

## Measuring the Efficiency of Madrasah Aliyah Negeri in Bangka Belitung Province through Data Emvelopment Analysis (DEA)

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### ABSTRACT

The importance of measuring the efficiency of State Madrasah Aliyah in the Province of the Bangka Belitung is at least based on the low achievement of Madrasah output or National Examination scores. This shows that the implementation of Madrasah Aliyah in terms of input and output is still not efficient. This study aims to measure the efficiency of State Madrasah Aliyah in the Province of the Bangka Belitung Islands in the 2017/2018 and 2018/2020 academic years. This research uses a Data Development Analysis (DEA) approach and is a type of qualitative research with non-parametric statistical analysis. The results of the DEA analysis show that there are inefficient DMUs in the 2017/2018 – 2018/2019 academic year, namely, MAN 1 Bangka, MAN 1 Belitung, and MAN 1 Pangkalpinang. meanwhile, MAN 1 West Bangka and MAN IC Bangka Tengah are DMUs that have been consistently efficient in the 2017/2018 - 2018/2019 Academic Year. Several corrective steps can be taken by the inefficient DMU, such as, 1) reducing the amount of budget that is adjusted to the ideal number of students by 236, 2) DMU needs to build a strict student selection system to maintain the ideal number of students, 3) increase the quantity and quality of teachers who have been certified, and 4) maintain a teacher-to-student ratio of at least 1:16.

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## 1. INTRODUCTION

Various efforts to improve the quality of madrasah have basically been carried out by the government through the Ministry of Religion. However, until now, the quality of madrasah nationally has not shown satisfactory results (Iskandar, 2019; Nurokhim, 2017). Although there are some madrasah that can outperform school performance, this only happens to certain or superior madrasah. From the

results of the 2019 National Examination (UN), for example, only one madrasah was ranked in the top 10, namely MAN Insan Cendekia Serpong, Tangerang. (Liputan6.com, 2019).

In addition, the problem of the low quality of madrasah can be seen from the low public perception of madrasah (Amiruddin, 2016; Maskur, 2017). Parents tend to choose madrasah if their children are not accepted in public schools. Thus, madrasahs are generally still the second choice for parents and even prospective students. The low level of public interest in choosing a madrasah is also strongly influenced by the quality of the madrasah. The results of a study conducted by Susilowati (2015) show that there is a relationship between public perception of the quality of madrasahs and interest in choosing schools for madrasahs.

Observing the above problems, serious efforts are needed from all parties to improve the quality of madrasah implementation. One of the efforts to ensure the quality of madrasah is to know the efficiency of madrasah implementation itself. According to Mulyasa in Handari (2012), as quoted by Lestari et al. (2015), efficiency is important to know the comparison between input and output. Furthermore, Handari (2012) in Lestari et al. (2015) mentions that efficient schools are also seen as the optimal use of resources. Often, schools appear to have high academic achievements, but this is not accompanied by the optimization of existing resources.

Basically, the term "efficiency" is more widely used in the economic field. However, this does not mean that the term "efficiency" cannot be used in other fields. In fact, the term "efficiency" is very relevant in all fields, as well as in the field of education. In the online KBBI, efficiency is the ability to carry out tasks properly and precisely so that it does not waste a lot of time, energy, or money (kbbi.we.id, 2019). According to Muharam and Pusvitasari in Nizar, (2015) efficiency is an indicator of the performance of a company capable of utilizing or optimizing its resources. Or in another sense, the ratio between the input and the output.

Furthermore, according to Farrell MJ, (1957), as cited by Nizar, (2015), efficiency can be defined in two ways: technical efficiency (the ability to produce the maximum possible output from existing resources or inputs) and economic efficiency (the ability to reduce the cost of production). Then there is allocative efficiency, which describes the ability of a company or organization to utilize or optimize inputs by including cost calculations.

The definition of efficiency above can also be understood as a production activity that requires optimizing the output of the available inputs. Martono, (2019) mentions that the factors that affect productivity and efficiency include internal and external factors. Internal factors consist of a competent workforce, optimal handling of materials or raw materials, machines as production tools, and methods related to standard operating procedures. External factors include customer satisfaction, the environment, and competition.

