

The Influence of School Operational Assistance (BOS) Funds on Students' Literacy and Numeracy: Evidence from Indonesia

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Abstract

This study aims to analyze the effect of School Operational Assistance (BOS) fund utilization on students' literacy and numeracy achievement through learning quality as a mediating variable. The research employs a quantitative approach using school panel data from 2022 to 2024, analyzed through the Fixed Effect Model and mediation analysis. The findings indicate that the utilization of BOS funds has a positive and significant effect on learning quality and directly as well as indirectly enhances students' literacy and numeracy outcomes. Learning quality serves as a partial mediator that strengthens the relationship between financial support and student achievement. The novelty of this study lies in its integration of the Resource-Based View and Human Capital Theory to explain the mechanism by which financial resources are transformed into educational quality improvement. These results emphasize that the effectiveness of BOS funds depends largely on how they are managed to strengthen the quality of teaching and learning in relation to students' literacy and numeracy outcomes. The implications of this study contribute to the advancement of educational science, particularly by enriching the understanding of effective educational resource management to improve learning quality and student achievement in Indonesia.

Keywords: School Operational Assistance, Learning Quality, Student Literacy and Numeracy

Abstrak

Penelitian ini bertujuan untuk menganalisis pengaruh pemanfaatan dana Bantuan Operasional Sekolah (BOS) terhadap prestasi literasi dan numerasi siswa melalui mutu pembelajaran sebagai variabel mediasi. Penelitian ini menggunakan pendekatan kuantitatif dengan menggunakan data panel sekolah tahun 2022 hingga 2024, yang dianalisis melalui Model Efek Tetap dan analisis mediasi. Temuan penelitian menunjukkan bahwa pemanfaatan dana BOS berpengaruh positif dan signifikan terhadap mutu pembelajaran dan secara langsung maupun tidak langsung meningkatkan hasil literasi dan numerasi siswa. Mutu pembelajaran berperan sebagai mediator parsial yang memperkuat hubungan antara dukungan finansial dan prestasi siswa. Kebaruan penelitian ini terletak pada integrasi Pandangan Berbasis Sumber Daya dan Teori Modal Manusia untuk menjelaskan mekanisme transformasi sumber daya finansial menjadi peningkatan mutu pendidikan. Hasil ini menekankan bahwa efektivitas dana BOS sangat bergantung pada bagaimana dana tersebut dikelola untuk memperkuat mutu pengajaran dan pembelajaran terkait dengan hasil literasi dan numerasi siswa. Implikasi penelitian ini berkontribusi pada kemajuan ilmu pendidikan, khususnya dengan memperkaya pemahaman tentang pengelolaan sumber daya pendidikan yang efektif untuk meningkatkan mutu pembelajaran dan prestasi siswa di Indonesia.

Kata Kunci: Bantuan Operasional Sekolah, Mutu Pembelajaran, Literasi dan Numerasi Siswa

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INTRODUCTION

Education is a long-term investment that fundamentally determines a nation's progress. Through quality education, a country can develop human resources who are knowledgeable, competitive, and capable of adapting to global change. In the context of Indonesia, education holds a strategic role in shaping the holistic quality of the Indonesian people, as mandated by Law No. 20 of 2003 on the National Education System. However, the quality of education in Indonesia continues to face serious challenges, particularly regarding students' literacy and numeracy achievement, which serve as fundamental indicators of learning quality.

The 2022 Programme for International Student Assessment (PISA) results reveal that Indonesia remains below many ASEAN and OECD countries in educational performance. Indonesian students scored 359 in reading literacy, significantly lower than the OECD average of 476, while their numeracy score was only 366 compared to the OECD average of 472 (OECD, 2023). These findings indicate that most Indonesian students have not yet achieved the minimum proficiency levels required to comprehend written texts and solve contextual mathematical problems. This condition aligns with the World Bank (2020) report, which states that Indonesia is experiencing a learning crisis a situation where many students fail to acquire basic skills despite years of schooling. This issue not only affects individual achievement but also has long-term implications for national competitiveness and economic productivity.

