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From Wealth Gap to Knowledge Gap: A Study on Socioeconomic Disparities in Education

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Abstract: This paper aims to discuss the interconnectedness of the issues of educational and income inequality since they are two issues that impact all spheres of society's development and are closely connected. While the existence of preschool education inequality is established by comparing the proportion of children from more endangered and privileged backgrounds, the measure of economic inequality is based on the Gini coefficient of the supply of resources. The study considers the enrollment rates of Secondary schools by income, student /teacher ratio, and Gini coefficient using data from the World Bank and UNESCO. Regression analysis of these variables presents high levels of correlation; this implies that income inequality might increase educational disparities and vice versa. The results vary to some extent depending on the wealth status, where the middle-income countries had a significantly higher level of negative correlation between secondary enrollment and Gini index. Therefore, it becomes imperative to gain a better understanding of the contextual factors tied to education and other social determinants of educational injustice, as noted in the paper's conclusion, which overviews the policy considerations and recommendations for future research.

Keywords: Income inequality, educational inequality, Gini coefficient, socioeconomic disparities

1. Introduction

Income inequality and educational inequality are deeply intertwined issues that have significant implications for societal development. Educational inequality is defined as educational attainment by people from higher relative to lower income backgrounds [1]. income inequality is the unequal distribution of earnings and resources among a population, usually measured by the Lorentz curve and Gini coefficient [2]. Income inequality has a negative impact on educational opportunities and, in turn, on future earnings. John Doe, a renowned education reform advocate, has dedicated his career to studying the disparities in educational opportunities, focusing on how socioeconomic factors influence access to quality education. In today's rapidly evolving economic landscape, the gap between the rich and the poor continues to widen, significantly impacting educational equity. According to the OECD [3], "Students from lower socio-economic backgrounds are less likely to perform well in school and more likely to drop out before completing their education." This statement highlights the pervasive nature of educational inequality. Furthermore, research by [4] indicates that

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the achievement gap between affluent and low-income students has grown by 40% over the past three decades, underscoring the essence of this issue.

Educational inequality remains a pressing issue, with children from low-income families often receiving substandard education compared to their wealthier peers. This growing divide not only perpetuates the cycle of poverty but hampers social mobility and economic growth. As [5] notes, "Educational inequality is one of the most significant barriers to achieving social justice and equity in our society."

Income disparity and educational disparity are two essential problems that are related to each other in many ways and have prospective impacts on any society. In this case, educational inequality is described as the level of education that people from a rich background have compared to those from a poor background [1]. income distribution is the way in which earnings and resources are split throughout a population, usually depicted with the help of the Lorentz curve and Gini coefficient [2]. Inequality in incomes reduces educational chances and, therefore, earning potential in the future. John Doe has been an education reform advocate for many years; the main emphasis of his work has been the inequality of the educational process comparing the influence of such factors as socio-economic status on the availability of education. Today's dynamic economic systems create heightened levels of inequality that determine the provision of education, including the disparity between the haves and haves, does not greatly influence educational fairness. This is as per the OECD [3], "Out of the school education system, less result oriented and more inclined towards dropping out from schools' students belong to low socio-economic status." This indicates that inequality starts at the education system. In addition, according to the investigation done by [4], the significant scholastic disparity between the competent and the less fortunate students has risen by 40 percent over three consecutive decades, which mirrors the spirit of this matter.

They indicate that across many developing countries, educational inequality has persisted, meaning that children from poor families are provided with a quality education compared to their counterparts from wealthy families. It also contributes to widening the poverty gap rather than promoting social status upliftment as well as economic development. According to [5], "Educational disparity stands out as one of the biggest hurdles that society will have to overcome if ever it is to attain social justice and equity".

Addressing this problem requires a comprehensive understanding of how income inequality exacerbates educational disparities and vice versa. By understanding this connection, we can better appreciate the broader implications of socioeconomic disparities on future generations. This essay will explore the relationship between income inequality and educational inequality and highlight its critical importance.

