

Efficiency Analysis of Educational Fund Expenditure in Daerah Istimewa Yogyakarta (DIY) and East Java Provinces

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Abstract: *This study aims to measure the level of technical efficiency of education funding from direct expenditure allocation and school operational assistance fund in 2014-2016 in Daerah Istimewa Yogyakarta Province (DIY) and East Java Province that can be used for policy makers to evaluate the realization of the planned budget and program. Funds that are direct government spending on education are used such as for teacher salaries, education-related trainings, school building improvements and others, while school operational assistance fund is only given to poor students in economic so that students can go to school. This research uses Data Envelopment Analysis (DEA) method with assumption of Variable Return to Scale (VRS). The inputs used are government direct expenditure funds for education and school operational assistance fund. The outputs used are the population literacy data and the net enrollment rate. The results of this study indicate that the province of DIY is able to maintain efficiency in 2014-2016 although government spending on education funding and school operational assistance fund is less than East Java. East Java gets inefficiency. This can be influenced by quality of human resources.*

Keywords: Educational Funds, DEA, Efficiency

1. Introduction

One of the Sustainable Development Goals (SDGs) 2015-2030 is ensuring equity of quality education and improving learning opportunities for all people. This means that it is hoped that in 2030 there will be no more illiterate people. However especially for Indonesia, more than 5 million people are still illiterate. DIY province which is famous as one of the provinces of which one city is known as the city of education, also still have an illiterate population obtained from data of Education and sports offices of DIY Province.

Table 1.1: Illiterate People in DIY Province

Year (%)			
2013	2014	2015	2016
7.14	8.03	7.14	7.14

In DIY Province, there are still people aged 15 and above who have not/ never attended school and who have been dropping out of school about 77% in 2016 obtained from the data of education and sports office. East Java is a province in Indonesia which has a population of illiteracy is still very high in 2015 about 9.67% for age 15 years old and above from Central Bureau of Statistics.

Based on the data of the Ministry of Education and Culture, in 2015-2016 there are about 946,013 elementary school students who were unable to continue to the middle level. The data of 51,541 people of the number of students continuing their education to junior high school did not pass. There are 997,445 Indonesian children who are only certified elementary school in 2015 until 2016 (<http://www.jawapos.com/read/2016/10/17/58205/angka-putus-sekolah-di-indonesia-masih-tinggi>).

One of the factors causing it is poverty so that lower economical people prefer to work to earn money for daily needs rather than school. So it is not surprising that the

number of people who do not go to school and drop out in Indonesia is still high. In 2010, the percentage of the population of 7-15 years who have no school about 2.51 percent and 6.04 percent for people who are no longer school (<http://www.seocontoh.web.id/2016/01/data-jumlah-sensus-penduduk-update-2016.html>).

The problem of students continuing or not to the higher level is also a concern of all provincial education office. Education can help the population to develop the mindset and ability so as to reduce the poverty level. The efforts have been made by the government including allocating 20% of the state budget funds for education, but still there are people who are illiterate and drop out of school because of unable to pay for school needs. Therefore, it is necessary to measure the efficiency of education fund from the government, whether it should be reduced or increased.

2. Previous Studies

There have been several previous studies that have evaluated the efficiency that is centered on the world of education. Bradley et al. (2001) calculated the technical efficiency of all secondary schools in the UK during the period 1993-1998 and found that competition was the determining factor of school efficiency over time. Wolszczak-Derlacz, J. (2014) evaluated the relative efficiency of 500 higher education institutions (HEIs) in ten European and US countries between 2000 and 2010 with the DEA and found that the role of the university funding structure in HEI technical efficiency is different in Europe and in the U.S. Increased government funding is associated with an increase in inefficiency only in the case of European units, while the share of funds from tuition fees decreases the efficiency of American public institutions but relates to efficiency improvements in European universities. (Wolszczak-Derlacz, J. (2014), "An evaluation and explanation of (in) efficiency in higher education institutions in Europe and the

U.S. with the application of two stage semi-parametric DEA”.