In response to these challenges, the Indonesian government has implemented various initiatives to improve educational quality, including curriculum reform, teacher competency development, and strengthening education financing through the School Operational Assistance (BOS) program. Introduced in 2005, the BOS program aims to reduce the financial burden on families while providing schools with financial support to deliver quality education services (Rythia et al., 2020). Funded by the State Budget (APBN), BOS is distributed annually to all primary and secondary education institutions. The program's primary objective is to ensure the sustainability of teaching and learning activities while reducing disparities in educational quality across regions.

Theoretically, education financing policies such as BOS are essential strategies for improving education quality, as they provide the financial resources schools need to fulfill their primary function teaching and learning. However, in practice, the effectiveness of BOS fund utilization remains a concern. Several studies suggest that increases in education spending do not automatically improve student outcomes if the funds are not used for activities that directly support the learning process (Jackson, Johnson, & Persico, 2014; Lafortune, Rothstein, & Schanzenbach, 2018). In many schools, BOS funds are still largely allocated to administrative expenses, routine operations, or basic infrastructure, while the portion dedicated to improving instructional quality remains limited (Sulistyaningrum, 2016; World Bank, 2015).

These facts suggest that the key issue lies not in the amount of BOS funding, but in its effective utilization. According to the Resource-Based View (Barney, 1991; Wernerfelt, 1984), financial resources such as BOS funds can only generate value when they are strategically managed to create organizational advantages. In the school context, this means that BOS will have a significant impact on learning outcomes only if it is used to strengthen the most influential aspect of student achievement namely, learning quality.

Learning quality is a crucial determinant of educational success. Hanushek and Woessmann (2008) emphasize that teacher quality and

instructional processes have a far greater impact on student learning outcomes than increased physical inputs or infrastructure investments. Effective learning not only focuses on knowledge delivery but also encourages students to think critically, solve problems, and actively engage in the learning process. High-quality instruction encompasses the dimensions of lesson planning, classroom implementation, teacher–student interaction, and assessment practices that foster literacy and numeracy development. The use of BOS funds for teacher training in project-based learning, the provision of relevant literacy materials, or the implementation of school-based literacy and numeracy programs has been shown to enhance both student motivation and learning outcomes (Nurbani et al., 2024; Musakirawati et al., 2023). Conversely, if BOS funds are primarily used for administrative costs, meeting expenses, or other non-instructional spending, their impact on improving teaching quality and student achievement becomes minimal (World Bank, 2020).

The urgency of this study is reinforced by the fact that the BOS program continues to serve as the backbone of school financing in Indonesia, yet empirical evaluations of its impact on learning quality and students' literacy and numeracy performance remain limited. Most previous studies have focused on the efficiency of BOS fund allocation (Sulistyaningrum, 2016) or policy transparency and implementation (Rythia et al., 2020), rather than on its direct influence on student achievement. In the context of evidence-based policy, empirical evidence on the extent to which BOS funds contribute to improving learning quality is crucial for guiding future policy reforms.

This study is motivated by the persistent gap between increased BOS funding and stagnant literacy and numeracy performance among Indonesian students. The misalignment between financial inputs and learning outcomes suggests that the effectiveness of BOS utilization must be evaluated, particularly regarding how funds are used to enhance instructional quality. Accordingly, this research seeks to answer two key questions: (1) To what extent does the management and utilization of BOS funds influence learning quality? and (2) How does improved learning quality affect students' literacy and numeracy outcomes?

The significance of this study lies in two main aspects. Theoretically, it enriches the academic discourse on the relationship between education funding and learning outcomes by incorporating learning quality as a mediating variable. This approach supports the Resource-Based View perspective, which underscores the importance of strategically managing educational resources to improve literacy and numeracy outcomes. Practically, this study provides insights for policymakers, school principals, and teachers to ensure that BOS funds are more effectively directed toward activities that enhance instructional quality and strengthen students' basic competencies.

