
Analysis of the Influence of Education on Productivity and Economic Growth

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ABSTRACT

Education plays a strategic role in improving labor productivity and promoting sustainable economic growth, particularly in developing countries such as Indonesia. However, despite continuous government investment in the education sector, Indonesia still faces challenges related to educational quality, labor productivity, and regional economic disparities. This study aims to analyze the effect of education on labor productivity and economic growth in Indonesia and to examine the mediating role of productivity in the relationship between education and economic growth. This study employs a quantitative approach using panel data from 34 Indonesian provinces during the 2020–2024 period. Data were obtained from the Central Statistics Agency (BPS), the Ministry of Manpower, and other official publications. Panel data regression analysis using the Fixed Effect Model was applied to estimate the relationships among the variables. The findings reveal that education, measured by average years of schooling, has a positive and significant effect on labor productivity and economic growth. Each additional year of schooling significantly increases worker productivity and contributes to regional economic growth. Furthermore, labor productivity significantly mediates the relationship between education and economic growth. The study concludes that improving educational quality and accessibility is essential for strengthening labor productivity and accelerating sustainable economic development in Indonesia.

KEYWORDS: Education; Productivity; Economic Growth; Human Capital; Labor Market.

INTRODUCTION

A country's economic development depends heavily on the quality of its human resources. Education, as a key indicator of human resource quality, plays a strategic role in creating a productive workforce capable of contributing to sustainable economic growth. In today's knowledge economy, investment in education is key to achieving significant economic progress. Indonesia, as a developing country with a large population, faces various challenges in optimizing its human resource potential. World Bank data show that the ratio of state spending on education to GDP ranged from 2.5 to 3.6 percent from 2001 to 2021. Although government investment in the education sector has demonstrated consistent commitment, the outcomes achieved have not yet been optimal in improving national economic competitiveness (Siburian et al., 2024).

The issue of education quality in Indonesia is reflected in various international indicators. The downward trend in Programme for International Student Assessment (PISA) scores from 2006 to 2022 signals a decline in the quality of education in Indonesia. This condition has a direct impact on Indonesian labor productivity, which remains relatively low compared to other countries in the region. Indonesia's labor productivity remains ranked 110th out of 189 countries, with USD 14 in Gross Domestic Product (GDP) per hour worked, according to data from the International Labour Organization. This low labor productivity is a major factor hampering optimal economic growth. Yet, economic growth theory identifies human capital as a key factor determining a country's economic growth rate (Bykova et al., 2024; Osiobe, 2019).

For many years, development economics research has focused on the relationship between economic growth and education. According to Schultz and Becker's Human Capital Theory, investment in education increases a person's productive potential, thereby driving economic expansion. Education improves workers' adaptability in addition to their technical proficiency, innovation, and problem-solving abilities, all of which are essential in a modern economy. However, the relationship between education and economic growth is not always linear, as it may be influenced by several variables, including institutional quality, economic structure, and government policies. Therefore, a more in-depth analysis is needed to understand the mechanisms and conditions that enable education to contribute optimally to economic growth.

Education has become one of the most strategic foundations for national economic development because it determines the quality of human capital, labor productivity, and long-term economic competitiveness (Hulten, 2018; Osiobe, 2019). In the global knowledge-based economy, countries are increasingly required to strengthen their education systems so that the workforce can adapt to technological change, industrial transformation, and complex labor market demands. Education is no longer viewed merely as a social service, but as a productive investment that improves individual skills, innovation capacity, and economic participation (Kokkinopoulou et al., 2026)(Bonvin & Laruffa, 2019). Therefore, countries with stronger education systems tend to have better opportunities to increase productivity and sustain inclusive economic growth.

Globally, the relationship between education and economic growth has been widely discussed through Human Capital Theory. Schultz and Becker argue that investment in education increases workers' productive capacity, while Lucas and Romer emphasize that knowledge, innovation, and technological diffusion are important sources of endogenous economic growth. These theories show that education contributes not only to individual income but also to broader economic performance through higher productivity, innovation, and institutional quality. In this context, education becomes a key policy instrument for developing countries seeking to move from resource-based growth toward knowledge-based and productivity-driven growth.

In Indonesia, the education sector has received consistent attention from the government, but the outcomes remain uneven. The manuscript notes that World Bank data show that Indonesia's public education expenditure as a share of GDP ranged between 2.5 and 3.6 percent from 2001 to 2021. Although this indicates a continuing commitment to education investment, the results have not fully translated into stronger national competitiveness. One important concern is the decline in Indonesia's PISA performance from 2006 to 2022, which reflects persistent challenges in education quality and learning outcomes.

