Analysis of The Performance of Junior High Schools in the Nisam Sub-District Using The Data Envelopment Analysis Method

Mudawali*, Dahlan Abdullah, Ilham Sahputra

Department of Informatics, Faculty of Engineering, Universitas Malikussaleh, Aceh, Indonesia

*Corresponding author E-mail: mudawali.180170059@mhs.unimal.ac.id

Abstract

Education plays a major role in improving the quality of human resources. To support this effort, an application is needed so that it can measure the efficiency of education performance quickly and automatically. This research uses the Data Envelopment Analysis (DEA) method. The Data Envelopment Analysis method is a method that utilizes linear programming to compare decision-making units, by comparing one Decision Making Unit (DMU) with other DMUs that use similar resources to produce similar outputs. This research successfully developed an application to measure the performance efficiency of junior high schools in Nisam District. The application was designed using UML, PHP, and MySQL, and data was collected through interviews with school officials. The application provides an attractive user interface and can calculate linear programming with the DEA method, in accordance with calculations using Lindo 6.1 software. The data used for the efficiency analysis includes input data, such as the number of teachers, other students, facilities and infrastructure, the number of students admitted in 2023, certified and uncertified teachers, teachers with master's degrees, PPPK teachers, honorarium teachers, as well as the average student pass rate and the number of students graduating in 2023 as output. Of the 6 sample schools, 5 schools (83.33%) achieved efficiency, while 1 school (16.66%) was not efficient.

Keywords: *Efficiency, Data Envelopment Analysis, Education, Junior High School, Linear programming.*

1. Introduction

Education is one of the main pillars in improving the quality of human resources. The extent of the performance of an education can show the quality of education. In addition to the planning process and strategies designed by teachers and schools, quality education also relies on the harmony of support from those closest to students and the community [1].

The progress of a nation is highly dependent on improving human resources, therefore school education must be instilled in children at various ages. However, this does not match the current conditions in Indonesia. In some districts, the nine-year education program mandated by the government has indeed produced results. However, the nine-year compulsory education program appears to be less successful in a number of remote districts. This phenomenon occurs due to various factors, including economic, cultural and geographical conditions.

Aceh is one of the provinces in Indonesia that also faces challenges related to the quality of education. From 2008 to 2013, the central government provided Special Autonomy (Otsus) funds to Aceh Province of around IDR 27.3 trillion. However, the education system in Aceh is still considered to be lagging behind despite receiving such large funds. So, why is education in Aceh still so lacking? This is due to the fact that some districts continue to place a high value on physical development without going hand in hand with improving the quality of their infrastructure and education. In Lhokseumawe City, the education sector received a budget of IDR 224 billion in 2013. That number increased to IDR 234 billion in 2014. However, physical development still received more than half of the funding. Emphasizing physical development is detrimental to the quality of education itself. Aceh has a low level of education because the quality does not match the physical development of education, both in terms of low graduation rates and the quality of teachers who are still below national standards. For example, the junior high school graduation rate in Aceh in 2012 was 99.42% (ranked 21st) and the MTs graduation rate was 99.27% (ranked 26th) [2]. This is in stark contrast to Aceh's current large budget.

From the brief explanation provided earlier, it is clear that the level and quality of education obtained by the people of Aceh is still far behind when compared to other provinces in Indonesia and developed countries. In this regard, schools need an efficiency indicator that

can illustrate whether their performance is efficient or not. Thus, this measurement is an important first step in monitoring the school's efforts in utilizing resources for the education process.

In educational institutions, the Data Envelopment Analysis (DEA) method has been widely used in various studies. In a study conducted by Meilyana which assessed the level of efficiency in the implementation of education at the Senior High School level using the DEA Method. This study only focused on five State Senior High Schools in North Aceh District. The efficiency assessment using the DEA CCR model shows that DMUs evaluated as efficient have a relative value of 1, while DMUs with a relative value of less than 1 are categorized as inefficient. SMA Negeri 1 Samudera obtained an efficiency value of 0.9918907 and SMA Negeri 1 Matangkuli obtained a value of 0.9947442. The computational results of the model show that the three SMA Negeri obtained an efficiency value of 1 [3].

Apart from educational institutions, this method is also widely used such as: Anindya Gita Atina Assessing the Evaluation of Production Process Efficiency Using the Data Envelopment Analysis (DEA) Method at CV. Mandiri Sejahtera Garment. This efficiency assessment process includes four input variables, namely the number of human resources, total work time, worker salaries, and additional pay for extra hours. The output variable represents the outcome of order fulfillment. The results of the efficiency calculation in this measurement, using the DEA method through the DEAP 2.1 program, show that three DMUs, namely DMU 6, DMU 8, and DMU 9, are classified as efficient DMUs. Meanwhile, the remaining six DMUs exhibit inefficiency. The efficiency values are respectively: DMU 1 has an efficiency level of 60.9%, DMU 2 reaches 90.3%, while DMU 3 shows an efficiency figure of 80.6%, DMU 4 of 85.6%, DMU 5 of 96.3%, and DMU 7 of 83%. Therefore, improvements are needed. For the 6 inefficient DMUs, the evaluation is done by comparing them against the efficient DMUs as a reference [4].

In addition, Muhammad Arasy Mi'raj analyzed the efficiency of Islamic Commercial Banks in Indonesia for the 2016-2020 period using the DEA method, employing input variables such as assets, labor costs, and operating costs, as well as output variables including financing and operating income. The results indicated that, in general, the efficiency level of Islamic Commercial Banks in Indonesia during the 2016-2020 period had attained an efficient level. However, for banks that are not yet efficient, improvements can be made by reducing the use of input resources in accordance with the predetermined target and increasing output to match the expected target [5].

