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THE NEXUS BETWEEN GOVERNMENT SPENDING ON EDUCATION, POVERTY, AND EDUCATION QUALITY IN INDONESIA'S UNDERDEVELOPED REGIONS[6]

Academicians and the policy maker have paid serious attention to the problem of quality of education in underdeveloped regions, due to its considerable impact on declining productivity, economic growth, and people's welfare. Therefore, this study aims to investigate the effect of government spending on education and poverty toward the quality of basic education in Indonesia's underdeveloped regions. The research result showed that government spending on education led to a significant impact on the quality of basic education in underdeveloped regions. Poverty also had a significant impact on the quality of basic education. From these findings on the importance of government spending on basic education improvement, it is crucial to allocate for developing school governance, supplying and distributing teachers, and increasing the number of schools.
Keywords: government spending; poverty; education quality; underdeveloped
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1. Introduction

The government faces the challenge of enhancing the quality of education (Neels et al., 2017; Socorro et al., 2019; Sánchez-Restrepo, Louçã, 2021) across all countries, particularly in underdeveloped countries or regions (Hickey, Hossain, 2019), where quality remains low. Subpar education quality leads to a corresponding decline in human resource quality. Therefore, it's imperative to uplift the standard of education in underdeveloped regions to match that of more developed areas. High-quality education serves as a cornerstone for

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improving living standards and competitiveness in the job market, boosting productivity, fostering economic growth, and reducing inequality (Sulis, Giambona, Porcu, 2020; Rodríguez et al., 2023).

The quality of education in Indonesia is still low, the indication is that the PISA scores between science, literacy and mathematics are still lower than in several ASEAN countries (OECD, 2018). In addition to PISA scores, the quality of education can also be proxied by the accreditation status of a school or institution (Duong, Nguyen, 2023). Accreditation status is a formal recognition given to a special institution or program because it meets the appropriate educational quality standards set by an accreditation body at the regional, national, or special level (Vlăsceanu, Grünberg, Pârlea, 2007). This proxy not only focuses on achieving standard learning outcomes but also measures the achievement of broader standards, namely education content, educational process, infrastructure and facility, teachers and staff, educational management, educational fundings, and educational assessment (Kemendikbudristek, 2021). If a school institution is able to exceed these standards, the quality of the school is good and very good, or vice versa. In Indonesia, the quality of basic education in 2021, reveals accreditation status of grade A at 7.51%, grade B at 32.97%, grade C at 34.38%, and non-accredited schools at 24.41% (Kemendikbud, 2021). This indicates a relatively low quality of education in underdeveloped regions, with a significant portion of schools yet to be accredited.

Previous studies on the quality of education focusing on underdeveloped regions in Indonesia are still relatively scarce (e.g. Khusaini, 2021), as are research endeavours exploring the social and economic dimensions. Scholars have examined various determinants of economic growth and development, poverty, income inequality, and education quantity in underdeveloped regions (Jumono et al., 2021; Rumere, Sugiyanto, Sulistyaningrum, 2022; Wau, 2022; Ariansyah et al., 2023). Hence, we aim to investigate the determining factors influencing the quality of basic education in the underdeveloped regions of Indonesia, particularly focusing on government spending on education and poverty.

An important factor in improving the quality of basic education is government spending on education. Government spending on basic education in the regions is important because basic education is a mandatory matter for the regional government. The mechanism for funding education by local governments is carried out in two ways, namely price and quantity mechanisms (Gruber, 2007). The price mechanism is by providing subsidies for education costs, for example, school operational costs (Indonesia, *BOS*), the Indonesia Smart Card program (Indonesia, *KIP*), additional allowances for teachers (Indonesia, *TPG*), and so on. Meanwhile, the quantity is funded by the compulsory education program for basic education. Over the last five years, the Central Government has kept education spending at a minimum of 20% of total spending. During the period 2017-2021, the highest level of development occurred in 2019, namely 10.90%, and the lowest was in 2017, only 0.14%. Meanwhile, the average realization of education spending towards total spending in underdeveloped districts continues to increase from 14.99% in 2017 to 16.97% in 2020. Factors causing the low education spending in underdeveloped regions are the development priorities of other sectors that must be funded, limited original regional income, and the extent of the development region, thereby interfering with the fulfilment of statutory obligations.

Several previous research findings underscore the significant impact of government spending on school resources, subsidies and educational scholarships on improving student learning outcomes and the quality of schools at the basic education level (Murnane, Reardon, 2018; Carneiro et al., 2020; Ranjan, Panda, 2022). Additionally, scholars have noted the significant effect of government spending on education on enhancing education quality (Musah, Aawaar, 2022; Fu, Ishimaru, Kennan, 2024). Otherwise, previous studies revealed that the correlation between government spending on education and the quality of education is less optimal, contributing weakly to increases in the quality of education (Haddad, Freguglia, Gomes, 2017; Rumere, Sugiyanto, Sulistyaningrum, 2022; Biedermann, Häner, Schaltegger, 2023; Lewis, 2023). The findings from these studies have not been mutually reinforcing due to differing measurements of the quality of education, often focusing solely on educational output. The resulting of the previous research findings remains a matter of debate and focus on educational outcomes regarding the connection between government spending on education and the quality of education.

