DATA ENVELOPMENT ANALYSIS FOR ESTIMATING THE EFFICIENCY OF GOVERNMENT PERFORMANCE IN ASSURING THE INCLUSIVE QUALITY EDUCATION

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ABSTRAK

Kualitas pendidikan merupakan hal fundamental di suatu negara karena ini terkait erat dengan daya saing sumber daya manusianya. Penelitian ini bertujuan untuk mengukur efisiensi pemerintah Indonesia dalam memanajemen pendidikan di tingkat sekolah menengah. Fokus penelitian ini adalah kualitas pendidikan yang inklusif dan merata. Metode nonparametrik DEA digunakan untuk mendapatkan skor efisiensi pada tiap-tiap provinsi di Indonesia. Metode ini dikenal metode yang powerful dalam pengukuran efisiensi yang melibatkan multi-input dan multi-output. Penelitian ini menggunakan delapan input dan tujuh output untuk membandingkan 34 *decision-making units* (DMUs), yang merupakan seluruh provinsi yang ada di Indonesia. Hasil analisis menggunakan software R menunjukkan bahwa sebagian besar provinsi di Indonesia memiliki kinerja yang efisien. Selanjutnya, 26 provinsi (76,47 persen) telah berhasil mengelola mutu pendidikan inklusif. Sedangkan, provinsi yang belum mencapai level efisien sebanyak 8 provinsi (23.53%). Setiap DMU yang dinyatakan tidak efisien maka menghasilkan slacks yang digunakan untuk memperbaiki atau meningkatkan tingkat efisiensinya. Oleh karena itu, menemukan strategi yang efektif dan efisien untuk meningkatkan kinerja pemerintah dalam mengelola kualitas pendidikan inklusif di tingkat sekolah menengah menjadi sangat penting.

Kata kunci: DEA, efisiensi, inklusif, kualitas pendidikan, pengukuran

ABSTRACT

Education quality is critical in a country since it is firmly related to the competitiveness of its human resources. The purpose of this study is to assess the Indonesian government's efficiency in managing secondary school education. The focal point of this exploration is inclusive and impartial education. The DEA nonparametric technique is utilized to obtain the proficiency score for every territory in Indonesia. This is known as a powerful strategy for estimating efficiency involving multi-input and multi-output. This study uses eight inputs and five outputs to compare 34 decision-making units (DMUs), which are all provinces in Indonesia. The results of the analysis using the R software indicate that most regions have not met the efficient performance in managing existing resources in order to provide inclusive and equitable quality education. The results of the analysis

using R software indicate that the majority of Indonesia's provinces have efficient performance. Furthermore, 26 provinces (76.47 percent) have successfully managed the quality of inclusive education. Meanwhile, eight provinces have not reached the efficient level (23.53 percent). Every DMU that has been declared inefficient generates slacks, which are then used to improve or increase the level of efficiency. As a result, finding an effective and efficient strategy to improve the government's performance in managing the quality of inclusive education at the high school level is critical.
***Keywords**: DEA, efficiency, inclusiveness, educational quality, measurement*

INTRODUCTION

Education is essential in human life and contributes to a country's prosperity. Education allows a person to learn knowledge that will be beneficial as a provision in the future. As a result, moral principles must be instilled in children from an early age. The advancement of a country can be determined by examining and measuring the quality of the existing education system. Education quality is critical in a country since it is directly tied to the competitiveness of its people resources (Mahmudah, Suhartono, & Rohayana, 2018). As a result, it should be mentioned that education plays a significant role in developing a young generation of high quality and competitiveness to face the quick and increasingly sophisticated advancement of the era.