Veiderpass and McKelvey (2016) evaluated the performance of 944 higher education institutions in Europe and suggested the evaluating higher education institution (HEI) performance in a production theory context, applying the well-known data envelopment analysis (DEA) method to a cross section of 944 HEIs in 17 European countries. The DEA approach is particularly suitable in this context where little is known about production technologies and economic behavior of the HEIs. On average, provision of education is found to be most efficient in the Slovak Republic followed by Belgium and Latvia, while Denmark and Norway display the lowest efficiency. The study also indicates a positive relation between efficiency and HEI size and efficiency and research intensity. Furthermore, the study points to the importance of continued data collection. Anatoliy G.G. (2016) found the Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) to be the most appropriate methods for performance evaluation of higher education under specific conditions.

3. Theoretical Framework

To provide services to the public, the government makes policies such as the expenditure of a country's funds. Making these policies has many considerations, including in terms of efficiency. Efficiency is the ratio of output to input. This means that the number of outputs generated in each input unit or using an input with a certain amount to produce the maximum amount of output. According Ozcan (2014) to improve the efficiency of a performance is to increase output or reduce input. The point is that the rate of increase in output should be greater than the rate of increase in input or the level of output decrease should be lower than the rate of input decline.

There are generally two types of efficiency, namely technical efficiency and allocative efficiency. According to Comes and Kersten (in Wautabouna, 2012) technical efficiency is the measurement of a production unit permits to surround it last one increases its production without consuming, at the same time, more resources, or reduce the use of at least one input by conserving at the same time, the same level of production. According to Tovar and Trujillo (in Wautabouna), allocative efficiency is required if the firm maximizes its profits or minimizes costs at a given level of production.

From the above explanation, the government's policy on the expenditure of funds is said to be efficient if the funds issued by the government can generate the purpose of spending the funds maximally, in this case is the welfare of the community included getting education.

4. Method of Study

The method used to measure the efficiency of a performance is using non-parametric method that is with Data Envelopment Analysis (DEA). DEA can measure the relative efficiency of DMUs that convert multiple inputs to multiple outputs. DEA has been used by researchers to

evaluate the efficiency of performance in the scope of hospitals, education, companies, businesses, and others. The size of the efficiency at DEA is

$$\begin{aligned} \text{Efficiency} &= \frac{\text{Results Obtained}}{\text{Results Used}} \\ &= \frac{\text{Weighted Sum of Outputs}}{\text{Weighted Sum of Inputs}} \\ &= \frac{u_1 o_{1j} + u_2 o_{2j} + \dots}{v_1 I_{1j} + v_2 I_{2j} + \dots} \end{aligned}$$

Where:

u_1 = weight given to output 1

O_{1j} = amount of output 1 from unit j

V_j = weight given to input 1

I_{1j} - amount of input 1 used by unit j

There are 2 types of Data Envelopment Analysis (DEA), namely:

1. Charles, Cooper and Rhodes (CCR)

This model is used to measure the overall technical efficiency by using the Constant Return to Scale (CRS) assumption which means the ratio between input and output additions is the same. This assumption is acceptable if the DMU operates under optimum size conditions. CRS's mathematical model of non-linear programming is:

Objective function:

$$\text{efficiency} = \frac{\sum_{r=1}^s u_r y_{r0}}{\sum_{i=1}^s v_i x_{i0}} \leq 1$$

Subject to:

$$\frac{\sum_{r=1}^s z_j u_r y_{rj}}{\sum_{i=1}^s v_i x_{i0}} \leq 1 ; j = 1, 2, \dots, n$$

where :

j = DMU, $j = 1, \dots, n$

i = Input, $i = 1, \dots, n$

r = Output, $r = 1, \dots, n$

Data :

y_{rj} = value of output to-r from DMU to j

x_{ij} = value of input ke-i dari DMU ke j

Variabel :

z_j = relative efficiency of DMU j

u_r = weight for output r

v_i = weight for input i

(Charnes, et al. 1978: 430)

CRS model has 2 approaches: input orientation and output orientation.

