國立政治大學應用經濟與社會發展
英語碩士學位學程
International Master's Program of Applied Economics and Social Development
College of Social Sciences
National Chengchi University

碩士論文
Master's Thesis

COVID-19 時代下印尼省份的教育支出效率：以 DEA 數據包絡分析法
The Efficiency of Education Expenditure in Indonesia by Province during COVID-19 Era: A DEA approach

Student: Yesika Berliana Sitorus
Advisor: Dr. Shiou-Yen Chu

中華民國 111 年 7 月
July 2022

DOI:10.6814/NCCU202200936

Acknowledgements

I express my deepest gratitude to my advisor, Dr. Shiou-Yen Chu, who has always been an understanding teacher since taking classes on semesters up to finishing my study in IMES. The long journey that I walked through to this point would be impossible without the patience and kindness of Dr. Chu, dealing with myself that sometimes lost motivation to write this thesis. I appreciate my thesis defense committee members, Dr. I-Ting Lu and Dr. Wen-Chieh Lee, for their positive responses and constructive feedback to this thesis so I can complete the last step for this master's diploma. I want to thank you, my friends, for the thoughtful messages, my seniors for the constant push and critique, and my family for the endless love and trust in me. This thesis would not be complete without all of your support.

DOI:10.6814/NCCU202200936

Abstract

This study aims to assess and analyze the efficiency of education expenditure in Indonesia by province during the COVID-19 era (2019-2021). Education is one of the sectors in which the government puts its focus. Exclusive for education, Indonesian government allocates at least twenty percent of its annual government budget. This study chooses several indicators, including one input and four outputs, to determine the efficiency of education expenditure utilization in Indonesia. Education expenditure (EE) is the input in the analysis. The four outputs are the teacher-to-students ratio (TSR), class-to-students ratio (KSR), the education completion rate (ECR), and average school life (ASL).

Data Envelopment Analysis (DEA) is chosen as the methodology for analyzing the education expenditure efficiency of Indonesian provinces. The model assumes a variable return to scale (VRS) and uses input and output orientations. The results show that most provinces were relatively inefficient throughout the three years of the COVID-19 era. Nevertheless, a higher number of efficient provinces are found in 2021. The increasing number of efficient provinces can not be accepted as the COVID-19 influence the provinces to be more efficient. The number of efficient provinces appears to be higher, but in reality, those provinces still have some slacks in one or more variables. Some strong efficient provinces are the Special Capital Region of Jakarta, Riau Islands, North Kalimantan, and Maluku. These efficient provinces spread geographically and can become a good model for other provinces located in the nearby region.

Based on the analysis results, the Indonesian government can focus on two essential aspects: teacher and class provision. Moreover, most provinces that need more teachers or classes are the ones that use more than twenty percent of government expenditure for education. The slack analysis also finds that these provinces should be able to achieve the current output level with much lower input. Therefore, in the future, the government must take bold action to ensure the availability of good and proper education in any parts of the country.

Keywords: Efficiency, Education Expenditure, Indonesia, Data Envelopment Analysis

DOI:10.6814/NCCU202200936

摘要

本研究旨在評估和分析 COVID-19 時代（2019-2021 年）印尼各省的教育支出效率。教育是政府重點關注的領域之一。印尼政府專門為教育分配了至少 20% 的年度政府預算。本研究選擇了幾個指標，包括一個投入和四個產出，來確定印尼的教育支出利用效率。教育支出 (EE) 是分析中的投入。四個產出是教師與學生的比率（TSR）、班級與學生的比率（KSR）、教育完成率（ECR）和平均在校生活（ASL）。

選擇數據包絡分析（DEA）作為分析印尼各省教育支出效率的方法。該模型假設變動規模報酬 (VRS) 並使用投入和產出導向。結果表明，在 COVID-19 時代的三年中，大多數省份的效率相對較低。儘管如此，在 2021 年發現了更多的高效省。雖然在 2021 年較多的省份變得有效率，但並非是受 COVID-19 的影響。有效省份的數量看似較多，但實際上，這些省份在一個或多個變量上仍有一些不足。一些強大的高效省份是雅加達特別首都區、廖內群島、北加里曼丹和馬魯古。這些高效的省份在地理上分佈廣泛，可以成為附近地區其他省份的良好模式。

根據分析結果，印尼政府可以重點關注兩個基本方面：教師和班級提供。此外，大多數需要更多教師或班級的省份是那些將政府支出的 20%以上用於教育的省份。差額變數分析還發現，這些省份應該能夠以低得多的投入達到目前的產出水平。因此，在未來，政府必須採取大膽的行動，確保在全國任何地方都能獲得良好和適當的教育。

DOI:10.6814/NCCU202200936

Table of Contents

DOI:10.6814/NCCU202200936

List of Tables

DOI:10.6814/NCCU202200936

List of Figures

DOI:10.6814/NCCU202200936

I. Introduction

Indonesia is a country with a population of the fourth highest in the world, with about 270 million people (BPS, 2021). This populous nation is home to over a thousand ethnic groups spread from Sabang (the westernmost city) to Merauke (the easternmost city). In Indonesia, central and local governments must allocate at least 20 percent of their total budget to education. The country has followed this practice since 2009. The government's role is crucial to provide high-quality education to its people as it is written in the state constitution, the 1945 State Constitution of the Republic of Indonesia (*Undang-Undang Dasar Negara Republik Indonesia Tahun 1945*, UUD 1945). It generally mentions the mandate that each Indonesian citizen has a right to obtain an education. Besides the fundamental provision, the government needs to ensure that the education is delivered with the proper medium, tools, and infrastructure so the students can follow the learning process without any issues.

"To fully take advantage of Indonesia's demographic dividend (i.e. working-age population greater than non-working-age population) and be competitive globally, Indonesia faces challenges in improving its human capital," said President Joko Widodo at the opening of the plenary cabinet meeting in January 2018.[1] A positive correlation between human capital and economic growth has been documented by Hanushek and Woessmann (2008). Their research found that cognitive skills have a real and significant effect on several important outcomes, such as earnings, income distribution, and economic growth. As one of the most populous countries globally, Indonesia, a developing country, relies on future generations to sustain its ongoing development. For this reason, since at least a decade ago, the central government put an essential highlight on investment in human capital, especially education.

As the education resources and facilities in the country vary significantly from one place to another, Indonesia adopts a decentralized approach to education provision. Decentralization of education aims to create more efficiencies in delivering the service to

[1] https://nasional.kompas.com/read/2018/01/03/16514421/2018-jokowi-ingin-pemerintah-fokus-tingkatkan-sdm

DOI:10.6814/NCCU202200936

the public (Busemeyer, 2007). The central government suggested the 12-year compulsory education in June 2015 for the local governments that can execute the plan according to their budget and capability. This action means that in the execution of education provision, although governed by the central government (in this case, the Ministry of Education, Culture, Research, and Technology), each local government could exercise its rights to adjust how they implement the instruction in their province. This delegation is because the local governments are more aware of their resources and needs in each region or city.

The government budget allocation to education is a big responsibility for both central and local governments to ensure that each person can access good education. Although the central government gives an extent of freedom in how local government fulfills its obligations in providing education to the public, there are still some final (absolute) regulations. One is the requirement of 20 percent of government expenditure for education. In general, the local government has its revenue and expense, but most of the funds that the provincial government uses for expenditure come from the central government. The fund travels from the upper level to the lower level of government. This flow of money, if not carefully controlled and mindfully spent, will be a loss for the country and its people.

One of the challenges in recent years to efficiently managing government expenditure is the pandemic COVID-19. In general, COVID-19 was firstly detected at the end of 2019. The virus then spread to almost all countries in the world. The first positive case in Indonesia was found on March 2nd, 2020. Although the pandemic mainly affected a country's health sector, it also harms other related sectors, not only limited to education. In this regard, to reduce the widespread of the virus, the government instructed the schools and universities to do some preventive measures. This is done to ensure that the learning process will not risk the health of teachers and students. Accordingly, starting from March 2020, Indonesia gradually conducts distance learning at all levels of education.

As a consequence of distance learning, the optimal learning process varies from each level of education. However, in general, both teacher and student feel distance learning via online classes is ineffective and difficult to implement. Moreover, students in

DOI:10.6814/NCCU202200936

the first years of each level of school have a very vague idea of how to start their studies in a new environment. The government did not prepare the education expenditure to accommodate the new condition of the teaching and learning process. The essential tools for both teacher and student are laptops or personal computers (PC) with internet connection. However, in reality, unless the parents already owned the laptop or PC for the job requirement, it is unlikely that each student will be provided with it at home.

Furthermore, as of April 2022, the pandemic impacted Indonesia even deeper. More than six million people are infected with the virus, and more than one hundred and fifty thousand death cases. This makes the death rate caused by COVID-19 of roughly 2.5% in Indonesia, which if we compare it to the rate in other countries, such as the USA and India at 1.2 percent, Brazil at 2.1 percent, and Russia at 2 percent, means that the death rate of COVID-19 patients in Indonesia is among the highest in the world.[2] From this current state, we could say that Indonesia is one of the countries heavily affected by the pandemic. This makes every step that the government takes to handle the pandemic in Indonesia needs to be proper to tackle the direness of the situation. Primarily to ensure their government expenditure (particularly in education) is managed efficiently. It is rising the urgency to explore the efficiency of Indonesian government education expenditure in the relevant period, which is COVID-19 era.

In sum, education expenditure is how the government takes responsibility to ensure the rights of the people to have access to proper education. To nourish a better generation for the country, Indonesia makes education its top priority investment in human capital. The budget is formulated, updated, and improved yearly to achieve the best possible outcome. The constitution explicitly mandates twenty percent of the total annual budget to the education sector. This grand sum of money will benefit and impact the young generation if used and distributed correctly. Indonesia, a country committed to its young generation's education, is willing to spend one-fifth of its government spending on education. This current system makes us wonder whether the government budget for education is well-spent, specifically efficient. Accordingly, the general research question

[2] https://covid19.who.int/table; calculation by author.

DOI:10.6814/NCCU202200936

proposed by this study is whether the Indonesian government expenditure on education is efficient or not during COVID-19 era (2019-2021)?

As Indonesia is one of the vast and populous countries, there is an unavoidable gap in education infrastructure in different regions. A study on Indonesia's education disparity found that there are inequality issues in socio-economic conditions, which manifested in the education disparity between Eastern and Western Indonesia (Azzizah, 2015). Figure 1 shows the Eastern and Western parts of Indonesia. There are twelve provinces in the East region and twenty-two provinces in the West part. Generally, the western part is better in terms of infrastructure, education, and overall economic activity than the eastern region.

Figure 1. Indonesia, Eastern and Western Parts

Source: https://www.mapchart.net/asia-detailed.html, modified by author.

The purpose of this study is twofold. First, I examine and analyze the efficiency of Indonesia's government expenditure on education during the pandemic COVID-19 (2019-2021) by provinces. Second, I identify the characteristics of the efficient and the inefficient provinces.

This research adopts the Data Envelopment Analysis (DEA) model to assess Indonesia's education expenditure efficiency. DEA is a non-parametric statistical method and is widely used in performance measurement. The efficiency scores indicated by DEA identify efficient producers in a studied population and allow benchmarking against the

DOI:10.6814/NCCU202200936

"best in class" producer (Shewell, 2016). The comparison to the best sample/producer makes DEA different from parametric methods such as regression analysis, which uses a comparison that represents the population's average performance. The application of DEA in this study suits its purpose: to determine whether the government spends the education expenditure efficiently or not. By assessing every province in Indonesia, we can see which regions perform better than the others.

This thesis focuses on the efficiency of education expenditure instead of effectiveness for two reasons. First, the terms efficieniency and effectiveness both refer to the capability of producing a result. Assuming there is a production of goods or services, they are both goal-oriented. Second, there is a fundamental difference in how they achieve the production goal. For example, effectiveness only considers whether the goal is achieved or not. On the other hand, efficiency cares about resources and time. It highlights how well a production takes place. Therefore, instead of analyzing whether the goal of education succeeds in delivering education, this thesis analyzes how well the education expenditure is utilized to generate a quality education. Considering the limited education expenditures and the urgency to raise the competitiveness of the young generation in Indonesia, I choose to study the efficiency of education expenditure in Indonesia via the DEA approach.

This study is organized as follows. Section one gives an overview of Indonesia and its education, especially how important is the education sector in Indonesia. Here also mentions how education provision is conducted in the country and the challenges Indonesia faces during the pandemic of COVID-19. Therefore, it highlights the urgency of efficiently utilizing education expenditure in the country. Section two provides the literature review covering the previous research on government expenditure and the methods used to measure its efficiency. This section also covers the previous research related to education efficiency in Indonesia. Section three presents the methodology that describes the data, variables, measurement, and also methods used in this thesis. Section four is the results of the analysis. The last section contains the conclusions and suggestions for the future actions possible for Indonesia.

DOI:10.6814/NCCU202200936

II. Literature Review

2.1. Human Capital and Economic Growth

Lucas (1988) emphasized that human capital played an important role in economic growth and considered it the engine of growth. One of the main factors in the formation of human capital is schooling. Human capital accumulation affects and contributes to the productivity of all production, both internally and externally. Human capital accumulation will intensify a country's initial product mix over time. Therefore, it is not surprising that some countries can have dramatic development in a short time.

Tallman and Wang (1994) examined the human capital relation with endogenous growth in Taiwan. They discovered that the educational attainment measures as human capital proxy enhances the accountability of economic growth in a developing economy. The research results show that human capital plays an essential role in the miraculous development of the Taiwan economy, aligned with the endogenous growth theory introduced by Lucas (1988).

2.2. Previous Studies Related to Government Expenditure

Government expenditures on education and health are two direct spending for social welfare purposes. It is undoubtedly crucial that the government have to utilize the funds in both sectors efficiently.

Gupta and Verhoeven (2001) discovered that government spending in African countries considerably impacts measurable production. On average, governments in the African countries were less efficient compared to Asian and Western countries in providing health and education services. The productivity of government spending was also found relatively unchanged since the mid-1980s. Furthermore, the efficiency analysis revealed that the degree of inefficiency rises rapidly as government spending increases. This implied that government needs to be careful in expanding its expenditure, especially on education and health.

