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Measuring the Efficiency of School System in all Provinces in Indonesia

Syarifa Hanoum, Anandita Ade Putri, Ilun Tisrinasari

Abstract. *Human resource plays an important role for the economy. How to obtain human resource quality is by implementing the quality of education system. Education is one of the important considerations sought by the government, as proved by the size of its allocation on budget. Therefore, evaluating the efficiency of its implementation in Indonesia is needed by using the Data Envelopment Analysis (DEA) method. This paper attempts to develop a new efficiency model of Indonesian education system and implement it to all school's levels: primary school, junior high school, senior and vocational high school, in 34 provinces in Indonesia. The results show provinces that already have achieved cost, technical and overall efficiency are only 1 and 2 provinces at each levels of education. Regarding the managerial implications, teacher's equity is a top priority in improving the quality of education system in Indonesia.*

Keywords: Data Envelopment Analysis, Education System, Efficiency Evaluation, National

1. INTRODUCTION

Education is one of the top from public sector decision makings, which currently gains much attention. In the national level, some of the economic models are linked with education for the sake of its growth. In Indonesia, education is considered to be important by the government, as stated in the 1945 Constitution; "Every citizen has the right to education". It indicates that efforts are needed to expand more access and equity.

The Ministry of Education and Culture of the Republic of Indonesia has released its achievement, called Program for International Student Assessment (PISA) 2018. Indonesia is ranked 74th (score 379, average: 489). The PISA ranking is a study conducted by the Organization for Economic Cooperation and Development (OECD) whose evaluates the ability of 15-year-old students in the field of mathematics, science and reading. Based on this result, it shows that the quality of education in Indonesia is not optimal yet. Therefore, evaluating the education system in Indonesia is highly needed as a further action. This research is expected to represent the educational assessment in developing countries. The law on national education (No.20/2003) describes school system in Indonesia consists of three stages: basic, secondary, and higher education. The first stage is basic education that consists of primary school (PS) and junior high school (JHS). The second represents secondary education or senior high school (SHS) which can be chosen either general high school or vocational high school. The final stage is higher education (HE) which can be formed as polytechnic, institute, or university. Our study will be focused in the primary and secondary education stages.

This article attempts to create a model for education system in Indonesia to be more efficient using Data Envelopment Analysis (DEA). Efficiency is one of the performance parameters that underlies the entire performance of an organization. Performance capability is used to produce maximum output from existing inputs [1]. When measuring efficiency, it is done by calculating the optimal level of output with the available input levels, or by assessing the minimum level of input to produce a

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certain output. During the process, it will also identify the cause of the inefficiency from the activity.

The DEA method has been widely used to model school production process. Huguenin [2] Fatimah & Mahmudah [3] has evaluated the efficiency of primary schools in Switzerland and Indonesia. Meanwhile, Badri et al [4], Yuan & Shan [5] and Minuci et al. [6] performed the efficiency measurement of secondary schools in Abu Dhabi, China and West Virginia. DEA is a non-parametric methodology based on linear programming, through a mapping of the production frontier that is also used to analyze the functions of production [7]. The DEA model was first introduced by Charnes et al. [8]. This DEA model uses to make assumption of a constant return to scale (CRS) condition which assumes that each DMUs has been operated at an optimal scale. This model was later developed by Banker et al[9]which known as DEA-BCC. The DEA-BCC model assumes that the comparison of company inputs or outputs will affect changes in productivity which called Variable Return to Scale (VRS).

The work at hand aims to develop an efficiency model of Indonesian education system under the following objectives:

a. To define input and output variables that construct Indonesian educationproduction function in Indonesia based on government strategy and previous similarstudies.
b. To measure the efficiency of the school system in all provinces inIndonesia.
c. To provide improvement target for the inefficient provinces.

The focus of efficiency measurement includes various education level starting primary school, junior high school, senior and vocational high school in to captured a real picture of education efficiency model at the national level.