a. Input orientation

Objective function

min θ

subject to:

$$\sum_{j=1}^n \lambda_j Y_{rk} - Y_{rk} \geq 0 ; r = 1, 2, \dots, s$$

$$\theta X_{ik} - \sum_{j=1}^n \lambda_j X_{ij} \geq 0 ; i = 1, 2, \dots, m$$

$$\lambda_j \geq 0 ; \text{weight from DMU, } j \in 1, 2, \dots, n$$

b. Orientasi output

Objective function

max ϕ

subject to :

$$\begin{aligned} \sum_{j=1}^n \lambda_j Y_{rj} - \theta Y_{rk} &\geq 0 \quad ; r = 1, 2, \dots, s \\ X_{ik} - \sum_{j=1}^n \lambda_j X_{rj} &\geq 0 \quad ; i = 1, 2, \dots, m \\ \lambda_j &\geq 0 \\ (\text{Coelli et al., 1996: 9}) \end{aligned}$$

2. Model Banker, Charnes and Chopper (BCC)

In the real world, It is not always a company operates on an optimal scale. Therefore CCR developed into BCC. BCC is used to measure pure technical efficiency. BCC uses the assumption of Variable Return to Scale (VRS), which means that if there is an addition of input can produce output more than, less than or equal to that addition. The formula in the BCC model is using:

$$\sum_{j=1}^n \lambda_j = 1$$

This is a BCC model with input-output oriented for DMUs:

$$\min_A = \theta_0$$

Subject to

$$\begin{aligned} \sum_{j=1}^n \lambda_j y_{rj} &\geq Y_{r0} \quad ; r = 1, 2, \dots, s \\ \theta_0 x_{i0} - \sum_{j=1}^n \lambda_j x_{rj} &\geq 0 \quad ; i = 1, 2, \dots, m \\ \sum_{j=1}^n \lambda_j &= 1 \quad ; \lambda_j \geq 0 \quad ; j = 1, 2, \dots, n. \end{aligned}$$

DEA has advantages and disadvantages. The advantages of DEA are:

- DEA can handle multiple input and multiple output models.
- It doesn't require an assumption of a functional form relating inputs to outputs.
- DMUs are directly compared against a peer or combination of peers.
- Inputs and outputs can have very different units. For example, X_1 could be in units of lives saved and X_2 could be in units of dollars without requiring an a priori tradeoff between the two.

DEA's weaknesses are:

- Since DEA is an extreme point technique, noise (even symmetrical noise with zero mean) such as measurement error can cause significant problems.
- DEA is good at estimating "relative" efficiency of a DMU but it converges very slowly to "absolute" efficiency. In other words, it can tell you how well you are doing compared to your peers but not compared to a "theoretical maximum."
- Since DEA is a nonparametric technique, statistical hypothesis tests are difficult and are the focus of ongoing research.
- Since a standard formulation of DEA creates a separate linear program for each DMU, large problems can be computationally intensive. (Michael, 1998)

This study uses DEA with the BBC model using VRS assumption to measure the technical efficiency of education fund expenditure. Educational output results are determined by various factors, therefore the addition of some inputs will not necessarily produce the same amount of output. This study can be used for policy makers to evaluate the realization of the planned budget and program.

5. Data

This study data uses data from two provinces in Indonesia, namely DIY Province as one of its city known as education city in Indonesia but still have the illiterate population and province of East Java as one of the provinces classified as having many people who are illiterate. The input data used is the realization of the direct expenditure allocation of education in 2014-2016 obtained from the performance reports of the Education Office of DIY and East Java Provinces. Input data also uses School Operational Assistance Fund data obtained from ministry of education and culture data.

According to Minister of National Education Regulation No. 69/2009, School Operational Assistance Fund is a government program fundamentally to provide funding for non-personal operating expenses for basic education units as implementers of compulsory education programs with a view to mitigating the public burden on education finance. In particular, this funding program aims to free levies for all elementary and junior high school students on school operating costs; to free the levy of all poor students from all charges in any form, whether in public or private schools; and help the burden of school operating costs for students in private schools. The output data used to measure education performance in these two provinces is the data of illiterate population and net enrollment rate obtained from data of Indonesian Central Bureau of Statistics.

