



The Impact of Regional Educational Development Policies on Poverty Reduction in North Sumatra Province

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ABSTRACT

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This study aims to evaluate the impact of educational development on poverty reduction in districts and cities of North Sumatra Province, Indonesia. The main focus of this study is to assess the influence of education budget realization on the Regional Education Development Index (REDI), the contribution of REDI and GRDP per capita to poverty reduction, and to develop the Regional Development of Education Index (RDEI) as a policy evaluation tool based on education. The methodology employed includes multiple regression analysis with classical assumption tests and the construction of an education index based on the conditional weighted product method. The research results show that 62% of the variation in REDI can be explained by the 20% realization of the education budget, while 62% of the variation in the poverty index at the regional level is explained by REDI, GRDP per capita, and other related variables. Medan City has the highest RDEI score in North Sumatra (67.22), far above the provincial average (52.14), reflecting the excellent educational performance in this area. The main contribution of this study is the development of RDEI, which provides a more comprehensive policy evaluation tool. It can be used to maximize the effectiveness of education budget allocation and promote improvements in educational policies to support regional development and poverty reduction in a more optimal way. This research makes an important contribution to the literature on educational policy and poverty reduction, particularly by integrating education-based index evaluation with regional development policy.

1. INTRODUCTION

Although the education budget allocation in North Sumatra is larger compared to other provinces on Sumatra Island, its positive impact on poverty reduction has not yet been fully optimized [1]. This issue may be influenced by the quality of education policy implementation, which depends not only on the size of the budget but also on the effectiveness of fund management. For example, some studies show that the quality of education and the effectiveness of education fund management play important roles in influencing educational outcomes and their impact on poverty reduction [2, 3]. Therefore, despite an increase in the education budget, without improvements in teaching quality and better management, the impact on poverty in North Sumatra may not be optimal [4].

Additionally, the uneven distribution of the education budget across districts and cities in North Sumatra is an important factor influencing the policy's impact. Some

districts and cities may receive larger budget allocations compared to others, but without a fair distribution strategy and improvements in education quality across all regions, the impact on poverty reduction will be limited. For example, based on data from the Central Bureau of Statistics [5], several areas in North Sumatra, such as Medan City and Deli Serdang Regency, received higher education budget allocations compared to other areas. However, the quality of education in isolated regions, such as Labuhanbatu Regency, remains lagging. This underscores the need for equitable budget distribution as well as improvements in education quality across all districts and cities [6, 7]. Research shows that effective education policy must consider the specific needs of each area to ensure that all districts and cities benefit from the allocated budget in a proportional manner [8]. With the right distribution strategy, the education budget allocation can be more effective in reducing poverty and increasing community welfare throughout North Sumatra [9, 10].

1.1 Impact of education budget on regional education development

Measuring the impact of education budget allocation on the REDI is crucial to understanding how educational development in the districts and cities of North Sumatra can be achieved. The REDI consists of several indicators, namely the School Participation Rate Index (SPRI), School Facilities and Infrastructure Index (SFII), and the Regional Education Index (REI). SPRI reflects the percentage of school-age children enrolled in school, indicating the level of access to education [2, 3, 11]. SFII measures the quality and adequacy of available education facilities, which significantly influence the learning environment in schools [7, 8]. On the other hand, REI includes the quality of teaching and student learning outcomes [12, 13]. In this regard, research shows that while an increase in the education budget has the potential to improve the REDI, its impact on enhancing education quality and access still requires further in-depth evaluation to ensure that the budget allocation truly leads to better educational outcomes [2].

1.2 The impact of educational development performance and GRDP percapita on poverty reduction

The impact of educational development performance and Gross Regional Domestic Product (GRDP) per capita on poverty reduction shows that while education budget allocation can contribute to poverty reduction, its impact is relatively small compared to other factors such as economic growth and access to health services [6]. Research by the Central Bureau of Statistics [14] revealed that, although there has been an improvement in education budget allocation, its impact on poverty reduction is not always significant. This is influenced by various other factors, such as the still low quality of education, social inequality, and suboptimal budget management. Similar findings were also reported in previous studies [6, 15], which indicate that ineffective educational development performance slows down the positive impact of education on poverty reduction. Considering these challenges, measuring the impact of educational development on poverty in Indonesia is often hindered by the limited availability of complete and up-to-date data on education quality, as well as other variables influencing poverty reduction, such as socio-economic infrastructure and government policies [16, 17].

1.3 Development of an education index for regional development

The development of the Regional Development Education Index (RDEI) is a strategic step for evaluating the effectiveness of educational development at the district and city level, especially in North Sumatra. The RDEI was developed to provide a more comprehensive picture of how various education indicators contribute to regional development in a holistic manner. This index integrates various aspects such as school participation rates, education quality, learning opportunities, and the impact on poverty, using a geometric mean of the conditional weighted product method (CWPM), which provides more accurate and contextual results [7, 18]. Given the challenges faced by North Sumatra in ensuring equitable education distribution and effective budget allocation across districts and cities, the development of RDEI is highly relevant. Previous research

emphasizes that while increased education budgets contribute to educational development, their effectiveness largely depends on the quality of policy implementation and budget management [2, 19]. Therefore, RDEI is expected to become a useful tool for further evaluation, helping to understand how education can function as a main catalyst for poverty reduction and sustainable development in underdeveloped regions. Further research is needed to understand the complex interaction between these factors and to identify more effective strategies for utilizing education as a tool for poverty reduction [19].

2. LITERATURE REVIEW

Research conducted by Hanushek and Woessmann [2] emphasized that investing in high-quality education can increase labor productivity, which ultimately drives economic growth and reduces poverty. In a subsequent study, Hanushek [3] stated that improving the quality of education, such as enhancing students' skills, has a more significant impact on economic outcomes compared to simply increasing the number of education participants. This study shows that higher quality education is a key prerequisite for successful economic development and poverty reduction in various areas.

Angrist and Krueger [20] highlighted that policies should influence the duration of individual education, which in turn impacts income growth and poverty reduction. This research also emphasizes the importance of aligning education policies with the local public's needs. Edelstein [21] confirms these findings, stating that better-quality education has a significant impact on poverty reduction, particularly in areas where access to education is still low. Schultz [22] found that education subsidies, especially those targeting poor groups, can reduce poverty by improving access to and the quality of education. These subsidies not only increase educational participation but also lead to improvements in workforce skills and economic welfare.

