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Digital Inequality and Educational Inclusion: Examining the Association of Internet Access and Socioeconomic Status with Academic Performance Among School Students

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ABSTRACT

Digital inequality has become a primary problem in education, with a focus on internet access, socioeconomic status, and learning opportunities of school students. The study was designed quantitatively and cross-sectional with the aim of examining the relationship between internet access, socioeconomic status and academic performance, as well as educational inclusion. Secondary data sources included in this research were those of the Student Performance Data (SPD24) repository with 91,624 student records analysed. Relationships between demographic characteristics, internet availability, socioeconomic status, educational participation, and academic proficiency were explored using descriptive statistics, chi square tests, independent-samples t-tests, correlation analysis and regression analysis. This finding indicated that there was no statistically significant relationship between SES and Internet access ($p = .343$). There was no significant difference in composite proficiency between students with and without Internet access ($p = .778$); academic proficiency scores were almost the same. The academic performance categories were not significantly linked to socioeconomic status ($p = .388$). There were relatively even distributions of learning resources available and participation in classrooms by socioeconomic groups. Regression analysis also revealed that having access to the internet and socioeconomic status were not significant predictors of overall academic proficiency. The results indicate that socioeconomic status and general internet accessibility might not be sufficient to account for educational disparities. To comprehend the issue of digital inequality and to advocate for equitable learning opportunities for school students in a variety of learning contexts, broader measures of digital literacy, connectivity, educational resources, and institutional support are required.

Keywords: *Digital Inequality; Educational Inclusion; Internet Access; Socioeconomic Status; Academic Performance*

1. Introduction

As digital technologies are more prevalent in teaching and learning and they have a significant impact on access to education, this phenomenon has emerged as an important concern in modern education. Digital inequality has become an important issue in contemporary education because digital technologies are playing an increasingly significant role in the way education is delivered, learned and access to education is facilitated. While technological progress has made online learning platforms and education materials increasingly accessible and accessible, inequalities in digital access and skills still exist, posing a barrier to students of different socio-economic backgrounds. Digital inequality transcends device and internet access to the differences in digital competence and ability to take advantage of the opportunities available online. Differences in online skills have been identified as an important dimension of the digital divide, while variations in digital competencies, internet usage, and associated outcomes further contribute to digital inequalities (Hargittai, 2001; Scheerder et al., 2017). The same applies to access to appropriate devices and technological resources which also cause educational inequalities (Van Deursen & Van Dijk, 2019). The understanding of digital inequality has also been increasingly focused on access, skills, participation and educational outcomes in recent research (Martin et al., 2026).

Internet access is a key component in enabling educational activities, such as access to learning material, executing assignments, interaction with teachers and access to digital learning environments. But not all school students have equal opportunities to these opportunities. Household resources, geographical location and educational infrastructure can impact students' participation in online learning. During school closures research was undertaken to show that access to, and the extent of, digital infrastructure and access to technology were an issue for students from disadvantaged backgrounds (Dhaygude et al., 2022). There has also been a correlation between economic inequality and disparities in remote learning opportunities and participation in education (Francis & Weller, 2022). A lack of digital readiness among students and schools can further intensify existing educational inequalities by limiting access to and effective participation in digital learning opportunities (Van De Werfhorst et al., 2022). The inequality of access to digital resources and their educational value also highlights the need to consider internet accessibility in addition to social conditions in general, as illustrated by the rural–urban variation in access and outcomes (Zhao et al., 2022).

Another factor that is important with regard to educational opportunities and academic achievement is socioeconomic status. Children in the more affluent families may have more access to learning materials, to support in the learning process and to an appropriate environment to learn. Students from disadvantaged backgrounds, however, might have families with a limited financial means and less educational resources. Differences in cultural and social resources contribute to the reproduction of educational inequalities, while international educational assessments have consistently identified socioeconomic disparities in students' academic achievement (Bourdieu & Passeron, 1990; Pisa, 2023). The study showed that there is a significant relationship between the socioeconomic status and academic achievement, especially, family background factors in learning differences (Sirin, 2005).