Education efficiency can also be defined as an activity to manage education. In the field of education, it is known as education administration, as according to Abu, (2014) in Purba et al., (2021), educational administration is understood as the whole process of carrying out activities carried out by several people to achieve more effective and efficient goals. In a broader understanding, educational administration is a service to all forms of educational institutions in an effective and efficient manner.

To achieve an effective and efficient education in the concept of management, at least it refers to the concepts of planning, organizing, actuating, and controlling. At least three things can be seen whether the management function has been effective and efficient: the input, process, and output are managed. These three concepts (input, process, and output) then become the scope of the quality of education itself. Kristiawan et al. (2017) describe the quality objectives as including;

1. Principals, teachers, education staff, the availability of facilities, a conducive environment, a high-standard curriculum, funds, selected students, and sufficient supporting funds are all examples of input.
2. The process consists of: a) KBM, effective methods and testing, b) organization/management, c) public relations, d) active extracurricular activities, and e) effective quality control.

3. Learning outcomes include: learning outcomes scores; graduate competencies that exceed the standard; a high graduation percentage; high absorption of graduates in universities and the workforce; and a high level of public trust.

DEA is a qualitative analysis method to measure the efficiency level of an organization or company. The concept of measuring efficiency in general was first introduced by Farrell (1957). This concept was later developed. Charnes et al. (1978) In their research, Charnes et al. (1978) developed a method of measuring efficiency derived from each DMU with the aim of improving the performance of a company.

Subsequent developments Banker, Charnes, and Cooper, (1984) as quoted Tuffahati et al., (2016) then develop an efficiency analysis method using DEA. The DEA approach technically measures the efficiency level of the DMU based on the production frontier concept. In terms of production efficiency, the term production frontier line is known. Broadly speaking, the frontier line can be seen through the following figure.

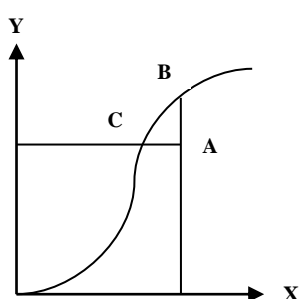


Figure 1. Source: (Tuffahati et al., 2016)

In Figure 1 above, there are two poles of the X-axis and two poles of the Y-axis. The X-axis pole represents the input variable, while the Y-axis pole represents the output variable. An organization or company can be said to be efficient if it is above the frontier line. In Figure 1 above, there is a point that shows an efficient company, namely at points B and C. As for point A, it describes the level of inefficiency, because in fact, the company can increase output to reach the point tangent to point B without having to require much more input. At least some terms are required to understand, as stated by Yeni and Siswanto (2005):

1. Output-oriented measurement: to identify inefficiencies that allow reducing inputs without changing outputs.
2. Input-oriented measurement to identify inefficiencies that allow for increasing output without changing inputs.
3. Constant Return to Scale to determine the unidirectional or linear relationship between input and output. For every additional input, there will be a proportional and fixed increase in output.
4. Variable return to scale is the opposite of constant return to scale, which means that there is no direct relationship between input and output.
5. Technical efficiency is the ability of a unit to produce the maximum possible output from several available inputs.
6. Allocative Efficiency is the unit's ability to optimize output by minimizing the cost of using inputs.
7. Overall efficiency is a combination of technical efficiency and allocated efficiency.

Studies on efficiency in the field of education have so far been carried out by several researchers. Outside the Indonesian context, for example, research on efficiency in primary and secondary education has been carried out by several researchers such as, Aparicio et al., (2019) which focuses on measuring school efficiency based on achievement in the PISA (Programme for International Student Assessment) competition. The measurement of school efficiency based on PISA data is also carried out by Aparicio et

al., (2018); Yahia & Essid, (2019) and several others such as focusing on teacher performance which has an impact on student achievement (Spantín & Sicilia, 2018).

In Indonesia itself, research on efficiency in educational institutions has also been carried out by several researchers, such as Jesus, (2010), measuring efficiency in senior high schools in the city of Surakarta and Suropto, (2011), conducting research on the efficiency of elementary schools and Madrasah Ibtidayah in East Kalimantan. On the other hand, Tsani et al. (2018) are conducting research on school efficiency that focuses on the efficiency of education spending in vocational schools in Indonesia. Efficiency research at the vocational high school level was also carried out in Sukoharjo Regency (2012).