In Indonesia, research by Kuncoro [9] highlights how education budget allocation can influence poverty reduction at the local level. Although the education budget has continuously increased, its impact on poverty reduction is still constrained by factors such as the quality of education, budget distribution inequality, and poor budget management at the local level. This is supported by the research of Murdiyana and Mulyana [23], which showed that regions with high budget allocations do not always succeed in lowering poverty levels if policy implementation is poor. The research by Wicaksono and Aliem [24] in Indonesia emphasized the importance of effective policies that are relevant to local needs. They demonstrated that education budget allocations must be accompanied by good management to ensure a positive impact on poverty reduction. This study also stresses the importance of strengthening the quality of education as an indicator of successful poverty reduction.

Van der Berg et al. [25] found that effective budget distribution and education policies are key to ensuring that education has a positive impact on poverty reduction. These findings are particularly relevant for areas such as North Sumatra, where budget inequality in education is a major obstacle to improving education quality. A recent study by Rira and Sinding [26] further strengthens the importance of designing curricula relevant to local needs and supporting education infrastructure to help reduce poverty in remote areas. This research shows that the success of an educational

program is highly dependent on local contexts, such as education accessibility, supporting infrastructure, and the public's needs.

In addition, research by Nugraha et al. [27] highlighted the importance of measuring educational performance through relevant indexes, such as the Regional Development Education Index (RDEI), to evaluate the impact of education on regional development in a comprehensive manner. The studies above are an important foundation for this research, which aims to develop the RDEI as a policy evaluation tool that measures the impact of education on poverty reduction in districts and cities. Through this comprehensive approach, this research not only highlights the importance of education budget allocation but also emphasizes the relevance of education quality and its distribution for public welfare.

3. RESEARCH METHODS

This study aims to measure the impact of the realization of the 20% education budget on the REDI, as well as the impact of REDI and GRDP per capita on the Regional Poverty Index (RPI). Secondary data used in this study originate from the Central Statistics Agency (BPS), the North Sumatra Provincial Education Office, and the Ministry of Education and Culture's Basic Data on Students, covering the period from 2019 to 2022. This research is conducted in 25 districts and 8 cities in North Sumatra Province. Data collection took place from December 2023 to February 2024.

3.1 Study approach

This study uses panel data analysis, which allows for the merging of dimensions over time and across regions. This method is useful for exploring the dynamic relationships between variables such as education, the economy, and poverty in a more in-depth manner. A panel data regression model is used to evaluate the relationship between education spending, REDI, GRDP per capita, and RPI, while considering the regional characteristics. Model assumption tests, such as multicollinearity, heteroscedasticity, and autocorrelation, were carried out to ensure the validity of the results.

3.2 Study variables

The variables used in this research include the REDI, GRDP per capita, the Regional Poverty Index (RPI), and dummy variables for districts/cities. REDI consists of three main components: the School Facilities and Infrastructure Index (SFII), the School Participation Rate Index (SPRI), and the Regional Education Index (REI), which together describe the quality and access to education in the region. GRDP per capita is chosen because it reflects the average income of communities in the district/city, which is relevant for explaining the economic capacity of the public to access education and reduce poverty. RPI measures the level of public welfare based on three main indicators: the Percentage of the Poor Population (PPP), the Poverty Depth Index (PDI), and the Poverty Severity Index (PSI).

The dummy variables for district/city are included to account for significant structural differences between districts and cities. In general, cities tend to have better infrastructure and more resources to support educational development compared to districts. This variable is important for controlling the differences that arise from administrative and geographical

distinctions between districts and cities, which can influence development outcomes. For example, cities may have better access to educational facilities and more qualified human resources compared to more remote districts with limited infrastructure. This explanation clarifies why this dummy variable is necessary to describe the differences in educational development and poverty reduction between these two types of regions.

3.2.1 Regression models and testing assumptions

The regression model used for the first objective is:

$$REDI = \beta_0 + \beta_1 20\% \text{ Education Spending} + \beta_2 \text{District/City Dummy} + \epsilon \quad (1)$$

where, $REDI$ is the District/City REDI; β_0 is a constant; β_1 is the 20% education spending coefficient, and β_2 is a dummy variable differentiating districts (0) from cities (1). The error term is denoted by ϵ . To test multicollinearity, we use the Pearson correlation between the 20% education budget and the district/city dummy, with the following formula:

$$r_{x_1x_2} = \frac{\sum(X_1 - \bar{X}_1)(X_2 - \bar{X}_2)}{\sqrt{\sum(X_1 - \bar{X}_1)^2 \sum(X_2 - \bar{X}_2)^2}} \quad (2)$$

where, X_1 is the 20% education spending value, and X_2 is the district/city dummy. The average 20% Education Budget is denoted as $\bar{X}_1$, and $\bar{X}_2$ represents the average of the district/city dummy. If $r_{x_1x_2}$ approaches 1 or -1, there is a strong correlation, indicating multicollinearity. If it approaches 0, there is no significant correlation, meaning multicollinearity does not occur. Heteroscedasticity testing is performed using the White test, which tests variables in quadratic form. Finally, autocorrelation testing is done using the Durbin-Watson test, where values approaching 2 indicate no autocorrelation.

3.2.2 Regression model for measuring poverty impact

The second objective is to measure the impact of REDI, GRDP per capita, and district/city dummies on regional poverty reduction. The regression model used is:

$$RPI = \beta_0 + \beta_1 REDI + \beta_2 GRDP \text{ per capita} + \beta_3 \text{District/City Dummy} + \epsilon \quad (3)$$

where, RPI is the Regional Poverty Index; β_0 is a constant; β_1 is the regression coefficient for REDI (including its three components: SFII, SPRI, REI); β_2 is the regression coefficient for GRDP per capita, and ϵ is the error term. Multicollinearity, heteroscedasticity, and autocorrelation tests are carried out for the second objective in the same manner as previously.

3.2.3 Calculation of the RDEI

The third objective is to measure the RDEI, which is calculated using the geometric mean formula of the Conditional Weighted Product Method (CWPM):

$$RDEI_{it} = \sqrt{X_{it} \cdot Y_{it}} \quad (4)$$

where, X_{it} is the normalized REDI value, and Y_{it} is the normalized RPI value. The geometric mean is calculated for each district/city based on the normalized REDI and RPI values. This approach maintains a balance between the two indicators, avoiding dominance by one over the other [28].

The use of the CWPM method for calculating RDEI offers advantages in integrating more comprehensive educational indicators related to extreme poverty. Unlike IREA, which is more limited, HDI combines broader and more comprehensive educational dimensions, focusing on accessibility to education and its impact on poverty.

4. ANALYSIS RESULTS

The increased allocation of the education budget plays an important role in improving the quality of education. In 2020, the allocation of the education budget in North Sumatra reached 20% of the total Regional Revenue and Expenditure Budget (RREB), in accordance with the mandate of the National Education System Law. This increase in allocation supports improvements in school infrastructure, teacher welfare, and the development of more comprehensive education programs. As a result, not only does the school participation rate increase, but the quality of education received by students also improves, which in turn has the potential to reduce poverty by increasing workforce productivity and competitiveness [29].