2. Data collection

In this study, the data collection process involves the following key steps: Firstly, we have defined two main variables. Variable 1 is a country's income inequality, which is defined as the country's Gini coefficient of income and wealth in this study. Variable 2 is a country's educational inequality, which is defined as the student-and-teacher ratio and secondary school enrollment rate. We collected and analyzed the Gini coefficient, student-and-teacher ratio, and secondary school enrollment rate of 10 high-income countries, middle- and higher-income countries, and middle-income countries, respectively, according to the classification of the World Bank. The data primarily comes from the World Bank and the United Nations Educational, Scientific, and Cultural Organization (UNESCO), chosen for its comprehensive and reliable datasets. Why do we choose the Gini coefficient as the indicator of income inequality?

According to Dorfman's interpretation of the Gini coefficient formula, the Gini coefficient is based on income distribution [6]. The Gini coefficient is a number between 0 and 1, and the end of a

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country's Gini coefficient represents the more equal distribution of income in that country. The higher a country's Gini coefficient, the more unequal its income distribution. Why use student and teacher ratio as a measure of equality in education? According to UNESCO [7], A higher student-and-teacher ratio may represent a teacher shortage in the education of a country, that is, insufficient educational resources, which means that education is less equitable. The secondary school enrollment rate measures the percentage of children in a country aged 11-18 who are in secondary school. According to [8], the secondary school enrollment rate of females can be used to measure gender equality in education. Similarly, the secondary enrollment rate for both sexes can be used to measure the educational inequality of a country. We collected each country's primary school enrollment rate and tertiary school enrollment rate, as well as their education spending as % of GDP, to make relevant references.

3. Data analysis

The data collected for this study encompassed 29 countries. The variables of interest included the Gini coefficient, Secondary Enrollment Rate, and Student-Teacher Ratio for each country. We want to study the overall impact of Secondary Enrollment Rate, and Student-Teacher Ratio on the Gini coefficient. To investigate the relationship between these variables, we construct linear models by separating the correlation relationship of two independent variables and the dependent variable to know the effect of each independent variable. The regression model was specified as (1) and (2).

$$\text{Gini}_{\text{SER}} = \beta_0 + \beta_1 \times \text{Secondary Enrollment Rate} + \varepsilon \quad (1)$$

$$\text{Gini}_{\text{STR}} = \beta_0 + \beta_1 \times \text{Student Teacher Ratio} + \varepsilon \quad (2)$$

Where:

- Gini_{SER} and Gini_{STR} are the observed Gini coefficients against secondary enrolment (SER) and student-Teacher Ratio (STR)
- β_0 and β_1 are the intercept and the slope parameters
- E is the error term.

An analysis of variance (ANOVA) was performed to test the significance of the entire model. Table 1 shows the results of the overall models.

Table 1: Estimate for overall models (1) and (2)

	Response variable Gini Coefficient	
	SER	*STR*
Intercept ($\hat{\beta}_0$)	1.071***	0.154***
	(0.124)	(0.034)
Slope ($\hat{\beta}_1$)	-0.760***	0.012***
	(0.130)	(0.002)
R^2	0.5589	0.5642
$F(1,8)$	34.21***	34.96***

Note: standard error (SE), ***p<.001, **p<.01, *p<.05

From table 1, the F-value was calculated to be 34.21 for Secondary Enrollment and 34.96 for Student-Teacher ratio with a corresponding p-values <.001 for Secondary Enrollment and Student-teacher ratio suggesting the model is statistically significant.

The Gini_{SER} regression line results indicated that the coefficient for the Secondary Enrollment Rate was estimated at $\hat{\beta}_1 = -0.76$ ($SE = 0.130, p < .001$). The model fit was assessed with an R^2

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value of 0.5589 and for the Gini_{STR} regression line, the coefficient was $\hat{\beta}_1 = 0.012$ ($SE = 0.002, p < .001$). The overall model fit was assessed with an R^2 value of 0.5642. We can see the F-value, coefficient and R-square are very close, which shows the impact on the Gini are quite similar.

Besides the overall trend of the relationship between income and wealth inequality. We divide countries into three categories using the World Bank's standards: high-income countries, middle-high-income countries, and middle-income countries, and see whether the overall global trend discussed above works similarly on each category of countries or which category has the most obvious trend. Table 2 shows the results for regression for high-income countries.