The results of previous studies regarding the efficiency of the education sector, especially the State Madrasah Aliyah, have not been widely carried out, even in the context of the State Madrasah Aliyah in the Province of the Bangka Belitung Islands. The measurement of efficiency is still dominantly carried out in the field of education in public schools. Studies on efficiency, which will have implications for the quality of madrasahs, are only limited to knowing the determinant factors through correlation and regression approaches as the research conducted Indayani, (2016); Taufik, (2013); (Muslim & Kartiko, 2020) The results of this study are still not able to show whether a madrasah has efficiently utilized existing resources (inputs) to produce ideal outputs. In contrast to this study, which uses the DEA (Data Envelopment Analysis) approach, it can more specifically determine the efficiency between input and output variables.

The importance of measuring the efficiency of State Madrasah Aliyah in the Province of the Bangka Belitung Islands is at least based on the low achievement of Madrasah output or National Examination scores. Obtaining the equivalent high school national examination in 2019 and then none of the madrasahs, both public and private, ranked in the top 5 (Malena, 2019). This shows that the implementation of madrasah Aliyah in terms of input and output is still not efficient. By knowing which madrasahs are efficient or inefficient, the relevant parties, both madrasahs and the government, can formulate strategic policies for the improvement and improvement of madrasah implementation. In addition, the results of this research will be an initial effort to control or supervise the use of resources in the educational process.

Based on the description of the background and the results of previous research, it can be stated that the importance of this research is based on the following points: 1) the low quality of Madrasah education, which is suspected of having inefficient input variables; 2) there is no research that focuses on efficiency studies in Madrasahs. 3) Several previous studies related to Madrasah efficiency only used a correlation or regression approach, which was unable to determine the efficiency of the input and output variables. 4) The DEA approach was still not widely implemented in the Madrasah education sector.

## 2. METHODS

This study analyzes the efficiency level of madrasah implementation using the DEA approach. Research using the DEA approach is a type of qualitative research and uses non-parametric statistical analysis. The Decision Making Unit (DMU) in this study is the State Madrasah Aliyah in the Province of the Bangka Belitung Islands, totaling 5 State Madrasah Aliyah in 5 Regencies/Cities (Ministry of Religion, Bangka Belitung, 2019). The selection of these 5 Madrasah is based on the fact that they are public schools that have adequate inputs and outputs compared to private madrasah. Under these conditions, it is possible to obtain more representative data. The data in this study came from every state madrasah Aliyah for the last two years, namely the 2017/2018 and 2018/2019 academic years. Data was collected through a questionnaire consisting of input and output variables. The input variables consist of the number of budgets (X1), the number of students (X2), the number of certified teachers (X3), the number of teachers (X4), and the ratio of teachers to students (X5). As for the output variable, it consists of the percentage of student graduation rates (Y2) and the average UN score (Y1).

As expressed by Rusydiana, (2018), the analytical instrument used in this study is the Banxia Frontier Analyst 4.0 to measure the efficiency level of all State Madrasah Aliyah DMUs starting from the 2016/2017 and 2017/2018 academic years. The analysis to measure efficiency will be carried out using the CRS or CCR models. (Rusydiana, 2018).

### 3. FINDINGS AND DISCUSSION

In the DEA analysis, there are two commonly used models, namely, the Constant Return to Scale (CRS) model and the Variable Return to Scale (VRS) model. Rusydiana, (2013) The CRS model assumes that every change or increase in the input variable will be followed by a change or increase in the output variable proportionally by a certain percentage.

Then for the VRS model, it is assumed that for every change or addition to the input variable, it is not followed by an addition or change to the output variable. Changes in the output variable can increase (increasing return to scale) or decrease (decreasing return to scale). (A. Lestari, 2015). The CRS model is also known as relative efficiency, while the VRS model is known as technical efficiency. (Top et al., 2020). A DMU is said to be efficient if it has a score equal to 1 or 100%. Meanwhile, DMU is said to be inefficient if it has a score of 1 (Yannick et al., 2016). Analysis of the data used in this study using the CRS model The following table presents DMU data based on input variables and output variables.