The quality of education in underdeveloped regions is also determined by the level of poverty. However, the government currently faces the challenge of a high poverty rate in these areas. In 2021, the average percentage of poor people in underdeveloped regions of Indonesia was 26.68%, which is significantly higher than the national poverty rate of 9.71% (Badan Pusat Statistik, 2022). The conditions are in line with the World Bank (2020) states that stagnation in poverty alleviation is one of the challenges in the modern economy. The government has reduced poverty and ensured the provision of education for the majority of eligible citizens, allowing the poor to benefit from quality education services (Mualuko, 2007). Efforts also need to be made to alleviate poverty by ensuring adequate financial resources for basic education in poor regions and improving school quality in rural areas (Song, 2012).

Previous studies show that conditions of poverty affect students' academic quality (Suryadarma, Suryahadi, 2009; Tienken, 2012). Continuous poverty in poor areas is likely to result in a lack of educational resources, which will decrease the quality of education. Likewise, the many poverty alleviation programs in poor areas cause public services to become hampered (Xu et al., 2020), for example, education services, and even have an impact on income inequality (Pan et al., 2024). Previous studies have indicated that the scarcity of skilled teachers, due to differences in living conditions and incomes between poor areas and cities, results in teachers with extensive teaching experience being unwilling to teach in underdeveloped areas (Xie, Sarntisart, Uddin, 2023), which thus declined the quality of education. Amaluddin (2019) showed that there is no significant connection between poverty alleviation and education in Indonesia.

Previous research has yielded inconclusive findings regarding the relationship between local government spending on education, poverty, and basic education quality. In addition, there have been limited investigations on this topic within underdeveloped regions in Indonesia, which are undergoing continual improvement as part of the government's initiative to reduce the number of underdeveloped regions. The current research departs from existing literature in several ways. First, this research introduces institutional accreditation status as a proxy for educational quality, especially at the basic education level. Second, there is still a lack of research with analysis units in underdeveloped districts in Indonesia, so this research

complements previous literature. Third, this research increases the consistency of the influence of government spending on education and poverty on the quality of basic education. Therefore, the current research is to examine the association between government spending on education and poverty, along with control variables, in relation to the quality of basic education. In the education system in Indonesia, basic education consists of primary education and lower secondary education. Given the pivotal role of education in the economic development of underdeveloped regions, the empirical findings of this research can offer valuable input for educational development initiatives and policies tailored to the specific needs of each region.

2. Literature Review

2.1. Government Spending and Education Quality

The quality of education is determined by the availability of books and relevant reading references, the needs of students and the availability of learning time, as well as the quality of teachers (Fuller and Clarke, 1994). Even Salinas and Solé Ollé (2009) revealed that educational outcomes were influenced by the decentralization in Spain. Haddad, Freguglia and Gomes (2017) proved that the correlation between education spending and quality of education is not optimal, contributing weakly to test score improvement. In addition, Sonje, Deskar-Skrbic and Sonje (2018) showed that the high inefficiency of public spending on education had an impact on educational outcomes in Croatia. Singh and Shastri (2020) empirically showed that public expenditure on education ineffectively influenced educational attainment. Meanwhile, Ranjan and Panda (2022) empirically found that development spending had a significant and positive effect on gross domestic product in the long term. Previous studies also showed that schools granted with state educational grants were proven to boost educational outcomes in low-income countries (Carneiro et al., 2020).

In addition, Gerged and Elheddad (2020) utilized fixed-effect and random-effect models for data from 2010 to 2017. They indicated that there was a significant and positive relationship between national governance and education quality in Europe. Current findings utilizing the Two-Step GMM model with data from 42 Sub-Saharan African countries for the period 2010 to 2019 was conducted by Musah and Aawaar (2022) have shown that public education funding has improved the quality of primary education. Another study, by Biedermann, Häner and Schaltegger (2023) found that higher regional spending does not necessarily enhance the quality or mobility of education in Switzerland. Lewis (2023) also demonstrates that fulfilling the education budget allocation of 20% in districts/municipalities in Indonesia has proven to have little impact on increasing school participation and improving learning outcomes. Finally, Fu, Ishimaru and Kennan (2024) investigate the balancing impact of federal policies such as the free college proposal, considering that human capital is cumulative and state governments have limited resources in the USA with OLS and IV models. As a result, government spending on education increases the likelihood of students graduating and reduces the burden on parents to pay for education.