Educational inclusion is about students' equal access to learning resources, participation in learning activities, and positive learning outcomes. Digital technologies can be used to promote inclusion in a variety of ways such as by providing access to educational resources and affordability of flexible learning opportunities. However, the unequal technological resources can pose further obstacles to the learning of disadvantaged students. The global education monitoring report has emphasized the need for assessing technologies in education in terms of equity, accessibility, and learning needs (Antoninis et al., 2023). The interplay between the access to technological tools, diversity, and educational inequalities (Gandolfi et al., 2021). Likewise, it is important to consider the various social, economic, and cultural contexts of students when it comes to inclusive digital learning (Liu, 2021). This is especially true to the experiences of students during the COVID-19 pandemic, which highlighted the need for opportunities for accessible and supportive digital learning (Livingston et al., 2023).

Although the body of knowledge on digital inequality in education has grown, there is still a lack of understanding of how the internet is associated with socioeconomic factors and academic outcome for students in the same school. Although some existing studies explored different aspects of digital equality,

there are still significant challenges regarding the conceptual approaches and measurement of digital equality (Luo & Liu, 2026). The existing literature on the link between digital access, digital skills and educational outcomes indicates that access to technology is not sufficient to guarantee equitable educational experiences (Ng & Chan, 2026). The current study seeks to explore digital inequality and educational inclusion among school students in terms of disparities in Internet access and learning resources among various socioeconomic groups of students. It also examines how access to the internet and socioeconomic status are related to academic outcomes and how academic participation, learning resources, and academic success relate to each other. The study aims to contribute to the understanding of inequalities and policy recommendations that ensure that digital learning is equitable.

2. Materials and Methods

2.1. Research Design and Data Source

The research design for this study was quantitative, cross sectional that used secondary data analysis with the aim of studying the association between internet access and socioeconomic status with academic performance of students in schools. Secondary data was collected from publicly available repository of Student Performance Data (SPD24 - Student Performance Data Revised Features) on Kaggle (DatasetEngineer, 2024). The data comprised 98,000 student records with 41 variables including social, demographic characteristics, socioeconomic background, internet access, educational participation, learning resources and academic achievement. These records were not collected for the specific purposes of the study, but were used to examine digital inequality and educational inclusion.

2.2. Study Population and Sample Selection

The study population were school students, who are represented in secondary data (SPD24). In the original file, there were a total of 98,000 records. Students in the records were from varied age groups, grade levels, socio-economic status, school types, and geographical school locations. Every record available was taken into account for this analysis. A review of the student records was conducted to determine if they were complete and for consistency and validity of the variables necessary for the research goals. Records where in a specific analysis some of the variables needed for this analysis were missing, or were not valid, were to be discarded from this analysis. These checks were then performed to determine the final analytical sample.

2.3. Study Variables and Measurements

Internet access and socioeconomic status were the main independent variables analyzed. The Internet was documented as dichotomous categorical data and SES was categorized as Low, Medium and High. The academic performance was measured by a categorical (Low, Medium, High) Performance Score variable as well as numerical reading, mathematics, science, and language proficiency measures. Educational inclusion was studied indirectly by the participation in the class and access to learning resources. Other factors were age, gender, grade level, parental education, parental employment status, type of school and location of the school. The following variables were chosen for analysis: to assess the differences between educational opportunities and academic outcomes in socio-demographic and digital access groups.

2.4. Data Preparation and Quality Assessment

The secondary data were checked on their completeness, consistency and suitability for statistical analysis. Prior to analysis, the analysis of the variables' names, measurement scales, categorical classifications and numeric values were analyzed. The two groups for internet access were formed and socioeconomic status and academic performance were left in categorical classifications. The ability in education was assumed to be continuous. Analytical errors were examined as there were missing values, duplicated student identifiers and invalid entries. If feasible, the original observations and variable definitions were retained, and no values were added during data preparation, or without support from the original observations.

2.5. Statistical Analysis

Descriptive statistics were employed to summarize the student characteristics, availability of internet, socioeconomic status, educational inclusion indicators and academic performance. Categorical variables were expressed as percent and frequencies and numerical variables were reported as the means and standard deviations. The Pearson's chi-square test was chosen to explore relationships between categorical variables, specifically, between socioeconomic status and access to the Internet. Students' numerical academic proficiency scores were compared between students with and without access to the internet using independent-samples t tests with the appropriate assumptions. When two variables were both

numerical or ordinal and measured properly, their relationship was considered to be continuous, and was analyzed by Pearson or Spearman correlation analysis. Simple linear regression analysis was conducted to explore the individual relationships of selected predictors with continuous academic outcomes and appropriate categorical analyses were conducted for categorical performance outcomes. A p-value of < 0.05 was considered statically significant and a 95% confidence interval was to be reported for effect estimates, as appropriate.