**Table 1.** Factual Data for Input Variables and Output Variables

DMU	Academic Year	Input					Output		
		Total Budget*	The number of students	Number of Certified Teachers	Total number of teachers	Teacher&Student Ratio	% Graduation	UN Average	
MAN 1 Pangkalpinang	2017/2018	1,421,000,000	976	29	61	16	100	43.38	
MAN 1 Bangka		2,581,932,687	475	21	33	34	100	43.50	
MAN IC Bangka Tengah		20,087,080,000	189	9	26	7	100	66.73	
MAN 1 West Bangka		346,873,000	236	7	23	10	100	49.93	
MAN 1 Belitung		4,142,241,000	537	11	33	16	100	43.14	
MAN 1 Pangkalpinang		1,421,000,000	912	31	65	14	100	45.81	
MAN 1 Bangka		4,724,122,000	530	20	32	38	100	46.21	
MAN IC Bangka Tengah		2018/2019	19,469,486,000	221	9	26	9	100	69.72
MAN 1 West Bangka		346,873,000	322	8	26	12	100	49.01	
MAN 1 Belitung		4,096,485,000	532	11	32	17	100	46.78	

Note: \*) Rupiah

The results of data processing on input and output variables (table 1) obtained efficiency scores using the CRS model for each DMU are presented in the following table.

**Table 2.** Value of DMU Efficiency Model CRS

DMU	Academic Year	Score	Percentage	Description
MAN 1 Bangka	2017/2018	0.696970	69.6%	Not efficient
MAN 1 West Bangka		1.0000000	100%	Efficient
MAN 1 Belitung		0.696970	69.6%	Not efficient
MAN 1 Pangkalpinang		0.636029	63.6%	Not efficient

DMU	Academic Year	Score	Percentage	Description
MAN IC Bangka Tengah		1.0000000	100%	Efficient
MAN 1 Bangka		0.718750	71.8%	Not efficient
MAN 1 West Bangka		1.0000000	100%	Efficient
MAN 1 Belitung	2018/2019	0.718750	71.8%	Not efficient
MAN 1 Pangkalpinang		0.723947	72.3%	Not efficient
MAN IC Bangka Tengah		1.0000000	100%	Efficient

Source: Banxia Frontier Analysis 4.0 Data Processing (2022)

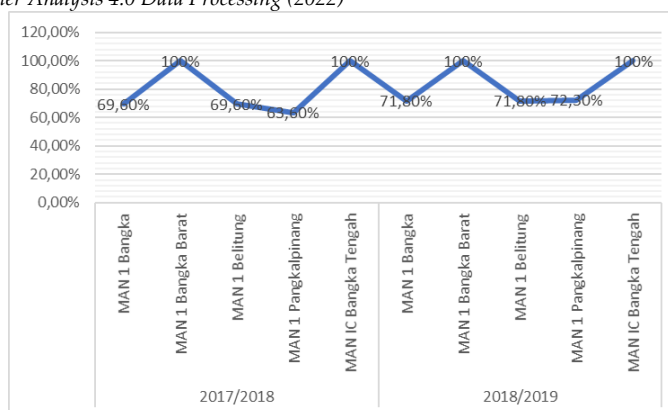


Figure 1. Graph of MAN efficiency in Prov. Kep. Bangka Belitung

Based on table 2 and figure 1 above, the analysis using the CRS model found that DMUs were inefficient in the 2017/2018 academic year, namely, MAN 1 Bangka (69.6%), MAN 1 Belitung (69.6%), and MAN 1 Pangkalpinang (69.6%). (63.6%) The DMUs that were inefficient in the 2018/2019 academic year were MAN 1 Bangka (71.8%), MAN 1 Belitung (71.8%), and MAN 1 Pangkalpinang (72.3%). MAN 1 West Bangka and MAN IC Bangka Tengah are DMUs that have been efficient with an efficiency value of 100% in the 2017/2018 and 2018/2019 Academic Years.

Based on the analysis of the CRS model, the inefficient DMU of MAN 1 Bangka, MAN 1 Belitung, and MAN 1 Pangkalpinang has not been able to optimize the input and output variables to achieve the actual target. Naufal and Firdaus (2017) In this case, the DMUs of MAN 1 Bangka, MAN 1 Pangkalpinang, and MAN 1 Belitung are still not able to optimize their inputs, such as the number of teachers and the number of certified teachers, which are relatively more than the DMUs of MAN IC Bangka Tengah and MAN 1 West Bangka. The resulting output (UN average) is lower than DMU MAN IC Bangka Tengah and MAN 1 Bangka in the 2017/2018 – 2018/2019 academic year. Supposedly, the number of certified teachers is directly proportional to student achievement. As research conducted by Meiliyani et al., (2021) and Pramesti et al., (2018) shows that teacher certification is able to improve the quality of graduates.