The quality of Indonesian education at the international level may be clearly judged based on the findings of many foreign studies. According to the 2018 PISA results, Indonesia is rated 73rd out of 79 nations in the maths category (OECD, 2019). Meanwhile, Indonesia ranks 46th out of 51 countries in the 2015 TIMSS results (Zairisma, Apriliani, & Yunus, 2020). This suggests that education in Indonesia is still of poor quality, particularly in the areas of reading, mathematics, and science. Furthermore, according to Education for All (EFA), Indonesia's education development index (EDI) in 2015 was 0.970 (Ahmad, 2018). According to UNESCO criteria, a country's EDI is classified as high if it has an EDI of 0.95, medium if it has an EDI of 0.80, and low if it has an EDI of 0.8. According to the

National Education Standards Agency (*Badan Standar Nasional Pendidikan-BSNP*), Indonesia's elementary and secondary education quality has not been as expected. This demonstrates there are gaps in the provision of education, and it remains a significant challenge for the state to maintain its lead in providing quality education.

The Indonesian state has its own idealistic standard. However, some areas in Indonesia have not yet reached the optimal level of education. In addition to achieving an ideal education, inclusive education is also required. Inclusive education is education that respects diversity (Alimin, 2013). Student management, curriculum management, teaching staff management, infrastructure management, financial management, environmental management, and special services management are all aspects of inclusive education management (Tulusmono, 2012).

Given the issues raised above, it is necessary to assess the effectiveness of high school performance in provinces across Indonesia. This is done to determine which provincial areas have high schools that perform well with the available resources. The most efficient high school can serve as a model for other schools that have not yet reached that level of efficiency in terms of improving their efficiency. Therefore, it is hoped that it can contribute to education in Indonesia in order to improve the quality of highly competitive human resources.

Despite the fact that there have been previous studies on the measurement of high school efficiency (Baba, Karim, Majid, & Sulaiman, 2020; Mustakim, Chamdani, & Mahmudah, 2019; Sri, 2018), however, there have not been many studies in Indonesia that focus on the quality of inclusive education at the high school level. This study focuses on high school education to investigate the effectiveness of the Indonesian government in managing high school education. The high school level was chosen because of the critical importance of high school education in determining students' future, namely whether to continue their studies or enter the workplace.

The DEA method was originally designed to measure

performance. Until recently, the DEA application was widely used as a measurement in a variety of scientific disciplines and operational activities (Mahmudah et al., 2018; Mukaromah, 2020; Mustakim et al., 2019; Zhang, 2010).

METHODS

This study uses secondary data on Statistics of Senior High Schools (SMA) in Indonesia published by the Ministry of Education and Culture of the Republic of Indonesia in 2020. Every year, the Ministry of Education and Culture of the Republic of Indonesia publishes data on education statistics in Indonesia, ranging from elementary to higher education. This study employs eight input variables and seven output variables to calculate the efficiency score of each DMU. Each province in Indonesia is represented by DMU. The input variables include the number of schools in each province (X1), the number of new students in all schools in each province (X2), the number of active students in all high schools in each province (X3), the number of classrooms (X4), the number of educators, both principals and teachers (X5), the number of laboratories (X6), the number of libraries (X7), and the number of school health units (X8). Meanwhile, the output variables used are the number of high school graduates in each province (Y1), the dropout rate (Y2), the repeat rate (Y3), the percentage of good classrooms to the number of classrooms (Y4), the percentage of laboratories to the number of schools (Y5), the percentage of libraries to the number of schools (Y6), the percentage of UKS to the number of schools (Y7). The determination of these variables follows Fatimah & Mahmudah (2017).

This study employs the Data Envelopment Analysis (DEA) method to calculate a score for the efficiency. It is a method for measuring efficiency that is usually associated with the performance of a unit/organization/program and reflects the output/input ratio (Mahmudah & Lola, 2018). In the DEA concept, units/organizations/programs are often referred to as Decision Making

Units (DMUs). DEA is the most widely used analytical method for measuring efficiency, particularly when multiple inputs and outputs are used (Fatimah & Mahmudah, 2017; Mahmudah & Lola, 2018; Mahmudah et al., 2018).

