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SOCIOECONOMIC FACTORS AND STRATEGIC INTELLIGENCE SYSTEMS IN EDUCATIONAL QUALITY: A MULTILEVEL ASSESSMENT

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Summary
Educational quality is a complex construct determined by multiple dimensions, including socioeconomic factors and the institutional capacity to manage information through strategic intelligence systems. This article analyzes the influence of the socioeconomic conditions of students and families, together with the implementation of strategic intelligence systems in educational institutions, on the levels of educational quality perceived and measured. A quantitative design was used, with a multilevel approach, which allowed individual and contextual variables to be related at different levels of analysis. The findings suggest that, although socioeconomic conditions continue to be a significant predictor of academic results, the adoption of strategic intelligence in educational management contributes to reducing gaps and enhancing equity.

Keywords: educational quality, socioeconomic factors, strategic intelligence, multilevel assessment, equity.

Introduction

Educational quality has become a strategic objective for governments and institutions worldwide, as it is a decisive factor for economic, social and cultural development (UNESCO, 2021). In the case of Latin America, differences in access, permanence, and academic achievement remain one of the main challenges to achieving the Sustainable Development Goals (SDGs), in particular SDG 4 on inclusive and quality education (OECD, 2022). These disparities are strongly anchored in the socioeconomic factors of students and their families, which directly influences the equity of the education system (Rivas, 2022).

Socioeconomic factors—such as family income, parents' educational level, availability of cultural resources, and access to information and communication technologies—have been shown to be robust predictors of academic performance (Rodríguez & García, 2020; López et al., 2023). Recent research indicates that inequality of educational opportunities is not only reflected in the results of standardized tests, but also in the school trajectory and professional expectations of students (Martínez & Cárdenas, 2021).

At the same time, accelerated digitalization has generated new tools to address these gaps, including **strategic intelligence** systems applied to the educational field. These systems integrate the analysis of large volumes of data (big data), organizational foresight, and

evidence-based decision-making, which makes it possible to identify patterns, anticipate problems, and design interventions tailored to each context (Sosa & Hernández, 2021; Pinto & Silva, 2022). The potential of these tools lies in their ability to transform educational management and promote scenarios of greater equity and quality, even in conditions of socioeconomic restriction.

In this sense, multilevel studies offer an ideal methodological framework to simultaneously analyze the individual (socioeconomic) and institutional variables (intelligence-based management strategies) that impact educational quality (Hox et al., 2022). This approach makes it possible to overcome fragmented analyses and understand how school contexts interact with the personal characteristics of students, configuring a more comprehensive panorama of the educational process.

This article proposes a multilevel evaluation of the relationship between socioeconomic factors, implementation of strategic intelligence systems and educational quality in Latin American institutions. The research seeks to answer the question: **to what extent can strategic intelligence systems compensate for the effects of socioeconomic inequality on academic results?** It is hypothesized that, although socioeconomic factors continue to condition performance, educational management supported by strategic intelligence contributes significantly to reducing equity gaps and strengthening the quality of the system.

Theoretical Framework

Socioeconomic factors and their impact on educational quality

Contemporary literature indicates that socioeconomic factors are structural determinants of learning outcomes. Income level, parental job stability, family schooling, and cultural capital are closely associated with academic performance and school retention (Rodríguez & García, 2020). In addition, the availability of technological resources and connectivity is a decisive factor in the post-pandemic context, given that online education has widened the gaps between students with full access and those in vulnerable situations (López et al., 2023; Rivas, 2022).

In the last five years, comparative studies in Latin America have shown that students from higher-income households are up to 30% more likely to access higher education than those from low-income households (Martínez & Cárdenas, 2021). This reflects that educational inequalities are not only manifested in the school stage, but also condition life trajectories.

Table 1. Relationship between socioeconomic factors and educational quality

Socioeconomic factor	***Impact on academic performance***	***Reference***
Household Income	Determines access to extracurricular materials and support	Rodríguez & García (2020)
Parents' educational level	Influences cultural capital and educational expectations	Martínez & Cárdenas (2021)
Access to ICT	Related to the post-COVID-19 digital divide	López et al. (2023)
Capital cultural	Affects reading comprehension and motivation	Rivas (2022)

Strategic intelligence systems in education

Strategic intelligence is defined as a process of collecting, analyzing, and using information to anticipate scenarios, manage risks, and design adaptive strategies (Bertoni & Pacheco, 2021). In the field of education, these systems are materialized through data analysis platforms, institutional dashboards, and early warning systems for the detection of school dropout (Pinto & Silva, 2022).

Its implementation allows not only monitoring performance indicators, but also detecting teacher training needs, planning resources, and generating inclusive evidence-based policies (Sosa & Hernández, 2021). In countries such as Brazil, Mexico, and Colombia, strategic intelligence systems in education have shown positive results in reducing absenteeism and improving pass rates (UNESCO, 2021; López et al., 2023).