In addition, teacher certification also has a correlation with teacher performance. If the teacher's performance is high, the student's learning achievement will also be high. Research results from Meiliyani et al., (2021) and Ristianey et al., (2020) prove that teacher performance has an effect on student achievement. Based on the number of students input, MAN 1 Pangkalpinang, MAN 1 Bangka, and MAN 1 Belitung have more students than DMU MAN IC Bangka Tengah and MAN 1 Bangka Barat. The number of students at DMU MAN 1 Pangkalpinang actually has the potential to increase output. The greater the number of students, the greater the chance of getting students with optimal cognitive abilities. Regarding the number of students, DMU MAN 1 Pangkalpinang, MAN 1 Bangka, and MAN 1 Belitung need to build a strict selection system for prospective students. Student selection is important to map students' initial abilities such as talent, motivation, learning styles, cognitive abilities, and student interests (Magdalena et al., 2020)

In terms of budgeting, DMU MAN 1 Pangkalpinang, MAN 1 Bangka, and MAN 1 Belitung have budgets far above MAN 1 Bangka Barat. MAN 1 West Bangka is the DMU that has the lowest budget (<

1 billion) among other DMUs. However, it is efficient in producing output with an average UN score over a period of 2 academic years. Although the number of students of DMU MAN 1 West Bangka in the 2018/2019 academic year increased (236 – 322) and the amount of the budget was still constant, the average output of the National Examination was relatively constant (49.01). Thus, DMU MAN 1 West Bangka was efficient in utilizing inputs, which is minimal but able to produce optimal output when compared to DMU MAN 1 Pangkalpinang, MAN 1 Bangka, MAN 1 Belitung. Meanwhile, DMU MAN 1 IC Bangka Tengah, although the total budget in the 2018/2019 academic year decreased Rp. 19,469,486.

In addition, one of the causes of the inefficiency of DMU MAN 1 Bangka is that the teacher-student ratio is not ideal for the input variables. Based on Government Regulation No. 74 of 2008, Santosa & Rahmawati (2018) state that the ideal ratio of teachers to students for SMA/MA level is 1:20. Meanwhile, DMU MAN 1 Bangka in the academic year 2017/2018–2018/2019 has not yet reached the ideal ratio, which is  $> 1:20$ .

Based on the results of the analysis using the CRS model, it is known that there are three DMUs that are inefficient, namely DMU MAN 1 Bangka, MAN 1 Pangkalpinang, and MAN 1 Belitung. The analysis using DEA is not only able to find out which DMUs are efficient and inefficient, but it can also find out how DMUs should achieve maximum efficiency by knowing the potential improvement value of each DMU. Potential improvements can suggest how much input variables can be reduced and how much output variables can be increased (Lepchak & Voese, 2020).

**Table 3.** Value of Potential Improvement of Inefficient DMU Input and Output Variables

DMU	Academic Year	Input					Output	
		Total Budget*	The number of students	Number of Certified Teachers	Total number of teachers	Teacher&Student Ratio	% Graduation	UN Average
MAN 1 Pangkalpinang	2017/2018	903.797.507	235	7	23	10	100	50,40
MAN 1 Bangka		346,873,000	236	7	23	10	100	50.00
MAN 1 Belitung		346,873,000	236	7	23	10	100	50.00
MAN 1 Pangkalpinang	2018/2019	1,028,728,755	234	7	23	10	100	50.51
MAN 1 Bangka		346,873,000	236	7	23	10	100	50.00
MAN 1 Belitung		346,873,000	236	7	23	10	100	50.00
<b>Average</b>		<b>553.336377</b>	<b>236</b>	<b>7</b>	<b>23</b>	<b>10</b>	<b>100</b>	<b>50.00</b>

Table 3 provides an overview of changes in the value of each input and output variable. Thus, DMUs that are still not efficient can find out which variables are recommended for increasing or decreasing values. Referring to the value of potential improvement above, the three inefficient DMUs need to increase and decrease in all variables except for the output variable, the percentage of student graduation.