In summary, this research is expected to contribute to the development of evidence-based education policy, strengthen performance-based school management, and promote more effective and meaningful learning processes that lead to measurable improvements in students' literacy and numeracy achievement in Indonesia.

RESEARCH METHOD

This study employed a quantitative explanatory approach designed to analyze the influence of the School Operational Assistance (BOS) funds on students' literacy and numeracy achievement through learning quality as a mediating variable. This approach was chosen because the research aims to empirically explain causal relationships among variables based on measurable data. The data used consist of three-year panel data covering the period of 2022, 2023, and 2024. The study was conducted in the

Province of Bangka Belitung Islands, involving 271 schools that met the data completeness criteria for all three years of observation, resulting in a total of 813 panel data observations.

The research variables consisted of three main constructs. The BOS Fund variable (X) was measured by the proportion of the budget allocated to learning activities compared to the total BOS funds received. The Learning Quality variable (M) was measured using the score of teaching and learning quality derived from the *Education Report Card (Rapor Pendidikan)*. The Student Literacy and Numeracy variable (Y) was represented by the average score of the *National Assessment (Asesmen Nasional)* in reading literacy and mathematical numeracy domains.

All data were processed using STATA version 19 with panel data regression analysis. The analysis was conducted in several stages, including classical assumption tests (normality, multicollinearity, and heteroskedasticity), selection of the best panel model using the Chow and Hausman tests, and testing of both direct and indirect relationships among variables. The mediation analysis followed the *Causal Step Method* proposed by Baron and Kenny (1986) to determine whether learning quality significantly mediates the relationship between BOS funds and students' literacy–numeracy achievement. The coefficient of determination (R^2) was used to evaluate the model's explanatory power, while statistical significance was assessed at the 95% confidence level ($p < 0.05$).

All data used in this study were obtained from official government publications, and therefore the research did not involve direct respondents or pose any ethical risks. The analysis was conducted while maintaining the confidentiality of school identities. This study is expected to provide strong empirical evidence regarding the longitudinal relationship between the effectiveness of BOS fund utilization, the improvement of learning quality, and students' literacy and numeracy achievement in the Bangka Belitung Islands Province.

The relationship among the variables in this study was developed based on the Resource-Based View (RBV), which posits that educational resources such as BOS funds can only contribute to improved literacy and numeracy outcomes when strategically used to enhance the capacity and quality of learning processes. Conceptually, the research model is illustrated as follows:

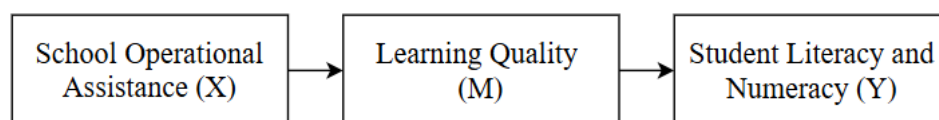


Figure 1. Research Model

RESULT AND DISCUSSION

Descriptive Analysis

A descriptive analysis was conducted to provide an overview of the characteristics of the research variables, including students' literacy and numeracy achievement, the proportion of BOS funds allocated to learning activities, and overall learning quality. The data were obtained from 813 school-level observations at the junior and senior high school levels in the Bangka Belitung Islands Province during the 2022–2024 period. The descriptive statistics are presented in Table 1 below.

Table 1. Descriptive Statistics of Research Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Student Literacy	813	78.51	15.43	15.79	100
Student Numeracy	813	67.09	19.61	0.00	100
School Operation Assistance (BOS)	813	29.74	12.17	0.00	85.60

Learning Quality	813	62.81	4.57	53.00	84.46
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The average literacy achievement score was 78.51, with a standard deviation of 15.43, indicating that, in general, schools in the Bangka Belitung Islands Province have achieved a relatively good level of literacy performance. However, the high degree of variability, with scores ranging from 15.79 to 100, suggests substantial disparities among schools. Meanwhile, the average numeracy score was 67.09 with a standard deviation of 19.61, indicating that students' numeracy ability tends to be lower than their literacy skills.