The literature review shows that improving the quality of education (especially basic education level) is determined by government spending on education which focuses on the

country level and between countries, both developed and developing countries. However, the effectiveness of government spending in education still depends on resource allocation and governance. In addition, needs and specific conditions of the education system, program accuracy, and efficiency are also considerations for the effectiveness of spending so as to produce higher educational outcomes. Empirical studies in underdeveloped countries and underdeveloped regions are still low. The current study explores the interaction of how government spending on education in underdeveloped areas affects the quality of basic education.

2.2. Poverty and Education Quality

In terms of poverty, individuals are also considered poor if their income level or living standard is considerably below their living cost, based on the opinion that the inability to achieve a living standard is referred to as poverty (Sen, 1999). A previous study by Song (2012) applied the instrumental variable model and discontinuity approach by utilizing data from the 2006 China Health and Nutrition Survey (CHNS). The results declared that the popularization of basic education has significantly poverty alleviation in China, especially in urban areas. Amaluddin (2019) built a dynamic panel model for 33 provinces in Indonesia in 2010-2018, namely, VECM found that there was strong evidence of a long-term feedback causality relationship between poverty and education. Study in 33 African countries from 2010 to 2017 using the FMOLS model. The study results show that energy poverty is negatively and significantly related to educational inequality. Insights from this study are useful for policymakers in African countries to support decision-making around energy poverty to optimize family health and well-being (Sule, Yusuf, Salihu, 2022).

A different approach was taken by Rodríguez et al. (2023) who investigated the relationship between poverty and academic outcomes. The coefficient variation (CV) model and general liner mix model (GLMM) for Census Evaluation Students data from 2007 to 2018 revealed that region and poverty index affect academic outcomes and variation coefficient, and the latter is also impacted by subject and *GDP* in Peru. Xie, Sarntisart and Uddin (2023) applied the system GMM model and quantile regression for the period 2007 to 2020 indicating that investment in education had a significant positive effect on regional poverty alleviation both statically and dynamically in 30 Yunan districts. On the other hand, they also found that the impact of investment in education on poverty reduction illustrates a diminishing marginal effect, but under different poverty conditions. The current study by Pan et al. (2024) evaluated poverty alleviation programs from 2010 to 2020 and their impact on education and health. Correlation coefficient analysis found that areas with many poor people increased investment in education and health in order to eliminate inequality in China.

Poverty is not the only phenomenon of a country's economic development. Comparing the above studies shows that the role education plays in poverty alleviation varies across countries and regions. Other findings show that, on the contrary, reducing poverty in a country has a significant impact on improving the quality of education, because some poor people have good academic abilities and receive the benefits of poverty alleviation programs (for example, scholarships and social security), so they can access good quality education even though the majority does not access it. To summarize the results of our literature review

and research, the author aims to examine the effect of poverty reduction on the quality of education, especially basic education in underdeveloped regions. In addition, there is still little research on analysis units in underdeveloped districts in Indonesia.

3. Methodology

3.1. Data

This study examined the impact of government spending on education, poverty, and control variables on education quality by applying a panel data model. Basic education includes primary education (ISCED-P = 1) and lower secondary education (ISCED-P = 2) (UNESCO Institute for Statistics, 2012). We used panel fixed effect GLS, panel robust, and ordered panel logit models. Secondary data in this study were obtained from second-party processing or data obtained from publications from the Central Bureau of Statistics and the Ministry of Education and Culture of the Republic of Indonesia. This study required time series data for 2016-2022 and cross-sectional data for 62 underdeveloped districts in Indonesia (7 x 62 = 434).

3.2. Variables

School management, extracurricular activities, infrastructure, classroom activities, socio-economic factors, and access were also considered in measuring education quality (Rodríguez et al., 2022). This measurement had more advantages because it included input, process, output, and outcome and was based on the school unit. The dimensions of educational quality standards consist of graduate competency, content, processes, educators and staff, infrastructure and facility, management, funding, and educational assessment (Kemendikbudristek, 2021). These various dimensions were quantified to produce scores and grades for accreditation status or quality standards. In this research, the quality of basic education was measured by the number of primary education and lower secondary education with A and B accreditation status divided by the total number of primary education and lower secondary education in percentage units.

The authors used a proxy for government spending in education in each underdeveloped region per student at the basic education level (Recuero, Olaberría, 2018; Kimani, 2022; Fu, Ishimaru, Kennan, 2024). Government spending on education is also used as a proxy for the realization of the percentage of education spending on total spending, which is district government discretion (Jasmina, Oda, 2022) There were several measurement methods to measure poverty. The World Bank used a measure of income of less than $ 1.9 per day/PPP (World Bank, 2018). In the context of Indonesia, the national poverty line in September 2022 was based on the poverty line of *IDR* 535,547 per capita per month (Badan Pusat Statistik, 2022). Poverty commonly used in research is the poverty rate or headcount index (Foster, Greer, Thorbecke, 2010).