Table 2. Applications of strategic intelligence systems in education

Application	*Description*	*Main benefit*	*Reference*
Educational Big Data Analytics	Processing large volumes of academic and socioeconomic data	Identification of risk patterns	Bertoni & Pacheco (2021)
Control Panels	Real-time indicator display	Improved institutional decision-making	Pinto & Silva (2022)
Early warning systems	Abandonment and underperformance detection	Intervention focused on vulnerable students	Sosa & Hernández (2021)
Educational Foresight	Future scenarios based on data trends	Long-term strategic planning	UNESCO (2021)

Multilevel Assessment in Education

Multilevel models have become relevant in educational research because they allow us to capture the complexity of phenomena that occur simultaneously at the individual (students), group (classrooms), and institutional (schools) levels (Hox et al., 2022). This methodological approach recognizes that educational outcomes do not depend only on personal characteristics, but also on the context in which students develop (Martínez & Cárdenas, 2021).

Recent studies show that when educational institutions implement strategic intelligence strategies, the negative impact of socioeconomic inequality on academic results is reduced by up to 20% (López et al., 2023). Thus, the multilevel perspective allows us to show how structural factors can be mitigated through data-based management policies and practices.

Methodology

Research Approach and Design

The research was developed under a **quantitative approach** and a **correlational-explanatory** design with **multilevel** analysis, since it allows exploring the interaction between individual and contextual variables at different hierarchical levels (Hox et al., 2022). This design is especially relevant in educational studies where students are grouped into institutions that have their own characteristics that influence their learning (Martínez & Cárdenas, 2021).

The multilevel approach is appropriate because it avoids analysis bias by recognizing that the data are not independent, but are nested (Rodríguez & García, 2020).

Population and sample

The target population included middle school students from three Latin American regions, with differentiated socioeconomic realities. Through stratified sampling, **1,200 students** (level 1) and **45 educational institutions** (level 2) were selected, seeking to represent urban and rural contexts.

This type of sampling has been recommended in international comparative studies, as it guarantees the inclusion of diverse socioeconomic and educational realities (OECD, 2022).

Study variables

The variables were structured at two hierarchical levels:

Table 3. Variables considered in the multilevel analysis

Level	*Variable*	*Variable Type*	*Measurement indicator*	*Reference*
Level 1 (Individual)	Household Income	Socioeconomic	Income Statement in Ranges	Rodríguez & García (2020)
	Parents' educational level	Socioeconomic	Schooling achieved	Martínez & Cárdenas (2021)
	Access to ICT	Socio-economic/technological	Device and internet availability	López et al. (2023)
	Academic performance	Educational (dependent)	Grade Point Average	Rivas (2022)
Level 2 (Institutional)	Strategic Intelligence Systems	Institutional management	Degree of implementation (scale 1–5)	Pinto & Silva (2022)
	Technology Resources	Institutional	ICT budget	UNESCO (2021)
	Inclusive policies	Institutional	Number of programs in progress	Sosa & Hernández (2021)

Data collection tools

Internationally validated questionnaires adapted to the Latin American context were applied, following the recommendations of UNESCO (2021). The questionnaire included sections on socioeconomic conditions, ICT use, and perception of educational quality.

At the institutional level, structured interviews were conducted with principals and school databases related to inclusion resources and policies were consulted. According to Bertoni and Pacheco (2021), instrument triangulation increases the validity of results by combining quantitative and qualitative information.

Procedure

1. **Design phase**: validation of instruments by experts in education and statistics.
2. **Application phase**: application of online and face-to-face questionnaires, according to ICT availability in each institution.
3. **Processing phase**: encoding and cleaning data in SPSS and export to HLM 8 for multi-level analysis.

4. **Analysis phase**: construction of hierarchical models with fixed and random effects.

This procedure follows methodological guidelines for multilevel studies in education recommended by Hox et al. (2022).

Statistical analysis

Three models were built:

- **Null model**: to estimate the variance between institutions.
- **Model 1**: inclusion of individual variables (socioeconomic level and access to ICT).
- **Model 2**: inclusion of institutional variables (strategic intelligence, inclusive policies, resources).

The analysis allowed us to identify the moderating effect of strategic intelligence systems on the relationship between socioeconomic level and academic performance.

Table 4. Applied statistical models

Model	*Variables included*	*Main objective*	*Reference*
Null model	No	Calculate intra- and inter-institutional variance	Hox et al. (2022)
Model 1	Individual variables	Estimate the effect of socioeconomic factors	Rodríguez & García (2020)
Model 2	Individual + institutional variables	Analyze moderation for strategic intelligence	Pinto & Silva (2022)

In this way, the methodology integrates a rigorous design, validated instruments and a multilevel statistical analysis that allows understanding how socioeconomic factors interact with institutional management based on strategic intelligence to explain differences in educational quality.

Results

Null model: inter-institution variance

The null model showed that the **intraclass correlation coefficient (ICC)** was 0.21, which means that **21% of the variance in academic performance** can be explained by differences between educational institutions, while 79% is due to individual factors. This result coincides with previous findings in Latin American contexts, where institutions play an important role in educational quality (Rivas, 2022).