Based on these problems, The author is interested in examining the efficiency level of the performance of the Junior High School in Nisam sub-district and made a final project proposal with the title "Analysis of the Performance of Junior High Schools in Nisam District Using the Data Envelopment Analysis Method". By utilizing the Data Envelopment Analysis (DEA) method, it is possible to measure and compare the level of efficiency among the units concerned.

2. Literature Review

2.1. Definition of Education

Education is a key factor in enhancing the quality of human resources. The extent to which an education unit performs can indicate the quality of that education. The planning process and strategies developed by teachers and schools are not the only indicators of quality education, but there are other important pillars such as the harmony of support from the community and those closest to students [6].

Thus, education can be defined as a process and effort made by individuals or educational groups aimed at shaping human maturity through various teaching, training, development, and application of educational methods. Ki Hajar Dewantara interpreted education as an effort to develop the character, intellectual, and physical characteristics of children, so that they can achieve a perfect life and live in harmony with nature and society [7].

2.2. Junior High School

In Indonesia, junior high school (SMP) is the first formal level of education after completing primary school (or its equivalent). Junior high school can be completed in a minimum of three years, starting from grades VII to IX. This school was known as Sekolah Lanjutan Tingkat Pertama (SLTP) from 1994/1995 to 2003/2004. The School Examination called Ujian Nasional (formerly Ebtanas) is one of the requirements for grade IX students and has an impact on the graduation rate. Junior high school graduates can enroll in SMA or SMK (or equivalent).

Junior high schools serve as a link between primary and secondary schools in some countries. Junior high school acts as a bridge between elementary school and high school. However, the term can be used in different ways, sometimes in opposite ways, in different countries. Junior high school has the same connotation as middle school for Chinese-speaking countries, especially China, Taiwan and Hong Kong, as well as Italy (= scuola media). Therefore, in some government and educational institutions, junior high school (SMP) is another term for "junior high school" which is basically schooling after primary school [8].

2.3. Definition of Efficiency

Efficiency is one of the methods to assess performance. Efficiency is one of the performance indicators on which all performance in an organization is based [9]. How well resources are used, it refers to efficiency in order to produce output results. Effectiveness refers to the extent to which a system successfully achieves its objectives, which is measured through a certain ratio or comparison between the actual output (results achieved) and the desired standard output. In the context of organizational activities, efficiency can be interpreted as saving the use of resources, where efficiency is related to "usability" or optimal utilization. The term "efficiency" refers to the ability to achieve the same results with fewer resources [3].

Efficiency is a measurement that compares the planned use of inputs with the actual application of their use. While achieving 100 percent efficiency is challenging, a level of efficiency close to that is highly desirable. This approach focuses more on managing inputs than outputs. Of the many methods that can be used, the frontier approach is a method that can be used in measuring efficiency [10]. This method has two main approaches, namely:

1. The parametric frontier approach is a method that uses a model to set all the conditions specific to the population parameters to be the basis of the study. The methods of Stochastic Frontier Analysis (SFA) and Distribution Free Analysis (DFA) can be used to measure the parametric frontier approach.
2. The non-parametric frontier approach, which does not require any special conditions on the parameters of the sample population used in the study. The non-parametric frontier approach can be measured using the Data Envelopment Analysis (DEA) method.
3. In Data Envelopment Analysis (DEA), the ratio of total output to total input is the main efficiency measure:

$$Efficiency = \frac{Output}{Input}$$ ………………………………..……………………………..…………………………………..(1)

The symbols in this formulation use x and y to represent inputs and outputs, while i and j refer to specific inputs and outputs. Thus, xi is the i-th input, and yj is the j-th output of the decision-making unit (DMU), while the total number of inputs is denoted by I and the total number of outputs by J, where I and J are greater than 0. Mathematically, this can be described as follows:

$$Virtual\ Input = \sum_{i=1}^{I} u_i x_i$$

....(2)

Where ui acts as a weight for input xi in the accumulation process. As for the output, the explanation is as follows:

$$Virtual\ Output = \sum_{i=1}^{J} v_i y_i$$

....(3)

With vj as the weight for output yj during the accumulation process. The following is the efficiency definition of the virtual input and output model mentioned above:

$$Efficiency = \frac{Output}{Input} = \frac{\sum_{i=1}^{J} v_i y_i}{\sum_{i=1}^{I} u_i x_i}$$

....(4)

Description:
Ui = Weight of output i
Xi = Number of "i-th output"
Vj = Input weight j
Yj = The jth input number

2.4. Data Envelopment Analysis (DEA) Method

The Data Envelopment Analysis (DEA) model was first introduced by Charnes, Cooper, and Rhodes in 1978. This approach, which is non-parametric, is used for the purpose of assessing the technical efficiency of each unit analyzed. DEA serves as a tool to evaluate operational performance in organizations by analyzing data from decision-making units (DMUs), which results in a comparison between weighted outputs and weighted inputs. efficiency score, also known as efficiency value, is the result of this ratio [3].

Data Envelopment Analysis (DEA) employs linear programming for compare decision-making units, by comparing one Decision Making Unit (DMU) with other DMUs that use similar resources to produce similar outputs. The solution of this model shows the level of productivity or efficiency of each unit when compared to other units. The main purpose of DEA is to provide a method for benchmarking and performance evaluation [6].