2.6. Ethical Considerations

This research used secondary data. No contact with students or recruitment or experimental intervention occurred. The analysis was limited to characteristics that were already available in the repository including educational, demographic and socioeconomic characteristics. Ensuring personal information or individuals could not be identified using student identifiers.

3. Results

3.1. Demographic and Socioeconomic Characteristics

A total of 91,624 student records were included in the analysis, comprising 45,849 females (50.0%) and 45,775 males (50.0%). The mean student age was 16.00 ± 1.42 years. Students were spread throughout grades 9-12 and were fairly well balanced between grade levels. The statistics of students were recorded as low socioeconomic status (30,636 students, 33.4%), middle socioeconomic status (30,364 students, 33.1%) and high economic status (30,624 students, 33.4%). Around 50% of the students indicated access to the internet. The demographic and socioeconomic characteristics are summarized in Table 1.

Table 1. Demographic and Socioeconomic Characteristics of Students (n = 91,624)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	45,775	50.0
	Female	45,849	50.0
Age (years)	Mean ± SD	16.00 ± 1.42	
Grade level	Grade 9	22,851	24.9
	Grade 10	23,154	25.3
	Grade 11	22,780	24.9
	Grade 12	22,839	24.9
Socioeconomic status	Low	30,636	33.4
	Middle	30,364	33.1
	High	30,624	33.4
Internet access	Yes	45,749	49.9
	No	45,875	50.1
School type	Public	45,730	49.9
	Private	45,894	50.1
School location	Rural	30,575	33.4
	Suburban	30,618	33.4
	Urban	30,431	33.2

3.2. Internet Access Across Socioeconomic Groups

Around half of the students in both the socio-economic groups accessed the internet. For students in low, middle and high socioeconomic groups, 15,366, 15,059 and 15,324 reported Internet access, respectively. There was no statistically significant relationship between socioeconomic status and Internet access found with the chi-square test ($\chi^2 = 2.14$, $p = .343$; Cramér's $V = 0.0048$). The distributions are shown in Table 2 and in Figure 1.

Table 2. Internet Access According to Socioeconomic Status

Socioeconomic status	Internet access: Yes, n (%)	Internet access: No, n (%)	Total
Low	15,366 (50.2)	15,270 (49.8)	30,636
Middle	15,059 (49.6)	15,305 (50.4)	30,364
High	15,324 (50.0)	15,300 (50.0)	30,624
Total	45,749 (49.9)	45,875 (50.1)	91,624

Note. Percentages are calculated within socioeconomic groups. Pearson's $\chi^2(2) = 2.14$, $p = .343$.