The CCR model (Charnes, Cooper, and Rhodes) is used in this study, which defines DEA efficiency as a weighted output ratio for weighted inputs with the condition that the similar ratio for each DMU is less than or equal to one. Suppose that the input variable i for entity j used is defined by X_{ij} where $i = 1,2,\dots,m$ and$j = 1,2,\dots,n$. Next, suppose the output variable r for entity j is defined by Y_{rj} where $r = 1,2,\dots,s$ and $j = 1,2,\dots,n$. Then, suppose that the input variable and the output variable are more than zero, namely $X_{ij} > 0$ and $Y_{rj} > 0$. Assume X_k and Y_k are on line k, and this matrix represents the quantified input/output of the DMUk unit. The CCR model's mathematical formula in DEA can then be written as follows (Charnes, Cooper, & Rhodes, 1978).

$$\max h_X = \frac{\sum_{r=1}^{s} u_r Y_{rk}}{\sum_{i=1}^{m} v_i X_{ik}} \quad (1)$$

Subject to

$$\frac{\sum_{r=1}^{s} u_r Y_{jr}}{\sum_{i=1}^{m} v_i X_{ij}} \leq 1$$

Where for each j, $j = 1,2,\dots,n$. Then, $u_r, v_i \geq \epsilon$ where $r = 1,2,\dots,s$ and $i = 1,2,\dots,m$. ϵ represents a small positive value. Equation (1) can be written in linear programming form as follows:

$$\max h_X = \sum_{r=1}^{s} u_r Y_{rk} \quad (2)$$

Subject to

$$\sum_{i=1}^{m} v_i X_{ik} = 1$$

$$\sum_{r=1}^{s} u_r Y_{rk} - \sum_{i=1}^{m} v_i X_{ik} \leq 0$$

Where

h_X: efficiency of DMU_k

u_r: weighted r output

Y_{jr}: quantity of output r produced by unit j

v_i: weighted i input

X_{ij}: the quantity of input i produced by units j

M: number of inputs

S: number of outputs

N: number of entities

In equation (2), the DEA CCR model is a linear programming problem that can be solved using a traditional/regular system of equations. The calculation of this DEA method is aided by R software.

RESULTS AND DISCUSSION

Table 1 summarizes the input and output variables used in this study.

Table 1. Description of input and output variables

Variable	Minimum	Maximum	Mean	Std. Deviation
X1	5,902	236,215	50,059	52,113
X2	3,092	544,274	127,182	118,812
X3	71	23,999	4,288	4,915
X4	168	8,354	1,691	1,868
X5	126	5,048	1,159	1,242
X6	53	1,611	398	373
X7	29	1,033	232	257
X8	5,132	223,434	45,037	49,832
Y1	31	2,595	707	693
Y2	14	1,563	460	381
Y3	14	1,563	460	381
Y4	13	51	26	9
Y5	32	74	47	11
Y6	80	114	96	6
Y7	14	102	54	19

This study is input-oriented, which means that when there is a DMU that is not working efficiently and wants to improve, the proportion of input variables must be reduced while the proportion of output variables remains constant (Fatimah & Mahmudah, 2017). Using the R software, Figure 1 depicts the efficiency scores for each DMU, namely the provinces in Indonesia.