DOI:10.6814/NCCU202200936

Furthermore, the study of Clements (2002) presented a result that suggests a substantial degree of inefficiency in education expenditure in the European Union (EU). By using the benchmark of "best practices" from the FDH (Free Disposal Hull) production frontier and comparison with other countries, EU countries could achieve a similar level of educational output with about twenty-five percent fewer resources. This finding showed that academic performance could be improved without increasing the spending on education. Furthermore, the cross-country examination implied that additional educational resources would not automatically translate into better educational performance. This emphasized the importance of educational reforms instead of extra spending to tackle problems in education performance.

A related point made by Hauner (2008) was that increased spending did not always imply better results. According to the study, significant increases in public spending could result in the projected improvement in public services when they were accompanied by reforms that promote expenditure efficiencies, such as administrative reforms to strengthen government governance and incentives.

Afonso and Aubyn (2005) focused their research on measurements of quantity inputs. The purpose was to evaluate if the efficient country appears inefficient from a technical standpoint if the inputs are pricey. In terms of input consumption, they discovered that most of the countries analyzed were inefficient. On average, the governments could have produced the same output with 11% fewer resources. From a different perspective, the average country created around 6% less than when it was efficient, using the same inputs.

Hunt and Link (2020) studied about the hospital efficiency related to public health spending. They found a positive correlation between the increase in public health spending and the hospital efficiency. This eventually resulted in a healthier population, increased hospital productivity, and lower expenditure.

From several studies mentioned above, we can see two opposite sides of the findings. The first one is that the increase in government expenditures does not equal the rise in expenditure efficiency. The other is that increased expenditure will eventually lead

DOI:10.6814/NCCU202200936

to better outcomes and higher efficiency. This means that the treatment of government expenditure is not necessarily uniform across countries but needs to be examined further whether the better solution is to increase the expenditure and its benefit or a more fundamental approach such as reforming the system.

2.3. Education Efficiency in Indonesia

There is currently a lack of literature that explicitly studies education efficiency in Indonesia. Some studies mention the efficiency problem regarding Indonesia's education sector, but they are not precisely measured and examine the education efficiency itself. A study by Maliki et al. in 2021 briefly discussed education efficiency issues in Indonesia. They stated that the problem of education efficiency is related to the utilization of resources. Instead of financial resources, the study focused on how Indonesia's education system did not utilize technology resources to its full extent.

Milawati and Fahrudin (2021) studied education performance in Indonesia. Their study showed that the government expenditure on education contributes to the education performance in the short-run but not in the long run. Here, they evaluated the education performance only based on the number of gross enrollment rates aged 15 years and over. They argued that the annual increase in education costs in Indonesia will eventually exceed the education budget that does not always increase yearly, thus making the education expenditure not sustainable in the long run.

Shaturaev (2022) discussed the challenge in Indonesian education that the quality needs to be improved in addition to increasing access to education. This study argued that Indonesia's poor education performance was caused by the low public spending on education, lack of human resources and management, and a problem of politics and power. It concluded that the intervention to raise education quality should proceed with a fundamental shift in the political and social relationships that shaped the evolution of the Indonesian education system.

DOI:10.6814/NCCU202200936

2.4. DEA Approach to Measure Efficiency

Data Envelopment Analysis (DEA) is a technique commonly used to assess the efficiency of a service-producing unit because it can manage various output characteristics of public sector production (Ruggiero, 1996). The application of DEA ranged in many aspects of the service sector, for example, in health care, universities, government, public transport services, or banks (Tapia et al., 2022).

In 2019, Kohl et al. studied the application of DEA in healthcare with a focus on hospitals. They reviewed the previous 262 publications in their study and grouped them according to the research purposes, such as to see the effects of reforms, application of the new method, find answers to specific management purposes, and the rest just to find out the efficiency estimation.

The academic research performance at universities and research institutes was studied by Korhonen et al. (2001). The purpose of the study was to allow the university's research units to utilize resources more efficiently. Academic research was analyzed as a form of the production process in this study, and used money as the input measure. On the other hand, the output measures were four relevant research criteria: research quality, research activity, impact, and activity in doctoral student education.

Focus on the case of Indonesia, Solihin et al. (2017) studied the efficiency and effectiveness of government education spending at the district/city level in Indonesia's East Java region. To examine the efficiency component of the research, they employed DEA with CRS (constant returns to scale) and VRS (variable returns to scale) assumptions as of the technique. According to the study, many locations in East Java were found to be inefficient in allocating government expenditure in the education sector.

This study follows the methodology conducted by Solicit et al (2017) but differs in the following aspects. First, the level of the DMUs is different. Solicit et al (2017) used the district level, while this thesis uses the province level. Second, the assumption for the scale returns is different. Solicit et al (2017) assumed constant return-to-scale (CRS). CRS is more suitable at the district level because the value of expenditure in the lower level of

DOI:10.6814/NCCU202200936

governments (districts and cities) are closer in size than the variation across the province. On the other hand, the variety of local governments (provinces) size in this analysis is large, thus VRS is deemed more suitable in this thesis. Last, this study uses slacks analysis to better understand the area that provinces could improve in the future. Table 2 summarizes the literature reviews related to government expenditure (mentioned in Section 2.2 to 2.4).

2.5. DEA Advantages and Limitations

Seiford and Thrall (1990) discussed development in DEA, a mathematical programming approach to efficient frontier estimation. They studied several DEA models and examined the effect of model orientation. In the discussion, they also mentioned the advantages and limitations of DEA. Table 1 summarizes the advantages and limitations of DEA.

Despite its limitation, DEA is still widely used in assessing performance. This thesis chooses DEA to analyze the efficiency of education expenditure because of DEA's capability to identify the sources of inefficiency based on the given output, and it can be quantified in terms of percentage.

Table 1. Advantages and Limitations of DEA

Advantages	Limitations
No assumptions required to determine the frontier form	Ignores statistical errors
Analyze the outputs and inputs at the same time	Ignores exogenous variables (external information) effect in a production
Determine efficiency relatively, according to best observation included in the study	No solution to improve efficiency
Multiple inputs and outputs can be included in the analysis	Ability to discriminate between DMUs decreases

DOI:10.6814/NCCU202200936

Table 2. Summary of Previous Relevant Studies

Studies	Sample/Period	Method	Findings
Gupta and Verhoeven (2001)	37 African countries/ 1984 to 1995	Free Disposal Hull (FDH)	Inefficiency rises as government spending rises
Clements (2002)	European Union countries/1996		A substantial degree of inefficiency in education expenditure
Afonso and Aubyn (2005)	OECD countries/ 2002	Data Envelopment Analysis (DEA) and FDH	The majority of the countries are technically inefficient
Hauner (2008)	Russia's regions/ 2004	DEA	Increased spending does not guarantee better results
Hunt and Link (2020)	6000 hospitals in US/2007, 2010, 2012		Positive correlation between public health spending and hospital efficiency
Maliki et al. (2021)	Related Literatures/ 1992 to 2020	Library Research	Problems in Indonesian education included quality, efficiency, and utilization aspects.
Milawati and Fahrudin (2021)	Indonesia/ 2006 to 2020	Auto Regression Distributed Model (ARDL)	Different results between education aspects that affect the education performance in short-term and long-term
Shaturaev (2022)	Indonesian Education/ various qualitative information	Literature Review	Change in the quality of Indonesian education related to politics in the country
Kohl et al. (2019)	262 papers of DEA application		DEA results still not adapted enough in practice
Korhonen et al. (2001)	18 research units at Helsinki School of Economics/1996	DEA	The majority show inefficient results
Solihin et al. (2017)	38 districts in East Java, Indonesia/ 2007 to 2014		Most districts were not efficient in allocating the education budget.

DOI:10.6814/NCCU202200936

III. Methodology

3.1. Data Envelopment Analysis (DEA)

DEA is a non-parametric method of linear programming used for assessing the efficiency and productivity of units called Decision Making Units (DMUs) (Ji and Lee, 2009). The application of DEA varies greatly because personal, business, or any government organization can be assigned as DMU. DEA originated from Farrell's original work in 1957, which Charnes, Cooper, and Rhodes later popularized in 1978.

3.1.1. DEA Inputs and Outputs

In order to assess the efficiency of education expenditure in Indonesia during COVID-19 era, this study adopts the DEA model proposed by Cuellar (2014), which uses single input and multiple outputs to appraise education expenditure efficiency. I analyze the efficiency difference in education expenditure at the province level. Accordingly, each province is treated as one decision-making unit (DMU). There are 34 DMUs and 5 variables of input and outputs.

In DEA, the larger numbers of inputs and output could diminish the discriminatory ability of the program (Cook et al., 2014). According to Golany and Roll (1989), the number of DMUs should be at least twice the number of the input and output variables. On the other hand, Banker et al. (1989) state that the number of DMUs should be at least three times the total number of inputs and outputs. However, there is no statistical basis for such a rule; but only imposed for convenience.

For optimum analysis in DEA, capturing all relevant input and outputs is crucial, meaning the more relevant variables are better (Cook et al., 2014). Accordingly, despite data availability limitations, I choose four outputs that can at least capture the performance of utilization of education expenditure by the government to provide education in Indonesia. Table 3 depicts the DEA model employed in this investigation with one input and four outputs. Variables will be explained in section 3.3.

DOI:10.6814/NCCU202200936

Table 3. DEA Model

DMU	Input	Output 1	Output 2	Output 3	Output 4
Province A	X_A	$Y_{1, A}$	$Y_{2, A}$	$Y_{3, A}$	$Y_{4, A}$
Province B	X_B	$Y_{1, B}$	$Y_{2, B}$	$Y_{3, B}$	$Y_{4, B}$
Province C	X_C	$Y_{1, C}$	$Y_{2, C}$	$Y_{3, C}$	$Y_{4, C}$
Province D	X_D	$Y_{1, D}$	$Y_{2, D}$	$Y_{3, D}$	$Y_{4, D}$

Source: Cuellar (2014)

3.1.2. Returns to Scale (RTS) Identification

DEA has two kinds of assumption in terms of return to scale, which are constant returns to scale (CRS) proposed by Charnes, Cooper, and Rhodes in 1978 (also known as the CCR model), and variable returns to scale (VRS) introduced by Banker, Charnes, and Cooper in 1984 (the so-called BCC model). CRS assumes that all DMUs are operating at maximum capacity, while VRS allows the technical and scale sides of efficiency to be separated. In other words, VRS focuses on the measurement of technical efficiency and CRS focuses on the measurement of scale efficiency. Figure 2 shows the difference in VRS and CRS frontier. Axis X represents the input, while axis Y represents the output. In this thesis, X is the education expenditure, while Y is several output indicators to show the input's performance. For example, point "L" is a DMU with technical inefficiency according to the VRS frontier. "L" could use less input to produce the current output level. From another perspective, it should attain a higher output level with the current input level.

DOI:10.6814/NCCU202200936

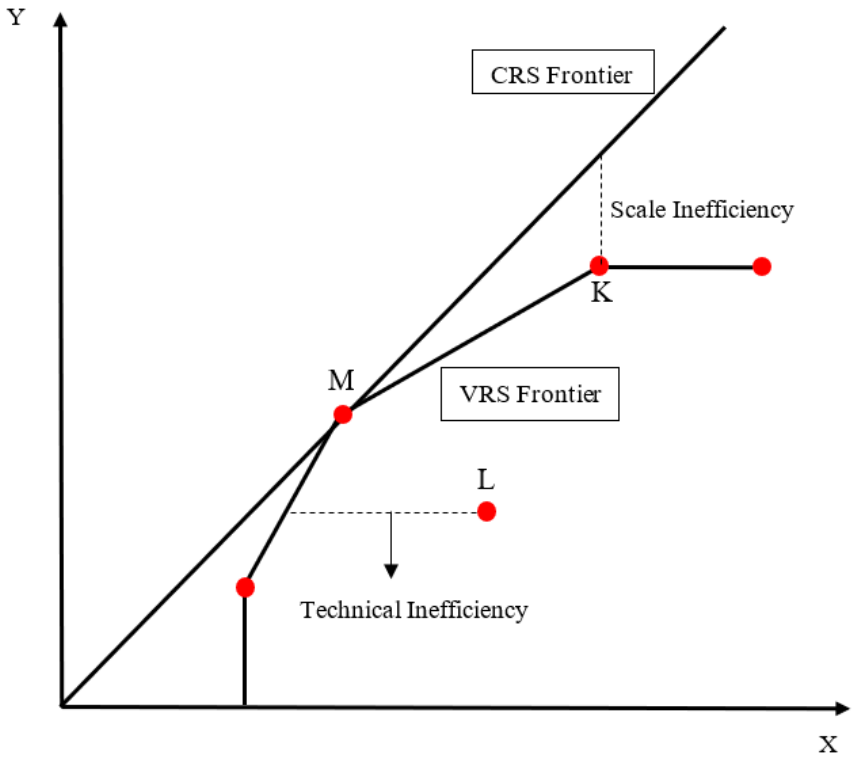

Figure 2. Pure Technical Efficiency and Scale Efficiency

Source: Coelli et al. (2005)

3.1.3. Model Orientations

DEA has two kinds of orientation, which are the output and input oriented models. The goal of analysis determines which model to be used in a study. For example if the study wished to identify whether a DMU using too many resources, then the focus is input reduction. Therefore, the input oriented model is more appropriate to be used in such circumstances. On the other hand, if the focus is to improve the outcome in a production or management, then the output oriented model is more suitable (Cook et al., 2014).

In this thesis, I use both orientations in the analysis, but the main focus is the ouput orientation. This is because the primary goal of government is to provide quality education, therefore the output from the education expenditure is the highlight of this study. Also, the practice of reducing input to achieve better outcome is unlikely to happen in government expenditure case. The government are more likely to maintain the level of expenditure while striving for better performance. The input oriented analysis is used as reference to

DOI:10.6814/NCCU202200936

identify any regions that might use too large of resources but do not deliver the expected performance.

3.2. Data

This study mainly uses secondary data collected from three related government institutions of Indonesia: 1) Ministry of Finance (*Kementerian Keuangan*), 2) Ministry of Education, Culture, Research, and Technology (*Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi*), and 3) National Statistical Bureau (*Badan Pusat Statistik,* BPS). The data obtained from the Ministry of Finance, specifically from the Directorate General of Fiscal Balance, is the regional government expenditure based on function. This annual data of the allocated budget summarizes the number of funds that the national government used for all sectors, such as education, health, economics, public safety, environment, tourism and culture, et cetera., which also breakdown specifically into the regional level.