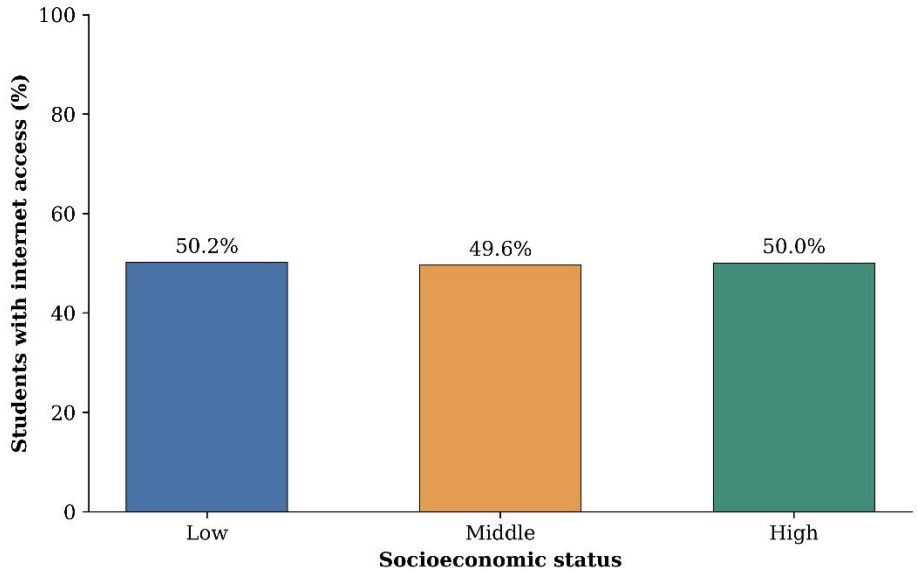


Figure 1. Internet Access Across Socioeconomic Groups

3.3. Academic Performance According to Internet Access

The academic attainment scores of pupils with and without an internet connection were comparable. The mean composite proficiency score (reading, mathematics, science, and language proficiency) for students who had internet access was 79.97 ± 5.76 while the mean composite proficiency score for students who did not have access to the internet was 79.96 ± 5.79. This difference was not significant ($t \approx 0.28$, $p = .778$) All four pair-wise subject proficiency comparisons were non-significant. The analysis of the results for each subject is presented in Table 3 and illustrated in Figure 2.

Table 3. Comparison of Academic Proficiency According to Internet Access

Academic indicator	Internet access: Yes, Mean ± SD	Internet access: No, Mean ± SD	p-value
Reading proficiency	79.94 ± 11.56	79.94 ± 11.53	.980
Mathematics proficiency	79.92 ± 11.56	79.94 ± 11.56	.788
Science proficiency	79.98 ± 11.54	80.02 ± 11.50	.624
Language proficiency	80.05 ± 11.54	79.95 ± 11.55	.194

Composite proficiency	79.97 ± 5.76	79.96 ± 5.79	.778

Note. SD = standard deviation. Comparisons use Welch's independent-samples t-test. Composite proficiency is the arithmetic mean of the four subject proficiency scores.

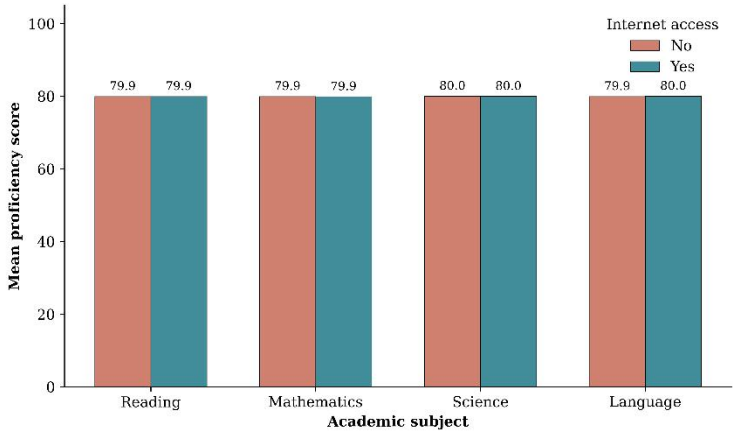


Figure 2. Academic Proficiency According to Internet Access

3.4. Socioeconomic Differences in Academic Performance

There was no difference in the distribution of the categorical academic performance among the groups. The results were impressive, with 38.1% of the students from high socioeconomic status, 37.7% from middle status and 37.3% from low status achieving high performance. A chi-square test revealed no statistical difference between the performance category and socioeconomic status ($\chi^2 = 4.14$, $p = .388$). The observed differences were minimal as reported in Table 4, and illustrated in Figure 3.

Table 4. Academic Performance Categories Across Socioeconomic Groups

Socioeconomic status	Low performance, n (%)	Medium performance, n (%)	High performance, n (%)
Low	7,595 (24.8)	11,619 (37.9)	11,422 (37.3)
Middle	7,513 (24.7)	11,408 (37.6)	11,443 (37.7)
High	7,491 (24.5)	11,478 (37.5)	11,655 (38.1)
Total	22,599 (24.7)	34,505 (37.7)	34,520 (37.7)

Note. Percentages are calculated within socioeconomic groups. Pearson's $\chi^2(4) = 4.14$, $p = .388$.