Table 2: Estimate for models (1) and (2) for high-income countries

	Response variable Gini Coefficient	
	SER	*STR*
Intercept ($\hat{\beta}_0$)	0.817**	0.186*
	(0.177)	(0.066)
Slope ($\hat{\beta}_1$)	-0.507*	0.010
	(0.185)	(0.005)
R^2	0.4848	0.3829
$F(1, 8)$	7.527*	4.964

Note: standard error (SE), ***p<.001, **p<.01, *p<.05

In Table 2, the regression results indicated that the coefficient for the Secondary Enrollment Rate in high-income countries was estimated at $\hat{\beta}_1 = -0.507$ ($SE = 0.187, p < .05$). The overall model fit was assessed with an R^2 value of 0.4848. Similarly, from table 2 for the student-Teacher Ratio, the coefficient in high income country was $\hat{\beta}_1 = 0.01$ ($SE = 0.005, p > .05$). The overall model fit was assessed with an R^2 value of 0.3829. From the statistics, it is obvious that the direction in higher-income countries is like the overall trend of 29 countries,. However the high p-value for Gini_{STR} in high-income countries indicates that the result is not statistically significant enough. Table 3 shows the results for regression for upper middle-income countries. Table 3: Estimate for models (1) and (2) for upper middle-income countries.

Table 3: Estimate for models (1) and (2) for upper middle-income

	Response variable Gini Coefficient	
	SER	*STR*
Intercept ($\hat{\beta}_0$)	-0.163	0.190***
	(0.398)	(0.029)
Slope ($\hat{\beta}_1$)	0.457	0.007**
	(0.403)	(0.002)
R^2	0.1383	0.5890
$F(1, 8)$	1.284	11.462**

Note: standard error (SE), ***p<.001, **p<.01, *p<.05

The result in table 3 indicate that the coefficient for the Secondary Enrollment Rate in middle-high income country was estimated at $\hat{\beta}_1 = 0.457$ ($SE = 0.403, p > .05$).The overall model fit was assessed with an R^2 value of 0.1383. Similarly. from table 3 for the student-Teacher Ratio, the coefficient in middle-high income country was $\hat{\beta}_1 = 0.007$ ($SE = 0.002, p < .01$). The overall model fit was assessed with an R^2 value of 0.589. In terms of SER and STR, middle-high income countries follow the norms found in the overall trend of mixing countries with different income levels.

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However, the correlation between Gini coefficient and SER in middle-high income countries is slightly weaker than the general norm, and the large p-value makes the data not statistically significant. While the correlation between Gini coefficient and STR is stronger and more like the general norms. Table 4: Estimate for models (1) and (2) for middle-income countries.

Table 4: Estimate for models (1) and (2) for middle-income

	Response variable Gini Coefficient	
	SER	*STR*
Intercept ($\hat{\beta}_0$)	0.911***	0.282***
	(0.103)	(0.050)
Slope ($\hat{\beta}_1$)	-0.528**	0.008*
	(0.113)	(0.003)
R^2	0.7581	0.5745
$F(1,7)$	21.943**	9.451*

Note: standard error (SE), ***p<.001, **p<.01, *p<.05

From Table 4, the result indicates that the coefficient for the Secondary Enrollment Rate in middle-income countries was estimated at $\hat{\beta}_1 = -0.528$ ($SE = 0.113, p < .01$).The overall model fit was assessed with an R^2 value of 0.7581. For the Student-Teacher Ratio, the coefficient in middle income country was $\hat{\beta}_1 = 0.008$ ($SE = 0.003, p < .05$). The overall model fit was assessed with an R^2 value of 0.5745. to sum up, the results in middle-income countries are both statistically significant. In addition, the correlation between the Gini coefficient and SER is stronger than the other two income categories, meaning that educational inequality has a greater impact on income inequality in middle-income countries compared to countries with higher income.

To sum up, although some of them have large p-values, the result is less statistically significant. However, through the coefficient and graphs, we can still conclude that there is a positive correlation between the Gini coefficient and the student-teacher ratio and a negative correlation between the Gini coefficient and the secondary enrollment rate. Differences can occur depending on a country's overall income level. To be more specific, the lower the country's income level, the more obvious the trend.

4. Results and discussion

The regression results indicate varying levels of influence of the Gini coefficient on secondary education and student-teacher ratios across different income groups. In high-income countries, the negative impact of the Gini coefficient suggests that higher income inequality is associated with lower secondary education levels and student-teacher ratios. This could be due to more resources being concentrated among fewer individuals, leading to less investment in education infrastructure and access. In countries with higher income thresholds, income inequality leads to a negative outcome, as it increases disparities amongst access to education and quality of life, a phenomenon documented by Mankiw [9].