The relative efficiency of a DMU is calculated by assessing the ratio between the value of outputs and inputs used and then compared with other DMUs. DMUs that score more than 100% are considered inefficient, while those that score more than 100% are considered efficient. To improve the performance of less efficient DMUs, DEA uses a set of efficient DMUs as benchmarks. In addition, DMU inputs and outputs can be improved with the help of DEA so that they become more efficient.

The DEA method consists of the following steps for completion:
1. Determine the decision-making unit (DMU) to be observed.
2. Determine the inputs and outputs that make up the DMU.
3. Determine how efficient each DMU is.

The goal is to achieve the required input and output targets to achieve optimal performance. The efficiency calculation process is done by changing it into a mathematical form (linear program), then to solve this linear program, the simplex method is applied.

The DEA model can be done through two methodologies, namely input-oriented and output-oriented. The DEA model known as input-oriented DEA assumes constant output to minimize input. In contrast, the output-oriented DEA model assumes that inputs remain constant to maximize outputs.

In the DEA approach, there are two models for efficiency measurement, namely CCR & BCC. The model will be explained in detail below [11]:

1. CCR Model
   This model, introduced by Charnes, Cooper, and Rhodes in 1978, is an early model of DEA known as the CCR model. This model presumes a constant relationship between input growth and output, which is referred to as Constant Return to Scale (CRS) assumes that if input increases, output will increase by the same proportion increased by x times, then output will also increase by the same proportion, which is x times. In addition, this model also Presumes that every company functions at an optimal scale [3].
   The mathematical programming problem in determining the efficiency measure of DMU can be solved in the following way:

   $$\max\ h_0(u,v) = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{s} v_r x_{io}}\ ; subject\ to\ \frac{\sum_{r=1}^{su} u_r y_{rj}}{\sum_{i=1}^{m} v_i y_x} \leq 1$$
   ....(5)

   For :
   j = 1,2, ..., n; ur 0, ur = 1,2, ..., s; 0, i = 1,2, ..., m
   Where:
   xij= Observed input value for the i-th of the j-th DMU
   vi= Weight value for input of the i-th type
   yrj= Observed output value with the rth type of the jth DMU
   ur= Weight value for output of the rth type

2. BCC Model
   The CCR model was further developed by Banker, Charnes, and Cooper in 1984 into the BCC model. Unlike the CCR model, the BCC model assumes that companies do not always operate at an optimal scale or have not reached full efficiency. There are several factors that prevent companies from operating at optimal scale, such as high competitive intensity and financial constraints. This model assumes that the ratio between increasing input and output is not fixed, known as VRS (Variable Return to Scale). In VRS (Variable Returns to Scale), if inputs are increased by x times, It does not necessarily lead to an x-fold increase in output. Output may increase less or more than x times the addition of the input [3].

2.5. Database

A collection of data and information stored and organized in a computer in a systematically structured manner is called a database. This collection of data and information can be examined, processed, or manipulated with the help of computer programs that obtain information from the database. A database management system is software used to manage and retrieve databases. A collection of related data whose purpose is used to manage data more effectively and efficiently is what is meant by the term "database" itself [3].

2.6. LINDO (Linear Interactive Discrete Optimizer)

The LINDO program is a piece of computer software. The function of this application is to quickly process linear program formulas, solve and correct adjustments or check basic formulas in the results. It solves linear programming problems quickly, easily, and precisely and can handle linear programming problems with up to 100 constraints and 200 constraints.

Premise The basic operation of the LINDO program is to enter a formula, solve, and then estimate the correctness based on the formula and results. The formula in question is mathematical in nature. LINDO software can be used to solve this problem using linear programming. In general, LINDO software provides students with an easy-to-use experience in terms of formulating, solving and estimating the truth based on the answers. As a result, LINDO software facilitates exploration activities and can encourage students in linear learning programs.

2.7. Unified Modelling Language (UML)

Unified Modeling Language (UML) is a software modeling language that has been standardized to be a medium for writing software blueprints (Pressman). UML can be used for visualization, specification, construction, and documentation of various system components in software. Just as an architect provides blueprints as a guide for construction companies in building a structure, software architects create UML diagrams to assist programmers or developers in building software. The more we understand the vocabulary used in UML, the easier it is to understand software specifications.

In the mid-1990s, Grady Booch, Jim Rumbaugh, and Ivar Jacobson developed UML with contributions from the software developer community. Then, in 1997, the UML 1.0 specification was submitted to the Object Management Group (OMG), a non-profit organization responsible for the maintenance of computer industry specifications. After that, UML 1.0 was revised to UML 1.1 and accepted as a standard at the end of the same year. Up to now, the latest version of UML is UML 2.3, which has been adopted as a standard by ISO. Like coding languages, modeling languages using UML are kept regularly updated by the OMG. There are different types of diagrams in UML that are applied in software modeling, although there are four main types of diagrams that are often applied, namely: Use Case Diagram, Class Diagram, Activity Diagram, and Sequence Diagram. Overall, UML is now recognized as a standard in the formation of software models that describe system design using various types of diagrams [12].

2.8. Hypertext Prepocessor (PHP)

PHP, also known as Personal Home Page, is a web-based programming language designed and written by web developers. Rasmus Lerdorf, a software engineer who is also part of the Apache team, created PHP, which was launched towards the end of 1994. PHP was first designed with the intention of being able to monitor visitors to Rasmus Lerdorf's personal website. Form Interpreter, a tool for interpreting SQL instructions, was included in the second release. PHP/FI was the name of the second release. Since then, PHP has been increasingly recognized as a widely used programming language. In 1997, it was found that more than 50,000 sites worldwide were using PHP.