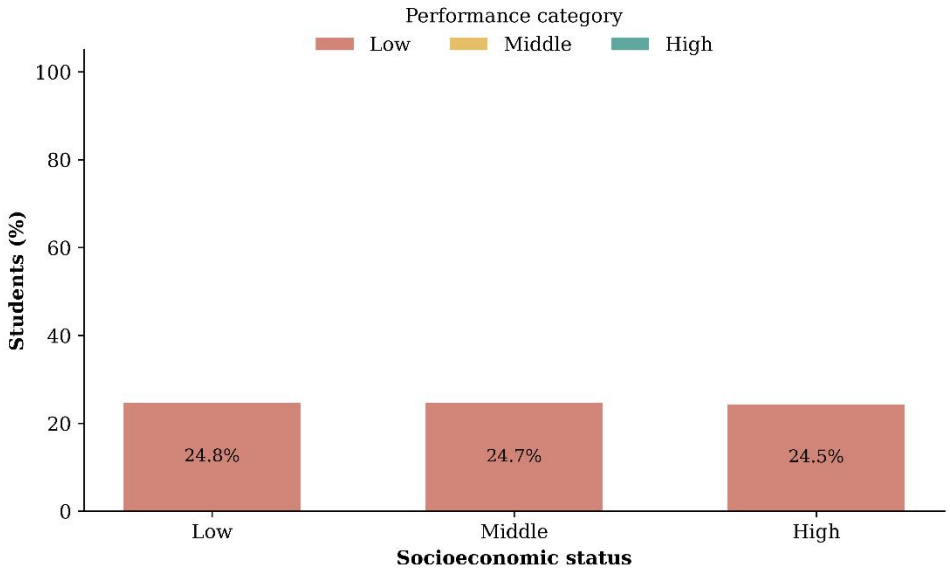


Figure 3. Academic Performance Distribution by Socioeconomic Status

3.5. Educational Inclusion and Learning Resource Availability

Indirect indicators of educational inclusion were analyzed: access to learning resources, and participation in the classroom. 50.0% of students in the low socioeconomic group reported that they had access to learning resources, while 50.3% of students in the middle socioeconomic group reported that they had access to learning resources, and 50.0% of students in the high socioeconomic group reported that they had access to learning resources. About one-third from each of the three groups reported high classroom participation. There was no association found between socioeconomic status and learning-resource availability ($\chi^2 = 1.05$, $p = .593$). The educational inclusion indicators are included in the Table 5 and the comparison by socio-economic groups is depicted in the Figure 4.

Table 5. Educational Inclusion Indicators Across Socioeconomic Groups

Socioeconomic status	Learning resources available, n (%)	High class participation, n (%)	Total (n)
Low	15,313 (50.0)	10,190 (33.3)	30,636
Middle	15,286 (50.3)	10,101 (33.3)	30,364
High	15,307 (50.0)	10,186 (33.3)	30,624
Total	45,906 (50.1)	30,477 (33.3)	91,624

Note. Percentages are calculated within socioeconomic groups. Educational inclusion is represented through indirect participation and learning-resource indicators.

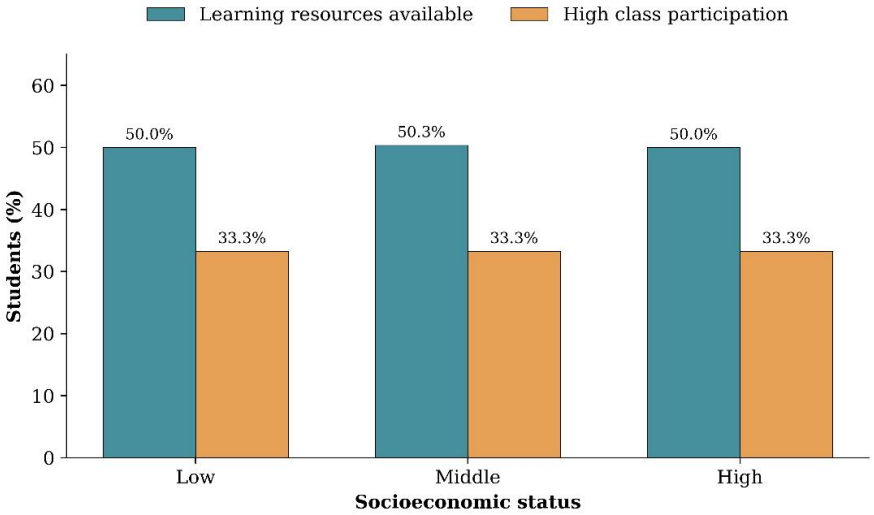


Figure 4. Learning Resource Availability and Classroom Participation Across Socioeconomic Groups

3.6. Associations of Internet Access and Socioeconomic Status with Academic Performance

Multiple linear regression was used to explore the relationship between composite academic proficiency and the two main independent variables (internet access and socioeconomic status) while controlling for gender, age, and school location. The association between Internet access and proficiency points was not statistically significant (p = .776), but an estimated increase of 0.011 points was found. Again, there was no significant relationship between composite proficiency and low or moderate SES groups compared to high SES groups. The overall model explained virtually none of the variation in academic proficiency ($R^2 < .001$; overall model p = .992). The regression estimates are shown in Table 6 and plotted in Figure 5.