Table 1 Variables description

Variable	Description	Measurement	Scale	Source
Dependent variable				
Quality of primary education (qps)	Percentage of primary education that obtain A and B accreditation status in underdeveloped districts.	The number of primary education with grade A and B accreditation status is divided by total primary education multiplied by 100%.	%	Ministry of Education, Culture, Research and Technology
Quality of lower secondary education (qlse)	Percentage of lower secondary education that obtain A and B accreditation status in underdeveloped regions.	The number of lower secondary education with grade A and B accreditation status is divided by the total lower secondary education multiplied by 100%.	%	Ministry of Education, Culture, Research and Technology
Quality of basic education (qbe)	Percentage of primary education and lower secondary education that obtain A and B accreditation status in underdeveloped regions.	The number of primary education and lower secondary education with grade A and B accreditation status is divided by total primary education and lower secondary education multiplied by 100%.	%	Ministry of Education, Culture, Research and Technology
Independent variable				
Government spending on education per student (lngse)	Realization of government spending on education per student in underdeveloped regions.	The natural logarithm of realized government spending in the field of education is divided by the number of primary education and lower secondary education students.	Ratio	Ministry of Finance
Government spending on education (lgse)	Realization of the percentage of government spending on education to total spending in underdeveloped regions.	Realized regional spending on education divided by total regional spending multiplied by 100%.	%	Ministry of Finance
Poverty (pov)	Percentage of population below the poverty line in underdeveloped regions.	Headcount index	%	Central Bureau of Statistics
Control variable				
Internet access (inter)	Percentage of population aged over 5 years who accessed the internet in the last 3 months in underdeveloped regions.	The share of individuals aged 5 years to the total population who accessed the internet in the last 3 months is multiplied by 100%	%	Central Bureau of Statistics
Health infrastructure (inhealth)	Health facilities consist of general hospitals, special hospitals, community health centres and supporting community health centres located in underdeveloped regions.	The number of health facilities is divided by the population.	Ratio	Central Bureau of Statistics
Population density (dens)	the number of people living in an area per 1 square kilometre in underdeveloped districts.	The population is divided by area.	Ratio	Central Bureau of Statistics
Decent drinking water service (water)	Percentage of households that use and access clean and adequate water in underdeveloped regions.	The number of households that access clean and suitable water is divided by the total number of households multiplied by 100%	%	Central Bureau of Statistics

Health infrastructure was measured by the number of hospitals, community health centres, auxiliary community health centres, clinics, and integrated service posts in underdeveloped regions (Kraft et al., 2017). Percentage of individuals aged 5 years and over who used the internet in the last three months from any location via fixed or mobile networks as a proxy for internet access (Chotia, Rao, 2017; Badan Pusat Statistik, 2022). Population density was measured by the ratio of population to area of each underdeveloped district (Asongu, Odhiambo, 2019; Kommers, 2022). The availability of decent drinking water service sources was measured by the percentage of the population that had access to decent drinking water services (Lucas, Cabrita, Ferreira, 2015). For more details, variable descriptions are presented in Table 1.

3.3. Model Specification and Diagnostic Test

The use of panel data by Baltagi (2005) it possible to overcome the heterogeneity of data related to individuals, countries, companies, or other individual units over time explicitly by providing subject-specific variables, more degrees of freedom, and more efficient, as well as studying complex behaviour modelling. Panel data can also minimize bias possibility when aggregating individuals into large aggregations. To test the effect of government education spending and poverty on the quality of education in underdeveloped regions, this study used a specified econometric model in the form of an equation. The model analysis is written as follows:

$$q_{it} = \alpha_0 + \alpha_1 lngse_{it} + \alpha_2 pov_{it} + \alpha_3 inter_{it} + \alpha_4 inhealth_{it} + \alpha_5 dens_{it} + \alpha_6 water_{it} + v_{it} \quad (1)$$

where q_{it} = dependent variable that represents the quality of education [quality of primary education (qps) or quality of lower secondary education (qlse) or quality of basic education (qbe)], $lngse_{it}$ = government spending on education in region i period t, pov_{it} = poverty rate in region i period t, $inter_{it}$ = internet access in region i period t, $inhealth_{it}$ = health infrastructure in region i period t, $dens_{it}$ = population density in region i period t, and $water_{it}$ = provision of decent drinking water services in region i period t. i = 1, 2, ..., 62, t = 2016, ..., 2022, α_0 = constant, α_1, α_2, ..., α_n = regression coefficient, v_{it} = regional term error i period t.

Model selection test on panel data was conducted based on the Chow, Hausman, and Lagrange Multiplier tests. The Chow test for primary education, lower secondary education, and basic education resulted in a Cross-section Chi-square statistical value of 575. 357 – 664.703 and the probability value was 0.000 < 0.05. This meant that the selected model had a fixed effect. Meanwhile, the results of the Hausman test obtained a Cross-section Chi-square statistical value of 16.895 – 20.252 and a probability value of 0.002 – 0.009 < 0.05. It was conclusive that the selected model had a fixed effect. Due to the results of the model selection test using the Chow and Hausman tests, the fixed effect model was selected (see Table 3).