2. EFFICIENCY MODEL OF INDONESIAN EDUCATION SYSTEM

Related studies that evaluate efficiency in education differ broadly with respect to its variables and methods. Some proxies are derived from the objective statement of the Indonesian government to increase the availability, quantity, service level of national educational infrastructure. Consideration for the formulation of DEA model in this studyrefers to the vision and mission of the Indonesian Ministry of Education and Culture, also from prior researches which adjusted by the data availability.

From the input side, school budget allocation is used in this study since it has large amount of portion from the government. However, each province has to obtain different amount of budget allocation. Some studies are used education cost (EC) as an important resource [10]; [11]; [12]. Input variables in this study is used to measure the cost efficiency. It can not be denied that the education cost is the initial capital to operate the whole facilities. This variable selection is also strengthened by the obligation from the government which is to allocate education budget of at least 20 percent.

The other variable, intermediate output, is used to facilitate the indirect relationship between input variables and output variables. This variable involves number of teachers, number of classrooms and number of school-age population (SAP) [2]. Since each province in Indonesia differs in terms of number of schools and its sizes, this study controls both factors by dividing each measure with the number of students. Teacher quality and effectiveness measured by teacher-student ratio (TSR) and classroom-student ratio(CSR). Intermediate output is a manifestation of education funding allocations input into an educational facility obtained by the students. The number of students and teachers are two main actors of education, and the classroom is a physical place of the educational process. Therefore, the students attendance, available teachers and lassrooms are included in the intermediate output. From the output side, some studies also used number of graduates [13] whilst many others also included student [10]; [14]. We follow Haerlermans and Ruggiero [12] and Brennan et al. [11] that used number of students as the output of the educational process.

The number of students is calculated by reducing the percentage of students whose being dropped out (100-DR). In addition, pursuing rate (PR) that indicates the number of graduates who pursue higher school level, is also taken into account as an intermediate factor of each educational level, except for the final stage. Number of graduates (NG) is defined as the output of the last stage (senior and vocational high school). Number of students, the pursuing rate and number of graduates are concordant with the mission of the Indonesian Ministry of Education and Culture that realize the widespread and equitable access, and the fair of educational process. The school production process in Indonesia's education system are summarized in the following Figure 1.

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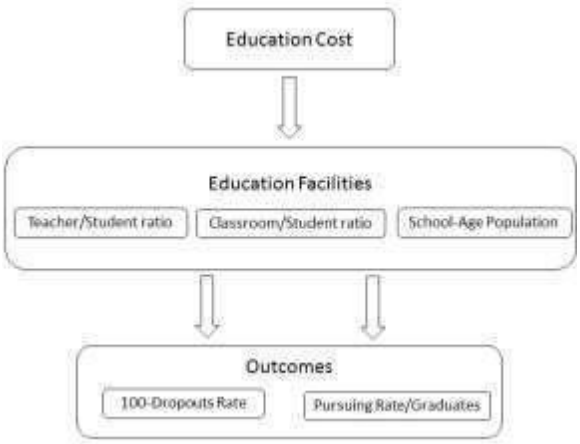

Figure 1. The efficiency model of Indonesian education system

3. MODEL IMPLEMENTATION

We implement the newly built model to evaluate Indonesia's education system using the last school year of 2018/2019. The data were obtained from the official website namely 'Indonesia Educational Statistics in Brief', which are published annualy by The Center for Educational Data and Statistics, Ministry of Education and Culture.

Decision Making Units (DMUs) are defined as units to be analyzed in this study. The number of DMU is determined based on total provinces in Indonesia, which is 34 provinces. The efficiency of each province will be analyzed at each level of education, starting from primary school, junior high school, senior high school and vocational school. We use DEA output-oriented with the aim to optimize the existing input variables. On the other hand, it is not ruled out the possibility that changes in input variables could be recommendations for improvement. DEA-VRS also selected in this study by the assumption from the scale of production which may affect efficiency.