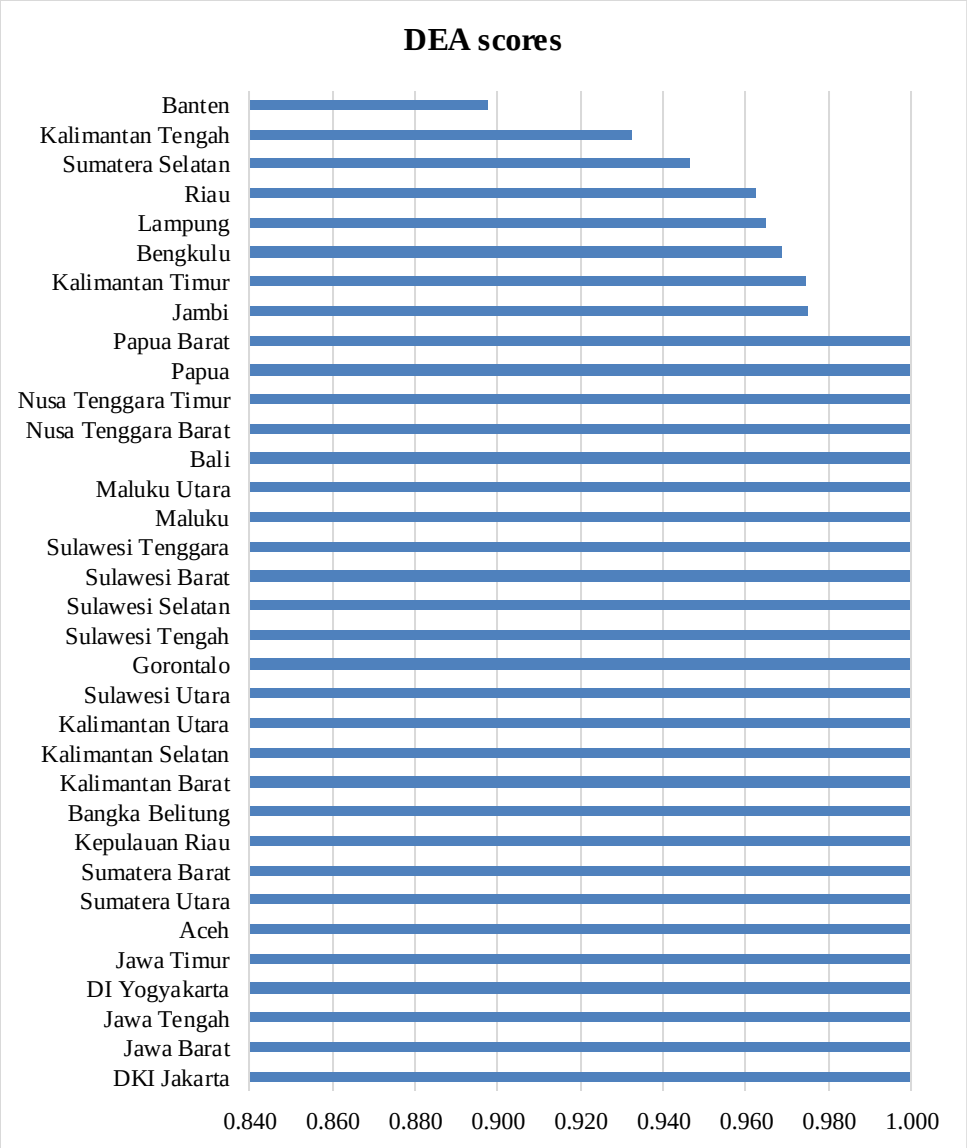

Figure 1. DEA Efficiency Score

According to Figure 1, the efficiency score based on the DEA approach is one, indicating that the DMU is working efficiently. A DEA efficiency score of less than one, on the other hand, indicates an inefficient DMU. The analysis results show that the average efficiency score is 0.989, with the lowest efficiency score being 0.898.

Banten Province is known as the province with the lowest efficiency score, indicating the lowest performance in quality management of high school education. According to Figure 1, the majority of provinces in Indonesia have efficient performance, as measured by an efficiency score of 1.000. There are 26 provinces, or 76.47 percent, that have effectively managed inclusive education quality. Meanwhile, eight provinces, or 23.53 percent, have not reached the efficient level. the provinces that were found to have inefficient performance were Jambi (DEA score=0.975), East Kalimantan (DEA score=0.975), Bengkulu (DEA score=0.969), Lampung (DEA score=0.965), Riau (DEA score= 0.962), South Sumatra (DEA score=0.946), Central Kalimantan (DEA score=0.932), and Banten (DEA score=0.898).

However, as shown in Figure 1, despite the fact that several DMUs do not perform efficiently, their efficiency scores are high, with the lowest score being 0.898. The explanation of the meaning of each DMU's efficiency score can be reported following Thanassoulis, Dyson, & Foster (1987). Using the discriminant stage description, with an efficiency score of 0.898, it indicates that the province of Banten is expected to be able to carry out its activities using 89.9 percent of its resources (Thanassoulis, Dyson, & Foster, 1987). Using the same example, Jambi province, with a DEA efficiency score of 0.975, is expected to be able to maintain its activities while using 97.5 percent of all available resources. The significance of efficiency scores in other provinces is directly analogous.