PHP is a server-side language, so it requires an always-on web server. PHP has various features that support the development of systems or websites, allowing integration with HTML. HTML is used to design displays, such as organizing text, tables, and creating forms. In addition, CSS is also needed to beautify the appearance of the web [13].

2.9. SQL (Structured Query Language)

MySQL is a database management system that uses basic SQL (Structured Query Language) commands and is quite popular. MySQL DBMS supports multiple users and multiple streams, MySQL has been used by more than 6 million users worldwide. As an open-source database management system (DBMS), MySQL offers two types of licenses: Free Software (free software) and Shareware (software with limited license). With the GNU General Public License (GPL), MySQL allows its users to access and utilize it for both personal and commercial purposes without license fees.

Unfortunately, UNIREG was not fully able to work properly for dynamic databases used on websites. Therefore, TcX searched for other solutions and eventually found miniSQL or mSQL, a software developed by David Hughes. However, mSQL did not support indexing so it did not meet TcX's needs. Eventually, there was a collaboration between the developers of UNIREG (Michael Monty Widenius), mSQL (David Hughes), and TcX to develop a new database system. In 1995, MySQL was released as it is known today. Currently, MySQL development is under Oracle [3].

2.10. XAMPP

XAMPP stands for Apache, MySQL, PHP, and Perl, with the letter 'X' indicating that the software can run on four major operating systems: Windows, Mac OS, Linux, and Solaris. This software is often referred to as cross platform or multi-OS software. As the name suggests, this software is a combination of several applications that support web creators who want to have their own web server on their PC or laptop. The software comes with a GNU license and can be downloaded at no cost over the internet, given its importance, especially for web developers who are just starting out.

XAMPP is a product of Apache Friends, a software development company. With features such as MySQL, PHP, and Perl, XAMPP is a very useful option for web developers. Its use requires users to have XAMPP, which includes these programming tools. In addition, the name "Apache" besides referring to the development company, also indicates that XAMPP provides a web server that can be run on the user's computer, similar to an actual web server [3].

XAMPP is a simple-to-use, free software that can be installed on both Linux and Windows operating systems. Every web server has a typical working directory structure. This directory is used to store all web application files, including PHP documents. In XAMPP, there is a working folder called 'htdocs' which is usually located at the C:/xampp/htdocs location for Windows users [13].

2.11. HTML (Hyper-Text Markup Language)

Hyper-Text Markup Language, commonly referred to as HTML, is the primary language used in website creation worldwide. Most websites that exist on the internet are built using HTML. With HTML, developers can add text, multimedia, and links to compatible web pages. Elements that link documents (hypertext) to elements that enhance interactivity can all be organized in a single HTML file.

HTML (Hypertext Markup Language) is a language used to mark up documents that will be published on the internet. In simple terms, HTML serves to organize the structure of web pages. This involves the use of various HTML elements that instruct the browser on how to display the content that has been selected. Since 1997, the HTML standard has been set by the W3C (World Wide Web Consortium) and continues to prove useful. In HTML, tags are used to define the structure, and those tags and elements are delimited with < and > characters [14].

2.12. CSS (Cascading Style Sheet)

CSS, which stands for "Cascading Style Sheets" is a language that serves to manage the style and appearance of elements in web development. With CSS, designers can define the appearance of elements such as headers on a website using IDs and classes to make it easier to organize layouts. As technology evolves, CSS is growing and becoming an essential component in modern web design. CSS is no longer limited to its use with HTML and XHTML, but has also been used to develop the appearance of Android applications. CSS works by using id or class [14].

CSS was created with the main purpose of separating content from document structure and appearance, thus making the creation and change of web design easier. Aspects of web design such as color, size, and formatting are included in the scope of CSS. By using CSS, web content and design can be clearly distinguished, so that they can be reused in certain views on the website. This also makes it easier to create large web pages [13].

2.13. Visual Studio Code

Visual Studio Code, editor kode sumber yang dirancang oleh Microsoft, tersedia untuk digunakan di Windows, Linux, dan macOS. The editor provides a variety of features, including support for debugging, integration with Git and GitHub, syntax highlighting, smart code completion, snippets, as well as code refactoring. Visual Studio Code offers extensive customization, enabling users to modify themes, keyboard shortcuts, and preferences, as well as install additional extensions to improve its functionality [15].

Visual Studio Code is designed to be lightweight and convenient to use, so it does not require high hardware specifications. It supports the creation and editing of source code in various programming languages, including Node.js, JavaScript, TypeScript, and many others. Visual Studio Code also provides a wide variety of extensions and an extensive ecosystem, so it has high compatibility with other programming languages and execution platforms, such as Python, PHP, .NET, and Java [16].