A. Input Data

1. Realization of Direct Expenditure Allocation of Education in 2014-2016

Table 5.1: Realization of Direct Expenditure Allocation of Education in 2014-2016

Province	2014 (IDR)	2015 (IDR)	2016(IDR)
DIY	156705512175	179793562376	218984322280
East Java	397615622381	322107627256	256196822661

2. School Operational Assistance Fund

Table 5.2: School Operational Assistance Fund

Province	Year	Level of Education	Total (IDR)
DIY	2014	Elementary	72636928042
		Junior High	43967823538
		Senior High	314000000
	2015	Elementary	98679006350
		Junior High	57214185488
		Senior High	2620300000
	2016	Elementary	142121646122
		Junior High	85572877164
		Senior High	58655147206
East Java	2014	Elementary	1359300746490
		Junior High	669051277925
		Senior High	10409490500
	2015	Elementary	1800544784327
		Junior High	900876737408
		Senior High	23974746541
	2016	Elementary	1878335003219
		Junior High	987040098510
		Senior High	885243757466

B. Output data

1) Literacy data

Table 5.3: Literacy Data

Province	Year	Age	Total (%)
DIY	2014	15+	94.44
		15-44	99.91
		45+	86.29
	2015	15+	94.50
		15-44	99.90
		45+	87.20
	2016	15+	94.59
		15-44	99.87
		45+	87.37
East Java	2014	15+	91.36
		15-44	98.57
		45+	80.34
	2015	15+	91.47
		15-44	98.76
		45+	80.76
	2016	15+	91.59
		15-44	98.91
		45+	81.16

The result shows that the central government expenditures for education in the province of DIY achieve perfect efficiency that is 100% in 2014, 2015 and 2016. Achieving this efficiency also occurs in School Operational Assistance Fund in the province of DIY by 100%. While the province of East Java cannot achieve the perfect efficiency in the expenditure of education funds and School Operational Assistance Fund in any year. In 2014, there is only 39.4% for government expenditures and 5.7% for School Operational Assistance Fund. In 2015 there is 55.8% for central government expenditure and 5.8% for School Operational Assistance Fund. In 2016 there is 85.5% for central government expenditure and 7.6% for School Operational Assistance Fund. One of the factors that caused the East Java Province to be inefficient was the lack of human resources in planning and budget execution compared to the province of Yogyakarta. This can be seen from the making of the Province of DIY as one of the provinces of education. This shows the quality of human resources in the Province of DIY can be categorized well so as to be able to manage the education fund well.

2) Net Enrollment Rate

Table 5.4: Net Enrollment Rate

Province	Year	Level of Education	Total (%)
DIY	2014	Elementary	98.98
		Junior High	82.2
		Senior High	68.46
	2015	Elementary	99.23
		Junior High	82.86
		Senior High	68.6
	2016	Elementary	99.21
		Junior High	83.05
		Senior High	68.96
East Java	2014	Elementary	96.98
		Junior High	80.94
		Senior High	60
	2015	Elementary	97.38
		Junior High	81.16
		Senior High	60.31
	2016	Elementary	97.49
		Junior High	81.35
		Senior High	60.76

Although the province of DIY achieves perfect performance efficiency in the year 2014, 2015 and 2016, there are still illiterate people who do not even attend school or drop out (from Net Enrollment Rate). Most of the people in this group are poor, so they are afraid to go to school because they are afraid of not being able to pay for their educational needs even though the government has created additional funds (School Operational Assistance Fund) to help poor students in economic terms. However because of lack of socialization and often late transfer of School Operational Assistance Fund results that this group might be lack of confidence to the government and decided not to go to school.

From input data, East Java Province receives education fund from central government and School Operational Assistance Fund more than DIY Province. This indicates that the high education expenditure funds by the government may not necessarily achieve the best results. It also can be influenced by quality of humans in using the funds. In addition to poverty, East Java residents still adhere to a "young marriage" culture that people choose to marry rather than go to higher levels (<http://jatim.tribunnews.com/2017/04/17/indeks-pembangunan-sdm-jatim-rendah-ketua-bps-jatim-prioritaskan-pendidikan-daripada-menikah-muda>). The high level of corruption in the province is also a non-optimal factor in the use of funds (<http://nasional.kompas.com/read/2016/02/24/17553841/JawaTimur>). This is relevant to the results of research by EjubarJafarov and Anna Ilyina (2008) for the IMF entitled Republic Croatia: Selected Issue which states that countries with the highest expenditure for education do not necessarily produce the best results.