3.1. The efficiency scores

In this study, we use the output-oriented DEA method with the calculation of cost efficiency (CE), technical efficiency (TE), overall efficiency (OE) and scale efficiency (SE). The DMU is efficient when the value of technical efficiency = 1, and otherwise inefficient if the value of technical efficiency DMU <1. The result of the calculation of the value of technical efficiency will become a reference for innefficient DMUs. The score of Cost Efficiency (CE), Technical Efficiency (TE) and Overall Efficiency (OE) are documented in Tabel 1.

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Table 1. Score of CE, TE and OE of all school levels in 34 provinces

No.	DMU (Province)	Primary School			Junior High School			Senior High School			Vocational High School		
		CE	TE	OE	CE	TE	OE	CE	TE	OE	CE	TE	OE
1	Jakarta	1	1	1	0.991	1	1	0.965	1	1	0.963	1	1
2	West Java	0.991	1	1	0.928	1	1	0.776	1	1	0.804	1	1
3	Banten	0.976	1	1	0.887	1	1	0.819	1	1	0.77	1	1
4	Central Java	0.957	1	1	0.901	1	1	0.831	1	1	0.805	1	1
5	Yogyakarta	0.956	1	1	0.952	1	1	1	0.999	1	1	1	1
6	East Java	0.994	0.999	0.999	0.974	0.997	0.997	0.869	1	1	0.869	0.997	0.997
7	Aceh	1	0.998	0.999	1	0.996	0.996	1	0.997	0.997	1	0.993	0.994
8	North Sumatera	0.96	0.998	0.998	0.935	0.997	0.997	0.857	0.997	0.997	0.92	0.99	0.99
9	West Sumatera	0.967	0.999	0.999	0.951	1	1	0.96	0.999	0.999	0.987	0.996	0.996
10	Riau	1	0.999	0.999	0.892	0.999	0.999	0.84	0.999	0.999	0.857	0.996	0.997
11	Riau Islands	0.91	1	1	0.934	1	1	1	0.999	1	1	0.999	1
12	Jambi	0.983	0.999	0.999	0.973	0.999	0.999	0.883	0.999	1	0.875	0.997	0.998
13	South Sumatera	0.976	0.999	0.999	0.844	1	1	0.823	1	1	0.784	1	1
14	Bangka Belitung	0.999	0.999	1	0.862	1	1	0.928	1	1	0.818	1	1
15	Bengkulu	0.982	0.998	0.999	0.948	0.998	0.998	0.967	0.997	1	0.945	0.989	0.989
16	Lampung	0.967	0.999	0.999	0.889	0.998	0.998	0.882	0.999	1	0.839	0.997	0.998
17	West Kalimantan	0.967	0.998	0.999	0.895	0.998	0.998	0.856	0.998	0.998	0.838	0.996	1
18	Central Kalimantan	1	0.999	0.999	1	0.997	0.997	0.921	0.998	0.998	0.86	0.994	0.994
19	South Kalimantan	0.98	0.999	0.999	0.953	1	1	0.865	0.999	1	0.82	0.999	1
20	East Kalimantan	1	0.999	1	0.92	0.999	0.999	0.843	0.999	1	0.879	0.996	0.997
21	North Kalimantan	1	0.999	1	0.941	0.997	1	0.974	0.997	1	1	0.999	1
22	North Sulawesi	1	1	1	0.937	0.998	0.998	0.982	0.997	0.998	0.951	0.995	0.996
23	Gorontalo	1	0.995	0.996	1	0.992	1	0.936	0.993	0.994	0.925	1	1
24	Central Sulawesi	0.975	0.998	0.998	1	0.995	0.995	0.873	0.997	0.997	0.94	0.995	0.995
25	South Sulawesi	0.961	0.998	0.998	0.916	0.996	0.996	0.843	1	1	0.908	0.993	0.994
26	West Sulawesi	1	0.996	1	1	0.991	1	1	0.995	1	0.963	0.988	0.988
27	Southeast Sulawesi	0.943	0.997	0.997	0.979	0.995	0.995	0.94	0.992	0.993	0.982	0.985	0.985
28	Maluku	0.893	1	1	0.979	0.997	0.997	0.961	0.992	0.994	0.993	0.992	0.993
29	North Maluku	1	0.996	0.997	1	0.993	0.993	0.995	0.988	0.991	1	0.973	0.974
30	Bali	0.967	1	1	0.897	1	1	0.932	1	1	0.948	1	1
31	West Nusa Tenggara	0.978	0.999	0.999	1	0.994	0.994	1	0.99	1	0.976	0.984	0.984
32	East Nusa Tenggara	0.947	1	1	0.896	0.994	0.994	0.902	0.992	0.992	0.959	0.988	0.988
33	Papua	0.796	1	1	1	1	1	1	1	1	1	1	1
34	West Papua	0.9	0.998	1	0.93	0.995	0.995	1	0.993	0.995	0.957	0.99	0.991