3. Methods

The system scheme of the Performance Efficiency Level of Junior High Schools in Nisam sub-district using the Data Envelopment Analysis (DEA) approach is used to be explained through the following illustration:
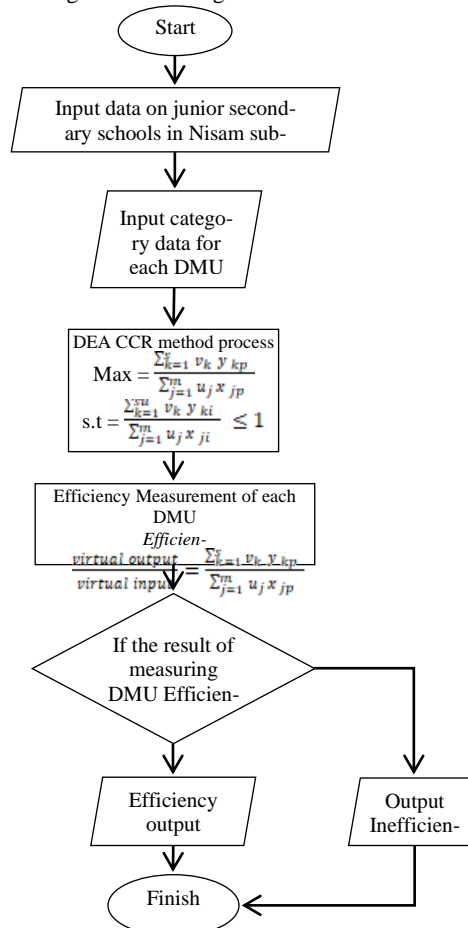

Fig 1. Schematic design of the system

Schematic explanation:
The process of evaluating the efficiency level in this program begins with the input of the required data, namely information on junior high schools or equivalent located in Nisam Sub-district. After the school data is inputted, the next step is to input the category for each DMU. This DMU data refers to the unit or organization that is the object of research. In this study, DMU data is in the form of the names of junior high schools in Nisam District. The next step is to apply the DEA CCR method to calculate the efficiency weight of each DMU that has been entered after the DMU data input process is complete. After the process of finding the weights for all DMUs is completed and the results are found, the next step is to determine the efficiency of each junior high school. We use the formula for efficiency which is the result of output divided by input to determine the percentage of efficiency produced by each DMU. The system will compare the efficiency level of each DMU. If the efficiency value reaches 1, the system will indicate that the unit is already efficient, while if the efficiency value is smaller than 1, the system will indicate inefficiency. The system workflow process will be completed when the result of the efficiency calculation is displayed.

4. Results and Discussion

This study aims to analyze the use of the Data Envelopment Analysis (DEA) approach with the aim of evaluating the level of efficient performance of six junior high schools (SMP) in Nisam District. The schools to be assessed include SMP Negeri 1 Nisam, SMP Negeri 2 Nisam, SMP Negeri 3 Nisam, SMP Negeri 4 Nisam, MTs S Nisam, and MTs S Hidayatullah. DEA (Data Envelopment Analysis) serves as an analytical tool to measure efficiency by basing the evaluation on predetermined inputs and outputs.

4.1. Process Analysis

This study aims to develop an application that can be used to measure the performance efficiency of junior secondary schools in Nisam sub-district, North Aceh district. The approach used in this study is Data Envelopment Analysis (DEA). In the application development framework, it is important to manage master data that includes variable, DMU, and value data. This master data will be used for the subsequent analysis process and will play a major role in the calculation process of the DEA model, which ultimately provides results in the form of education performance efficiency values and also the relevant optimal values for each variable in question.

Master data refers to a collection of information that includes variables, DMUs (Decision Making Units), and values associated with each DMU.

Table 1. Variable Data

Number	Type	Variable Name	Description
1	V1	Number of Teachers	*Input*
2	V2	Number of other Education Personnel	*Input*
3	V3	Number of Students	*Input*
4	V4	Facilities and Infrastructure	*Input*
5	V5	Number of Students Accepted in 2023	*Input*
6	V6	Number of Certified Teachers	*Input*
7	V7	Number of Uncertified Teachers	*Input*
8	V8	Number of Masters Graduate Teachers	*Input*
9	V9	Number of PPPK teachers	*Input*
10	V10	Number of Honorary Teachers	*Input*
11	U1	Average Student Graduation Score	*Output*
12	U2	Number of Students Graduated in 2023	*Output*

Table 2. DMU Data

Code	DMU
D1	SMP Negeri 1 Nisam
D2	SMP Negeri 2 Nisam
D3	SMP Negeri 3 Nisam
D4	SMP Negeri 4 Nisam
D5	MTs S Nisam

Code	DMU
D1	SMP Negeri 1 Nisam
D2	SMP Negeri 2 Nisam
D3	SMP Negeri 3 Nisam
D4	SMP Negeri 4 Nisam
D5	MTs S Nisam
D6	MTs S Hidayatullah

Table 3. Value Data

Number	DMU	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	U1
1	D1	34	16	322	36	147	176	19	1	2	2	12	87
2	D2	15	6	101	20	40	40	8	1	0	1	4	86
3	D3	21	4	115	19	55	94	11	10	0	2	5	85
4	D4	23	1	92	16	37	36	5	18	0	1	13	84
5	D5	25	4	183	30	70	45	8	13	2	4	17	93
6	D6	6	2	61	18	20	18	1	5	0	0	6	80

Table 4. Variable Weight Data

Type	Variable Name	Weight					
		D1	D2	D3	D4	D5	D6
U1	Average Student Graduation Score	0	0.0076	0	0.0080	0.0070	0.0111
U2	Number of Students Graduated in 2023	0.0057	0.0087	0.0106	0.0091	0.0007	0.0062
V1	Number of Teachers	0	0	0	0	0	0
V2	Number of Other Educators	0	0	0	0.1050	0.0079	0
V3	Number of Students	0.0030	0.0095	0	0.0097	0	0
V4	Facilities and Infrastructure	0	0	0.0526	0	0.0288	0.0401
V5	Number of Students Accepted in 2023	0	0	0	0	0	0.0139
V6	Number of Certified Teachers	0	0	0	0	0	0
V7	Number of Uncertified Teachers	0.0184	0.0363	0	0	0.0081	0
V8	Number of Masters Graduate Teachers	0	0	0	0	0	0
V9	Number of PPPK Teachers	0	0	0	0	0	0
V10	Number of Honorary Teachers	0	0	0	0	0	0