4.1 Impact of 20% education spending on regional education development

A heteroscedasticity test was performed by regressing the residuals of Eq. (1) as the dependent variable against the second independent variable. The regression results indicate no heteroscedasticity problem. The significance value of F in ANOVA is 0.5477 ($p > 0.05$), which reflects that both independent variables do not significantly affect the residual variance. Thus, the assumption of homoscedasticity in the model is met, where the residual variance can be considered constant across the data range, as shown in Table 1 below.

Table 1. Results of heteroscedasticity test

Variables	Coefficients	Standard Error	t-Stat	P-Value
Intercept	60.09817	20.68795	2.904985	0.0068
20% Education Spending	0	6.05E-08	-1.07552	0.2907
District/City Dummy	6.8539	25.92123	0.264413	0.7933

Source: Research Results, 2024

In addition, the R Square value of 0.0393 indicates that only about 3.93% of the variation in the residual variance can be explained by the independent variables in the model, while the rest is random. The p-value for each independent variable, such as Realization of Spending 20% (0.2907) and Dummy (0.7933), shows insignificance, which supports the result that there is no systematic relationship between the independent variables and the residual variance. With no heteroscedasticity found, the model can be used to produce reliable conclusions regarding the significant influence of independent variables on the dependent variable.

4.1.1 Multicollinearity test

The results of the multicollinearity test, shown in Table 2, show a very low correlation value between the independent variables, which is -0.0033. This correlation value is far below the threshold commonly used to detect multicollinearity,

which is ± 0.7 . This means that there is no significant linear relationship between the two variables, so it can be concluded that the regression model is free from multicollinearity problems.

Table 2. Results of the multicollinearity test for the 20% education spending variable with district/city dummy

Variables	20% Education Spending	District/City Dummy
20% Education Spending	1	
District/City Dummy	-0.003339	1

Source: Research Results, 2024

These results indicate that each independent variable provides a unique contribution to the dependent variable without any redundancy of information between variables. Thus, the conclusions drawn from the regression analysis are stronger and more relevant, especially in identifying the influence of each independent variable on the education development index. This analysis also supports the feasibility of the model for use in data-driven policies without worrying about distortion due to multicollinearity.

4.1.2 Autocorrelation test

The results of the autocorrelation test on the effect of 20% spending realization and dummy variables on the REDI show that the Durbin-Watson (DW) value of 1.8600 is between the upper limit value (DU) of 1.7466 and the value (4-DU) of 2.2534. Based on this criterion, it can be concluded that there is no autocorrelation in the model being tested, because the DW value is between DU and 4-DU. This shows that there is no pattern that suggests a linear relationship between residual errors in adjacent observations. Thus, this model can be considered quite valid and accurate in explaining the significance of the influence of 20% education spending on the REDI.

Based on the results of the classical assumption tests, the regression model used has met three main criteria: homoscedasticity, no multicollinearity, and no autocorrelation. These results indicate the validity of the model for analysis. With the fulfillment of these three assumptions, the regression model is declared valid and suitable for use in predicting the relationship between the realization of education spending, district/city dummy variables, and the REDI [30, 31].

Next, Figure 1 shows the relationship between the realization of 20% education spending and the REDI. Visually, it can be observed that there is a positive relationship that tends to be linear, with minimal variation around the regression line. Cities such as Padangsidempuan and Sibolga stand out as positive outliers, with their education development index being higher compared to other districts/cities with similar levels of spending realization. In contrast, Asahan and several districts, such as West Nias, show lower performance.

Figure 1 indicates that although the realization of the 20% education spending has contributed to the education development index, other factors also play a significant role in increasing the education development index in a region. Positive outliers, such as Padangsidempuan, may reflect regions that have succeeded in utilizing the budget more efficiently, while regions with a low index despite having high spending realization may face challenges in resource distribution or local policy priorities.