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In general, the results of the DEA calculation above shows that there are only a few provinces which have reached an efficient calculation. The vocational high school level gets the highest inefficiency value, especially on the value of cost efficiency. Elementary school levels has contributed to the value of education efficiency. Furthermore, provinces that have high efficiency values at cost, technical and overall efficiency sequentially from elementary school level in the provinces of Jakarta and North Sulawesi, junior high school and senior high school in Papua province and vocational school levels in Papua and Yogyakarta provinces.

Based on the whole calculations regarding cost, technical and overall efficiency for each province in Indonesia, it is better to focus on increasing the value of cost efficiency. It is because the average value of cost efficiency is still lower than the average value of technical efficiency, and the smallest value of cost efficiency is lower than the smallest value of technical efficiency. Thus, the cost efficiency value determines the overall efficiency if its compared to the technical efficiency value.

3.2. Improvement Targets

The determination of these improvement use two types of targets that refers to strong efficient frontier and the other one refers to weak efficient frontier. Improvement targets for all inefficient provinces are obtained, but in this paper one example of improvement targets for overall efficiency for the province Gorontalo will be given as seen on Tabel2.

Table 2 Improvement Targets-Overall Efficiency Primary School in Gorontalo

Gorontalo	**CE**	**TSR**	**CSR**	**SAP**	**PR/NG**	**100-DR**
Preliminary data	232.12	70.10	53.00	91.98	81.64	99.46
Proportionate	-	-	-	-	0.31	0.37
Slack	-	-	-10.47	-	6.61	-
Weak Projection	-	-	-	-	81.95	99.84
Strong Projection	-	-	42.52	-	88.56	99.84

In Table 2, it can be seen that Gorontalo can increase its efficiency by projecting a strong efficient frontier by reducing the Classroom-Student Ratio to 45.52 but this certainly needs to be considered, then raising the pursuing rate target to 88.56 and minimize the dropout rates as much as 0.31. In a weak projection it is necessary to increase the pursuing rate value to 81.95 and minimize the dropout rates as much as 0.37 since this projection is considered to be more realistic.

4. CONCLUSION

This study theoretically contributes to research education efficiency by adopting DEA at the national level. The overall efficiency for each province which achieved maximum efficiency in a row for 16 provinces in primary schools, 15 provinces in junior high schools, 20 provinces in senior high schools and 14 provinces in vocational high schools. Inefficiency which derived from the cost value is relatively low. It indicates that technical efficiency is better than cost efficiency.

This empirical finding leads to a conclusion that extra attention should be given to the teacher-student ratio, in order to equalize the number of teachers for each region. Further national best performance variables are a number remain in school with a relatively small improvement value, and therefore a good condition needs to be maintained. For further research can be expanded other variables such as the quality of students using school grades and the quality of teachers based on recent education, besides the use of other methods combined with DEA can realize future comprehensive research.

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