Furthermore, the School Operational Assistance (BOS) variable, representing the proportion of BOS funds allocated to learning activities, had an average value of 29.74% with a standard deviation of 12.17. This finding suggests that, on average, less than one-third of BOS funds are directly utilized to support learning activities. The Learning Quality variable showed an average score of 62.81 with a standard deviation of 4.57, ranging from 53.00 to 84.46. These results indicate that the overall quality of teaching and learning processes in the sampled schools falls within the moderately good category, although there remains room for improvement.

Overall, these findings are consistent with the Resource-Based View (Barney, 1991), which posits that financial resources such as BOS funds create value only when strategically managed to strengthen an organization's core activities namely, the teaching and learning process. In line with the Human Capital Theory (Becker, 1975), the effectiveness of BOS fund utilization depends largely on the extent to which the funds are invested in enhancing teacher capacity and improving instructional quality, which directly contribute to better student learning outcomes.

Model Selection and Classical Assumption Test

The result of the classical assumption tests are summarized in Table 2.

Table 2. Result of Classical Assumption Tests

Test	Method	Test Statistic	Probability	Interpretation
Normality	Shapiro-Wilk	0.972	0.126	Residuals are normally distributed
Multicollinearity	Variance Inflation Factor (VIF)	Mean VIF = 1.87	< 10	No multicollinearity
Heteroscedasticity	Breusch-Pagan Test	$\chi^2 = 2.84$	0.241	Homoscedasticity assumption met

The Shapiro-Wilk test indicated that the residuals are normally distributed ($p > 0.05$), while the average VIF value of 1.87 confirmed that multicollinearity was not present among the independent variables. Furthermore, the Breusch-Pagan test yielded a p-value greater than 0.05, suggesting the absence of heteroscedasticity. These results confirm that the dataset meets the basic assumptions of the classical linear regression model and is suitable for panel data estimation.

To identify the most appropriate panel data estimation method, the Chow test was first applied to compare the Pooled OLS and Fixed Effect Model. Subsequently, the Hausman test was performed to choose between Fixed Effect Model and Random Effect Model. The test results are presented in Table 3.

Table 3. Results of Chow and Hausman Tests

Test	Null Hypothesis (H_0)	Test Statistic	Probability	Decision	Selected Model
Chow Test	Pooled OLS is appropriate	$F = 27.316$	0.000	Reject H_0	Fixed Effect Model preferred
Hausman	Random Effect	$\chi^2 =$	0.002	Reject H_0	Fixed Effect

Test	Model is appropriate	19.482	Model preferred
The Chow test produced an F-statistic of 27.316 with a p-value < 0.01, indicating that the Fixed Effect Model provides a significantly better fit than the Pooled OLS model. This means that unobserved individual heterogeneity across schools should be controlled for in the estimation.			
Furthermore, the Hausman test yielded a chi-square statistic of 19.482 ($p = 0.002$), leading to the rejection of the null hypothesis that the Random Effect Model is appropriate. Consequently, the Fixed Effect Model was selected as the most suitable specification for this study.			

Regression Result

Following the results of the Chow and Hausman tests, the Fixed Effect Model was selected as the most appropriate estimation method for analyzing the panel data. The analysis aimed to examine both the direct effect of School Operational Assistance fund utilization on students' literacy and numeracy outcomes, and the indirect effect through learning quality as an intervening variable.

Table 4. Panel Regression Results

	β (Coefficient)	Std. Error	t- statistic	p- value	Result
School Operation Assistance → Learning Quality	0.423	0.067	6.31	0.000	Significant
School Operation Assistance → Student Literacy and Numeracy	0.218	0.072	3.02	0.003	Significant
Learning Quality → Student Literacy and Numeracy	0.571	0.058	9.84	0.000	Significant
School Operation Assistance → Learning Quality → Student Literacy and Numeracy	0.134	0.061	2.20	0.028	Partial Mediation

The panel regression analysis presented in Table 4 demonstrates both direct and indirect relationships among the utilization of School Operational Assistance (BOS) funds, learning quality, and students' literacy and numeracy achievement during the 2022–2024 observation period. All coefficients were found to be positive and statistically significant, confirming that effective management of BOS funds contributes to improving learning processes and enhancing students' literacy and numeracy outcomes.