From the efficiency ratio calculation, it is possible to identify which DMUs exhibit efficiency values, where DMUs with efficiency weight values of less than 1 are considered inefficient. The results of the efficiency ratio calculation show that as seen in the following table:

Table 5. Variable Weight Data

Code	DMU	Efficiency Ratio	Status
D1	SMPN 1 Nisam	1	Efficiency
D2	SMPN 2 Nisam	1	Efficiency

D3	SMPN 3 Nisam	1	Efficiency
D4	SMPN 4 Nisam	1	Efficiency
D5	MTSS Nisam	0.68	Inefficiency
D6	MTsS HIDAYATULLAH	1	Efficiency

4.2. System Implementation

1. Homepage

    When the application is run, the first login page is displayed. The administrator is required to log in by entering the correct username and password to access the system. If the login information provided is correct, the system will take the admin to the admin portal. However, if there is an error in the login data, the admin will be asked to re-enter the correct login information.
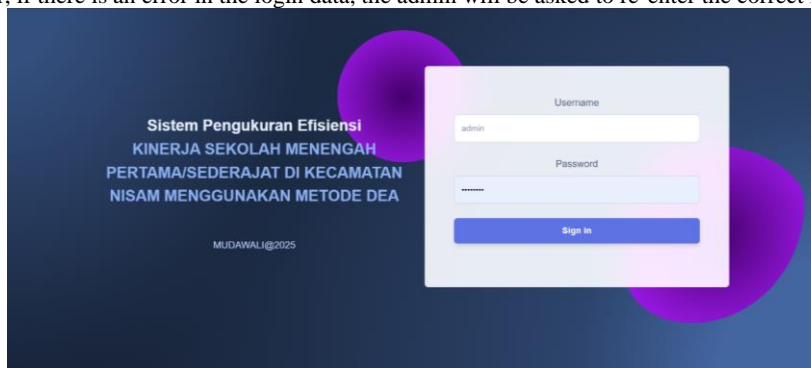
Fig 1. Home page view (Indonesia)

2. Admin Portal Page

    The admin portal is the main page in the application that presents various menus, such as Dashboard, Variables, Values, Analysis, Analysis Results, and Logout. This page displays information related to input variables, output variables, and DMUs involved. In addition, there is one table on the admin portal page, namely the analysis results data table that shows the conclusions of the analysis. There is also a bar chart graph that shows the efficiency ratio value for each DMU.
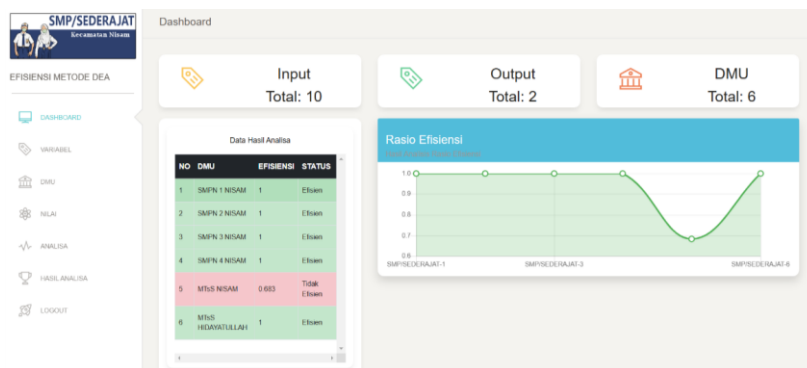
Fig 2 Admin portal page view (Indonesia)

3. Variable Page

    This page can be opened through the Variable menu option in the main menu. In this Variable menu, there are buttons that function to add data and a table that displays variable data. The Add Data button in this menu functions to open the variable data input field, while the data table functions to display information that has been input into the application. Each row in the table is equipped with a button to edit or delete data. The Edit button in the table allows users to open the edit form to update existing parameter data, while the delete button in the variable data table functions to delete the selected parameter data. However, before the deletion is carried out, a confirmation popup will appear to confirm the action. If the user selects the 'Yes' button, the variable data will be deleted from the database. Conversely, if the 'No' button is selected, the confirmation box will be closed and the variable information will fail to be deleted.

Fig 3 View Variable data page (Indonesia)

4. DMU Page

This page can be opened through the decision unit (DMU) data menu option. In this menu, there are action buttons to add information and a table containing DMU information. The button to add data is used to open a form to enter DMU data. The table contains information that has been entered into the application, and on each row of the table there is a button to edit or delete DMU data. The button to edit in the DMU data table is used to open the editing form, which allows users to update DMU data. Meanwhile, the delete button in the DMU data table is used to delete DMU data. Before the deletion is carried out, a confirmation popup will appear, where if the user selects 'Yes', the DMU data will be deleted from the database, but if the user selects "Cancel", the confirmation box will be closed and the data will not be deleted.

Fig 4 DMU data page view (Indonesia)

5. Value Page

This page can be opened by selecting the Value menu located in the main menu, precisely under the DMU menu and above the Analysis menu. On this page will display a table of values that have been entered into this application and is equipped with an action button at the end of each row whose function is to open an editing form that allows users to update numeric information.