Table 6. Regression Analysis of Factors Associated with Composite Academic Proficiency

Predictor	Coefficient (B)	95% CI	p-value
Internet access: Yes vs No	0.011	-0.064 to 0.086	.776
SES: Low vs High	0.007	-0.085 to 0.098	.885
SES: Middle vs High	-0.010	-0.102 to 0.082	.831
Gender: Male vs Female	0.009	-0.065 to 0.084	.806
Age (years)	-0.008	-0.035 to 0.018	.537
School location: Suburban vs Rural	-0.018	-0.109 to 0.074	.706
School location: Urban vs Rural	0.015	-0.076 to 0.107	.745

Note. B = unstandardized regression coefficient; CI = confidence interval; SES = socioeconomic status. Heteroscedasticity-robust (HC3) standard errors were used. Reference categories are shown in the predictor labels.

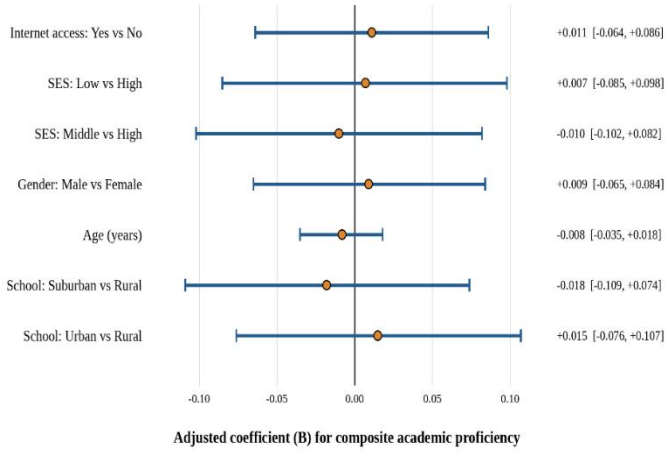


Figure 5. Adjusted Associations with Composite Academic Proficiency

4. Discussion

This study explored the links between internet access and socio-economic status with school students' academic outcomes and school inclusion. The results indicated that there was no statistically significant relationship between socioeconomic status and access to the internet ($p = .343$) and the distribution of internet access was approximately equal among socioeconomic groups. Academic performance scores were also comparable in the students with and without internet. Also, the differences in the academic performance between the students based on the socioeconomic differences were not statistically significant. This represents a shift from the previous research which highlights significant inequalities and educational disadvantages for vulnerable students in digital access and use (Golden et al., 2023). Digital technologies, however, do not automatically lead to disparities in learning outcomes, but rather the use and embedding of digital resources in learning activities play a crucial role in shaping the educational value of technology (Kastorff et al., 2025).

This finding of no association between socioeconomic status and internet access indicates that access to the internet was evenly distributed among the socioeconomic categories in the records that were analysed. However, the result does not indicate that the situation of digital inequality has been eradicated. Socioeconomic disparities can impact the quality of internet access, device availability, digital skills, and access to technology and its use. Past studies have shown that digital inequalities exist on dimensions of digital participation and outcomes (Han, 2026). The study reveals that digital disparities are not just about access to the internet, but also about how technology is used, as urban inequalities in access and use suggest that there are deeper inequalities in technology use than in basic connectivity (Reddick et al., 2024). There can also be demographic differences and broader social environment differences with regard to socioeconomic differences in digital participation (Ren & Zhu, 2024). Thus the binary indicator used in this study, online access, may not fully reflect the digital inequalities.

Students' academic achievement was virtually the same, whether they had access to the internet or not, and nothing significant was found when academic achievement (composite academic proficiency) was regressed on the internet availability. These results indicate that the gap in educational outcomes may not be entirely accounted for using the Internet connection of these records. Learning-related factors and learning environments have also been emphasized as key factors in the development of students' digital competencies in the field of digital reading research (Chen & Xiao, 2024). Likewise, the use of ICTs by teachers might affect the effectiveness of the ICTs in supporting students' learning outcomes (Hong et al., 2024). Digital-device use-academic performance relationships can also vary as a function of purpose, frequency, and educational relevance of digital-use (Wang et al., 2024). Future research therefore needs to differentiate between access to basic internet services and quality of digital learning experiences of students.