In principle, the residual normality test is not necessary if the number of observations is n >= 30 based on the central limit theorem. The multicollinearity test of this study used Pearson's correlation. The correlation calculation between the independent variables produced a correlation value of -0.5248 – 0.6639 < 0.800, meaning that the regression model is free from multicollinearity problems. The autocorrelation test used the Durbin-Watson (*DW*) value

criterion and generated the *DW* value between 1 – 3 (Field, 2009). In this model, the *DW* value was 1.443-2.653, and thus the model was free from autocorrelation problems. The heteroscedasticity test was done using the White-Heteroscedasticity test, and the Obs*R-squared statistical value was 93.729–115.708 and the probability value for all models was 0.000 < 0.05. This meant that the regression model had a heteroscedasticity problem. Based on these results, we use the Generalized Least Squares (GLS) fixed effect model because it can overcome the problem of heteroscedasticity and autocorrelation (Greene, 2003).

Researchers also use a different model, namely robust regression. It is a method utilized when the distribution of residuals is not normal and/or there are several outliers that affect the model (Ryan, 2008). Robust panel regression estimation uses the "S-estimation" approach (Rousseeuw, Yohai, 1984). The advantage of this approach is that it overcomes the weaknesses of the median or M-estimation approach, namely not considering the distribution of the data and not functioning the data as a whole because it only uses the median as a weighted value (Yohai, 1987; Susanti et al., 2014).

According to Rousseeuw and Yohai (1984), S-estimation is defined as:

$$\hat{\beta} = min_{\beta}\hat{\sigma}_s(e_1(\beta), e_2(\beta), \dots, e_n(\beta)) \tag{2}$$

where e_i = residual *i* of β and $s(e_i, e_2, \dots, e_n)$, by minimizing the robust estimation scale $\hat{\sigma}_s$. The estimation step "S-estimation" is the same as "M-estimation" using an iteration method to estimate the parameter $\hat{\sigma}_s$. The value of $\hat{\sigma}_s$ is obtained from:

$$\hat{\sigma}_i \begin{cases} \frac{median|e_i - median(e_i)|}{0.6745}; & Iterasi = 1 \\ \sqrt{\frac{1}{nK}\sum_{i=1}^{n} w_i\, e_i^2} & ; Iterasi > 1 \end{cases} \tag{3}$$

where e_i is the residual *i* from the OLS estimate. In addition, estimate β_s using the weighted least squares (WLS) method. The weighting function for S-estimation uses:

$$w_i \begin{cases} \left\{ \begin{array}{ll} \left[1 - \left(\frac{u_i}{1.547}\right)^2\right]^2 & ; |u_i \le c \\ 0 & ; |u_i| > c \end{array} \right\}; Iterasi = 1 \\ \frac{\rho(u)}{u^2} \qquad ; Iterasi > 1 \end{cases} \tag{4}$$

where $u_i = \frac{e_i}{\hat{\sigma}_i}$ and c = intercept = 1.547 to reach *breakdown point* 50% (Rousseeuw, Yohai, 1984). Furthermore, the estimation of the parameterβ_s using the WLS method and weighting W is obtained using iteratively reweighted least squares (IRLS), namely:

$$\hat{\beta}_s = (X'WX)^{-1}X'WY \tag{5}$$

The iteration will stop if $\hat{\beta}_s$converges, that is, the difference between the values of $\hat{\beta}_s^{(m+1)}$and $\hat{\beta}_s^{(m)}$ approaches zero. The empirical model specification used is using equation (1).

Finally, the author estimates another model to strengthen the previous findings and identify robustness. The author employs an ordered probability model, often referred to as ordered panel logit regression. This model is used to estimate the relationship between an ordered

multiple-category dependent variable and the independent variables. The ordered panel logit model can generally be written as:

$$Q^* = X_{it}\alpha + \mu_i + u_{it} \quad (6)$$

where Q*it is a categorical variable, X_{it} is an independent variable. If κ is a threshold parameter with an individual-specific threshold, then it can be written:

$$If \mathcal{K}_k < Q_{it}^* < \kappa_{ik+1}, then\ Q_{it} = k, k = 1, 2, 3 \quad (7)$$

In the panel ordered logit model, X_{it}, μ_i and u_{it} IID have the standard logistic distribution. The distribution of u_{it} follow:

$$F(u_{it}|X_{it}, \mu_i) = F(u_{it}) = \frac{1}{1+\exp(-u_{it})} \equiv \Lambda(t_{it}) \quad (8)$$

In addition, the probability of observation k for individual i and time t is as follows:

$$\Pr(Q_{it} = k|X_{it}, \mu_i) = \Lambda(\kappa_{ik+1} - X_{it}\alpha - \mu_i) - \Lambda(\kappa_{ik} - X_{it}\alpha - \mu_i)$$