Fig 5 View value data page (Indonesia)
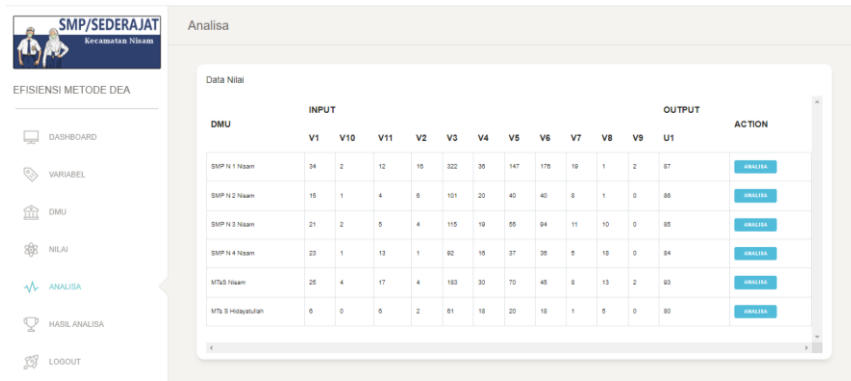
6. Analysis Data Page

Fig 6 Analysis page view (Indonesia)

This page can be opened through the Analysis menu option located between the Value menu and the Analysis Results menu. On this page, there is an Analysis button that is used to display the analysis results of linear programming. In addition, this page also has a 'Show Linear Programming' button that functions to display the equations of linear programming.
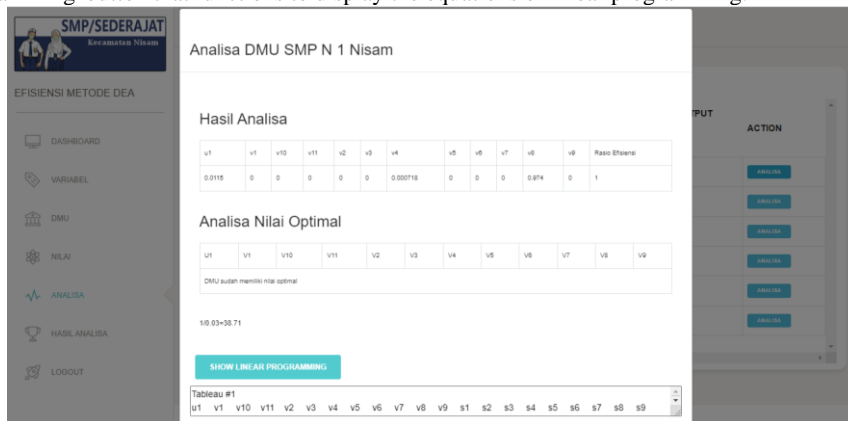

Fig 7 Show Linear Programming Page View (Indonesia)

7. Analysis Results Page

    This page can be viewed through the Analysis Results menu option located between the Analysis menu and the Logout menu. On this page, the results of the analysis will be displayed, namely the efficiency status obtained. If the efficiency value shows efficient results, the value displayed is 1, while if it is not efficient, the value displayed is less than 1. There is a Print Table button in the Analysis Results menu whose function is to print a table of the Analysis results.
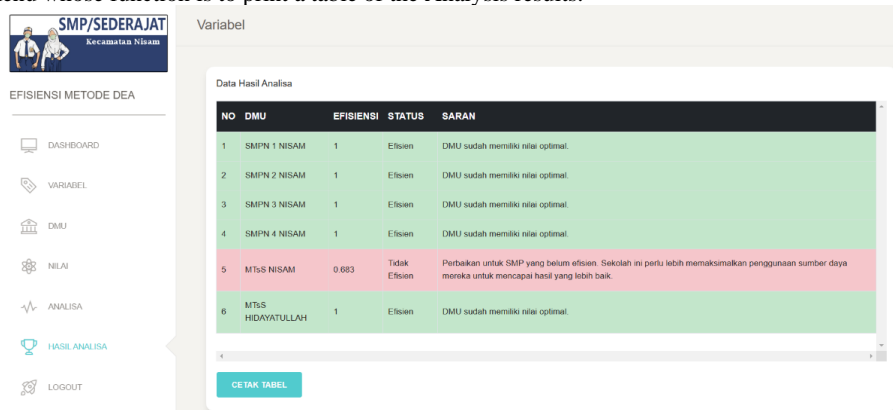

Fig 8 View the analysis results data page (Indonesia)

5. Conclusion

Based on the research that has been done, the authors get the following conclusions:
1. This research shows success in developing an application to measure the performance efficiency of Junior High Schools and Equivalent in Nisam District using the Data Envelopment Analysis method. This application is designed using UML, PHP, and MySQL, and data is collected through interviews with the school.
2. This application provides an attractive and dynamic user interface to calculate linear programming with the DEA method, in accordance with the calculations carried out using Lindo 6.1 software. Users can enter input and output variables to perform many DMU calculations without the need to type complicated linear equations. The result of efficiency calculation, optimal variable recommendation, and efficiency value graph are displayed directly by the application.

3. The data used in the efficiency analysis includes input data, namely the number of teachers, other students, facilities and infrastructure, the number of students admitted in 2023, certified and uncertified teachers, teachers with master's degrees, PPPK teachers, honorarium teachers, as well as the average value of student graduation and the number of students graduating in 2023 as output. Of the 6 sample schools, 5 schools (83.33%) achieved efficiency, while 1 school (16.66%) was not efficient..

References

[1] A. Mustadi, E. Zubaidah, and S. Sumardi, "Peran Komite Sekolah Dalam Peningkatan Mutu Pembelajaran Di Sekolah Dasar," *J. Cakrawala Pendidik.*, vol. 35, no. 3, pp. 312–321, 2016, doi: 10.21831/cp.v35i3.10578.