The data collected from the Ministry of Education, Culture, Research, and Technology are the Indonesian Statistics of Education, which summarizes the conditions of Indonesian education at each level (e.g., primary school, junior high school, vocational or senior high school, et cetera). The data contains the number of schools, students, teachers, classes, and some other aspects. These data are also breakdown into a regional level. The last data collected from the Indonesian Statistical Bureau is the education completion rate and average school life, or the school life expectancy.

Based on the research objective, the sample period of the data is from 2019 to 2021. In this regard, the year 2019 was when the world was COVID-19-free, whereas the year 2020 was the starting year of COVID-19 entering Indonesia. In this case, the budgeting plan of the government was not prepared enough to deal with the pandemic. On the other hand, the year 2021 was when the government had already experienced the pandemic condition, particularly related to their budgeting plan.

3.3. Variables

Five variables are used in this current study, classified as input and output variables.

DOI:10.6814/NCCU202200936

Input Variable

Education Expenditure (EE) stands for the amount of annual education expenditure allocated by each province. This variable is measured by the amount of government expenditure allocated for education. This variable is in money terms, Rupiah (Rp.), the Indonesian currency. The exchange rate between Rupiah and New Taiwan Dollar is around Rp. 495 for NT$ 1.

This variable is chosen as the input because education expenditure is the primary account of the government's expense for education. 20% of the annual government budget allocated to education is through education expenditure. This amount might vary yearly according to the condition of each provincial government (The percentage could be lower or higher than 20%, a very few cases of it be lower).

Output Variables

1. Ratio of Teacher to Students (TSR)

This variable is measured by the total number of teachers and students ranging from primary school to junior high school to vocational and senior high school. According to Indonesian government regulation (*Pasal 17 Peraturan Pemerintah Nomor 74 Tahun 2008*), the ideal TSR for primary school to senior high school is one teacher for every twenty students, while one teacher for every fifteen students for vocational high school. The ratio number (1:X), refers to "X" number of students supervised by one teacher.

This variable is chosen to capture the government's capability to provide human resources in the education sector. The students possibly perform better if they have enough attention from teachers in school. If the availability of teachers is assured, the quality will improve, and it will achieve better educational attainment.

2. Ratio of Class Students (KSR)

Like TSR, the KSR variable is measured by the total number of classes and students from all levels of education mentioned before. From the same government regulation mentioned above, instead of the ideal number of KSR for each level of education, the law

DOI:10.6814/NCCU202200936

stated the minimum and the maximum number of students for each class, which is 15 to 28 students for primary school, 15 to 32 students for junior high school, 15 to 36 students for senior high school and 12 to 36 students for vocational high school. This variable also shown as 1:X.

This variable is selected to capture the condition of schools throughout provinces in Indonesia. Besides ensuring enough teachers in the region, the government must provide conducive learning conditions. Smaller class will allow the students to interact more with teachers, thus improving the learning outcome.

3. Education Completion Rate (ECR)

ECR is measured by taking the average number of ECR from three levels of education mentioned above. In Indonesia case, highest ECR is found in lower level education (primary school).

This variable is selected to reflect the general condition of students in Indonesia that still not pursuing the 12-year education encouraged by the government. Also, the gap between the eastern and western parts of Indonesia is well captured in this variable. We could find that most provinces in the eastern region have lower completion rates.

4. Average School Life (ASL)

ASL is the average school life duration of a population age ≥ 15 years old, commonly referred to as school life expectancy (SLE). A relatively high ASL, or close to 12, indicates a probability that the young population spent long years in education. In Indonesia, it is mandatory to have twelve years of schooling.

This variable is chosen to capture the education attainment duration of Indonesia's population. To support the ECR that highlights the completion of each level of education, ASL shows the average of the most extended period of schooling experienced by people in each province. Unlike ECR, the shorter schooling period is also found in the western part of Indonesia, even the provinces on Java Island (Central and East Java).

DOI:10.6814/NCCU202200936

In some studies, for example Koc and Celik (2015), Ajani and Akinyele (2014), and Adunola (2011), TSR or KSR is used to assess education performance from the input side or determining factor. However, as the objective of this study is to see how efficient the government utilizes the education expenditure, a proper and adequate TSR or KSR is seen as one of the effort of government to ensure the quality of education. For example, by supplying enough teachers that can accommodate a supportive environment for learning activities, thus the reasoning behind choosing TSR and KSR as outputs in this current study. Table 4 summarizes the data variables.

Table 4. Summary of Data Variables

Variable	Variable Name	Type	Data Source	Sample Period
EE	Education Expenditure	Input	Ministry of Finance	2019 - 2021
TSR	Teacher-Students Ratio	Output	Ministry of Education, Culture, Research, and Technology	Academic Year 2018/2019 to Academic Year 2020/2021
KSR	Class-Students Ratio			
ECR	Education Completion Rate		National Statistical Bureau	2019 - 2021
ASL	Average School Life			

3.4. Model Equations

This study aims to assess if the allocation of the input, EE efficiently produces the four outputs (e.g., TSR, KSR, ECR, ASL). Moreover, this study also analyzes which provinces are efficient or less efficient. As mentioned in previous part, this thesis conducts the analysis using DEA with VRS assumption. In DEA, besides the scale model (CRS and VRS assumptions), there is also an orientation model. This orientation model is divided into two, input orientation and output orientation. The input orientation model focuses on minimizing input, similar to cost minimization. The input-oriented model highlights the

DOI:10.6814/NCCU202200936

importance of using the lowest input level to achieve the current output level. On the other hand, the output orientation model focuses on maximizing output, similar to profit maximization. The output-oriented model emphasizes getting the highest level of output while maintaining the usage of the current input level.

The equations for calculating the efficiency of education expenditures are as follows:

1. Output-oriented VRS model

$$\text{Max } Eff_0 = \mu_1 TSR + \mu_2 KSR + \mu_3 ECR + \mu_4 ASL + \mu_0 \quad (3\text{-}1)$$

Subject to

$$\gamma_1 EE = 1 \quad (3\text{-}2)$$

$$-\gamma_1 EE + \mu_1 TSR + \mu_2 KSR + \mu_3 ECR + \mu_4 ASL + \mu_0 \leq 0 \quad (3\text{-}3)$$

$$\gamma_1, \mu_{1,2,3,4} \geq 0, \mu_0 \in \mathbb{R} \quad (3\text{-}4)$$

Description:

TSR = The teacher to students ratio

KSR = The class to students ratio

ECR = The education completion rate

ASL = The average school life

EE = The amount of education expenditure

The objective function represents efficiency that maximizes the weighted output by utilizing the available input (Equation 3-1). So that, the sum of weighted input equals one (Equation 3-2). So that, the weighted outputs minus the weighted input is less than or equals zero (Equation 3-3). Equations 3-4 show that the weights of input and outputs are more

DOI:10.6814/NCCU202200936

than or equal to zero. μ_0 is interpreted as a scale factor. The positive μ_0 indicates increasing returns to scale, while the negative μ_0 indicates decreasing returns to scale. If μ_0 is null, it means constant returns to scale.

2. Input-oriented VRS model

$$\text{Min } Eff_0 = \gamma_1 EE + \gamma_0 \tag{3-5}$$

Subject to

$$\mu_1 TSR + \mu_2 KSR + \mu_3 ECR + \mu_4 ASL = 1 \tag{3-6}$$

$$-\gamma_1 EE + \mu_1 TSR + \mu_2 KSR + \mu_3 ECR + \mu_4 ASL + \gamma_0 \leq 0 \tag{3-7}$$

$$\gamma_1, \mu_{1,2,3,4} \geq 0, \gamma_0 \in \mathbb{R} \tag{3-8}$$

Description:

TSR = The teacher to students ratio

KSR = The class to students ratio

ECR = The education completion rate

ASL = The average school life

EE = The amount of education expenditure

The objective function represents efficiency that represents the minimization of input while attaining the current level of outputs (Equation 3-5) so that the sum of weighted outputs equals one (Equation 3-6). So that, the weighted outputs minus the weighted input is less than or equals zero (Equation 3-7). Equations 3-8 show that the weights of input and outputs are more than or equal to zero. γ_0 is interpreted as a scale factor. The positive γ_0 denotes decreasing returns to scale, while negative γ_0 denotes increasing returns to scale. If γ_0 is null, it means that the scale returns are constant.

DOI:10.6814/NCCU202200936

IV. Results

4.1. Provinces of Indonesia

This part is the brief information about provinces mentioned in section 4.2. In addition, Figure 3 highlights the discussed provinces. The provinces appear according to their sequence in the next section.

First, Special Capital Region of Jakarta (SCR Jakarta) is the province where the capital city of Indonesia is located, while North Kalimantan is the youngest province of Indonesia. It was formed on October 25th, 2012. West Java and Banten are the second and the third most densely populated provinces after SCR Jakarta. Meanwhile, Central Kalimantan is one of the loosely populated provinces after North Kalimantan and regions in Papua Island (BPS, 2019). Aceh is the province located in the most northern part of Sumatera Island and one of the Indonesian regions where the highest percentage of its population is Moslems. Papua is a province located in the very eastern part of Indonesia. Papua is the most underdeveloped region with the shortest period of expected years of schooling in the country (BPS, 2021).

Bangka Belitung Islands are an archipelago province on the east coast of Sumatera Island. This province consists of 470 islands, including two main islands called Bangka and Belitung, but only 50 of them are inhabited. Bangka Belitung was the thirty-first province of Indonesia, established on November 21st, 2000. North Sulawesi is the northernmost province of Indonesia, and most of its area consists of mountains, hills, and valleys. Agriculture is the main occupation in this province. Lastly, the Special Region of Yogyakarta (SR Yogyakarta) is renowned as the center of education in Indonesia. One of the reasons is that SR Yogyakarta has more than 100 universities. The oldest and currently the best Indonesian university is also located in this province (Gajah Mada University).

DOI:10.6814/NCCU202200936

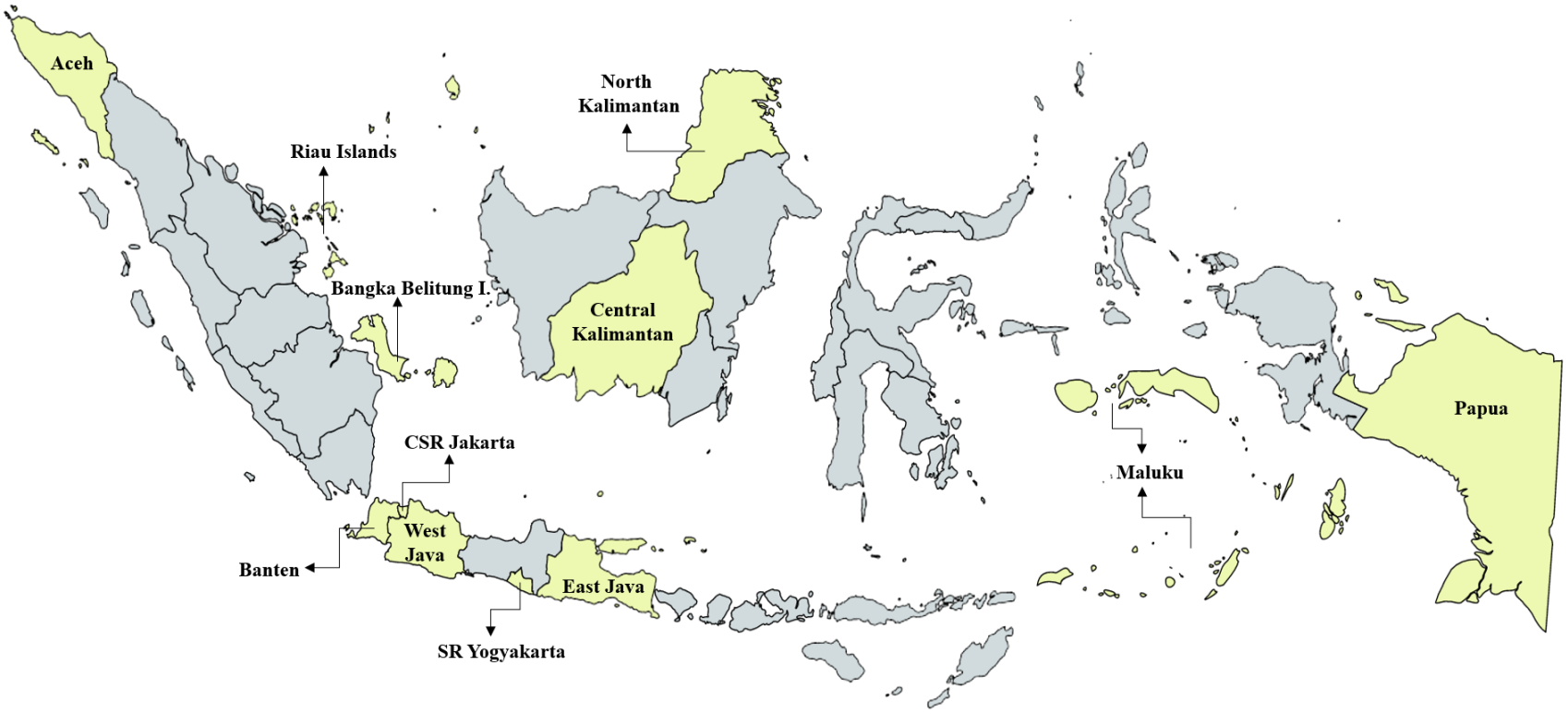

Figure 3. Indonesia Map

Source: https://www.mapchart.net/asia-detailed.html; modified by author

DOI:10.6814/NCCU202200936

4.2. Descriptive Statistics

Table 5 to 7 describe each variable's maximum and minimum value. Table 5 presents the descriptive statistics for 2019. In 2019, the province with the highest sum of education expenditure is SCR Jakarta, while the province with the lowest sum is North Kalimantan.

On the output side, I find the highest teacher-student ratio (TSR) in West Java with 1:21.76 (one teacher to supervise 22 students) and the lowest in Aceh with 1:10.01. The higher the TSR does not mean the better, as it shows that the province does not have enough teachers for the students. The highest class-students ratio (KSR) is found in Banten with 1:28.87 (one class has 29 students), and the lowest is found in Central Kalimantan with 1:19.03.