The empirical model specification can be written by adapting the Jackson, Johnson and Persico (2016) and Rumere, Sugiyanto and Sulistyaningrum (2022) models:

$$Q_{it} = \alpha_0 + \alpha_1 lgse_{it} + \alpha_2 pov_{it} + \alpha_j \sum Z_{it} + v_{it} \quad (9)$$

where $1 \leq Q \leq 3$, i = 1, 2, …, 62; and t = 2016, 2017, …, 2022, while Q is assumed to be conditioned on the level of the quality of primary education in region i period t ($oqps_{it}$) or the quality of lower secondary education in region i period t ($oqlse_{it}$) or the quality of basic education in region i period t ($oqbe_{it}$). $lgse_{it}$ = government spending on education in region i period t, pov_{it} = poverty rate in region i period t, and $\sum Z$ is the control variable. Thus, the odds were calculated by taking the exponent of the appropriate coefficients α_0 and α_i. The ordered panel logit model is said to be good and efficient if it is supported by the smallest Akaike's informational criterion (AIC) and Bayesian information criterion (BIC) values (Domínguez-Almendros, Benítez-Parejo and Gonzalez-Ramirez, 2011). The goodness of fit of this model is shown by the small AIC and BIC values and the model's predictive ability of more than 50% (see Table 5).

4. Results and Discussion

4.1. Statistical summary

The data used in the study is presented with statistical descriptions, including the average score, standard deviation, maximum score, and minimum score. The average quality of education in the underdeveloped regions which was ranked good and very good in primary education was 28.71%, lower secondary education was 33.02%, and basic education was 30.86%. These results indicate that the average quality of education falls into a less-than-good category, as it is still below 50%. The average quality of primary education in underdeveloped regions was quite good, lower secondary education was good, and basic education levels were quite good. It can be said that the level of quality of basic education level is still low. Meanwhile, the average realization of district education spending per

student was IDR 7,231,811 per student. The average percentage of education expenditure per underdeveloped district was 11.14% and was still below the legal provisions. The average poverty rate in underdeveloped districts was 27.19%, thus indicating a relatively high poverty rate (see Table 2).

Table 2 Statistical summary

Variables, n=434	Mean	Std. Dev.	Max.	Min.
Quality of primary education (qps)	28.708	21.179	87.280	0.000
Quality of lower secondary education (qlse)	33.019	19.746	75.000	0.000
Quality of basic education (qbe)	30.863	19.084	78.050	0.000
Ordered of the quality of primary education (oqps)	1.954	0.614	3	1
Ordered of the lower secondary education (oqlse)	2.000	0.615	3	1
Ordered of the quality of basic education (oqbe)	1.988	0.643	3	1
Government spending on education per student (lngse)	15.794	0.620	17.341	13.228
Government spending on education (lgse)	11.143	0.249	11.640	10.012
Poverty (pov)	27.189	8.447	45.110	6.880
Internet access (inter)	18.837	15.397	65.550	0.000
Health infrastructure (inhealth)	2.627	0.515	3.689	1.099
Population density (dens)	61.819	67.394	316.00	0.400
Decent drinking water services (water)	54.603	24.236	99.300	0.000

4.2. Regression Results

The overall model produced a fixed effect model, which thus made it necessary to use a model that accommodates the problem of heteroscedasticity, namely the *GLS* fixed effect model. The estimation results indicated that the coefficient value of government spending on education was positive (3.768-5.379 and sig. at 1%). In other words, an increase in government spending on education of IDR 1,000,000 per student can improve the quality of education in underdeveloped regions by 3.768% to 5.379% for primary education, lower secondary education levels, and basic education (see Table 3). The coefficient value of poverty was negative (-0.471 to -1.006 and sig. at 1% and 5%). This result suggests that for every 1% reduction in poverty, education quality in primary education, lower secondary education, and basic education increased by 0.471% to 1.006% in underdeveloped regions.

Health infrastructure, as a control variable, had a significant effect on the quality of primary education, lower secondary education, and basic education (sig. = 1%). Another control variable, the average population density in underdeveloped regions, had a significant positive effect on improving the quality of lower secondary education and basic education, though not for primary education. The availability of decent drinking water services, another control variable, had no significant effect on improving the quality of primary education, lower secondary education, and basic education (see Table 3).

A robust panel model shows that government spending on education has a significant effect on the quality of lower secondary education and basic education levels in underdeveloped regions, with significance levels of 5% and 10%, respectively, but not on primary education. Meanwhile, reducing poverty has also a significant effect on improving the quality of education with a significance level of 1%. The relationship between these variables supports previous results (see Table 4).