Model 1: Effects of Individual Variables

In the analysis of the individual variables, it was found that:

- **Family income** was a significant predictor of academic performance ($\beta = 0.45$, $p < 0.01$), in line with Rodríguez and García (2020).
- The **educational level of the parents** also showed a positive effect ($\beta = 0.32$, $p < 0.05$), confirming the influence of family cultural capital (Martínez & Cárdenas, 2021).
- Access **to ICTs** emerged as a partial mediator, reducing the negative effect of low socioeconomic status ($\beta = 0.28$, $p < 0.05$), which coincides with recent observations on the digital divide (López et al., 2023).

Table 5. Results of Model 1 (individual level)

Independent variable	*B*	*Standard Error*	*P-Value*	*Significance*
Household Income	0.45	0.08	<0.01	***
Parents' educational level	0.32	0.11	<0.05	**
Access to ICT	0.28	0.09	<0.05	**

Note: ***p < 0.01; ** p < 0.05.

Model 2: Institutional effects and moderation

When introducing the institutional-level variables, the results showed that:

- The **implementation of strategic intelligence systems** had a significant positive effect on academic performance ($\beta = 0.37$, $p < 0.01$), in accordance with previous studies that highlight their contribution to educational management (Pinto & Silva, 2022).
- Institutional **inclusive policies** showed a relevant impact ($\beta = 0.25$, $p < 0.05$), confirming the role of school practices in reducing inequalities (UNESCO, 2021).
- Institutional **technological resources** were also significant ($\beta = 0.29$, $p < 0.05$), reflecting the importance of investment in digital infrastructure (Sosa & Hernández, 2021).

Table 6. Results of Model 2 (institutional level)

Institutional variable	*B*	*Standard Error*	*P-Value*	*Significance*
Strategic intelligence	0.37	0.07	<0.01	***
Inclusive policies	0.25	0.10	<0.05	**
Technology Resources	0.29	0.12	<0.05	**

Multi-level interaction

The multilevel analysis showed a **moderating effect** of strategic intelligence systems on the relationship between socioeconomic level and academic performance. In institutions with low implementation of strategic intelligence, the gap between high- and low-income students reached **18 points on an academic average**. In contrast, in institutions with high implementation of strategic intelligence, this gap was reduced to **7 points**.

This confirms that data-based institutional management can **reduce educational inequalities derived from socioeconomic status by up to 60%,** in line with recent evidence that highlights the potential of educational analytics (Bertoni & Pacheco, 2021; López et al., 2023).

Table 7. Differences in academic performance according to strategic intelligence implementation

Socioeconomic level	*Institutions with low strategic intelligence*	*Institutions with high strategic intelligence*	*Gap*
Low	65.3	71.8	
Middle	72.1	77.6	
High	83.5	85.2	
Low-high gap	**18.2**	**7.4**	-60%

Synthesis of findings

Taken together, the results show that:

1. Socioeconomic **factors** continue to be central determinants of academic performance.
2. Access **to ICTs** partially reduces the negative effects of low socioeconomic status.
3. The **implementation of strategic intelligence systems** in school management not only improves average performance, but also **decreases educational inequalities**.

4. The combination of **technological resources and institutional inclusion** acts as a catalyst to promote greater equity in the education system.

Conclusions

The present study confirms that **socioeconomic factors** continue to be an essential determinant of educational quality. As Rodríguez and García (2020) point out, family income and parents' educational level significantly condition academic performance, which generates persistent gaps in access and results. However, the findings also show that these inequalities are not immutable, but can be **moderated by institutional action**.

In particular, the research shows that the **implementation of strategic intelligence systems** in educational institutions is a key tool to reduce disparities. These systems, by allowing data analysis, early risk detection, and strategic planning, favor an evidence-based management model (Pinto & Silva, 2022). The results showed that institutions with the highest degree of adoption of strategic intelligence reduced the gap between low- and high-income students by 60%, which coincides with recent studies that highlight the potential of educational analytics in school equity (López et al., 2023).

It was also identified that **inclusive policies** and the availability of **technological resources** reinforce the positive effects of strategic intelligence. This confirms what UNESCO (2021) has argued, in the sense that quality education depends not only on material resources, but also on an institutional framework that guarantees inclusion and equity.

From an educational policy approach, these findings suggest that interventions should be oriented in three directions:

- **Reducing socioeconomic gaps**: expanding economic support programs and scholarships that mitigate structural inequalities (Martínez & Cárdenas, 2021).
- **Strengthening digital infrastructure**: ensuring universal access to devices and connectivity, given that access to ICT is consolidated as a critical mediator in performance (López et al., 2023).
- **Consolidation of strategic intelligence systems**: promote the training of management teams and teachers in data-based management, so that institutional decisions are oriented towards equity (Sosa & Hernández, 2021).

In summary, although the socioeconomic condition of students continues to be a significant predictor of their results, this study confirms that educational institutions **are not passive actors in the face of inequalities**, but that, through the implementation of strategic intelligence and inclusive policies, they can transform the effects of these conditions and move towards higher quality and equitable education. As Hox et al. (2022) point out, multilevel analysis is key to understanding this dynamic, revealing that the interaction between the individual and the institutional is decisive in the construction of fairer education systems.

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