Every DMU declared inefficient in DEA results in slacks, which are used to improve or increase the level of efficiency. In the meantime, the DMU has been declared efficient (efficiency score equal to one, then the value of the slack is zero). In linear programming, slacks are calculated where the sum of all slacks is maximized after efficiency correction. Table 2 provides a detailed description of slacks in the inefficient DMU for each variable. Because this is an input-oriented study, only slacks will be provided for the input variables.

Table 2. Slacks input variables

Provinces	sx1	sx2	sx3	sx4	sx5	sx6	sx7	sx8
Banten	77	0	38,851	0	88	56	59	0
Riau	70	1,881	1,864	199	434	0	61	19

Jambi	5	0	26	0	53	0	0	0
Sumatera Selatan	69	0	0	0	192	0	44	62
Bengkulu	2	0	1,682	0	54	0	0	0
Lampung	61	0	0	0	284	0	34	0
Kalimantan Tengah	75	0	0	207	0	61	64	28
Kalimantan Timur	30	0	0	0	144	0	18	26

From table 2, sx1 shows the required slacks on the number of schools variable (X1), sx2 is the number of slacks on the number of new students (X2), sx3 is the number of slacks on the number of students variable (X3), sx4 is the number of slacks on the number of spaces variable class (X4), sx5 is the number of slacks in the education staff variable (X5), sx6 is the number of slacks in the number of laboratories (X6), sx7 is the number of slacks in the number of libraries (X7), and sx8 is the number of slacks on the variable number of units school health (X8).

As previously stated, the input-oriented DEA model requires a DMU to reduce the input variable when the output variable is constant in order to achieve an efficient level of performance. Therefore, based on the value of the slack in table 2, the province of Banten requires a reduction in the input variables in the following categories to achieve the level of efficiency: as many as 77 schools; 38,851 students; 88 education staff; 56 laboratories; and 59 libraries. Meanwhile, Riau province should reduce the proportion of input variables as follows: There are 70 schools, 1,881 new students, 1,864 students, 199 classrooms, 434 education personnel, 61 libraries, and 19 school health units. Then, in order to achieve the level of efficient performance for Jambi province, the following input variables must be reduced: 5 schools, 26 students, and 53 education personnel.

Furthermore, it necessitates the reduction of several input variables, including as many as 69 schools, 192 education personnel, 44 libraries, and 62 school health units for the province of South Sumatra. When it comes to achieving an efficient level in Bengkulu province, it is preferable to reduce the input variables in the following categories: There are 2 schools, 1,682 students, and 54 education personnel. Lampung Province requires input variable reductions in the following categories: 61 schools, 284 education personnel, and 34 libraries. In addition, the province of Central Kalimantan requires cutback input variables in the following categories: 75 schools, 207 classrooms, 61

laboratories, 64 libraries, and 28 school health units. Meanwhile, for the province of East Kalimantan to achieve a high level of efficiency, decrement input variables in the following categories are required: up to 30 schools, 144 education personnel, 18 libraries, and 26 school health units.

CONCLUSIONS

It is critical to assess the effectiveness of education administrators in Indonesia in order to control the quality of national education, which is closely linked to qualified and highly competitive human resources. This study provides an efficiency score for each province in Indonesia in the context of managing the quality of inclusive education using Data Envelopment Analysis (DEA). This is done to provide an overview of each province's position as a decision-making unit in improving national education quality. Provinces found to have efficient performance can be used as a model for other provinces looking to improve their efficiency.

According to the findings of the analysis, the majority of provinces are performing efficiently. Even though some provinces have yet to achieve an efficient level of performance, their efficiency scores are high. As a result, it is safe to conclude that Indonesian provinces have done well in terms of efficiency in managing the quality of inclusive education at the high school level. Those who did not perform well must reduce some input variables based on the resulting slack values. Thus, the efficiency of government performance in ensuring the quality of inclusive and equitable education can be created.

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