If you pay attention, the suggested potential improvement values for the 3 DMUs are relatively the same in 2 academic years, except for the DMU 1 Pangkalpinang MAN, which differs in the input variables of the number of budgets and the number of students. Basically, the input variables used in this study, if they can be utilized and optimized properly by the DMU, will produce optimal output (Syuhud, 2019). Table 3 illustrates that three inefficient DMUs need to evaluate or improve on all input variables and one output variable. The value of potential improvement in table 3 provides suggestions for 3 inefficient DMUs to reduce the amount of budget and be followed by a reduction in the number of students. The ideal amount of budget for 3 DMUs is Rs. 553,336,377, assuming the number of students is 236.

The total budget and the number of students are compared with DMU MAN 1 West Bangka, which has a budget of 1 billion per academic year, but the output of the UN scores is higher than 3 inefficient DMUs (MAN 1 Pangkalpinang, MAN 1 Bangka, MAN 1 Belitung). Although theoretically the amount of budget managed by the school affects the improvement of school quality (Elik, 2018), it is also necessary to consider the school's ability to manage the budget. Thus, the findings of this study indicate that DMU MAN 1 Pangkalpinang, MAN 1 Bangka, and MAN 1 Belitung have not been able to manage the education budget optimally. Regarding the reduction in the number of students, DMU MAN 1 Pangkalpinang, MAN 1 Bangka, and MAN 1 Belitung can build a strict selection system. Thus, the input of students who enter really has the basic qualifications required by the school. Because student selection is one of the criteria for a superior school (Syuhud, 2019),

Another input variable that needs to be taken into account by the inefficient DMU is the number of certified teachers. The findings of this study indicate that the quantity of teachers who have been certified does not correlate with students' cognitive output. Based on the value of potential improvement for the inefficient DMU, it is suggested to reduce the number of certified teachers to 7 people. However, this is likely to be very difficult to do, considering that teacher certification is a legal mandate that must be fulfilled by teachers (Teachers and Lecturers Law, 2019). The solution that can be implemented is related to this. DMU can carry out a program to gradually increase the capacity and teaching ability of teachers who have been certified.

The teacher-student ratio input variable is also recommended to be adjusted. The ideal ratio based on the value of potential improvement is 1:10, with the assumption that the average number of students is 236 and the number of teachers is 23. This reference value is also compared with the efficient DMU of MAN 1 Bangka Barat and MAN IC Bangka Tengah. Then, for the output variable, the average UN value also needs to be increased again by an average of 50.

## CONCLUSION

Based on the results of the DEA analysis using the CRS model and the discussion, it can be concluded that the inefficient DMUs in the 2017/2018 academic year were MAN 1 Bangka (69.6%), MAN 1 Belitung (69.6%), and MAN 1 Pangkalpinang (63.6%). The DMUs that were inefficient in the 2018/2019 Academic Year were MAN 1 Bangka (71.8%), MAN 1 Belitung (71.8%), and MAN 1 Pangkalpinang (72.3%), while MAN 1 Bangka Barat and MAN IC Bangka Tengah are DMUs that have been efficient with an efficiency value of 100% consistently in the 2017/2018 and 2018/2019 Academic Years.

The 3 DMU inefficiencies occur in all input variables (number of budgets, number of students, number of certified teachers, number of teachers, ratio of teachers to students) and output variables (average UN scores). according to the target output. In addition, inefficiency also occurs in the output variable (the average value of UN). This shows that large inputs cannot be optimized properly by DMU MAN 1 Bangka, MAN 1 Belitung, and MAN 1 Pangkalpinang when compared to DMU MAN 1 Bangka, West, and MAN IC Bangka Tengah, which have a higher average output of UN scores.

Several corrective steps can be taken by the inefficient DMU, such as: 1) reducing the amount of budget that is adjusted to the ideal number of students by 236; 2) building a strict student selection system to maintain the ideal number of students; 3) increasing the quantity and quality of teachers who have been certified; and 4) maintaining a teacher-to-student ratio of at least 1:16.

The research findings at least provide implications both theoretically and practically. Theoretically, the concept of efficiency measurement developed in the fields of economics and management is very relevant to be applied to efficiency measurement, especially in the field of education. Practically, the findings of this study can be taken into account in decision-making related to efforts to improve the efficiency of the implementation of State Madrasah Aliyah in Bangka Belitung. In addition, the variable percentage of passing the national exam needs to be considered to be replaced with other output variables such as the absorption of graduates in higher education.

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