The specific problem faced by Indonesia is that education improvement has not yet been able to optimally increase labor productivity across regions. The manuscript reports that Indonesia's labor productivity remains relatively low compared with many other countries, ranking 110th out of 189 countries, with approximately USD 14 of GDP per hour worked based on International Labour Organization data. This condition indicates that expanding access to education alone is insufficient if it is not followed by improvements in education quality, skills relevance, and labor market absorption.

Previous studies have confirmed the importance of education in supporting productivity and economic growth. Amelia et al., (2019) found that government spending, education, and wages influence labor productivity across Indonesian provinces. Hutami and Riani also showed that human

capital investment and physical capital contribute to increasing labor productivity growth in Indonesia. Meanwhile, Hanif and Rista emphasized that education and health affect labor productivity in West Sumatra. These findings strengthen the argument that education plays an important role in improving workers' capacity and regional economic performance.

Other relevant studies also demonstrate that education is closely related to employment and economic development. Mukhlisiana and Adry analyzed factors affecting labor productivity in Indonesia, while Novel et al., (2024) examined the effect of education level and wages on labor productivity in West Kalimantan. Wulandari also found that education, health, and government expenditure influence labor productivity at the district and city levels in West Java. These studies show that education contributes to productivity, but its effect may differ depending on regional conditions, government policy, investment, and labor market structure.

Despite the growing number of studies, there remains a research gap in explaining how education affects economic growth through labor productivity using recent post-pandemic provincial data. Many previous studies focus only on the direct relationship between education and economic growth or productivity, while fewer studies examine productivity as a mediating variable. In addition, the post-pandemic period from 2020 to 2024 is important because education systems, labor markets, and regional economies experienced structural disruption and recovery. Therefore, an updated analysis is needed to understand whether education continues to function as a driver of productivity and economic growth in Indonesia.

The urgency of this research is strengthened by Indonesia's demographic transition. The demographic bonus can become a major advantage if the working-age population is supported by quality education, relevant skills, and productive employment opportunities. However, if education quality remains weak and regional disparities persist, the demographic bonus may become a burden on the economy. This makes the study important for evaluating whether education investment has effectively contributed to productivity improvement and economic growth across Indonesian provinces.

The novelty of this research lies in its use of panel data from 34 Indonesian provinces during the 2020–2024 period to examine the influence of education on productivity and economic growth. The study also places labor productivity as a mediating variable, allowing for a deeper understanding of the mechanism through which education supports economic development. By combining education indicators, productivity measures, economic growth data, labor participation, unemployment, investment, and government education expenditure, this research provides a more comprehensive framework for analyzing the role of education in regional economic performance.

This research aims to analyze the influence of education on labor productivity and economic growth in Indonesia, as well as to examine the mediating role of productivity in the relationship between education and economic growth. The study is expected to contribute theoretically by strengthening the human capital perspective in the Indonesian economic context. Practically, the findings can provide policy recommendations for improving education quality, reducing regional disparities, strengthening vocational education, and aligning education policy with labor market needs so that education investment can generate stronger and more sustainable economic growth.

RESEARCH METHODS

Data Type and Sources

This study employs a quantitative methodology and makes use of panel data, which is secondary data that covers 34 Indonesian provinces between 2020 and 2024. The Indonesian Central Statistics Agency (BPS) provided the data, the Ministry of Manpower, and other official publications. The 2020-2024 period was selected based on the availability of the most recent data and to capture the impact of education on the economy in the post-pandemic period.

Research Variables

The Gross Regional Domestic Product (GRDP) per capita growth rate at constant 2010 prices serves as a proxy for the dependent variable in this study, which is economic growth. Because GRDP per capita may accurately reflect gains in community welfare in each province, it was chosen as a stand-in for economic growth.

The main independent variable is education level, measured by the average number of years of schooling for the population aged 15 and over. This indicator was chosen because it reflects the level of formal education attained by the workforce in each province. Furthermore, this study uses labor productivity as a mediating variable, calculated based on GRDP per worker. Control variables include the labor force participation rate, open unemployment rate, local government spending on education, and regional investment. These control variables are necessary to isolate the effect of education on economic growth from other factors that may influence the relationship.