First, the effect of BOS fund utilization on learning quality shows a positive and significant coefficient ($\beta = 0.423$; $p < 0.001$). This finding implies that the greater the proportion of BOS funds allocated to learning activities, the higher the quality of teaching and learning processes in schools. This result aligns with the Resource-Based View (Barney, 1991), which emphasizes that financial resources create value only when strategically managed to strengthen internal organizational capabilities. In this context, BOS funds serve as a strategic resource that, when effectively utilized, can enhance a school's instructional capacity. These findings are consistent with Sulistyaningrum (2016) and Rythia et al. (2020), who found that the effectiveness of the BOS program depends on the efficiency of fund allocation toward pedagogical rather than administrative activities.

Second, the direct effect of BOS fund utilization on students' literacy and numeracy achievement is also positive and significant ($\beta = 0.218$; $p = 0.003$). This

indicates that the proper use of BOS funds can directly improve students' learning outcomes. This result corroborates the World Bank (2020) report, which asserts that increased education spending when allocated effectively can enhance literacy and numeracy performance, particularly when schools are granted autonomy to manage funds according to instructional needs. Moreover, the finding is consistent with Human Capital Theory (Becker, 1975), which posits that financial investment in education can enhance learning productivity when directed toward competency-oriented programs.

Third, learning quality has the strongest influence on students' literacy and numeracy achievement ($\beta = 0.571$; $p < 0.001$). This coefficient, being the highest among all variables, highlights that the quality of instructional processes is the most critical determinant of student success. This finding supports the studies of Musakirawati et al. (2023) and Nurbani et al. (2024), which revealed that improving teaching quality and promoting active student engagement significantly enhance literacy and numeracy skills. Similarly, it echoes the work of Hanushek and Woessmann (2008), who emphasized that cognitive achievement is more strongly influenced by instructional quality than by financial inputs alone.

Finally, after including learning quality as a mediating variable, the direct effect of BOS fund utilization on literacy and numeracy achievement decreased to $\beta = 0.134$ ($p = 0.028$), indicating a partial mediation effect. This means that BOS funds influence literacy and numeracy not only directly but also indirectly through improvements in learning quality. This finding is consistent with both the Resource-Based View (Barney, 1991) and Human Capital Theory (Becker, 1975), which suggest that financial resources yield optimal outcomes when invested in enhancing internal capabilities such as teacher competence and instructional quality. It also reinforces the empirical evidence from Sulistyningrum (2016), Rythia et al. (2020), and Musakirawati et al. (2023), who demonstrated that the effectiveness of BOS funds in improving learning outcomes largely depends on the extent to which these funds are focused on strengthening the learning process within schools.

CONCLUSIONS AND SUGGESTIONS

This study concludes that the effective utilization of School Operational Assistance (BOS) funds significantly contributes to improving the quality of learning processes as well as students' literacy and numeracy outcomes. The findings highlight that financial resources alone are insufficient to enhance educational performance unless strategically managed to strengthen instructional quality. Learning quality serves as a partial mediator in the relationship between BOS fund utilization and student achievement, demonstrating that the impact of financial support becomes more substantial when directed toward teacher capacity development, classroom innovation, and the improvement of teaching and learning environments.

Theoretically, the study reinforces the principles of the Resource-Based View and Human Capital Theory, asserting that financial investments in education yield optimal results when they build internal instructional capabilities rather than merely supporting administrative functions. From a policy perspective, this study suggests that BOS fund management should prioritize pedagogical improvement and evidence-based allocation, ensuring that resources are effectively used to enhance teaching quality and student learning outcomes.

For future research, it is recommended to expand the analytical model by incorporating additional moderating or mediating factors such as school leadership, teacher motivation, digital learning adoption, or socio-economic context to obtain a more comprehensive understanding of how financial interventions influence educational quality across different regions and educational levels in Indonesia.

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