Following the same logic with TSR, the higher the KSR, the higher the number of students in one class. This means that the quality of the education received by the students can not be assured as the classroom is too crowded to conduct conducive teaching and learning activities.

The province with the highest education completion rate (ECR) is SCR Jakarta (91.14), while the lowest is found in Papua (53.27). The highest number of average school life (ASL) comes from SCR Jakarta (11.11), and the lowest comes from Papua (6.85). The mandatory education in Indonesia is 12 years, with 11.11 years of ASL in SCR Jakarta. Therefore, most people aged 15 years and older in SCR Jakarta completed mandatory education.

DOI:10.6814/NCCU202200936

Table 5. Descriptive Statistics (N=34), the Year 2019

2019	INPUT	OUTPUT			
	EE: Education Expenditure (in millions of Rupiah)	TSR: Teacher-Students Ratio (1:X)	KSR: Class-Students Ratio (1:X)	ECR: Education Completion Rate (%)	ASL: Average School Life (years)
Max	24,061,095.00 (SCR Jakarta)	21.76 (West Java)	28.87 (Banten)	91.14 (SCR Jakarta)	11.11 (SCR Jakarta)
Min	447,366.78 (North Kalimantan)	10.01 (Aceh)	19.03 (Central Kalimantan)	53.27 (Papua)	6.85 (Papua)
Mean	3,762,515.64	15.65	23.43	78.95	8.96
Standard Deviation	4,860,220.88	2.72	2.68	6.86	0.84

Note: Rp is Rupiah, Indonesian currency (Rp 1.47 million ≈ 100 USD). A ratio of 1:X indicates that one teacher supervises X number of students (for TSR); one class consists of X number of students (for KSR).

In 2020 (Table 6), similar to 2019, the highest value of education expenditure is also found in SCR Jakarta, 4.8% lower compared to the previous year, and the lowest value is found in Bangka Belitung.

The highest TSR is found in West Java (1:45.79), while the lowest ratio is found in North Sulawesi (1:22.77). For the KSR, the highest comes from SCR Jakarta (1:29.54), while the lowest comes from North Sulawesi (1:19.42).

The highest and the lowest ECR are held by the same provinces as the previous year. They are SCR Jakarta (92.68%) with an increase of 1.6% from the prior year, and Papua (58.36%) with a significant increase of 9.55% compared to 2019 percentage. Similar to the ECR, the ASL, both the highest and the lowest number, comes from SCR Jakarta

DOI:10.6814/NCCU202200936

with 11.17 years and Papua with 6.96 years. Both numbers have a slight increase from the year 2019.

Table 6. Descriptive Statistics (N=34), the Year 2020

2020	INPUT	OUTPUT			
	EE: Education Expenditure (in millions of Rupiah)	TSR: Teacher-Students Ratio (1:X)	KSR: Class-Students Ratio (1:X)	ECR: Education Completion Rate (%)	ASL: Average School Life (years)
Max	22,952,845.31 (SCR Jakarta)	45.79 (West Java)	29.54 (SCR Jakarta)	92.68 (SCR Jakarta)	11.17 (SCR Jakarta)
Min	516,300.28 (Bangka Belitung)	22.77 (North Sulawesi)	19.42 (North Sulawesi)	58.36 (Papua)	6.96 (Papua)
Mean	4,064,949.67	31.77	23.86	81.97	9.08
Standard Deviation	5,019,235.73	6.56	2.70	6.07	0.83

Note: Rp is Rupiah, Indonesian currency (Rp 1.47 million ≈ 100 USD). A ratio of 1:X indicates that one teacher supervises X number of students (for TSR); one class consists of X number of students (for KSR).

In 2021 (Table 7), the highest sum of education expenditure, although having a 12.53% decrease compared to 2020, also comes from SCR Jakarta, while the lowest sum came from North Kalimantan.

From the output side, the highest TSR is held by Banten with 1:24.51, while the lowest comes from Aceh with 1:11.84. The KSR is both the highest and lowest ratio for this year held by the same provinces in the year 2020, which are SCR Jakarta (1:29.34) and North Sulawesi (1:19.33).

DOI:10.6814/NCCU202200936

SR Yogyakarta holds the highest ECR with 94.51%, and the lowest percentage comes from Papua with 59.15%, a slight increase (1.35%) from the previous year. For the ASL, similar to the last year but with a small rise, the highest number is held by SCR Jakarta (11.20) and the lowest number held by Papua (7.05).

Table 7. Descriptive Statistics (N=34), the Year 2021

2021	INPUT	OUTPUT			
	EE: Education Expenditure (in millions of Rupiah)	TSR: Teacher-Students Ratio (1:X)	KSR: Class-Students Ratio (1:X)	ECR: Education Completion Rate (%)	ASL: Average School Life (years)
Max	20,076,756.79 (SCR Jakarta)	24.51 (Banten)	29.34 (SCR Jakarta)	94.51 (SR Yogyakarta)	11.20 (SCR Jakarta)
Min	445,067.78 (N. Kalimantan)	11.84 (Aceh)	19.33 (N.Sulawesi)	59.15 (Papua)	7.05 (Papua)
Mean	3,887,692.26	17.54	23.72	83.40	9.16
Standard Deviation	4,701,594.36	3.03	2.73	6.30	0.83

Note: Rp is Rupiah, Indonesian currency (Rp 1.47 million ≈ 100 USD). A ratio of 1:X indicates that one teacher supervises X number of students (for TSR); one class consists of X number of students (for KSR).

Table 5 to 7 show that SCR Jakarta holds the highest education expenditure for three consecutive years (2019 to 2021), and North Kalimantan holds the lowest education expenditure for 2019 and 2021. For the TSR, the lowest ratio for the years 2019 and 2021 is held by Aceh, meaning that the province has an adequate number of teachers for the total number of students. Meanwhile, the highest ratio for the years 2019 and 2020 is held by West Java. The year 2020 is exceptionally high compared to the other years' ratios, which is 1:45.79. This high number is caused by the significant decrease (51.87% lower compared

DOI:10.6814/NCCU202200936

to the previous year) in the number of teachers in West Java. In 2020 and 2021, the highest KSR is held by SCR Jakarta, but this number is still within the allowed maximum number of students for one class. The lowest KSR for year 2020 to 2021 is held by North Sulawesi but is considered normal on the island.[3] The highest ECR in 2019 and 2020 and the highest ASL from 2019 to 2021 are held by SCR Jakarta, while in 2021 for highest ECR is held by SR Yogyakarta. Meanwhile, the lowest ECR and ASL in three consecutive years are held by Papua (the number is increasing by year). Please see Table 8 for the comparison across the year of the maximum and minimum value variables mentioned above.

Table 8. Comparison of Maximum and Minimum Value of Variables

Type	Variable		2019	2020	2021
Input	EE (in thousands USD)	Max	1,636,809.18	1,561,418.05	1,365,765.77
		Min	30,433.11	35,122.47	30,276.72
Output	TSR (1:X)	Max	21.76	45.79	24.51
		Min	10.01	22.77	11.84
	KSR (1:X)	Max	28.87	29.54	29.34
		Min	19.03	19.42	19.33
	ECR (%)	Max	91.14	92.68	94.51
		Min	53.27	58.36	59.15
	ASL (years)	Max	11.11	11.17	11.2
		Min	6.85	6.96	7.05

Note: A ratio of 1:X indicates that one teacher supervises X number of students (for TSR); one class consists of X number of students (for KSR).

Next, we proceed to the variables' mean from the year 2019 to 2021 (Table 9). The three provinces with the highest mean of education expenditure are SCR Jakarta, West Java, and East Java (all of these provinces are located in Java Island). The province with the lowest mean of education expenditure is North Kalimantan (the youngest province).

[3] The average number of KSR in six provinces in Sulawesi Island ranged from 1:20.8 to 1:21.2.

DOI:10.6814/NCCU202200936

For the variable of teacher-student ratio (TSR), the highest mean ratio is held by West Java (1:30.61), the second-highest held by Banten (1:30.29), and the third-highest held by Bangka Belitung Islands (1:27.95). Meanwhile, the lowest mean of TSR is held by Aceh (1:14.89).

For the variable of classroom-students ratio (KSR), the highest mean ratio comes from SCR Jakarta (1:29.24), the second-highest comes from Banten (1:29.10), and the third-highest comes from West Java (1:28.86). On the other hand, the lowest mean of KSR comes from Central Kalimantan (1:19.28).

For the variable of education completion rate (ECR), the highest mean rate is found in SR Yogyakarta (92.46%), the second-highest rate found in SCR Jakarta (92.30%), and the third-highest found in Riau Islands (89.56%). On the contrary, the lowest mean of ECR is discovered in Papua (56.93%).

For the last variable, average school life (ASL), students' most extended mean duration of schooling period can be seen in SCR Jakarta (11.16 years), the second-longest in Riau Islands (10.24 years), and the third-longest in Maluku (10.16 years). In contrast, the shortest period of ASL can be seen in Papua (6.95 years).

DOI:10.6814/NCCU202200936

Table 9. Variables' Mean (2019-2021) by Province

DMU	INPUT	OUTPUT			
	EE (in millions of Rupiah)	TSR	KSR	ECR	ASL
Aceh	4,909,799.11	14.89	22.11	87.18	9.69
North Sumatera	6,443,168.51	22.93	25.26	85.76	9.81
West Sumatera	2,929,548.32	20.52	23.15	82.00	9.34
Riau	3,510,522.79	22.21	25.11	82.27	9.45
Jambi	1,717,658.48	19.72	22.80	81.74	8.95
South Sumatera	2,831,184.75	22.75	25.74	81.86	8.69
Bengkulu	1,068,376.01	17.63	22.50	81.78	9.18
Lampung	3,012,637.49	21.27	24.52	80.54	8.48
Bangka Belitung Islands	776,500.09	27.95	26.87	77.88	8.46
Riau Islands	1,159,607.77	23.16	26.15	89.56	10.24
SCR Jakarta	22,363,565.70	22.77	29.24	92.30	11.16
West Java	16,109,016.17	30.61	28.86	82.44	8.93
Central Java	12,010,246.79	27.53	24.96	80.03	8.16
SR Yogyakarta	2,358,130.43	22.70	24.07	92.46	9.94
East Java	13,005,060.45	24.85	23.89	82.77	8.26
Banten	4,768,497.03	30.29	29.10	82.66	9.19
Bali	2,379,305.08	22.00	26.49	87.56	9.32
West Nusa Tenggara	2,071,928.90	17.72	24.32	83.48	8.06
East Nusa Tenggara	3,011,770.27	19.96	23.01	70.83	8.09
West Kalimantan	2,383,165.04	23.91	22.19	74.05	7.90
Central Kalimantan	1,604,074.88	17.04	19.28	79.44	8.94
South Kalimantan	1,851,955.95	21.09	21.12	79.68	8.67
East Kalimantan	2,374,997.32	23.99	25.45	86.01	9.99
North Kalimantan	470,499.27	20.22	22.81	81.96	9.31
North Sulawesi	1,520,016.72	17.47	19.32	84.55	9.73
Central Sulawesi	1,686,974.90	19.57	20.30	78.45	9.08
South Sulawesi	4,352,361.24	21.75	22.68	82.47	8.85
Southeast Sulawesi	1,430,054.73	19.21	21.49	83.79	9.39
Gorontalo	689,397.09	21.81	21.83	75.14	8.23
West Sulawesi	628,624.54	19.22	20.45	76.67	8.31
Maluku	1,088,467.51	17.04	21.38	85.22	10.16
North Maluku	939,226.12	17.76	20.70	82.80	9.42
West Papua	2,190,173.46	19.61	21.03	76.73	9.98
Papua	3,125,272.90	25.11	26.61	56.93	6.95
AVERAGE	**3,905,052.52**	**21.65**	**23.67**	**81.44**	**9.07**

Table 10 shows the variables' standard deviation for three years from 2019 to 2021. SCR Jakarta shows the most significant variance in education expenditure data (9% difference from its mean value). For the teacher-students ratio data, Central Java has the largest variance. The data of class-students ratio overall have slight variance, with Papua at the largest with less than one student difference. Similarly, the education completion rate

DOI:10.6814/NCCU202200936

(ECR) and average school life (ASL) also have a slight deviation from their mean value. The biggest variance for ECR is found in Central Kalimantan, while East Java for the ASL variable.

Table 10. Variables' Standard Deviation (2019-2021) by Province

DMU	INPUT	OUTPUT			
	EE (in millions of Rupiah)	TSR	KSR	ECR	ASL
Aceh	282,252.29	6.92	0.31	1.66	0.09
North Sumatera	225,137.80	8.61	0.02	2.05	0.09
West Sumatera	480,083.44	9.53	0.15	3.23	0.12
Riau	191,939.83	9.58	0.29	2.41	0.09
Jambi	96,637.97	7.95	0.17	2.30	0.09
South Sumatera	858,089.23	9.41	0.20	2.51	0.09
Bengkulu	220,885.21	5.80	0.17	1.77	0.09
Lampung	56,785.67	7.95	0.21	2.15	0.10
Bangka Belitung Islands	234,356.06	14.32	0.10	2.85	0.10
Riau Islands	77,074.12	8.31	0.21	1.09	0.13
SCR Jakarta	2,056,495.95	3.75	0.36	1.02	0.05
West Java	1,777,536.43	13.21	0.25	1.88	0.12
Central Java	192,782.41	15.57	0.18	2.48	0.12
SR Yogyakarta	257,320.85	12.05	0.24	1.96	0.11
East Java	999,042.06	13.54	0.25	2.43	0.14
Banten	354,294.83	12.53	0.22	2.64	0.11
Bali	459,603.75	7.48	0.09	1.92	0.13
West Nusa Tenggara	66,005.91	7.95	0.22	2.33	0.08
East Nusa Tenggara	130,584.32	7.76	0.21	2.01	0.11
West Kalimantan	191,545.14	9.71	0.13	3.42	0.10
Central Kalimantan	52,248.99	6.38	0.22	3.84	0.10
South Kalimantan	666,740.06	10.79	0.27	1.54	0.08
East Kalimantan	129,073.96	9.96	0.31	3.15	0.11
North Kalimantan	42,073.35	6.90	0.55	2.29	0.08
North Sulawesi	17,160.02	4.69	0.11	1.28	0.10
Central Sulawesi	115,666.90	8.49	0.17	2.50	0.10
South Sulawesi	203,676.55	11.76	0.22	2.50	0.11
Southeast Sulawesi	330,671.88	8.87	0.23	2.18	0.14
Gorontalo	35,783.18	12.05	0.28	1.43	0.11
West Sulawesi	216,005.96	7.97	0.20	3.69	0.09
Maluku	304,413.75	5.54	0.32	1.42	0.12
North Maluku	13,728.52	5.48	0.27	3.02	0.10
West Papua	957,633.45	5.26	0.30	2.87	0.06
Papua	282,135.57	3.94	0.79	3.19	0.10
AVERAGE	**369,866.63**	**8.82**	**0.24**	**2.32**	**0.10**

DOI:10.6814/NCCU202200936

4.3. DEA Results

Table 11 and 12 present the efficiency rank provinces in Indonesia had from 2019 to 2021. The efficient provinces had a score of 1.0, and the inefficient provinces had a score of less than 1.0. An efficient score of 1.0 can also be considered 100 percent efficient. Both provinces' efficiency ranks in Table 11 and 12 use the VRS (variable return to scale) assumption, as the increase of inputs will not necessarily have an identical increment on output. The difference between both tables is the orientation of the analysis used in DEA. Table 11 uses output orientation that focuses on maximizing the outputs, for example, better ratio of teacher-students (TSR) and the ratio of classroom-students (KSR), higher education completion rate (ECR), and longer average school life (ASL). On the other hand, Table 12 uses input orientation that focuses on minimizing the input. In this case, lower education expenditure (EE) is better than higher.