6. Result and Discussion

Boussofiane et al. (in Joseph Sarkis.2001) stipulated that to get good discriminatory power out of the CCR and BCC models the lower bound on the number of DMUs should be the multiple of the number of inputs and the number of outputs. It means that data in this study can be used. Using DEA model BBC assumed VRS, it is gotten result:

Table 6.1: Efficiency Level for Input Data

Year	Province	Input	
		Government's Expenditure For Education (%)	School Operational Assistance Fund (%)
2014	DIY	100	100
	East Java	39.4	5.7
	DIY	100	100
2015	East Java	55.8	5.8
	DIY	100	100
2016	East Java	85.5	7.6

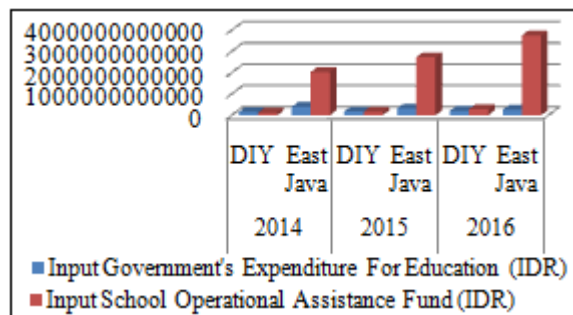


Figure 6.1: Educational Funds

East Java Province is inefficient in 2014-2016, to be efficient needed reducing education expenditure by 60.60% (2014), 44.2% (2015), 15.5% (2016) and reduction of school operational assistance fund by 94.3% (2014), 94.2% (2015), 92.40% (2016). The inefficiency occurs because of the inability of the province to use the funds optimally resulting in waste, e.g. to hire honorary workers in some schools using school operational assistance funds. In fact, while the government regulation stated that school operational assistance fund can only be used for poor students. Students are categorized as poor if parental income divided by members of the nuclear family is less than or equal to IDR 750000. From the level of efficiency, East Java Province increases efficiency from the previous year. This means that the province of East Java is trying to use these funds well and improve performance in the educational sector.

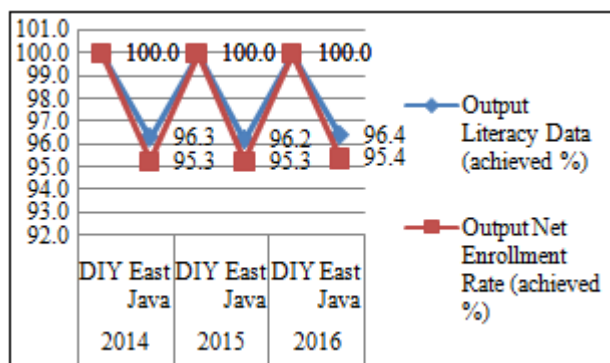


Figure 6.2: Efficiency Level of Output

Besides minimizing the input, it can also be undertaken to maximize outputs to overcome inefficiency. In 2014, East Java needs to increase 3.70% for the literate population and 4.70% for the net enrollment rate, while in 2015 it needs to increase 3.80% for the literate population and 4.70% for the net enrollment rate. In 2016, it needs an increase of 3.60% for the literate population and 4.60% for net enrollment rate. In 2015 and 2016, East Java has the decrease of direct expenditure of education and increase of school operational assistance funds. Yet, East Java Province does not still use the funds optimally. Nevertheless this province uses the increase of additional funds (school operational assistance fund), which is only used to reduce the cost of education for poor students to increase the literate population and net enrollment rate from the previous year. Despite the increase in literacy and net enrollment rates from 2015 to 2016, this increase is higher than that from 2014 to 2015 which is 24% increase for literate people and 31% for net enrollment. From 2015 to 2016 there was a 22% increase for literate people and 25% for net enrollment. However, DIY Province

gets the increase of educational funds both direct expenditure of education and school operational assistance funds. This means that it is needed the increase educational funds with using them well. From that study, it was found that it needs more the government attention from previous years by increasing the allocation of direct expenditure of education (e.g. by increasing teacher salaries and repair schools) and school operational assistance fund according to provincial needs and using those funds optimally so there is no waste that their result is not maximal.