Table 3. Panel regression results

Variables, n=434	Primary education	Lower secondary education	Basic education
Government spending on education per student (lngse)	3.768*** (0.606)	5.379*** (0.739)	5.181*** (0.569)
Poverty (pov)	-0.471** (0.185)	-1.006*** (0.332)	-0.687*** (0.217)
Internet access (inter)	0.349*** (0.030)	0.336*** (0.039)	0.347*** (0.030)
Health infrastructure (inhealth)	6.569*** (1.206)	10.172*** (2.046)	8.697*** (1.512)
Population density (dens)	0.008 (0.013)	0.060*** (0.021)	0.032** (0.017)
Decent drinking water services (water)	-0.025 (0.015)	-0.021 (0.022)	-0.022 (0.013)
constant	-40.957*** (11.875)	-62.523*** (17.184)	-62.459*** (11.961)
R^2	0.9563	0.9189	0.9556
Adjusted R^2	0.9483	0.9041	0.9474
F-stat	119.449	61.934	117.461
Pob(F-stat)	0.000	0.000	0.000
Chow test ($p_{\text{-value}}$)	0.000	0.000	0.000
Hausman test ($p_{\text{-value}}$)	0.002	0.009	0.008

Notes: *** = sig 1%, ** = sig. 5%, * = sig. 1%.

Table 4. Robust panel regression results (S-estimation method)

Variables, n=434	Primary education	Lower secondary education	Basic education
Government spending on education (lngse)	1.388 (1.361)	4.155** (2.161)	2.915* (1.552)
Poverty (pov)	-0.653*** (0.095)	-0.566*** (0.151)	-0.978*** (0.108)
Internet access (inter)	0.684*** (0.055)	0.858*** (0.088)	0.764*** (0.063)
Health infrastructure (inhealth)	3.707** (1.610)	-0.588 (2.557)	-3.895** (1.836)
Population density (dens)	0.093*** (0.012)	-0.029 (0.018)	0.013 (0.013)
Decent drinking water services (water)	-0.050 (0.031)	-0.044 (0.049)	-0.025 (0.036)
constant	39.990* (23.496)	-30.836 (37.320)	3.938 (26.801)
R-squared	0.4159	0.3982	0.4435
Adjusted R-squared	0.4077	0.3897	0.4357
Rn-squared stat.	567.888	206.414	438.808
Prob(Rn-squared stat.)	0.000	0.000	0.000
Wald test	598.959***	232.692***	450.813***

Note: *** = sig. 1%, ** = sig. 5%, * = sig. 1%

4.3. Discussion

The provision of quality education must be realized by central and regional policymakers, along with community involvement. All communities, especially those in the 62 underdeveloped regions, have the right to receive quality basic education services. One significant contribution from policymakers in the education sector is ensuring that the allocation of the education development budget in the regions is adequate. The size of the education spending allocated and distributed in the form of educational programs and assistance has been impacted to the improvement of education quality in underdeveloped regions. The assessment of the relationship between local government spending on education and the quality of education reveals a significant correlation with the quality of primary education, lower secondary education, and basic education levels.

These results are also confirmed by previous theory, which stated that governments experiencing a fiscal crisis were a significant cause of the decline in the quality of public education and public services (Reschovsky, 2004). Therefore, the local government should be able to compensate for the lack of education funds it allocates by increasing community involvement in education and empowering local resources devoted to education services. Another finding that is supported by these results is that government expenditure plays an important role in improving the quality of education (Carneiro et al., 2020; Musah, Aawaar, 2022; Ranjan, Panda, 2022; Xie, Sarntisart, Uddin, 2023; Fu, Ishimaru, Kennan, 2024). In other words, an increase in local government spending on education at all levels of government is expected to encourage an increase in the quality of education, so that graduates have good productivity and are competitive. However, the findings of this study were inconsistent with the conclusions of the study, which showed that public expenditure on education did not effectively influence educational outcomes (Ochieng, Yeonsung, 2021; Rumere, Sugiyanto, Sulistyaningrum, 2022).

The poor are often faced with low levels of education because they generally find it difficult to access quality education services. This study proved that impoverished people living in underdeveloped regions had lower quality education, except at the lower secondary education level. One of the criteria for underdeveloped regions is a high poverty rate, which leads to low quantity and quality of schools. This study is consistent with previous studies that found a significant correlation between poverty and the quality of education (Amaluddin, 2019; Rodríguez et al., 2023). However, the research findings do not confirm the results of the work carried out by Pan et al. (2024) which showed that good investment in education reduces poverty in regions.

The difference between the findings of the current study and previous findings is likely due to differences in variable measurement and the analysis model used. For example, measuring education spending using a proxy for the allocation of special autonomy funds from the central government given to groups of beneficiaries of education programs, namely the education grant program and the ordered logistic regression (Rumere, Sugiyanto, Sulistyaningrum, 2022) model, accountability of government spending on education, the ratio of education spending to GDP, as well as approaches qualitative (Ochieng, Yeonsung, 2021) which states that it has little impact on efforts to improve the quality of education. The use of education funds is not in accordance with planning and the group of program

beneficiaries (poor students and schools) who need it. Likewise, the impact of poverty on the quality of education produces different findings because it measures the poverty variable using government investment to create public services for poor and non-poor regions and sustainable development as a proxy for the education variable (one element of the sustainable development indicator). The results show that the gap is widening, resulting in less impact on education in terms of both quality and quantity (Pan et al, 2024).