The provinces' efficiency rank from 2019 to 2021 in Table 11 and 12 show that the provinces counted as efficient by using output orientation are also counted as efficient by analysis using input orientation. The ranks of the efficient provinces are almost identical, except for Bangka Belitung Islands in the year 2020 using input orientation (Table 12) included in the efficient group.

However, if we look at the scores between output-oriented and input-oriented analysis, there is a considerable difference between the efficient and inefficient provinces. From the average scores, the output-oriented analysis shows that provinces are at least 94% efficient (0.94 to 0.95). Meanwhile, the average scores from the input-oriented analysis show that provinces are only at 50 to 57 percent efficient. This low efficiency means that most provinces use too many resources to generate the current output level.

Regarding the efficiency ranking of provinces in Indonesia, both analyses using the output and input orientation give similar results. In both results, the number of efficient provinces increased in 2021. This condition can indicate a better outcome of education expenditure usage in this particular year. However, this does not imply that the COVID-19 makes provinces more efficient. The reason is the provinces that become efficient in 2021 have been scored close to efficient since the previous years. So, the COVID-19 does not necessarily cause the increasing number of efficient provinces.

DOI:10.6814/NCCU202200936

Table 11. DEA Results (2019-2021), Output Orientation

Rank	2019	Score	2020	Score	2021	Score
1	Aceh	1	Aceh	1	Aceh	1
2	Riau Islands	1	Riau Islands	1	Riau Islands	1
3	SCR Jakarta	1	SCR Jakarta	1	SCR Jakarta	1
4	SR Yogyakarta	1	SR Yogyakarta	1	SR Yogyakarta	1
5	Central Kalimantan	1	North Kalimantan	1	W. Nusa Tenggara	1
6	North Kalimantan	1	North Sulawesi	1	Central Kalimantan	1
7	North Sulawesi	1	West Sulawesi	1	North Kalimantan	1
8	West Sulawesi	1	Maluku	1	North Sulawesi	1
9	Maluku	1	North Maluku	1	S.E.Sulawesi	1
10	West Papua	0.997	Central Kalimantan	0.998	West Sulawesi	1
11	Gorontalo	0.994	West Papua	0.990	Maluku	1
12	North Maluku	0.992	Bali	0.982	North Maluku	1
13	East Kalimantan	0.973	East Kalimantan	0.974	West Papua	1
14	Southeast Sulawesi	0.972	Gorontalo	0.971	Bengkulu	0.994
15	Bengkulu	0.968	Southeast Sulawesi	0.961	E. Kalimantan	0.977
16	Central Sulawesi	0.964	West Nusa Tenggara	0.958	S. Kalimantan	0.966
17	West Nusa Tenggara	0.958	Bengkulu	0.958	Central Sulawesi	0.955
18	North Sumatera	0.950	North Sumatera	0.956	North Sumatera	0.954
19	Bali	0.946	Central Sulawesi	0.950	Jambi	0.952
20	South Kalimantan	0.934	Bangka Belitung Islands	0.939	Gorontalo	0.952
21	Jambi	0.932	West Sumatera	0.935	South Sulawesi	0.949
22	South Sulawesi	0.931	South Sulawesi	0.932	West Sumatera	0.946
23	West Sumatera	0.927	Riau	0.929	Bali	0.942
24	Riau	0.924	Jambi	0.928	East Java	0.930
25	East Java	0.914	East Java	0.928	Riau	0.929
26	South Sumatera	0.895	South Kalimantan	0.927	Bangka Belitung I.	0.918
27	Lampung	0.895	South Sumatera	0.909	Banten	0.908
28	Banten	0.895	Lampung	0.907	Lampung	0.905
29	Bangka Belitung I.	0.885	Banten	0.901	South Sumatera	0.903
30	West Java	0.885	West Java	0.900	Central Java	0.897
31	Central Java	0.880	Central Java	0.896	West Java	0.889
32	West Kalimantan	0.867	West Kalimantan	0.884	W. Kalimantan	0.886
33	E. Nusa Tenggara	0.857	E.Nusa Tenggara	0.843	E. Nusa Tenggara	0.863
34	Papua	0.743	Papua	0.774	Papua	0.715
	AVERAGE	**0.943**	**AVERAGE**	**0.948**	**AVERAGE**	**0.951**

DOI:10.6814/NCCU202200936

Table 12. DEA Results (2019-2021), Input Orientation

Rank	2019	Score	2020	Score	2021	Score
1	Aceh	1	Aceh	1	Aceh	1
2	Riau Islands	1	Riau Islands	1	Riau Islands	1
3	SCR Jakarta	1	SCR Jakarta	1	SCR Jakarta	1
4	SR Yogyakarta	1	SR Yogyakarta	1	SR Yogyakarta	1
5	North Kalimantan	1	North Kalimantan	1	W. Nusa Tenggara	1
6	North Sulawesi	1	North Sulawesi	1	Central Kalimantan	1
7	West Sulawesi	1	West Sulawesi	1	North Kalimantan	1
8	Maluku	1	Maluku	1	North Sulawesi	1
9	Central Kalimantan	1	North Maluku	1	Southeast Sulawesi	1
10	Gorontalo	0.920	Bangka Belitung Islands	1	West Sulawesi	1
11	North Maluku	0.897	Central Kalimantan	0.905	Maluku	1
12	Bengkulu	0.837	Gorontalo	0.861	North Maluku	1
13	West Nusa Tenggara	0.718	Bengkulu	0.720	West Papua	1
14	Southeast Sulawesi	0.630	Central Sulawesi	0.567	Bengkulu	0.937
15	Central Sulawesi	0.538	Bali	0.468	Gorontalo	0.752
16	Bangka Belitung I.	0.531	Southeast Sulawesi	0.452	Central Sulawesi	0.573
17	Bali	0.436	East Kalimantan	0.364	South Kalimantan	0.563
18	Jambi	0.364	West Papua	0.361	East Kalimantan	0.462
19	West Papua	0.346	South Kalimantan	0.329	Bangka Belitung I.	0.458
20	East Kalimantan	0.340	W. Nusa Tenggara	0.291	Jambi	0.402
21	South Kalimantan	0.273	Jambi	0.284	Bali	0.374
22	West Sumatera	0.260	West Kalimantan	0.248	West Sumatera	0.250
23	South Sumatera	0.243	Papua	0.179	West Kalimantan	0.191
24	West Kalimantan	0.206	Lampung	0.169	South Sulawesi	0.184
25	South Sulawesi	0.155	East Nusa Tenggara	0.164	South Sumatera	0.181
26	East Nusa Tenggara	0.152	West Sumatera	0.164	Riau	0.176
27	Riau	0.150	Riau	0.162	E. Nusa Tenggara	0.164
28	Lampung	0.149	South Sumatera	0.154	Lampung	0.151
29	Papua	0.130	North Sumatera	0.125	Papua	0.147
30	North Sumatera	0.124	South Sulawesi	0.114	North Sumatera	0.145
31	Banten	0.116	Banten	0.107	Banten	0.142
32	East Java	0.042	Central Java	0.042	East Java	0.049
33	Central Java	0.037	East Java	0.039	Central Java	0.038
34	West Java	0.037	West Java	0.030	West Java	0.033
	AVERAGE	**0.519**	**AVERAGE**	**0.509**	**AVERAGE**	**0.570**

DOI:10.6814/NCCU202200936

The education expenditure comes from the total government expenditure, which usually increases yearly. This is because countries, in general, have increasing budgets annually. In Indonesia's case, the amount of education expenditure yearly is usually relatively constant, meaning it does not fluctuate and varies significantly by year. On this note, the thesis focuses on the analysis using output orientation, optimizing the outcome of the input's utilization, as it is unlikely for the country or the provinces to cut the budget on the education aspect precisely.

Table 13 presents the frequency distribution of efficiency scores in 34 provinces. The analysis using output orientation shows that more than half of the provinces' score is close to efficient (at least 73% of provinces scored more than 0.90). Papua is the only province that stays in the lowest distribution of efficiency scores (see Table 11). In addition, the number of efficient provinces also increase from 2020 to 2021. Although there are more efficient provinces in 2021, the provinces that increase the efficiency score are the ones that were previously efficient (Central Kalimantan) or its score is very close to 1.0 (West Papua). Therefore, this condition does not mean that COVID-19 makes provinces better in utilizing the education expenditure.

Table 13. Efficiency Score Frequency Distribution; output orientation

Technical Efficiency	2019		2020		2021	
	#	%	#	%	#	%
0.70-0.79	1	2.94	1	2.94	1	2.94
0.80-0.89	8	23.53	4	11.76	4	11.76
0.90-0.99	16	47.06	20	58.82	16	47.06
1.00	9	26.47	9	26.47	13	38.24
Total	34	100.00	34	100.00	34	100.00

Table 13 shows that overall the efficiency of education expenditure in Indonesia is not optimal. Most provinces were inefficient in using the education expenditure and did not generate the best possible outputs. These outputs are supposed to eventually create the education outcome, in this case, quality education. Therefore, the Indonesian government, aiming to deliver quality education to its young generation, should reassess its education system. To see whether the way of education service provision is proper or not.

DOI:10.6814/NCCU202200936

Table 14 to 16 present the slacks analysis from DEA that used VRS assumption and output orientation from 2019 to 2021. Slacks analysis is used to determine the "gap" between the efficient peers or production frontier and the inefficient DMUs. The term "slacks" in DEA represents the portions of inefficiencies. The efficient DMU with a score of 1.0 can still have slacks, which can be referred to as "weak" efficiency. On the other hand, the condition where DMU has a score of 1.0 and zero slacks can be referred to as "strong" efficiency (Cooper et al., 2006).

The slacks analysis shown in Table 14 to 16 used the output orientation, also can be called output maximization. Using this orientation, the DMUs with slacks other than zero mean that their efficient peers appear to be using less input. This analysis can show the potential improvements in the future, that the inefficient provinces with slacks need to push their performance up to the gap percentage of output.

The slacks analysis results in Table 14 show that nine provinces have a score of 1.0, but only six of them have zero slacks. Similarly, in Table 15, only seven out of nine provinces have strong efficiency. In Table 16, of thirteen efficient provinces, only nine provinces have zero slacks. The number of provinces that are strong efficient increased by year, and in 2021 Indonesia has nine provinces that can be referred to as strong efficient DMUs.

The idea of quality education centered around the capital region of a country is true, but having the model of provinces that is closer to one's condition is good news. For example, the "strong efficient" provinces in Indonesia, in Table 16, are spread all over parts of Indonesia. The efficient province can be used as an example of a particular region (western, middle, or eastern part of Indonesia). The spread condition means that any province in Indonesia can follow a model province close to its advantage and disadvantage. The advantage and disadvantages here refer to geographical and resource (human and financial) aspects. For example, in Papua, it is not ideal for the province located in the far east of Indonesia, which with fewer resources in terms of expenditure and a lack of infrastructure, to follow the path of SCR Jakarta, which is the country's capital region. However, it is more likely to follow Maluku, which is also located in the eastern part of Indonesia but is included in "strong efficient" provinces in 2021.

DOI:10.6814/NCCU202200936

Table 14. Slacks Analysis Based on VRS Assumption and Output Orientation, 2019

Province 2019	VRS Technical Efficiency	INPUT (%)	OUTPUT (%)			
		Education Expenditure	Teacher-Students Ratio	Class-Students Ratio	Education Completion Rate	Average School Life
Aceh	1	-86.67	0.00	48.43	16.56	18.58
North Sumatera	0.949545	0.00	3.37	0.00	0.00	0.00
West Sumatera	0.926632	0.00	0.00	0.00	0.00	0.00
Riau	0.923873	0.00	0.00	0.00	0.00	0.00
Jambi	0.932157	-17.84	0.00	0.00	0.00	3.89
South Sumatera	0.895055	0.00	0.38	0.00	0.00	2.75
Bengkulu	0.967784	-15.28	0.00	0.00	0.00	1.88
Lampung	0.895027	-33.52	0.00	0.00	0.00	4.60
Bangka Belitung Islands	0.885214	-1.56	0.00	0.00	0.00	3.35
Riau Islands	1	0.00	0.00	0.00	0.00	0.00
SCR Jakarta	1	0.00	0.00	0.00	0.00	0.00
West Java	0.884619	-29.46	19.04	0.00	0.00	3.16
Central Java	0.879995	-73.59	6.73	0.00	0.00	6.92
SR Yogyakarta	1	0.00	0.00	0.00	0.00	0.00
East Java	0.914496	-76.58	0.97	0.00	0.00	9.94
Banten	0.894886	0.00	16.61	1.74	0.00	0.00
Bali	0.945795	0.00	3.03	3.36	0.00	1.61
West Nusa Tenggara	0.958164	-29.15	0.00	15.45	0.00	18.40
East Nusa Tenggara	0.856822	-57.66	7.01	0.00	0.00	2.13
West Kalimantan	0.866587	-31.17	4.62	0.00	0.00	3.25
Central Kalimantan	1	-18.54	0.00	0.00	3.63	0.00
South Kalimantan	0.933556	-30.73	0.00	0.00	0.00	5.21
East Kalimantan	0.97291	0.00	1.70	0.00	2.77	0.00
North Kalimantan	1	0.00	0.00	0.00	0.00	0.00
North Sulawesi	1	0.00	0.00	0.00	0.00	0.00
Central Sulawesi	0.964107	-19.29	0.00	0.00	2.52	0.00
South Sulawesi	0.930609	-55.15	0.00	0.00	0.00	3.94
Southeast Sulawesi	0.972099	-13.32	0.00	0.00	0.00	4.45
Gorontalo	0.993853	-29.29	0.00	9.00	0.38	3.19
West Sulawesi	1	0.00	0.00	0.00	0.00	0.00
Maluku	1	0.00	0.00	0.00	0.00	0.00
North Maluku	0.992149	-43.65	0.00	0.00	0.00	0.00
West Papua	0.997125	-63.95	21.25	0.00	13.51	0.00
Papua	0.742807	-53.46	39.94	0.00	8.79	0.00

Note: Negative value in the input (education expenditure) column shows how much percentage of input could be reduced to achieve the current output. The positive value in the outputs column shows how much percentage of output could be increased with the current input.