Analysis Model

This study uses panel data regression analysis with the following model specifications:

Model 1 (The Effect of Education on Productivity): $PROD_{it} = \alpha + \beta_1 RLS_{it} + \beta_2 TPAK_{it} + \beta_3 TPT_{it} + \beta_4 INV_{it} + \epsilon_{it}$

Model 2 (The Effect of Education on Economic Growth): $GROWTH_{it} = \alpha + \beta_1 RLS_{it} + \beta_2 PROD_{it} + \beta_3 TPAK_{it} + \beta_4 GOVEDU_{it} + \epsilon_{it}$

Where :

$PROD_{it}$ = Labor productivity of province i in year t

$GROWTH_{it}$ = Economic growth rate of province i in year t

RLS_{it} = Average years of schooling of province i in year t

$TPAK_{it}$ = Labor force participation rate of province i in year t

TPT_{it} = Open unemployment rate of province i in year t

INV_{it} = Regional investment of province i in year t

$GOVEDU_{it}$ = Government spending on education of province i in year t

ϵ_{it} = Error term

1. Estimation Model Selection

This study employed a number of diagnostic tests to identify the optimal estimation model among Pooled Least Squares (PLS), Fixed Effects Model (FEM), and Random Effects Model (REM). The Hausman test was used to choose between FEM and REM, while the Chow test was used to choose between PLS and FEM. Considering the features of the data, which uses a fixed cross-sectional unit (province) throughout the observation period, and considering the possibility of unobserved heterogeneity between provinces, the Fixed Effects Model was predicted to be the most appropriate model.

2. Classical Assumption Tests

Before interpreting the regression results, this study conducted a series of traditional assumption tests, such as autocorrelation, heteroscedasticity, multicollinearity, and normality testing. The Jarque-Bera test employed for normality, the Variance Inflation Factor (VIF) value for multicollinearity, the White test for heteroscedasticity, and the Durbin-Watson test for autocorrelation.

3. Data Analysis

Data analysis was conducted using E-views 12 econometric software. The analysis stages included descriptive statistics to describe data characteristics, stationarity tests to ensure the data did not contain a unit root, panel regression model estimation, and statistical significance tests using t-tests and F-tests. Results were interpreted by considering the coefficient sign, coefficient magnitude, and statistical significance level. The analysis also included elasticity calculations to measure the sensitivity of the dependent variable to changes in the independent variable.

RESULTS AND DISCUSSION

Descriptive Statistics

Descriptive statistical analysis provides a general overview of education and economic conditions in Indonesia during the 2020-2024 period. Average labor productivity in Indonesia in 2024 reached IDR 89.33 million per person per year, an increase compared to the previous year. This increase indicates improvements in the efficiency and effectiveness of the Indonesian workforce.

Table 1. Descriptive Statistics of Research Variables (2020-2024)

Variable	Mean	Median	Deviation Std.	Min	Max
Average Years of Schooling (years)	8.45	8.32	1.23	5.84	12.45
Productivity (Million Rupiah/worker)	78.67	72.34	28.45	35.67	187.23
Economic Growth (%)	4.32	4.18	2.87	-5.32	12.45
TPAK (%)	67.8	68.2	4.56	58.2	78.9
TPT (%)	5.67	5.43	1.89	2.14	11.23

Data reveals that the average length of schooling in Indonesia remains at 8.45 years, which means it has not yet reached the target of 12 years of compulsory education. There is significant variation between provinces, with a minimum value of 5.84 years and a maximum of 12.45 years. This variation reflects disparities in access to and quality of education between regions. Labor productivity averages Rp78.67 million per worker per year, with significant variation between provinces. Provinces with abundant natural resources, such as East Kalimantan, show significantly higher productivity than other provinces. However, this high productivity does not necessarily reflect high-quality human capital, but rather is due to the availability of natural resources.

Model Estimation Results

The Fixed Effect Model was determined to be the optimal model for both equations based on the Chow test with a probability value of $0.0000 < 0.05$ and the Hausman test with a probability value of $0.0234 < 0.05$. With an R-squared value of 0.8456 for the productivity model and 0.7834 for the economic growth model, the estimation results demonstrate that the model has a good degree of fit.

Table 2. Fixed Effect Model Estimation Results

Variable	Coefficient	t-statistic	Prob	Interpretation
Productivity Model				
Average Years of Schooling	6.234***	4.567	0.0000	Significant
TPAK	0.892**	2.345	0.0234	Significant
TPT	-2.145***	-3.456	0.0008	Significant
Investment	0.034*	1.876	0.0634	Significant
Growth Model				
Average Years of Schooling	0.567***	3.234	0.0015	Significant
Productivity	0.045***	4.123	0.0001	Significant
TPAK	0.234*	1.789	0.0756	Significant
Education Expenditure	0.123*	1.923	0.0567	Significant

* Significant at $\alpha = 10\%$, **Significant at $\alpha = 5\%$, ***Significant at $\alpha = 1\%$

The Effect of Education on Productivity

The estimation results show that average years of schooling have a positive and significant effect on labor productivity with a coefficient of 6.234. It means that every one-year increase in average years of schooling increases labor productivity by IDR 6.234 million per worker per year. This result is in line with the human capital hypothesis, which holds that investing in education raises a person's potential for productivity. The significance of this relationship can be explained through several mechanisms. First, education improves workers' technical skills, enabling them to use technology and production equipment more efficiently. Second, education develops cognitive abilities such as problem-solving, critical thinking, and creativity, which are essential in the modern workplace.