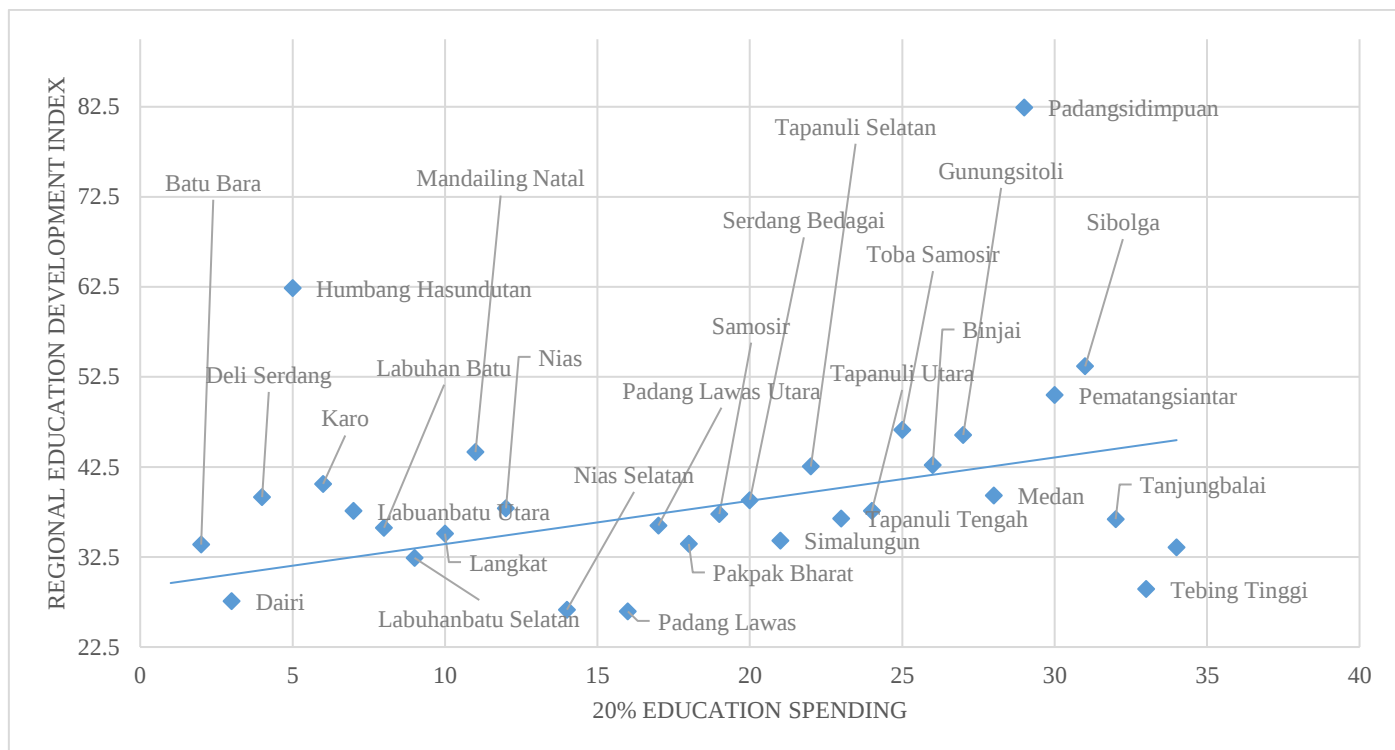


Figure 1. Relationship between realization of education expenditure and REDI

Table 3. Regression model estimation results

Regression Statistics		ANOVA					
Multiple R	0.818		df	SS	MS	F	Significance F
R Square	0.670	Regression	2	2970.62	1485.3	30.5007	0.00
Adjusted R Square	0.648	Residual	30	1460.92	48.69		
Standard Error	6.978	Total	32	4431.55			
Observations	33						

Source: Research Results, 2024

The estimation results show that the regression model used has a good ability to explain variations in the REDI, as indicated by the R Square value of 0.6703, or 67.03%, in Table 3. This means that 67.03% of the variation in the REDI can be explained by both independent variables: the realization of education spending and the district/city dummy. The remaining variation is explained by other factors not included in the model. The Adjusted R Square value of 0.6484 indicates that the model remains robust and does not experience overfitting, even when adjusted for the number of variables. Additionally, the results of the significant F test at a p-value of 0.0000 confirm that the overall regression model is significant, indicating that both independent variables together have a significant influence on the dependent variable.

Table 4 shows the results of partial tests that describe the influence of several variables on the REDI. The variable "20% Education Spending" has a coefficient of 0.0000 with a p-value of 0.0000, indicating a significant positive influence on the education development index. Although the coefficient value is very small, the very low p-value confirms that, despite its small size, the realization of education spending still has a consistent and significant impact on increasing the education development index. This suggests that while the contribution per unit of additional education spending may seem small, overall, increasing education spending plays an important role in driving progress in education development, both in terms of quality and access to education.

Table 4. Partial test results of REDI variables

Variables	Coefficients	Standard Error	t-Stat	P-Value
Intercept	23.8631	2.262352	10.547	0
20% Education Spending	0	6.62E-09	6.9362	0
District/City Dummy	10.2427	2.834643	3.6134	0.0011

Source: Research Results, 2024

It is important to note that although the magnitude of the coefficient is very small, its statistically significant effect demonstrates that other larger factors in the education system (such as national policies, teaching quality, and educational infrastructure) may have a more dominant contribution. However, spending realization still plays a role as a driving factor that supports the improvement of the education index, even though its impact is more gradual and indirect. Research by Cui et al. [32] in a study of public expenditure in developing countries suggests that gradual and sustained government spending can have long-term impacts on social and educational outcomes.

In addition, the variable "Dummy Regency/City" shows a coefficient of 10.2427 with a p-value of 0.0011, which confirms that the difference between regencies and cities has a significant effect on the education development index. This

result indicates that cities generally have higher education index values than regencies, which may be due to better access to educational resources in cities. The regression model used in this study shows a significant positive correlation between the variables analyzed, with R^2 reflecting the goodness of this model in explaining the relationship between the dependent and independent variables. This aligns with findings in the literature, which state that regression models with dummy variables can provide deeper insights into the influence of certain factors in public policy [31].

4.2 The Impact of regional education development performance and GRDP percapita on decreasing regional poverty

Heteroscedasticity testing was performed by regressing the residuals from Eq. (3) as the dependent variable against the fifth set of independent variables. The test results indicate that this model does not have significant heteroscedasticity problems. The p-value of the F-test, 0.5368, signifies that the independent variables do not have a significant influence on the residuals of the Regional Poverty Index (RPI). In other words, the assumption of homoscedasticity (constant residual variance) is met in the model. The results of the heteroscedasticity test are shown in Table 5.

Table 5. Results of the REDI heteroscedasticity test (SFII, SPRI, REI) of GRDP per capita, and regency/city dummy against the regional poverty index

Variables	Coefficients	Standard Error	t-Stat	P-Value
Intercept	0.01415	0.08818	0.1604	0.8737
SFII	0.00006	0.0002	0.2976	0.7683
SPRI	0.00161	0.00156	1.0368	0.309
REI	-0.01124	0.0064	-1.7574	0.0902
GRDP Percapita	0	0	-0.1308	0.8969
District/City Dummy	0.00521	0.01004	0.519	0.608

Source: Research Results, 2024

Furthermore, the p-values for each regression coefficient from the independent variables show no significant relationship (at the 5% significance level) with the dependent variable, which is the residual from the RPI equation. This strengthens the argument that the model is free from heteroscedasticity problems. With no heteroscedasticity detected, the regression model can be validly used to analyze the relationship between the independent and dependent variables.

4.2.1 Multicollinearity test

The multicollinearity test was performed by examining the correlation matrix between the independent variables (Table 6). This test shows that there is no serious multicollinearity problem among the independent variables in the model. The correlation values between variables are mostly below the commonly used threshold of 0.8. For example, the highest correlation is between SPRI (School Participation Rate Index) and REI (Regional Education Index), which is 0.617, still within the tolerance limit. This indicates that although these two variables have a fairly strong relationship, they do not replace each other (i.e., they are not redundant) in explaining the variability of the regional poverty index.

In addition, other variables such as GRDP per capita and the District/City Dummy also show relatively low correlation values with other variables. For example, the correlation

between GRDP and REI is 0.292, and the correlation between the District/City Dummy and SPRI is 0.283. This indicates that each variable provides a unique contribution to the model without excessive overlap. With no indication of serious multicollinearity in this model, the regression analysis can be considered valid for describing the relationship between the independent variables and the regional poverty index, as shown in Table 6 below.

Table 6. Results of the REDI multicollinearity test (SFII, SPRI, REI) of GRDP per capita, and regency/city dummy against the regional poverty index

Variables	SFII	SPRI	REI	GRDP Percapita	District/City Dummy
SFII	1				
SPRI	-0.0241	1			
REI	0.2497	0.6170	1		
GRDP Percapita	0.4015	-0.0413	0.2926	1	
District/City Dummy	-0.0331	0.2831	0.5672	0.1441	1

Source: Research Results, 2024

4.2.2 Autocorrelation test

The results of the autocorrelation test on the influence of the REDI (SFII, SPRI, REI), GRDP per capita, and dummy variables on the decrease in the Regional Poverty Index show a Durbin-Watson (DW) value of 1.9470. This DW value lies between the upper limit (DU) of 1.8808 and (4-DU) of 2.1192. Since the DW value lies between DU and 4-DU, it can be concluded that there is no autocorrelation in the model. This means that there is no linear relationship between the residuals of adjacent observations, so this model is considered valid and not affected by autocorrelation problems.