7. Conclusion

DIY Province can maintain perfect efficiency (100%) from 2014-2016, while the province of East Java gets inefficiency which means this province still cannot use funds optimally. To reduce the illiterate population and increase the number of people for schools, those province requires to increase education funding from the government both for students, teachers, as well as repair to the physical condition of the school but an increase in accordance to the province's needs and to be used optimally. Based on the results of this study, governments and citizens need to monitor and to evaluate the use of educational funds. Central governments need to give training for increasing humans resources in making and using educational funds. Further research can measure the government expenditure in districts or schools using DEA and balanced scores.

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Attachment

1. Main Data

a. 2014

Province	input1	input2	output1(%)	output2(%)
DIY	156705512175	116918751580	93.55	83.21
East Java	397615622381	2038761514915	90.09	79.31

b. 2015

Province	input1	input2	output1	output2
DIY	179793562376	158513491838	93.87	83.56
East Java	322107627256	2725396268276	90.33	79.62

c. 2016

Province	input1	input2	output1	output2
DIY	218984322280	286349670492	93.94	83.74
East Java	256196822661	3750618859195	90.55	79.87

2. Result

1. Table of Efficiency Value for Realization of Direct Expenditure Allocation in 2014-2016

Province	2014	2015	2016
DIY	100.00%	100.00%	100.00%
East Java	39.40%	55.80%	85.50%

2. Table of Efficiency Value for School Operational Assistance Fund

Province	2014	2015	2016
DIY	100	100.00%	100.00%
East Java	5.70%	5.80%	7.60%

1. Table of Efficiency Value of Minimum Input for Realization of Direct Expenditure Allocation in 2014-2016

Year	Province	Actual	Target	To Gain	Achieved
2014	DIY	156705512170	156705512170	0.0%	100.0%
	East Java	397615622380	156705512170	60.6%	39.4%
2015	DIY	179793562380	179793562380	0.0%	100.0%
	East Java	322107627260	179793562380	44.2%	55.8%
2016	DIY	218984322280	218984322280	0.0%	100.0%
	East Java	256196822660	218984322280	14.5%	85.5%

2. Table of Efficiency Value of Minimum Input for School Operational Assistance Fund

Year	Province	Actual	Target	To Gain	Achieved
2014	DIY	116918751580	116918751580	0.0%	100.0%
	East Java	2038761514900	116918751580	94.3%	5.7%
2015	DIY	158513491840	158513491840	0.0%	100.0%
	East Java	2725396268300	158513491840	94.2%	5.8%
2016	DIY	286349670490	286349670490	0.0%	100.0%
	East Java	3750618859200	286349670490	92.4%	7.6%

3. Table of Efficiency Value of Maximum Output for Literacy Data

Year	Province	Actual	Target	To Gain	Achieved
2014	DIY	93.6%	93.6%	0.0%	100.0%
	East Java	90.1%	93.6%	3.7%	96.3%
2015	DIY	93.9%	93.9%	0.0%	100.0%
	East Java	90.3%	93.9%	3.8%	96.2%
2016	DIY	93.9%	93.9%	0.0%	100.0%
	East Java	90.6%	93.9%	3.6%	96.4%

4. Table of Efficiency Value of Maximum Output for Net Enrollment Rate

Year	Province	Actual	Target	To Gain	Achieved
2014	DIY	83.2%	83.2%	0.0%	100.0%
	East Java	79.3%	83.2%	4.7%	95.3%
2015	DIY	83.6%	83.6%	0.0%	100.0%
	East Java	79.6%	83.6%	4.7%	95.3%
2016	DIY	83.7%	83.7%	0.0%	100.0%
	East Java	79.9%	83.7%	4.6%	95.4%

Note:

Input 1 is Realization of Direct Expenditure Allocation in 2014-2016.

Input 2 is School Operational Assistance Fund

Output 1 is Literacy Data

Output 2 is Net Enrollment Rate