DOI:10.6814/NCCU202200936

Table 15. Slacks Analysis Based on VRS Assumption and Output Orientation, 2020

Province 2020	VRS Technical Efficiency	INPUT (%)	OUTPUT (%)			
		Education Expenditure	Teacher-Students Ratio	Class-Students Ratio	Education Completion Rate	Average School Life
Aceh	1	0.00	0.00	0.00	0.00	0.00
North Sumatera	0.955599	-4.97	7.71	0.00	0.00	0.00
West Sumatera	0.935067	-45.99	8.73	0.00	0.00	0.00
Riau	0.928792	0.00	7.93	0.00	0.00	0.00
Jambi	0.928161	0.00	0.00	0.81	0.00	1.64
South Sumatera	0.908806	0.00	0.00	0.00	0.00	3.72
Bengkulu	0.957806	0.00	0.00	5.22	0.00	4.23
Lampung	0.907292	0.00	0.00	0.00	0.00	4.92
Bangka Belitung Islands	0.938979	0.00	47.41	9.96	0.00	2.31
Riau Islands	1	0.00	0.00	0.00	0.00	0.00
SCR Jakarta	1	0.00	0.00	0.00	0.00	0.00
West Java	0.899758	-35.49	28.71	0.00	0.00	4.84
Central Java	0.895611	-75.01	32.69	0.00	0.00	8.08
SR Yogyakarta	1	0.00	0.00	0.00	0.00	0.00
East Java	0.927634	-79.17	23.35	0.00	0.00	10.29
Banten	0.901386	0.00	20.59	2.77	0.00	0.00
Bali	0.982386	0.00	0.00	15.65	0.00	4.17
West Nusa Tenggara	0.95821	0.00	0.00	11.32	0.00	16.23
East Nusa Tenggara	0.842909	-43.14	5.61	0.00	0.00	1.55
West Kalimantan	0.884158	-30.83	31.64	0.00	0.00	9.20
Central Kalimantan	0.998481	-8.48	6.84	0.00	6.07	8.66
South Kalimantan	0.927421	-27.22	30.66	0.00	0.00	4.20
East Kalimantan	0.974047	0.00	16.06	0.00	0.00	0.00
North Kalimantan	1	0.00	0.00	0.00	0.00	0.00
North Sulawesi	1	0.00	0.00	0.00	0.00	0.00
Central Sulawesi	0.949525	-15.63	22.11	0.00	3.23	1.74
South Sulawesi	0.932294	-55.84	19.92	0.00	0.00	3.49
Southeast Sulawesi	0.960554	-2.96	8.20	0.00	0.00	0.15
Gorontalo	0.970862	-23.63	30.77	0.00	14.26	16.39
West Sulawesi	1	-34.01	11.60	0.00	18.79	23.70
Maluku	1	0.00	0.00	0.00	0.00	0.00
North Maluku	1	-37.30	0.00	0.00	0.96	0.00
West Papua	0.989751	-59.49	9.24	0.00	8.21	0.00
Papua	0.774390	-36.82	0.00	6.97	13.26	8.37

Note: Negative value in the input (education expenditure) column shows how much percentage of input could be reduced to achieve the current output. The positive value in the outputs column shows how much percentage of output could be increased with the current input.

DOI:10.6814/NCCU202200936

Table 16. Slacks Analysis Based on VRS Assumption and Output Orientation, 2021

Province 2021	VRS Technical Efficiency	INPUT (%)	OUTPUT (%)			
		Education Expenditure	Teacher-Students Ratio	Class-Students Ratio	Education Completion Rate	Average School Life
Aceh	1	-80.83	0.00	63.86	0.00	0.00
North Sumatera	0.954226	0.00	8.03	0.00	0.00	0.00
West Sumatera	0.946234	-21.00	0.00	0.00	0.00	0.00
Riau	0.929131	0.00	2.63	0.00	0.00	0.00
Jambi	0.952186	0.00	0.00	0.00	0.00	5.26
South Sumatera	0.902745	-22.43	3.40	0.00	0.00	2.06
Bengkulu	0.994129	-51.03	0.00	0.00	0.00	2.61
Lampung	0.905445	-24.31	4.46	0.00	0.00	2.95
Bangka Belitung Islands	0.918063	-1.92	3.32	0.00	0.00	7.68
Riau Islands	1	0.00	0.00	0.00	0.00	0.00
SCR Jakarta	1	0.00	0.00	0.00	0.00	0.00
West Java	0.888501	-65.26	26.11	4.90	0.00	0.00
Central Java	0.897293	-73.04	12.03	0.00	0.00	6.00
SR Yogyakarta	1	0.00	0.00	0.00	0.00	0.00
East Java	0.930226	-78.51	8.57	0.00	0.00	8.05
Banten	0.908344	0.00	28.02	6.76	0.00	0.00
Bali	0.94216	-8.12	6.83	4.31	0.00	0.10
West Nusa Tenggara	1	0.00	0.00	0.00	0.00	0.00
East Nusa Tenggara	0.862886	-35.27	0.00	0.00	1.40	0.00
West Kalimantan	0.885611	-32.50	11.22	0.00	0.00	8.98
Central Kalimantan	1	0.00	0.00	0.00	0.00	0.00
South Kalimantan	0.965978	-45.77	0.00	0.00	0.00	5.57
East Kalimantan	0.977379	0.00	8.11	0.00	0.00	0.00
North Kalimantan	1	0.00	0.00	0.00	0.00	0.00
North Sulawesi	1	0.00	0.00	0.00	0.00	0.00
Central Sulawesi	0.955132	-0.67	0.00	0.00	0.00	1.22
South Sulawesi	0.94895	-53.19	0.00	1.26	0.00	1.41
Southeast Sulawesi	1	0.00	0.00	0.00	0.00	0.00
Gorontalo	0.95156	-23.83	4.53	0.00	17.14	21.78
West Sulawesi	1	-8.56	5.70	0.00	19.10	28.08
Maluku	1	0.00	0.00	0.00	0.00	0.00
North Maluku	1	-22.38	0.00	0.00	0.00	2.60
West Papua	1	-11.35	0.00	0.00	11.60	0.00
Papua	0.714754	-36.18	9.23	0.00	2.25	0.00

Note: Negative value in the input (education expenditure) column shows how much percentage of input could be reduced to achieve the current output. The positive value in the outputs column shows how much percentage of output could be increased with the current input.

DOI:10.6814/NCCU202200936

Table 17 summarizes the slacks analysis results from Table 14 to 16. For this part, all efficient provinces are grouped and we can differ them into weak and strong efficiency. Stong efficiency means that the decision-making unit has a score of 1.0 and has no slacks. Table 17 contains the names of provinces with a DEA score of 1.0 (efficient) at least once in three years (2019 to 2021). In Table 17, column islack (input slacks) and oslack (output slacks) show whether the province has "slacks" and is referred to as weak efficient.

Table 17. Comparison of Slacks Analysis of Efficient Provinces

Province	2019		2020		2021	
	islack	oslack	islack	oslack	islack	oslack
Aceh*	O	O			O	O
Riau Islands***						
SCR Jakarta***						
SR Yogyakarta***						
West Nusa Tenggara*	-	-	-	-		
Central Kalimantan*	O	O	-	-		
North Kalimantan***						
North Sulawesi***						
Southeast Sulawesi*	-	-	-	-		
West Sulawesi*			O	O	O	O
Maluku***						
North Maluku	-	-	O	O	O	O
West Papua	-	-	-	-	O	O

Note: 1. The asterisk beside the province name indicates its frequency as a strong efficient province (for example, *** = three years); 2. "O" indicates the province has slacks; 3. "-" indicates the province is not efficient in that particular year.

Figure 4 highlights the provinces mentioned in Table 17. From Figure 4, we can see the efficient provinces spread all over the country. For example, in Sumatera Island, there are two efficient provinces; one of them, the Riau Islands, is strong efficient. In Java Island, there are two strong efficient provinces, such as SCR Jakarta and SR Yogyakarta. In eastern Indonesia, North Sulawesi and Maluku are strong efficient provinces. Based on this result, other provinces in the nearby region can take the strong efficient province as a model and motivation to do better in terms of education expenditure efficiency.

DOI:10.6814/NCCU202200936

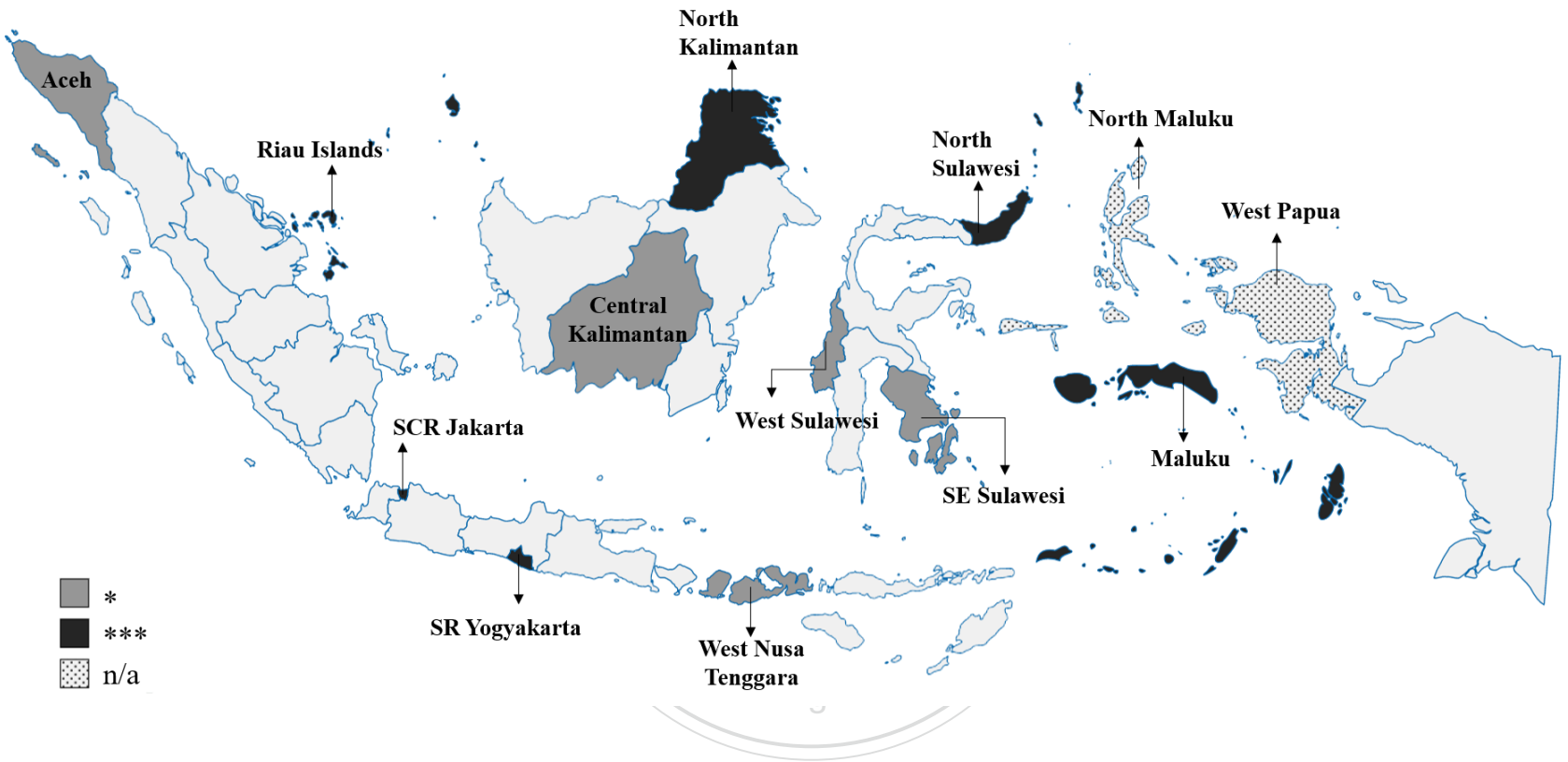

Figure 4. Indonesia, Efficient Provinces

Source: https://www.mapchart.net/asia-detailed.html; modified by author

Note: Darker shade (***) means the province is strong efficient for three years; Lighter shade (*) means the province is strrong efficient for one year; Dotted area (n/a) means the province is weak efficient.

DOI:10.6814/NCCU202200936

4.4. Robustness Check

I consider four output variables as the benchmark model. This section provides robustness checks with fewer output variables. Tables 18 to 21 show the top ten and bottom ten ranks of DEA (VRS assumption and output orientation) results using two and three output variables. I choose RGM (teacher to students ratio) and ECR (education completion rate) as the outputs for the two-output robustness check and RKM (class to students ratio) as the additional output variable for the three-output robustness check. Both results are similar to the primary findings in Section 4.3, which includes four output variables.