Based on the results of the classical assumption tests, the regression model in this study can be considered valid because it meets the three main assumptions. The heteroscedasticity test shows that the model does not experience heteroscedasticity problems. The multicollinearity test shows that there are no significant multicollinearity problems. Additionally, the results of the autocorrelation test, with the Durbin-Watson value within the accepted range, indicate the absence of autocorrelation between adjacent residuals.

Furthermore, in Figure 2, you can observe the relationship between the REDI and the Regional Poverty Index (RPI), which overall does not show a clear pattern. However, for relatively low values of REDI, there is a positive relationship between REDI and RPI. On the other hand, for relatively high values of REDI, there is a negative relationship.

Districts and cities such as Padang Lawas and South Nias have high poverty index values, despite having certain REDI and GRDP per capita values. This suggests that other structural factors outside of REDI and GRDP also influence poverty levels in these regions. In contrast, districts like Humbang Hasundutan and Asahan show low poverty index values despite having relatively low REDI and GRDP. This indicates that local policies, resource distribution, or other factors such as social infrastructure or government investment in basic services may play a more significant role in reducing poverty in these regions.

The regression model estimation results for Eq. (3) are presented in Table 7. The estimation results show that the model used has a strong relationship between the independent and dependent variables, with an R-squared value of 0.742. This indicates that approximately 74.2% of the variability in

the regional poverty index can be explained by the independent variables in the model. The Adjusted R-squared value of 0.694 suggests that the model remains robust even after adjusting for the number of variables and samples. Based on the ANOVA results, the F-statistic value of 15.527 with a

significance level of 0.000 indicates that the overall independent variables have a significant impact on the dependent variable. This means that all the independent variables together have an influence on the regional poverty index.

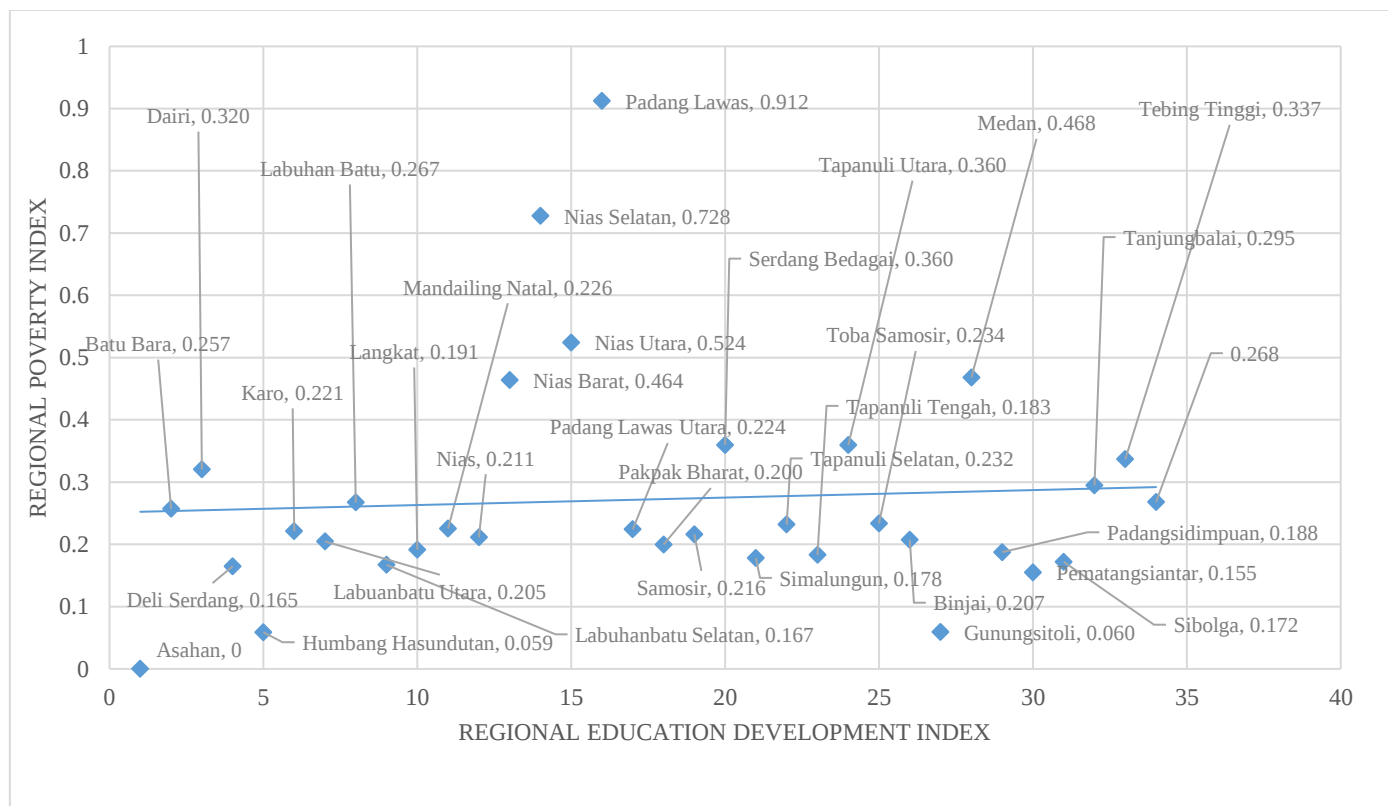


Figure 2. Relationship between REDI and regional poverty index

Table 7. Regression model estimation results for the regional poverty index

Regression Statistics					ANOVA		
Multiple R	0.861	Variables	df	SS	MS	F	Significance F
R Square	0.741	Regression	5	0.723	0.144	15.527	0.000
Adjusted R Square	0.694	Residual	27	0.251	0.009		
Standard Error	0.096	Total	32	0.974			
Observations	33						

Source: Research Results, 2024

Table 8 shows the results of partial tests, which provide insight into the contribution of various variables to the regional poverty index. The School Participation Rate Index (SPRI) has a positive coefficient of 0.032 with a p-value of 0.00027, indicating a significant positive relationship between improving school facilities and infrastructure and the poverty index. This suggests that higher poverty is likely associated with poor educational infrastructure, which can hinder educational accessibility for the poor. In contrast, the Regional Education Index (REI) has a negative coefficient of -0.239 and a p-value of 0.00000, indicating a significant negative relationship with the poverty index. Improving the quality of education, as reflected in the REI, has the potential to reduce poverty levels because better education can increase employment opportunities and community income. The Regency/City Dummy variable also shows a significant effect with a p-value of 0.00124, indicating that regional differences between regencies and cities affect poverty levels. This can be attributed to local factors such as government policies, budget allocations, and varying economic conditions in each region.