Secondary education, especially in the case of higher middle-income countries, can be seen to have an insignificant relationship with the Gini coefficient. However, a slightly positively significant impact can be analyzed on the ratio between students and teachers. This finding is important, as it can depict that although income inequality might not have a strong effect on education at the secondary level, due to educationally oriented investments specifically targeting inequality gaps, there exists a slightly positive influence on the student and teacher ratio. This finding is in line with the findings from [10], which state that in an attempt to reduce income inequality, a few selected countries undertook targeted educational policies and reforms.

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With regards to the case of middle-income countries, it can be seen that a strong positive relationship exists between the Gini coefficient and secondary education, and a similar relationship can be analyzed with student and teacher ratios. This finding depicts that there exists a correlation between higher income inequality and better education metrics. A wide array of academic literature documents this relationship, stating that in some situations, the existence of inequality drives private investment, which subsequently improves educational results [11]. Hence, such a relationship can be explained by investments from high-income persons arising due to policies which aim to educationally target resources distributed more evenly.

The analysis shows that there is a negative relationship between the Gini coefficient and secondary education in high-income countries, which means that there is an opportunity to reverse the impacts of inequality by attaining higher levels of education. Concretely, applying the regression model, secondary education proves to make up to 48 percent. 48% of the total variability of the Gini coefficient of these nations, which underlined the fact that education has a very significant role in shaping income sources and distribution within these countries [12].

On the other hand, in the cases of upper-middle-income countries, there is no obvious association between the Gini coefficient and secondary education, with regression model accountancy of only 13 per cent. 83% of the variance. This finding supports several findings showing that the expansion of education in some developing countries affects the reduction of income inequality, mainly due to the quality of education and its relation to market demands [13,14]. In middle-income countries, the negative relationship between the Gini coefficient and the level of secondary education indicates that education has been portable as a tool in the reproduction of the income divide. Therefore, this result partly confirms the theoretical and empirical literature that highlights the ability to enhance education equity to enhance the essential component in decreasing income inequality [15].

As illustrated from the analyses above regarding the student-teacher ratio, the results differ depending on the assorted categories of income. In high income countries, the inequality explained by the Gini coefficient is about 38 percent. 30% of the variance that can be explained by the student-teacher ratio, meaning that, increased contribution and reduction in inequality would result in enhanced education input [16]. Therefore, for the upper middle-income countries, both the estimates of the overall effect of Gini coefficient and its highly significance value of 0. 5889 convey a strong message that inequality hampers quality education and student teacher ratio improves only if there is a focus on reducing inequality. Likewise, in Middle-income countries, the important association between the Gini coefficient with the student-teacher ratio with R2 = 0. 5745 means that income inequality hampers educational resources and thus proliferates inequalities in education [17-19].

5. Conclusions

In conclusion, the above-undertaken analysis of the relationship between the Gini coefficient and education metrics provides a deeper and more valuable gauge into the chosen subject, especially considering income group segmentation. It can be determined that the economic status of a country affects the impact of income inequality on education. In the case of higher-income countries, a high-income inequality impacts both education metrics negatively, namely, secondary education levels and student-to-teacher ratios. However, there exists a slight distinction when considering the case of upper-middle-income countries, where income inequality suggests a slightly positive impact on student-to-teacher ratios, but secondary education levels are not significantly affected. Lastly, in the case of middle-income countries, targeted investments and government policies drive a significantly correlated relationship between improved education metrics and higher income inequalities.

It is important to note a few limitations, such as the presence of a less populated sample size may negatively affect result accuracy in this regression analysis, when coupled with the fact that the overall dynamics between income inequalities and impact on education cannot be captured by solely the Gini

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coefficient, and multiple additional factors such as government policy, historical contexts and ease of access to educational opportunities can all affect the overall outcome. Omitted variable bias may occur due to this reason, and the absence of considering multicollinearity amongst the above variables may lead to inaccuracy in results.

For future studies, recommendations arise within the features of expanding sample size, testing differing geographies and time periods and including all relevant variables such as public expenditure, economic metrics, and quantified policy metrics. This approach would yield better results and deeper insights when analyzing the relationship between income inequality and education.

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Youran He and Yuhang Su contributed equally to this work and should be considered co-first authors.

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