In addition, Table 22 shows the score frequency distribution using a different number of output variables. The analysis with a smaller number of output variables results in fewer efficient provinces (score equals 1) each year. The majority of efficiency score distributions are between 90 to 99 percent regardless of the number of output variables used in the analysis. The two-output robustness check also generated the lowest score for Papua (ranked at 34th) in 2019 at 59.7% efficient.

Table 18. Top 10 Rank of DEA Results using 2 Outputs (RGM and ECR)

Rank	2019	Score	2020	Score	2021	Score
1	Riau Islands	1	Aceh	1	Riau Islands	1
2	SCR Jakarta	1	Riau Islands	1	SR Yogyakarta	1
3	SR Yogyakarta	1	SCR Jakarta	1	W. Nusa Tenggara	1
4	North Kalimantan	1	SR Yogyakarta	1	Central Kalimantan	1
5	West Sulawesi	1	North Kalimantan	1	North Kalimantan	1
6	Maluku	1	North Sulawesi	1	Southeast Sulawesi	1
7	Aceh	1	Maluku	1	Maluku	1
8	Gorontalo	0.994	North Maluku	0.990	West Sulawesi	1
9	Central Kalimantan	0.985	Bali	0.982	North Maluku	1
10	Bengkulu	0.968	W.Nusa Tenggara	0.958	Aceh	1

DOI:10.6814/NCCU202200936

Table 19. Bottom 10 Rank of DEA Results using 2 Outputs (RGM and ECR)

Rank	2019	Score	2020	Score	2021	Score
25	Riau	0.885	East Java	0.902	Banten	0.904
26	Banten	0.885	West Java	0.898	East Java	0.900
27	West Java	0.883	Central Sulawesi	0.895	Riau	0.898
28	Bangka Belitung I.	0.883	Banten	0.892	South Sumatera	0.892
29	Lampung	0.874	South Kalimantan	0.890	West Java	0.887
30	Central Java	0.853	Gorontalo	0.883	Lampung	0.881
31	West Papua	0.821	Central Java	0.872	Central Java	0.869
32	West Kalimantan	0.797	West Kalimantan	0.847	E. Nusa Tenggara	0.820
33	E. Nusa Tenggara	0.795	E. Nusa Tenggara	0.831	West Kalimantan	0.815
34	Papua	0.597	Papua	0.774	Papua	0.636

Table 20. Top 10 Rank of DEA Results using 3 Outputs (RGM, ECR and RKM)

Rank	2019	Score	2020	Score	2021	Score
1	Riau Islands	1	SCR Jakarta	1	Riau Islands	1
2	SCR Jakarta	1	North Kalimantan	1	SCR Jakarta	1
3	North Kalimantan	1	West Sulawesi	1	North Kalimantan	1
4	Maluku	1	Maluku	1	North Sulawesi	1
5	West Sulawesi	1	North Maluku	1	Maluku	1
6	Central Kalimantan	1	Riau Islands	1	West Sulawesi	1
7	North Sulawesi	1	North Sulawesi	1	West Papua	1
8	Aceh	1	Central Kalimantan	0.998	North Maluku	1
9	West Papua	0.997	Aceh	0.998	Central Kalimantan	1
10	Gorontalo	0.994	West Papua	0.990	W. Nusa Tenggara	1

DOI:10.6814/NCCU202200936

Table 21. Bottom 10 Rank of DEA Results using 3 Outputs (RGM, ECR and RKM)

Rank	2019	Score	2020	Score	2021	Score
25	Banten	0.884	Banten	0.888	Banten	0.883
26	West Kalimantan	0.863	West Kalimantan	0.870	West Kalimantan	0.873
27	East Nusa Tenggara	0.857	W. Nusa Tenggara	0.847	East Nusa Tenggara	0.863
28	South Sumatera	0.853	South Sumatera	0.845	Bangka Belitung I.	0.856
29	Lampung	0.845	Lampung	0.844	South Sumatera	0.852
30	West Java	0.836	West Java	0.842	Lampung	0.848
31	Bangka Belitung I.	0.835	E. Nusa Tenggara	0.838	West Java	0.846
32	East Java	0.834	East Java	0.837	East Java	0.842
33	Central Java	0.814	Central Java	0.818	Central Java	0.823
34	Papua	0.743	Papua	0.774	Papua	0.715

Table 22. Efficiency Score Distribution using Different Number of Output Variables

Technical Efficiency	2019			2020			2021		
	4*	**3**	**2**	**4***	**3**	**2**	**4***	**3**	**2**
Below 0.70	0	0	1	0	0	0	0	0	1
0.70-0.79	1	1	2	1	1	1	1	1	0
0.80-0.89	8	10	10	4	11	8	4	9	8
0.90-0.99	16	15	14	20	15	18	16	13	15
1	9	8	7	9	7	7	13	11	10

Note: * is the benchmark (4 output variables)

DOI:10.6814/NCCU202200936

V. Conclusion

This thesis aims to assess the efficiency of education expenditure in Indonesia by province from 2019 to 2021 (COVID-19 era). Education provision is one of the most critical aspects for the government to ensure the social welfare of its population. Moreover, for a developing country like Indonesia, education is the long-term investment in human resources that will be a ticket to a better future. To achieve this, the government assigns one-fifth of its annual education expenditure. This significant portion of the annual budget should be used efficiently to attain the best outcome, such as good quality education for the young generation. In addition, COVID-19 pandemic started in 2020 makes the process of teaching and learning difficult for educators and students all over the world. With no exception, Indonesia also faced significant challenges during and after the pandemic of COVID-19. For the purpose of this study, Data Envelopment Analysis (DEA) is applied to data from 34 provinces assigned as the decision-making units (DMUs). The findings can be summarized as follows.

First, the results show a slight variance in the efficiency score across years. Most of the provinces' efficiency rank remains the same in those three years. Nevertheless, the percentage of efficient provinces increased in 2021. This condition does not mean that COVID-19 positively affects the situation by making provinces more efficient. The reason is that those efficient provinces have scored close to 1.0 since the previous period (see Table 11). The analysis using output orientation shows that provinces had roughly 94% efficiency on average during COVID-19 era. However, using the input orientation, the gap between efficient and inefficient provinces is very significant, making the efficiency scores during the observed period are around half efficient on average (50% to 57%). These results show that most provinces can use smaller amounts of education expenditure to generate the current level of outcome. Moreover, from the observation, most provinces use more than the mandated 20% of annual expenditure for education. The governments can use the excess expenditure percentage for other related sectors supporting education.

Second, according to what was observed (see Figure 4), the efficient provinces utilizing the education expenditure spread geographically, which means that provinces in

DOI:10.6814/NCCU202200936

Java Island, where the capital city is located, are not necessarily the best-performing ones. Only two provinces, SCR Jakarta and SR Yogyakarta were the efficient provinces during the three observed years. Unexpectedly, most provinces in Java Island are in the bottom ten ranks of efficiency scores. Two provinces in Java Island are in the bottom five, West Java and Central Java. On the other side, the number of provinces located in the Eastern part of Indonesia included in the efficient provinces is gradually increasing every year. In 2021, out of 12 provinces, seven provinces were observed as efficient provinces. From this result, we can see that the disadvantage of infrastructure and resources is not hindering the governments from using the education expenditure efficiently.

Third, the characteristics of inefficient provinces include the high ratio of teacher-students, meaning there is currently a lack of teachers to accommodate the total number of students in those provinces (see Table 14 to 16). This condition happened in West Java and Central Java. On top of that, these two provinces are also included in provinces that should reduce a significant amount of input they currently utilize (ranging from 29 to 75% reduction). Other reasons are the low education completion rate and the short period of average school life. Such conditions mean that the population in these provinces did not complete their education or graduate from school. In addition, these populations also spent fewer years attaining education, for example, only staying in school up to junior high school and not continuing to senior or vocational high school. These conditions happened in East Nusa Tenggara and Papua.

Fourth, further analysis shows that the number of efficient provinces with "strong efficiency" is smaller as not all provinces have zero slacks (see Table 17). There are still potential improvements that the weak efficient and inefficient provinces can target in the future. The spread of provinces with strong efficiency all over Indonesia is a good signal that the country has "model" provinces not centered only around the country's capital region. In addition, the provinces in Java Island, which have more advantages in terms of resources and infrastructure, could be more ambitious to reach the level of peer provinces in the same island.

Nevertheless, there are two limitations to this study. First, the period chosen is only during COVID-19 era, so the outcome of education expenditure in one year may not be

DOI:10.6814/NCCU202200936

immediately felt in the same year or even the following year. It might take several years to see the significant result of any decision on how the government uses the education expenditure. Therefore, the future study can choose a more extended period of years observed to understand better the change in education expenditure efficiency in Indonesia. When the period started much earlier, it can be used to analyze the present condition; meanwhile, the current period can be assessed for the future estimation.

Second, on the method side, DEA sets DMUs that use smaller input and generate bigger output as the production frontiers or best performances. However, in reality, those DMUs, or in this case, provinces, might have other sectors as a priority; thus, the education expenditure budget is smaller. On the other hand, a bigger expenditure budget does not necessarily mean that the provinces are using too many resources unknowingly and without purpose. The reality might be that the variety of development stages across regions could affect how much expenditure the government needs for education or other sectors.

Regardless of its limitations, the author hopes this study can provide a basic understanding of the education expenditure efficiency in Indonesia. Future research may dig deeper into the detail of each efficiency across the school level in the country. This thesis used the aggregate data of all education levels because there is a data availability constraint. The data for education expenditure does not precisely determine the percentage of the budget that goes into a different level of education. Another reason is that each province may have a different way of allocating the budget; therefore, future research may look into the data provided by each province individually.

Nevertheless, the analysis done in this thesis contributes to the overview of education expenditure in each province in Indonesia. Also, the finding that strong efficient provinces spread geographically is another crucial point for future analysis. Compared to previous literature focusing on the efficiency analysis at the district/city level in one province, this thesis adds a broader perspective that compares the efficiency of education expenditure at the province level in Indonesia.

DOI:10.6814/NCCU202200936

References

Adunola, O. M. O. T. E. R. E. (2011). An analysis of the relationship between class size and academic performance of students. Ego Booster Book: Ogun State, Nigeria.

Afonso, A., & Aubyn, M. S. (2005). Non-parametric approaches to education and health efficiency in OECD countries. Journal of applied economics, 8(2), 227-246.

Ajani, I. R., & Akinyele, O. B. (2014). Effects of student-teacher ratio on academic achievement of selected secondary school students in Port Harcourt Metropolis, Nigeria. Journal of Education and Practice, 5(24), 100-106.

Arestis, P., Şen, H. & Kaya, A. (2021). On the linkage between government expenditure and output: empirics of the Keynesian view versus Wagner's law. Econ Change Restrict 54, 265–303.

Atems, B., & Liu, Q. (2020). Public education expenditures, taxation, and growth: a state-level analysis. Applied Economics Letters, 27(21), 1730-1734.

Azzizah, Y. (2015). Socio-Economic Factors on Indonesia Education Disparity. International Education Studies, 8(12), 218-229.

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. Management Science, 30(9), 1078-1092.

Barro, R. J. (2001). Education and economic growth. The contribution of human and social capital to sustained economic growth and well-being, 79, 13-41.

Blankenau, W. (2005). Public schooling, college subsidies, and growth. Journal of economic dynamics and control, 29(3), 487-507.

BPS. (2021). Average School Life. Indonesian Statistical Bureau. https://www.bps.go.id/indicator/28/1429/1/average-school-life-age-15-years-by-province.html

DOI:10.6814/NCCU202200936

BPS. (2021). Education Completion Rate. Indonesian Statistical Bureau. https://www.bps.go.id/indicator/28/1980/1/education-completion-rate-according-to-education-level-and-province.html

BPS. (2021). Mid-Year Population (Thousand People), 1960-2021. Indonesian Statistical Bureau. https://www.bps.go.id/indicator/12/1975/1/mid-year-population.html.

BPS (2021). [New Method] Expected Years of Schooling (Year), 2020-2021. Indonesian Statistical Bureau. https://www.bps.go.id/indicator/26/417/1/-new-method-expected-years-of-schooling.html.

BPS (2019). Population Density by Province (person/sq.km), 2015-2019. Indonesian Statistical Bureau. https://www.bps.go.id/indicator/12/141/1/population-density-by-province.html.

Busemeyer, M. R. (2007). Determinants of public education spending in 21 OECD democracies, 1980–2001. Journal of European Public Policy, 14(4), 582-610.

Busemeyer, M. R. (2008). The impact of fiscal decentralization on education and other types of spending. Swiss Political Science Review, 14(3), 451-481.

CDC (Centers for Disease Control and Prevention). 2020. 'COVID-19 Pandemic Planning Scenarios'. May 22nd. https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision-making units. European journal of operational research, 2(6), 429-444.

Clements, B. (2002). How efficient is education spending in Europe? European Review of Economics and Finance, 1(1), 3-26.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). An introduction to efficiency and productivity analysis. Springer Science & business media.

Cook, W. D., Tone, K., & Zhu, J. (2014). Data envelopment analysis: Prior to choosing a model. Omega, 44, 1-4.

DOI:10.6814/NCCU202200936

Cooper, W. W., Seiford, L. M., & Tone, K. (2007). Data envelopment analysis: a comprehensive text with models, applications, references, and DEA-solver software (Vol. 2, p. 489). New York: Springer.

Facchini, F., & Melki, M. (2013). Efficient government size: France in the 20th century. European Journal of Political Economy, 31, 1-14.

Flach, L., Mattos, L. K. D., Will, A. R., & Roschel, L. F. (2017). Efficiency of expenditure on education and learning by Brazilian states: A study with Data Envelopment Analysis. Flach, L, 111-128.

Ghose, A., & Das, S. (2013). Government size and economic growth in emerging market economies: a panel co-integration approach. Macroeconomics and Finance in Emerging Market Economies, 6(1), 14-38.

Glomm, G., & Ravikumar, B. (1997). Productive government expenditures and long-run growth. Journal of Economic Dynamics and Control, 21(1), 183-204.

Golany, B., & Roll, Y. (1989). An application procedure for DEA. Omega, 17(3), 237-250.

Grossman, G. M., & Helpman, E. (1990). Trade, innovation, and growth. The American economic review, 80(2), 86-91.