Table 8. Partial test results of regional poverty index variables

Variables	Coefficients	Standard Error	t-Stat	P-Value
Intercept	0.5948	0.4345	1.3687	0.1823
SFII	0.0006	0.0009	0.6468	0.5231
SPRI	0.0320	0.0076	4.1806	0.0002
REI	-0.2394	0.0315	-7.5973	0
GRDP Percapita	-1.20E-0	1.48E-09	-0.79758	0.4320
District/City Dummy	0.1783	0.0494	3.6060	0.0012

Source: Research Results, 2024

However, the School Facilites Infrastructure Index (SFII) variable does not have a significant effect on the poverty index, with a P-value of 0.52319. This may be attributed to the large variability in the data or the indirect impact of school infrastructure on poverty, where factors such as teaching quality and accessibility to education might play a more significant role. Furthermore, GRDP per capita also does not show a significant effect on the poverty index, with a

coefficient of $-1.2\text{E-}09$ and a P-value of 0.43208. Although GRDP per capita is often regarded as an indicator of economic growth that can alleviate poverty, these findings suggest that in this region, economic growth per capita does not directly contribute to poverty reduction. This could be due to income inequality, where the benefits of economic growth are not evenly distributed, leaving many individuals unaffected. Other factors, such as workforce quality, education levels, and socio-economic inequality, appear to have a more dominant influence on the poverty rate in this region, rendering GRDP per capita less significant in explaining poverty.

4.3 RDEI

Figure 3 presents the average results for the calculation of the composite index, known as the Regional Development Education Index (RDEI), for districts and cities in North Sumatra Province during the 2019–2022 period.

A higher RDEI value indicates a higher level of RDEI, reflecting the quality of education and its influence on regional development. Based on the analysis, it is evident that 11 regencies/cities in North Sumatra have RDEI values above the provincial average, while 12 regencies/cities fall below the provincial average (Central Statistics Agency, 2020). Medan City ranks at the top, with the highest geometric mean value in North Sumatra at 67.22, significantly exceeding the provincial average of 52.14. This highlights Medan City's superior educational performance, supported by better education

infrastructure, broader access to health services, and relatively higher economic welfare. Deli Serdang takes second place with an RDEI value of 65.35, followed by Langkat in third place with a value of 58.66, both demonstrating education performance above the provincial average. Overall, 10 regencies/cities in North Sumatra have higher geometric mean RDEI values compared to the provincial average.

In contrast, most other regions remain below the provincial average despite efforts to improve education quality. These regions show geometric mean values ranging from 49 to 53. Areas with the lowest values, such as Sibolga City, Pakpak Bharat, and West Nias, each record a geometric mean value of 49.08. This reflects significant challenges in these regions, including limited access to essential services such as education and health, as well as ongoing infrastructure issues that hinder improvements in quality of life and education [33]. The findings of this study indicate that factors such as educational infrastructure, economic welfare, and access to public services play a pivotal role in determining geometric mean values for each region. Medan City, with its advanced educational infrastructure and broader access to health services, demonstrates superior performance compared to other regions [34]. Conversely, regions with the lowest geometric mean values, such as Sibolga, Pakpak Bharat, and West Nias, face more substantial challenges in accessing basic services and overcoming infrastructure limitations, which hinder their development [5].