No statistically significant relationships with academic performance categories and composite academic proficiency were found for socioeconomic status. There was a small difference in the percentage of high academic outcomes with students from higher socioeconomic status; however, this was not significant.

These findings diverge from those that have recorded educational disadvantages due to socioeconomic inequalities, especially when there are interruptions in the school attendance process (Engzell et al., 2021). The family socioeconomic status can affect students' academic support, academic learning opportunities and academic help-seeking online behaviours (Fan, 2025). Moreover, unequal learning opportunities may give rise to differences in learning outcomes, especially if students rely on home-based learning environments to a large degree (van de Werfhorst, 2021). The present results need to be considered in the context of the items and constraints of the secondary data, not as valid for all schools.

Socio-economic differences were also apparent for some of the educational inclusion indicators, such as learning resources and participation in classrooms. About half of the students indicated that they had access to learning resources, and one-third of students had high classroom participation. The results show that there are few observed differences between the indicators that they selected, but not that they are equally educated included. The digital skills of educators and institutional support are significant factors to consider in assessing educational disparities. (Jiao et al., 2026) However, digital distraction and differences in classroom technology experience could also impact academic engagement and performance (Li & Chen, 2026). Furthermore, the educational technology policies could have distinct impacts on students across socioeconomic and demographic categories (Liu et al., 2025). Therefore, it is necessary to measure educational inclusion on the basis of other indicators of participation, access, learning support and learning experiences.

The results are of importance for educational justice and social policy. Solutions to the digital inequality challenge should go beyond giving people Internet access, to enhancing digital skills, digital educational materials and opportunities for learning with technology. Studies of digital learning channels have shown the need for an understanding of how students engage in learning activities in various social contexts (Schulz & Robinson, 2022). Likewise, solutions to the digital inequalities focus on coordinated efforts for the improvement of infrastructure, institutional support and inclusive education practices (Simui & Ngubane, 2026). Schools and decision makers need to therefore look at fully-integrated interventions that tackle technological access and the capacity of students to engage with digital learning opportunities.

The major advantage of this study was the number of student records that were available for analysis and comparisons across the various demographic and socio-economic groups. Multiple measures of education also allowed for an analysis of academic achievement, Internet access, and involvement in the same framework. It has to be admitted, however, that there are a number of caveats. Only 91,624 out of 98,000 records were analysed and it was not possible to determine the original sampling procedures or the representativeness. Internet access was determined by a binary variable and the measure for educational inclusion was done through learning-resource availability and classroom participation. In addition, cross-sectional design made it impossible to interpret the results as being causal. No statistically significant associations do not equate to equivalence between groups. Going forward, studies should continue to employ reliable and representative data and include detailed indicators of quality of connectivity, household resources, and educational engagement to gain a deeper understanding of digital inequality and educational inclusion.

5. Conclusion

This study adopted secondary data to analyse the relationship between internet access and socioeconomic status with academic achievement and educational integration of students in school. The results showed that there was no significant relationship between SES and internet, and the relationship between the two groups was relatively similar. The academic achievement scores were also similar for Internet-connected and non-Internet-connected students, and no statistically significant differences were found between the scores for students from different socio-economic backgrounds. In addition, there was only a slight difference between socioeconomic groups in terms of the availability of learning resources and class participation. This research indicates that socioeconomic status and basic Internet access is not sufficient to account for disparities in student achievement. The lack of significant association does not mean that digital inequality or educational disparities do not exist, however. The Internet quality, digital literacies of students, parental support, teaching method, and access to the appropriate learning materials also can affect students' educational experiences outside the variables examined. The study calls for a broader understanding of digital inequality, based on indicators of meaningful educational access and participation

to a child's experiences. As much as technological infrastructure, educational policies need to emphasize digital competencies, learning resources that can be accessed and learning environments that facilitate learning. For future research, student samples need to be representative, educational inclusion measures need to be more extensive, and longitudinal studies need to be implemented to gain a deeper understanding of the impact of digital and socioeconomic inequalities on academic outcomes and educational opportunities.

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