[2] Sudarwati, *Analisis Kinerja Pendidikan Provinsi Aceh*. 2015.

[3] D. Abdullah Meilyana Muhammad Syahrul Kahar Bunyamin, *Penerapan Metode Data Envelopment Analysis Untuk Pengukuran Efisiensi Kinerja*. 2020.

[4] A. G. Atina, "Pengukuran Tingkat Efisiensi Aktivitas Proses Produksi Menggunakan Metode Data Envelopment Analysis (DEA) (Studi Kasus : CV . Mandiri Sejahtera Garment)," *Lap. Tugas Akhir*, 2023.

[5] M. A. Mi'raj, *Analisis Efisiensi Bank Umum Syariah di Indonesia Pada Periode 2016-2020 Dengan Metode Data Envelopment Analysis (DEA)*. 2022.

[6] Meilyana and D. Abdullah, "Prototipe Aplikasi Penerapan Metode DEA Untuk Pengukuran Efisiensi Kinerja Pendidikan Sekolah Menengah Atas Negeri Di Kabupaten Aceh Utara," *Ind. Eng. J.*, vol. 8, no. 2, 2019, doi: 10.53912/iejm.v8i2.412.

[7] Hariyanto, "Pengembangan Karakter Pada Peserta Didik Melalui Pendidikan Kewarganegaraan," vol. 1, no. 2, pp. 92–98, 2021, doi: 10.51878/educational.v1i2.204.

[8] A. Shah and A. J. Rakhmadi, "Manajemen Peserta Didik Pada Smp Swasta Dharma Utama Desa Sukasari Kabupaten Serdang Bedagai," *Edumaniora*, vol. 01, pp. 97–102, 2022, [Online]. Available: https://journal.cdfpublisher.org/index.php/edumaniora/article/download/32/30

[9] I. Tisrinasari, S. Hanoum, and S. Hanoum, "Evaluasi Efisiensi Penyelenggaraan Pendidikan di Indonesia Menggunakan Metode Data Envelopment Analysis. Studi Kasus: Jenjang Sekolah Menengah Kejuruan Tahun 2018," *J. Sains dan Seni ITS*, vol. 9, no. 1, pp. 52–57, 2020, doi: 10.12962/j23373520.v9i1.50923.

[10] L. F. Israwan, B. Surarso, and F. Frikhin, "Implementasi Model CCR Data Envelopment Analysis (DEA) Pada Pengukuran Efisiensi Keuangan Daerah," *J. Sist. Inf. Bisnis*, vol. 6, no. 1, p. 76, 2016, doi: 10.21456/vol6iss1pp76-83.

[11] N. Farida and M. Azhari, "Pengukuran Efisiensi Menggunakan Dea dan Pengaruhnya Terhadap Stock Return Efficiency Measurement Using Dea And Its Effect Towards Stock Return," *Sikap*, vol. 2, no. 2, pp. 112–121, 2018, [Online]. Available: http://jurnal.usbypkp.ac.id/index.php/sikap

[12] R. Abdillah, "Pemodelan Uml Untuk Sistem Informasi Persewaan Alat Pesta," *J. Fasilkom*, vol. 11, no. 2, pp. 79–86, 2021, doi: 10.37859/jf.v11i2.2673.

[13] I. R. Ahmad, "Pengembangan Sistem Informasi Pesantren Di Kota Semarang Berbasis Responsive Web Design," *J. Ilm. Sist. Inf. dan Ilmu Komputeri*, vol. 3, no. 1, p. 5, 2020.

[14] Dendy Kurniawan, *Belajar Pemrograman Web Dasar HTML, CSS, & Javascript Untuk Pemula*. 2015. [Online]. Available: https://penerbit.stekom.ac.id/index.php/yayasanpat/article/view/417

[15] Agustini and W. J. Kurniawan, "Sistem E-Learning Do'a dan Iqro' dalam Peningkatan Proses Pembelajaran pada TK Amal Ikhlas," *J. Mhs. Apl. Teknol. Komput. dan Inf.*, vol. 1, no. 3, pp. 154–159, 2019, [Online]. Available: http://www.ejournal.pelitaindonesia.ac.id/JMApTeKsi/index.php/JOM/article/view/526

[16] A. Sulistiyani, "SISTEM INFORMASI PELAYANAN DESA BERBASIS WEBSITE DI DESA KEDUNGDAWA," *J. Chem. Inf. Model.*, vol. 53, no. 9, pp. 1689–1699, 2023, [Online]. Available: http://kbbi.web.id/preferensi.htmlDiakses

[17] F. Julianda, "Aplikasi Pengukuran Tingkat Efisiensi Kinerja Usaha Mikro Kecil dan Menengah (UMKM) di Kota Lhokseumawe Menggunakan Metode Data Envelopment Analysis," p. 62, 2023, [Online]. Available: https://rama.unimal.ac.id/id/eprint/152

[18] E. A. Putri, "Aplikasi Pengukuran Efisiensi Penggunaan Pupuk Pada Usaha Tani Cabai Merah Dengan Menggunakan Metode Data Envelopment Analysis," pp. 1–39, 2023, doi: 10.1007/1-4020-7798-x_1.

[19] M. A. Mi'raj, *Analisis Efisiensi Bank Umum Syariah Di Indonesia Pada Periode 2016-2020 Dengan Metode Data Envelopment Analysis (Dea)*. 2022.