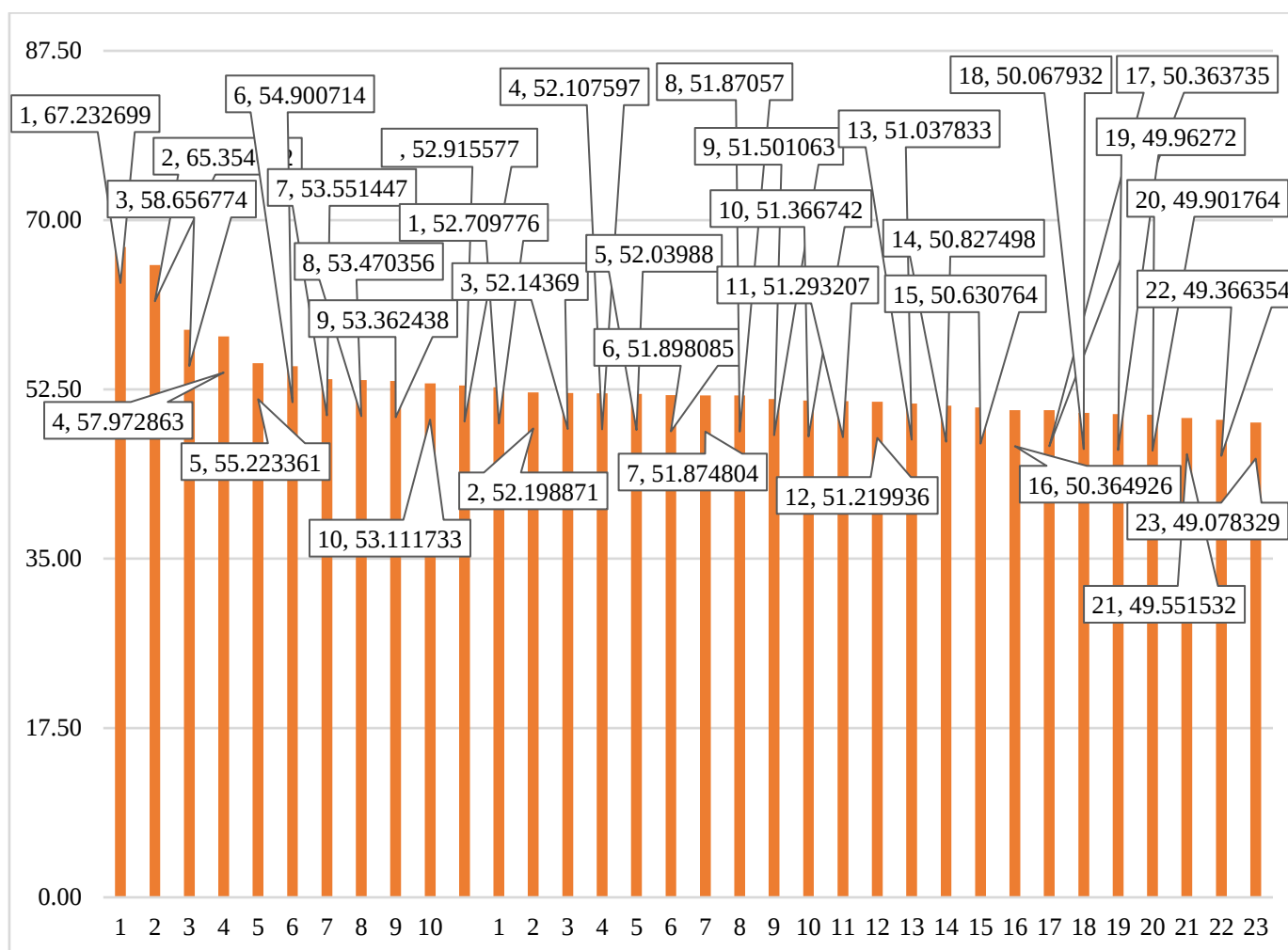


Figure 3. Geometric average of RDEI in North Sumatra

5. DISCUSSION

5.1 Impact of 20% education spending realization on regional education development

The impact of the realization of education spending of 20% and the expansion of regional autonomy on education development in districts/cities throughout North Sumatra shows complex results. Although there is a positive relationship between the realization of education spending and the REDI, with an R-squared value of 0.6703 indicating that 67.03% of the variation in REDI can be explained by this model, as well as a significant F-Statistic value, the impact remains limited. The coefficient for the variable "20% Spending Realization" is small (0.0000), and the p-value of 0.2907 indicates that although there is a positive impact, the influence is not significant at the conventional level.

Several factors explain why this impact is limited, one of which is the uneven distribution of the budget that occurs in various regions. As stated by Saputra and Mahmudi [35], uneven budget distribution, combined with corrupt practices and weak supervision, can reduce the effectiveness of education spending, reflected in cases of misappropriation of School Operational Assistance (BOS) funds or procurement of school infrastructure that does not meet needs. On the other hand, although regional expansion increases the education budget, fund management remains a significant challenge in new regions.

Research by Buheji [36] shows that in India, regional expansion increases the education budget, but managing these funds remains a major challenge. The realization of 20% of education spending aims to improve the quality of education, but its impact on REDI in North Sumatra remains limited, due to inefficient fund management, uneven distribution of education infrastructure, and the quality of educators which is still a problem. Although the allocation of the education budget has reached 20%, gaps in fund management remain. The inability to allocate and use funds optimally causes most of the funds to be used to meet basic needs such as facilities and infrastructure, rather than programs that focus on improving the quality of teaching or teacher training, so that even though the education budget is large, the quality of education reflected in REDI remains low.

The uneven distribution of the budget for the development of educational infrastructure also affects the low impact of education spending. In remote or rural areas, educational infrastructure is still very limited, with many schools lacking adequate basic facilities. This is in accordance with the findings of Filmer and Pritchett [37], which show that the quality of educational infrastructure has a significant effect on educational outcomes. The quality of teaching and the competence of educators in North Sumatra are also important factors that affect the impact of education budget allocation. Many areas still have difficulty providing competent teachers, especially in remote areas, and without continuous training for teachers, the quality of teaching will not improve, which in turn affects the low REDI.

Poor teaching quality can reduce the effectiveness of the use of the education budget. In addition, long and non-transparent bureaucratic processes often hinder the effective use of the education budget. Several regions experience the practice of politicization of education, where more funds are allocated to projects that are more related to political interests than to improving the quality of education. This is further exacerbated

by weak supervision of budget use, which allows for waste and misuse of funds. Limited community participation in planning and monitoring the use of the education budget also reduces the effectiveness of fund allocation. Without active community involvement, management of the education budget tends not to reflect real needs in the field and has the potential to not provide maximum results, because budget use is often not on target.

5.2 The Impact of regional education development performance and percapita GRDP on regional poverty reduction

Educational development is widely recognized as a critical instrument in reducing poverty. However, the implementation of this policy at the district/city level in North Sumatra reveals that the impact of educational development remains limited. Recent research by Hanushek and Woessmann [2] highlights that the quality of education, particularly the quality of teaching, has a greater influence on economic growth and poverty reduction than merely increasing the education budget allocation. The findings of this study indicate that despite the implementation of the 20% education budget allocation, the quality of human resources produced is still suboptimal. This suggests that increasing the budget alone is insufficient to address poverty if the quality of education remains inadequate.

Moreover, the relationship between GRDP per capita and poverty reduction also yielded statistically insignificant results. This underscores that economic growth does not automatically translate into poverty reduction, particularly when the growth is not derived from labor-intensive sectors that absorb large numbers of low-income workers [38]. Economic growth driven by non-labor-intensive sectors that fail to create sufficient employment opportunities for poor households can hinder poverty alleviation. Conversely, sectors that generate more jobs for skilled workers with quality education tend to have a more substantial impact on poverty reduction. The regression test results of this study confirm that although a positive relationship exists between GRDP per capita and poverty reduction, its impact on poverty alleviation in specific regions, such as South Nias and Padang Lawas, remains minimal.

Another challenge in reducing poverty is the inefficiency in managing the education budget. According to World Bank findings [16], the lack of transparency in education budget management often leads to inefficiencies that undermine efforts to improve educational quality. The practice of budget misappropriation, as documented in the reports of the Audit Board of Indonesia (2024) and the Corruption Eradication Commission (2024), exacerbates the challenges associated with the 20% budget allocation policy for education. For example, the misuse of School Operational Assistance (BOS) funds in North Sumatra has resulted in uneven educational quality and impeded efforts to achieve optimal human resource development.

Research by Psacharopoulos and Patrinos [18] emphasizes the importance of expanding access to education alongside improving teaching quality to alleviate poverty. However, in North Sumatra, disparities in educational quality between developed areas, such as Medan and Binjai, and underdeveloped areas, such as South Nias and Padang Lawas, continue to hinder poverty alleviation efforts. Economic development, which is expected to bring positive changes to poverty levels, must be accompanied by substantial reforms in the education system, particularly in underdeveloped areas.

The quality of education is also closely tied to the adequacy of educational infrastructure. The UNESCO report [7] emphasizes that both the quality of teaching and robust educational infrastructure are essential for creating human resources capable of breaking the cycle of poverty. While developed areas in North Sumatra have benefited from better access to educational facilities, significant gaps persist in underdeveloped areas, which must be addressed urgently. This study supports these findings by showing that although variations in the RDEI exist across regions, the overall quality of education remains a major barrier to poverty alleviation.

