.

All coefficients indicate there is a negative relationship between educational spending and its efficiency, with only the expenses for stays and trips in VRS model with log showing a positive correlation. A bias in the literature assists in this interpretation, stating that there is no empirical evidence strong enough to support the notion that increased spending has a significant positive influence on educational outcomes (Worthingtonw, 2001). For example, Hanushek (2003, p. 91, our translation) states that "resources are not closely related to student performance". Moraes (2018), on the other hand, demonstrates that the variable referring to the teaching salary alone is not necessarily correlated to the best school efficiency and effectiveness indicators. However, the same associated with the variables of adequacy and teaching effort are reflected in the results of efficiency and effectiveness of the networks. Therefore, the association between the profile of the municipal network at the level of efficiency is relevant, so it is possible to demystify whether it is feasible that the cities can be efficient, according to the available resources, and effective, delivering to society an educational policy that guarantees equity to the citizens. students.

Possible correlations of these values with the other performance indicators are found in Sobreira and Campos's studies (2008), whose results point to the importance of the financial contribution and the qualification of the teaching profession, together, for the improvement of public education quality.

Regarding the category of permanent expenses, the results do not corroborate with the data demonstrated by Moraes (2018), where the author notes the clusters that presented the best results in the infrastructure indicator also obtained better performance in the efficiency score, as well as in the results of Prova Brasil. The author also shows that efficiency in education must not be separated from effectiveness. Due to the social sensitivity of each educational system, we must always consider not only the simple link between what is invested in the system and the educational results, but also pay attention to the balance between the dimensions of efficiency and effectiveness in the creation of educational policies (OECD , 2016).

The absence of a positive correlation between public spending and efficiency can also be observed in Ázara, Pessanha and Neto (2017), who, when investigating the efficiency of public educational spending in the cities of the Varginha region, in Minas Gerais, find that there is a negative correlation between spending and its efficiency. Also, Matias, Qualio, Oliveira, Lima and Bertolin (2018), when analyzing the efficiency of public educational spending in 47 cities in São Paulo in 2009, 2007 and 2011, note that although there was an increase in spending in the period, there was no increase in the results in their correspondence, so this relationship is due to the inefficiency of these educational expenditures.

On the other hand, Kakihara, Silva and Poker Junior (2020) focus on São Paulo cities of eight regional teaching boards from 2009 to 2013, to identify which are the educational variables that correlate with the level of efficiency of public spending educational. Thus, the authors conclude that these variables are the amount of rural population, number of students per class, professors with higher education and their regularity in the educational process. Therefore, it is evident that there are other factors besides expenditure that explain the levels of efficiency of public expenditure, and some of these factors may be associated with the level of expenditure, such as the number of students per class, but others not necessarily, such as the rural population amount or the professors' regularity in the educational process.

It is also abstracted from the results expressed in table 3 that in all regression models constructed there is a positive correlation between the variable "Population in 2017" and the level of efficiency, which indicates that the larger the population of the city, the greater the tendency of high levels of efficiency. A plausible explanation for this phenomenon is that the larger cities have better conditions for the use of resources, in terms of state capacities this can be expressed because they tend to have a larger bureaucratic body, in addition to economies of scale.

The results presented in this section, in addition to indicating the sense of the correlation between public spending and its efficiency, also demonstrate that this analysis carried out from the categories of expense elements, of the expenses classified in wages, trips, purchases and permanent, enable a more precise interpretation of the dynamics that involve spending and its efficiency, thus providing better subsidies for decision-making about the allocation of educational resources. In the constructed models, it is observed that all the coefficients are negative, so that any increase in expenditure would result in worse levels of efficiency, however the magnitude of the coefficients demonstrates there are different impacts on efficiency depending on the type of expenditure made. It also highlights the importance of paying attention to the fact that the correlation observed in this study is between public

spending and efficiency, and not between public spending and school performance, so that the second relation cannot necessarily be inferred from the first.