4.4. Robustness Check

To strengthen the previous analysis, the author used an ordinal logit panel. We set the proxy for basic education quality as an ordered variable: very good, good, and quite good. The criteria for achieving education quality are as follows: if the average primary education accreditation status grade A and B is > 49.89% = 3; 7.53% to 49.89% = 2; and < 7.53% = 1. For lower secondary education, an average grade A and B accreditation of > 52.76% = 3; 13.27% to 52.76% = 2; and < 13.27% = 1. For basic education levels, an average grade A and B accreditation status of > 49.95% = 3; 11.78% to 49.95% = 2; and < 11.78% = 1. Additionally, the variable for district government spending in the education sector was proxied by the percentage of realized spending in the education sector to total spending in each underdeveloped region (*lgse*).

The coefficients presented in Table 5 show that the results remain consistent when using the natural logarithm proxy for district government expenditure in different areas of education. The results consistently showed a significant relationship, aligning with previous findings (Jackson, Johnson, Persico, 2016). Moreover, the results remain strong in explaining the impact of government spending in the education sector and poverty on the potential for improving basic education quality in underdeveloped regions in Indonesia. However, government spending on education did not have a significant effect on the potential for improving education quality in lower secondary education (see Table 5).

This study has some drawbacks regarding the use of analytical models, data availability, and research variables. It does not compare districts or cities that are not lagging, so the generalizability is still limited. Future research should expand to include areas that are not lagging behind for a more comprehensive and higher-quality analysis. Additionally, this research does not account for central government transfer budgets to regions for education funding, making the role of the central government unclear. Future studies could include the impact of central government transfer funds on education. The use of a static model is a limitation because the education quality variable is relatively stable, indicating the need for a dynamic panel data model.

Table 5. Ordinal logit panel results

Variables, n = 434	Primary education	Marginal effect	Lower secondary education	Marginal effect	Basic education	Marginal effect
lgse	1.727*** (0.560)	5.623	0.773 (0.513)	2.116	1.378*** (0.525)	3.967
pov	-0.090*** (0.015)	0.914	-0.025* (0.014)	0.975	-0.038*** (0.014)	0.963
lnter	0.056*** (0.009)	1.058	0.060*** (0.009)	1.062	0.059*** (0.009)	1.061
inhealth	-0.560** (0.249)	0.571	-0.110 (0.236)	0.896	-0.255 (0.237)	0.775
dens	0.006*** (0.002)	1.006	0.001 (0.001)	1.001	0.003** (0.001)	1.003
water	-0.007* (0.004)	0.993	0.011** (0.005)	1.011	0.004 (0.005)	1.004
Limits Points						
Limit_2:C(7)	14.393** (5.937)		9.035* (5.459)		13.471** (5.571)	
Limit_3:C(8)	18.623*** (5.976)		12.577** (5.482)		17.067*** (5.602)	
Pseudo R^2	0.2180		0.1246		0.1738	
LR stat.	174.491		100.002		145.327	
Prob(LR stat.)	0.000		0.000		0.000	
Schwarz criterion	1.554		1.731		1.704	
Hannan-Quionn criter.	1.508		1.686		1.659	
Akaike info criter.	1.479		1.656		1.629	
Prediction evaluation	64.52		62.90		61.06	

Note: *** = sig. 1%, ** = sig. 5%, * = sig. 1%

5. Conclusion

This study aims to describe the quality of education in underdeveloped regions and examine the impact of government spending on education and poverty on the quality of basic education. The test results showed that government education spending had a significant effect on improving the quality of education in underdeveloped regions. In other words, increased government spending on education leads to greater improvements in the quality of schools in primary education and lower secondary education. Additionally, poverty was found to have a significant effect on the quality of education. This result indicates that lower poverty rates in underdeveloped regions are associated with better-quality schools at the basic education.

This study revealed that local government spending on education contributes to the improvement of education quality. Education budget policy priorities should be directed at providing more schools and classrooms for lower secondary education in remote regions, completing educational equipment that supports learning, teacher fulfilment and distribution, and expanding lower secondary education scholarships. Regional governments, especially

underdeveloped districts, provide program options for each school institution to be creative according to their characteristics, capacity, and ability to improve the quality of their schools. Poverty reduction is also a crucial factor in improving the quality of education in underdeveloped regions. Reducing the poverty rate cannot be achieved by underdeveloped region governments alone; a synergy of poverty alleviation programs between underdeveloped region, provincial, and national governments is needed. Despite many poverty alleviation programs launched by the national government, such as the Indonesian rice subsidy program for the poor, pre-welfare cards, and pre-employment cards, there has been slow progress in reducing the poverty rate.

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