Baker and Letendre [19] caution that an uneven and low-quality education system perpetuates the cycle of poverty. This is particularly relevant in North Sumatra, which not only requires a substantial allocation of the education budget but also necessitates comprehensive reforms in the education system. Without equitable improvements in education quality, economic development efforts through education will struggle to have a significant impact on poverty reduction. Disparities in education quality, both in teaching standards and infrastructure, are key reasons why certain districts/cities in North Sumatra continue to experience high poverty levels despite achieving high GRDP figures.

Additionally, the Central Statistics Agency (2020) report highlights significant disparities in educational quality among districts/cities in North Sumatra. While areas such as Medan and Binjai offer better quality education, regions like Nias and Padang Lawas remain far behind in terms of teaching quality and educational infrastructure. This underscores the need for comprehensive and equitable improvements, with a particular focus on the most disadvantaged areas. Enhancing the transparency and accountability of education budget management, as well as improving access to and the quality of education in underdeveloped regions, are crucial steps toward breaking the cycle of poverty. This study demonstrates that local factors, such as regional policies and resource distribution, play a significant role in influencing poverty reduction. The district/city dummy variable also reveals significant differences in the impact of education budget management and distribution across various regions in North Sumatra, as indicated by its P-value.

5.3 RDEI

The Regional Development Education Index (RDEI) in North Sumatra provides a comprehensive overview of the quality of education across various districts and cities, incorporating factors such as educational infrastructure, teaching quality, and access to basic services. The analysis reveals significant disparities between regions with high and low scores, highlighting the major challenges in achieving equitable education quality throughout the province. Medan City, with the highest RDEI score of 67.22, demonstrates that factors such as superior educational infrastructure and broader access to public services play a crucial role in enhancing education quality. As the provincial capital and primary economic hub, Medan benefits from a larger education sector budget, more extensive educational facilities, and better-trained teachers. These advantages contribute to improved teaching quality and better educational outcomes compared to other regions in North Sumatra.

Conversely, areas with low RDEI scores, such as Sibolga, Pakpak Bharat, and West Nias, face significant challenges, particularly in terms of access to adequate educational

facilities. Insufficient infrastructure, such as inadequate classrooms and limited educational equipment, exacerbates the quality of education in these regions. Additionally, the shortage of qualified teaching staff poses a critical obstacle. These deficiencies hinder students in these areas from accessing quality education, which adversely impacts their RDEI performance. Research by Pierskalla and Sacks [39] underscores the importance of infrastructure and economic welfare in determining education quality. This is evident from the observed inequalities, where regions with low scores struggle to provide the basic facilities necessary to enhance education quality. Furthermore, these limitations are closely tied to restricted access to other public services, such as healthcare and transportation, which collectively influence the quality of life and education in these areas.

Although certain districts in North Sumatra achieve favorable RDEI outcomes, the disparities between high- and low-scoring regions underscore the need for greater focus on equitable education development. By improving infrastructure quality, providing enhanced training for teachers, and ensuring a fairer allocation of the education budget, the quality of education in low-scoring areas can be elevated. This, in turn, is expected to improve the overall RDEI across North Sumatra.

6. POLICY IMPLICATION

The findings show that the impact of quality education remains limited, particularly in areas with low Regional Development Education Index (RDEI) scores. Therefore, more targeted and integrated policies are needed between the education and economic sectors to optimize budget management and reduce disparities in education quality across regions. The following are some key policy implications; First, to increase the impact of the 20% education spending on regional education development, there must be improvements in budget allocation and management. Although the 20% education spending policy has been implemented, its impact on education quality in disadvantaged areas remains limited. This is due to the imbalance between budget allocation and development priorities, which often do not emphasize improving teaching quality or evenly developing education infrastructure. Based on previous research by Filmer and Pritchett [37], more effective and targeted allocations for improving teaching quality and teacher training have a greater impact on education outcomes. Therefore, policies should prioritize transparency, accountability, and alignment of budget distribution with the actual needs of schools, particularly in regions with low RDEI scores. Additionally, stricter supervision of education spending is essential to prevent misuse of funds and to enhance spending effectiveness. A study on education budget management in developing countries demonstrated that tighter oversight and more efficient use of budgets can significantly improve education quality.

Second, for regions with low RDEI scores, such as Sibolga, Pakpak Bharat, and West Nias, it is imperative to prioritize policies aimed at improving teaching quality and educational infrastructure. A valuable lesson can be learned from Medan, which has a higher RDEI score compared to other regions. Medan's success in educational development can be attributed to better budget allocation and higher teaching quality, achieved through the integration of education policies with regional development strategies. Regions with low RDEI

scores can improve education quality by focusing on teacher training, upgrading facilities and infrastructure, and enhancing student skills to meet labor market demands. Efforts to improve these regions must also include providing incentives for teachers and continuous training programs. Given the stark disparities between districts/cities with high and low RDEI scores, such policies are expected to reduce gaps in education quality.

Third, although GRDP per capita has a positive relationship with poverty reduction, economic development policies in North Sumatra must integrate the education sector with productive sectors. This approach will enhance the quality of the workforce produced by education and strengthen the connection between the education system and the labor market. For instance, the agriculture, manufacturing, and tourism sectors could benefit from skilled labor produced through quality education programs. Collaboration between the education and economic sectors can lead to effective employment opportunities for graduates. Therefore, education policies should focus on developing skills aligned with labor market needs in these productive sectors. Policies that integrate education and productive sectors have the potential to significantly reduce poverty. Moreover, reforms in education budget management and efforts to equalize education quality in disadvantaged areas must be pursued to support the achievement of these goals.

7. CONCLUSION

This study found that the allocation of the 20% education budget and regional expansion showed a positive relationship with education development in North Sumatra, although its influence was limited. The low but significant coefficient indicates that the effectiveness of the budget depends on proper implementation and management. Challenges such as administrative capacity issues and corruption are inhibiting factors, which have implications for the inequality in education quality between regions.

The analysis shows that increasing access to education must be accompanied by improvements in the quality of services in order to support significant poverty reduction. Areas with strong infrastructure, such as Medan and Deli Serdang, show better educational performance. The same trend was observed when comparing urban and rural areas, with rural areas, especially those that are relatively underdeveloped, such as Nias and Padang Lawas, requiring special attention. This highlights that economic and educational development must go hand in hand to address social disparities and improve the quality of human resources.

The development of the RDEI helps identify gaps between regions and serves as an important reference for formulating education policies in North Sumatra. The main recommendations from this study include reforms for more transparent budget management, increasing administrative capacity, and expanding access to education in disadvantaged areas. With these steps, education development is expected to contribute more significantly to poverty alleviation and inclusive economic development.

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NOMENCLATURE

REDI	Regional Education of Development Index
SFII	School Facilities Infrastructure Index
SPRI	School Participation Rate Index
REI	Regional Education Index
RPI	Regional Poverty Index
RDEI	Regional Development of Education Index