5 Final Considerations

Efficiency, a constitutional principle of public administration, understood as the utilization relationship between inputs and products, must have its studies deepened in all sectors of the State's performance, primarily in the sectors that most require public resources and with the greatest development impacts, such as the education. These studies are becoming more and more necessary due to the growing limitations of resources and the growing need to provide public services. In this relationship the efficiency analysis aims to save the highest level of resources and offer the largest possible number of services, and its understanding aims to give public management the means to achieve better levels of efficiency.

This study, in a pioneering way, develops a means of understanding the efficiency of public spending on basic education in São Paulo cities, through the specific analysis of public spending on education through categories of expenditure element, so that the found results are equally specific and targeted. From the categories of the expenditure element, it is possible to verify which are the expenses that most impact on the efficiency of public spending and how they impact, whether negatively or positively, in addition to establishing how this relationship happens to the different sizes of cities in the country of São Paulo state. From the breakdown of total budgetary expenditure into spending on salaries, purchases, trip, interest and permanent expenses, it is possible to abstract from public administrations which types of expenditure should be prioritized over others, thus an expense that impacts negatively in efficiency, it should be restricted to the detriment of an expense that positively impacts in efficiency, observing considerations and limitations in the allocation of resources.

The results of this study demonstrate that there is a negative correlation between all categories of spending, of all models, and the efficiency of public educational spending in São Paulo cities in the cycle from 2014 to 2017, expressing that any increase in spending levels would imply an increase in their inefficiency. However, it is noteworthy that this would not necessarily imply a drop in school performance, as this relationship is not being tested in this study, with the possibility, for example, of an inefficient expenditure resulting in an improvement in performance measured by indicators such as grades of Prova Brasil grades or IDEB. Therefore, the evaluation of educational policy from the perspective of efficiency should not be an end in itself, that is, it must be associated with other dimensions of the evaluation of educational policy to provide subsidies for its improvement, without disregarding, for example, the dimensions of effectiveness. So, it is argued that the decrease in public spending cannot be justified in the name of efficiency, without disregarding the impact of this expenditure on society; instead, better levels of efficiency should be sought so that the results are expanded.

There are several factors that impact the efficiency of public spending and that influence the quality of spending that are not necessarily expressed in the amount of public spending. These factors are also related to students' performance, which in turn are related to efficiency, so that greater propensities for better school performance result in the need for lower levels of spending, which directly impacts efficiency levels; or substantial increase in teaching results, as measured in the present study by Prova Brasil score for students in the municipal elementary school.

In order to have a better understanding of the impact of public spending on efficiency, it is necessary to explain in the regression model adopted the largest possible number of

variables that impact on the efficiency of public spending on education, so that all these variables can be controlled so that have the measurement of estimated coefficients that best represent the impact of public expenditure by category of the expenditure element on the studied response variable. Consequently, a higher percentage of explanation of the variability of the response variable can be obtained through the explanatory variables (R2). These variables that contribute to the ability to explain the efficiency of public spending on municipal basic education are, as indicated by the literature in the area (Moraes, 2018), for example: student's socioeconomic profile, family income, number of family unit members, profile of residence place, student's race, level of parents' education, training of professors responsible for students, adequacy between teacher's training and taught discipline and other variables that explain the efficiency of public spending on basic education.

A limitation of this study was precisely to have considered only public spending, through the categories of the expense element, as explanatory variables in the Multiple Linear Regression model, which restricted the explanatory capacity of the adopted model and was unable to control all other variables that have this explanatory character about the response variable.

As a proposal for future studies is to insert these explanatory variables in the adopted regression models, in which the analysis unit is the student himself, or the classes and school units where he develops his learning process and, therefore, the variables correspond directly to the student, and the expenditure by category of the expense element is the average expenditure per student, also specific and directed to it. It is necessary to create conditions that analyze the performance of the public sector to approach the *locus* of the public service, the classroom, in this case.

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