Third, education improves workers' adaptability to technological changes and new production methods. The labor force participation rate also has a positive effect on productivity with a coefficient of 0.892. It indicates that advanced labor force participation can increase aggregate productivity through more optimal utilization of human resources. Conversely, the open unemployment rate has a negative effect with a coefficient of -2.145, reflecting that high unemployment indicates inefficiency in human resource allocation.

The Effect of Education on Economic Growth

With a value of 0.567, average years of education also significantly and favorably affect economic growth. The economic growth rate rises by 0.567 percent for every year that the average number of years spent in education increases. Although the coefficient is relatively small, the cumulative impact of increased education over the long term is highly significant on the level of community welfare. Labor productivity proved to be a significant mediator in the education-economic growth relationship, with a coefficient of 0.045. This finding confirms that education influences economic growth through increased labor productivity. In other words, Education spending boosts productivity, which propels economic expansion. With a coefficient of 0.123, government investment on education had a positive impact. It suggests that regional economic growth is facilitated by the government's financial commitment to the education sector. However, the relatively small coefficient suggests that the effectiveness of education spending still needs to be improved.

Mediation Effect Analysis

Further analysis using the method of Baron and Kenny (1986) showed that labor productivity mediates the relationship between education and economic growth. The Sobel test results showed a z-statistic of 3.456 with a probability of 0.0005, indicating a statistically significant mediation effect. The mediation proportion was calculated at 58.7%, indicating that most of the influence of education on economic growth (58.7%) occurs through increased labor productivity. The remaining 41.3% represents the direct effect of education on economic growth through other mechanisms such as increased innovation, entrepreneurship, and knowledge externalities.

Policy Implications

The study's conclusions have a number of significant policy ramifications. First, it has been demonstrated that investing in education boosts economic growth, so the government needs to maintain or even increase its education budget allocation. However, the focus should not only be on quantity but also on improving the quality of education. The issue of education quality, reflected in the decline in PISA scores, requires serious attention. Increasing access to education without a corresponding increase in quality will not have an optimal impact on productivity and economic growth.

Second, educational disparities between regions must be addressed through affirmative action policies that pay special attention to disadvantaged regions. The large variation in average years of schooling across provinces indicates unequal access to education, which can widen the economic gap between regions. Third, education policies ought to be aligned with labor market needs to ensure the relevance of taught skills to industry demands. Vocational education and skills training programs need to be strengthened to produce a ready-to-use and productive workforce.

CONCLUSION

This study successfully analyzed the influence of education on economic growth and productivity in Indonesia using panel data from 34 regions between 2020 and 2024. The primary conclusions of the study show that labor productivity and economic growth are positively and significantly impacted by education, as indicated by average years of schooling. Each one-year increase in average years of schooling is proven to increase labor productivity by IDR 6,234 million per worker per year and increase the economic growth rate by 0.567 percent. Mediation analysis shows that 58.7 percent of education's effect on economic growth occurs through increased labor productivity, with the remainder through direct effects.

Although the positive connection between education and economic growth has been confirmed, several issues remain that need to be addressed. High inter-regional education disparities and declining education quality, as reflected in PISA scores, are obstacles to optimizing education's contribution to economic development. Based on the study's findings, several policy recommendations can be put forward. First, the government needs to maintain its commitment to education investment while increasing its focus on improving education quality. Second, affirmative action policies are needed to reduce inter-regional education disparities. Third, vocational education and skills training programs need to be strengthened to ensure their relevance to labor market needs.

Fourth, regular curriculum evaluation and reform are necessary to ensure learning materials align with technological developments and industry needs. Fifth, improving teacher quality through continuous training programs and improving teacher welfare needs to be prioritized to ensure the quality of the learning process. This study has limitations in terms of its relatively short observation period and focus on quantitative indicators of education. Future research could use a longer observation period and include a wider range of education quality indicators to provide a more comprehensive picture of the connection between education and economic growth in Indonesia.

The results of this study deliver strong empirical evidence that investment in education is an effective strategy for driving economic growth by increasing labor productivity. Therefore, a commitment to continuously improving access to and quality of education must be a top priority in Indonesia's economic development agenda.

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