Gupta, S., & Verhoeven, M. (2001). The efficiency of government expenditure: experiences from Africa. Journal of policy modeling, 23(4), 433-467.

Hanushek, E. A., & Kimko, D. D. (2000). Schooling, labor-force quality, and the growth of nations. American economic review, 90(5), 1184-1208.

Hanushek, E. A., & Woessmann, L. (2007). The role of education quality for economic growth. World Bank policy research working paper, (4122).

Hanushek, E. A., & Woessmann, L. (2008). The role of cognitive skills in economic development. Journal of economic literature, 46(3), 607-68.

Hanushek, E. A., & Woessmann, L. (2010). Education and economic growth. Economics of education, 60, 67.

DOI:10.6814/NCCU202200936

Hauner, D. (2008). Explaining differences in public sector efficiency: evidence from Russia's regions. World Development, 36(10), 1745-1765.

Hunt, D. J., & Link, C. R. (2020). Better outcomes at lower costs? The effect of public health expenditures on hospital efficiency. Applied Economics, 52(4), 400-414.

Ivanyna, M., & Salerno, A. (2021). Governance for Inclusive growth. IMF Working Papers, 2021(098).

Kirjavainen, T., & Loikkanent, H. A. (1998). Efficiency differences of Finnish senior secondary schools: An application of DEA and Tobit analysis. Economics of Education Review, 17(4), 377-394.

Koc, N., & Celik, B. (2015). The impact of number of students per teacher on student achievement. Procedia-Social and Behavioral Sciences, 177, 65-70.

Kohl, S., Schoenfelder, J., Fügener, A., & Brunner, J. O. (2019). The use of Data Envelopment Analysis (DEA) in healthcare with a focus on hospitals. Health care management science, 22(2), 245-286.

Korhonen, P., Tainio, R., & Wallenius, J. (2001). Value efficiency analysis of academic research. European Journal of Operational Research, 130(1), 121-132.

Kusumah, C. K. (2021). 12-Years Compulsory Education Policy and Education Participation Completeness: Evidence from Indonesia. JISDeP: The Journal of Indonesia Sustainable Development Planning, 2(2), 187-201.

Lee, C., & Ji, Y. B. (2009, July). Data envelopment analysis in Stata. In Stata Conference DC (Vol. 9, pp. 267-280).

Lucas Jr, R. E. (1988). On the mechanics of economic development. Journal of monetary economics, 22(1), 3-42.

International journal for equity in health, 18(1), 1-13.

Maliki, B. I., Kusuma, J. W., Tabrani, M. B., & Hamidah, H. (2021). Identification Of Education in Indonesia and Learning Models in Student Learning with Learning

DOI:10.6814/NCCU202200936

Management System (LMS). International Journal of Economy, Education, and Entrepreneurship, 1(1), 37-46.

Mankiw, N. G. (2021). Brief Principles of Macroeconomics (9th ed.). CENGAGE Learning Custom Publishing.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. The quarterly journal of economics, 107(2), 407-437.

Milawati, M., & Fahrudin, A. R. (2021). How is the Performance of Education in Indonesia? International Review of Management and Marketing, 11(1), 29-35.

Mota, T. R., & Meza, L. A. (2020). The use of DEA as a tool to evaluate public expenditure on education: an analysis of the cities of the state of Rio de Janeiro. Anais da Academia Brasileira de Ciências, 92.

OECD (2022), General government spending (indicator). doi: 10.1787/a31cbf4d-en (Accessed on 14 April 2022)

Olivia, S., Gibson, J., & Nasrudin, R. A. (2020). Indonesia in the Time of Covid-19. Bulletin of Indonesian economic studies, 56(2), 143-174.

Ortiz-Ospina, E., & Roser, M. (2016). Government spending. Our World in Data.

Overview of Primary School, Junior High School, Senior High School, and Vocational Senior High School by Status of School. Ministry of Education and Culture of Indonesia. https://statistik.data.kemdikbud.go.id/index.php/ (Accessed on April 14th, 2022)

Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. Higher Education for the Future, 8(1), 133-141.

Pragholapati, A. (2020). COVID-19 impact on students.

Prasetyo, A. D., & Zuhdi, U. (2013). The government expenditure efficiency towards the human development. Procedia Economics and Finance, 5, 615-622.

Ram, R. (1986). Government size and economic growth: A new framework and some evidence from cross-section and time-series data. The American economic review, 76(1), 191-203.

DOI:10.6814/NCCU202200936

Regional Government Expenditure based on function. Directorate General of Fiscal Balance. Ministry of Finance of Indonesia. https://djpk.kemenkeu.go.id/?p=5412 (Accessed on April 14th, 2022)

Ruggiero, J. (1996). On the measurement of technical efficiency in the public sector. European journal of operational research, 90(3), 553-565.

Salazar Cuéllar, A. F. (2014). The efficiency of education expenditure in Latin America and lessons for Colombia. Revista Desarrollo y Sociedad, (74), 19-67.

Seiford, L. M., & Thrall, R. M. (1990). Recent developments in DEA: the mathematical programming approach to frontier analysis. Journal of econometrics, 46(1-2), 7-38.

Senra, L. F. A. D. C., Nanci, L. C., Mello, J. C. C. B. S. D., & Meza, L. A. (2007). Estudo sobre métodos de seleção de variáveis em DEA. Pesquisa Operacional, 27(2), 191-207.

Shaturaev, J. (2022). Financing Public Education in Indonesia. Scientific Research Archive, 2(1).

Shewell, P., & Migiro, S. (2016). Data envelopment analysis in performance measurement: A critical analysis of the literature. Problems and Perspectives in Management, (14, Iss. 3 (cont. 3)), 705-713.

Solihin, A., Mursinto, D., & Sugiharti, L. (2017). Efficiency and effectiveness of government expenditure on education at districts/cities level in East Java Indonesia. Asian Social Science, 13(8), 91.

Susilawati, S., Falefi, R., & Purwoko, A. (2020). Impact of COVID-19's Pandemic on the Economy of Indonesia. Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences, 3(2), 1147-1156.

Tallman, E. W., & Wang, P. (1994). Human capital and endogenous growth evidence from Taiwan. Journal of Monetary Economics, 34(1), 101-124.

Tapia, J. A., & Salvador, B. (2022). Data envelopment analysis efficiency in the public sector using provider and customer opinion: An application to the Spanish health system. Health Care Management Science, 1-14.

DOI:10.6814/NCCU202200936

Tóth, R. (2009). Using DEA to evaluate the efficiency of higher education. Applied Studies in Agribusiness and Commerce, 3(3-4), 79-82.

United Nations. (2020). Policy brief: Education during COVID-19 and beyond. United Nations. https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf

Winardi, W. (2017). Decentralization of education in Indonesia—A study on education development gaps in the provincial areas. International Education Studies, 10(7), 79-93.

Wu, S. Y., Tang, J. H., & Lin, E. S. (2010). The impact of government expenditure on economic growth: How sensitive to the level of development? Journal of Policy Modeling, 32(6), 804-817.

DOI:10.6814/NCCU202200936

Appendix: Overview of Schools by Province

Table 23. Schools Overview: Academic Year 2018/2019

No.	PROVINCE	TEACHERS	STUDENTS	CLASSES	SCHOOLS
1	Aceh	86,996	871,046	40,029	5,345
2	North Sumatera	180,297	3,035,054	120,190	14,337
3	West Sumatera	77,126	1,081,528	47,046	5,519
4	Riau	83,775	1,311,134	52,854	5,599
5	Jambi	44,842	638,711	28,230	3,544
6	South Sumatera	99,292	1,597,234	62,572	6,892
7	Bengkulu	27,325	376,738	16,857	2,040
8	Lampung	93,712	1,449,165	59,463	7,024
9	Bangka Belitung Islands	14,505	275,108	10,282	1,151
10	Riau Islands	22,220	392,059	15,134	1,544
11	SCR Jakarta	79,593	1,578,311	54,729	4,738
12	West Java	369,645	8,042,921	281,140	29,345
13	Central Java	295,785	5,186,784	208,290	24,756
14	SR Yogyakarta	38,151	565,785	23,695	2,672
15	East Java	334,417	5,325,501	223,955	27,598
16	Banten	94,503	2,050,352	71,025	7,300
17	Bali	47,016	777,527	29,458	3,193
18	West Nusa Tenggara	68,328	859,892	35,726	4,736
19	East Nusa Tenggara	92,718	1,363,569	59,853	7,577
20	West Kalimantan	60,492	1,019,327	46,118	6,366
21	Central Kalimantan	38,297	486,441	25,558	3,842
22	South Kalimantan	44,456	621,093	29,580	3,827
23	East Kalimantan	42,539	719,786	28,687	2,958
24	North Kalimantan	8,604	135,949	6,117	735
25	North Sulawesi	33,060	458,208	23,864	3,359
26	Central Sulawesi	42,704	577,913	28,727	4,135
27	South Sulawesi	116,923	1,646,894	73,240	9,109
28	Southeast Sulawesi	41,508	561,902	26,438	3,529
29	Gorontalo	15,844	215,577	9,928	1,395
30	West Sulawesi	19,784	274,050	13,512	1,911
31	Maluku	31,040	410,513	19,527	2,817
32	North Maluku	19,230	269,705	13,231	2,118
33	West Papua	13,734	222,953	10,779	1,508
34	Papua	30,944	670,038	26,038	3,551
	INDONESIA	**2,709,405**	**45,068,768**	**1,821,872**	**216,070**

DOI:10.6814/NCCU202200936

Table 24. Schools Overview: Academic Year 2019/2020

No.	PROVINCE	TEACHERS	STUDENTS	CLASSES	SCHOOLS
1	Aceh	38,969	888,977	39,808	5,412
2	North Sumatera	92,832	3,042,593	120,386	14,488
3	West Sumatera	34,639	1,089,729	46,778	5,608
4	Riau	40,218	1,335,373	52,631	5,671
5	Jambi	22,362	644,892	28,082	3,538
6	South Sumatera	48,218	1,615,889	62,320	6,945
7	Bengkulu	15,589	378,746	16,691	2,062
8	Lampung	48,542	1,472,020	59,445	7,095
9	Bangka Belitung Islands	6,332	281,570	10,444	1,159
10	Riau Islands	12,371	404,785	15,395	1,604
11	SCR Jakarta	59,380	1,602,746	54,262	4,755
12	West Java	177,911	8,146,512	279,942	29,772
13	Central Java	114,410	5,202,044	206,779	24,822
14	SR Yogyakarta	15,592	570,197	23,435	2,670
15	East Java	132,425	5,354,041	221,378	27,729
16	Banten	46,811	2,090,662	71,342	7,437
17	Bali	25,558	780,266	29,430	3,207
18	West Nusa Tenggara	32,551	875,158	35,731	4,839
19	East Nusa Tenggara	47,655	1,375,770	59,326	7,733
20	West Kalimantan	29,478	1,031,279	46,166	6,413
21	Central Kalimantan	20,337	495,504	25,471	3,856
22	South Kalimantan	18,743	627,840	29,299	3,869
23	East Kalimantan	20,855	737,747	28,759	3,005
24	North Kalimantan	4,961	139,776	6,104	748
25	North Sulawesi	20,095	457,554	23,556	3,371
26	Central Sulawesi	19,783	579,271	28,317	4,165
27	South Sulawesi	46,894	1,655,001	72,214	9,165
28	Southeast Sulawesi	19,271	567,204	26,122	3,544
29	Gorontalo	6,087	216,948	9,794	1,405
30	West Sulawesi	9,726	276,009	13,355	1,927
31	Maluku	17,686	413,738	19,239	2,844
32	North Maluku	11,431	274,935	13,201	2,153
33	West Papua	8,976	230,440	10,844	1,557
34	Papua	23,098	679,155	25,311	3,671
	INDONESIA	**1,289,786**	**45,534,371**	**1,811,357**	**218,239**

DOI:10.6814/NCCU202200936

Table 25. Schools Overview: Academic Year 2020/2021

No.	PROVINCE	TEACHERS	STUDENTS	CLASSES	SCHOOLS
1	Aceh	75,535	894,346	40,221	5,789
2	North Sumatera	157,402	3,018,988	119,604	15,835
3	West Sumatera	67,477	1,084,764	46,848	5,914
4	Riau	74,840	1,329,944	52,856	6,241
5	Jambi	39,805	640,051	28,066	4,064
6	South Sumatera	86,920	1,620,806	62,899	7,517
7	Bengkulu	25,364	375,401	16,714	2,247
8	Lampung	81,593	1,470,129	60,156	7,842
9	Bangka Belitung Islands	13,834	282,430	10,506	1,315
10	Riau Islands	21,392	409,145	15,586	1,747
11	SCR Jakarta	73,925	1,587,594	54,106	6,114
12	West Java	336,274	8,164,512	282,665	33,383
13	Central Java	263,027	5,154,542	207,720	26,568
14	SR Yogyakarta	33,703	562,920	23,463	2,833
15	East Java	291,144	5,293,328	223,158	30,007
16	Banten	85,622	2,098,809	72,089	8,093
17	Bali	40,901	774,612	29,161	3,369
18	West Nusa Tenggara	64,410	882,643	36,186	5,274
19	East Nusa Tenggara	83,489	1,361,633	59,025	8,398
20	West Kalimantan	51,694	1,028,206	46,464	6,844
21	Central Kalimantan	35,038	492,251	25,442	4,106
22	South Kalimantan	38,987	615,792	29,427	4,083
23	East Kalimantan	37,515	737,752	28,813	3,215
24	North Kalimantan	8,698	145,101	6,224	871
25	North Sulawesi	28,649	451,965	23,385	3,599
26	Central Sulawesi	36,035	573,056	28,199	4,520
27	South Sulawesi	102,484	1,627,447	71,876	9,717
28	Southeast Sulawesi	38,411	562,621	26,153	3,901
29	Gorontalo	13,113	212,142	9,808	1,725
30	West Sulawesi	17,545	270,618	13,270	2,134
31	Maluku	28,473	412,812	19,097	3,091
32	North Maluku	18,177	276,414	13,235	2,362
33	West Papua	13,649	231,137	10,932	1,759
34	Papua	28,763	698,473	25,615	4,200
	INDONESIA	**2,413,888**	**45,342,384**	**1,818,969**	**238,677**

DOI:10.6814/NCCU202200936