

Progress Curves and Stagnation Plateaus: How Administrative Fragility Conditions Educational Indicators in The Lower Amazon

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Abstract

Amazonian municipalities demonstrate a low rate of conversion from public resources into sustainable learning gains. The standard explanation, fiscal scarcity and historical legacies, treats local governments as mere passive conduits, overlooking what occurs inside the administrative "black box." This study argues that institutional coordination capacity, that is, the ability to align transportation, infrastructure, nutrition, and pedagogy into a coherent system, mediates the relationship between public investment and educational outcomes. It probes a theoretical proposition by examining the evolution of the FIRJAN Municipal Development Index (Education) in Alenquer, Pará, between 2005 and 2018. Polynomial regression was applied to secondary data. The quadratic model captures curvatures in the trajectory that a linear analysis would flatten. The advance from 0.36 (low level) to 0.74 (medium level) conceals contractions between 2009 and 2010, as well as a deceleration after 2013. These patterns coincide with administrative discontinuities and reductions in intergovernmental transfers. Diminishing returns indicate that resources exist, yet learning does not keep pace. Thus, the analysis shifts from budget to organizational coherence. The study reveals previously implicit causalities, though it recommends caution in generalization. Future research should extend the model's external validity.

Keywords: educational policy, educational development, institutional coordination, municipal management.

1. Introduction

Education is widely recognized as a structural driver of socioeconomic development, particularly in territories shaped by deep-rooted inequalities. By building human capital and catalyzing social mobility, effective educational systems function as powerful equalizers of regional disparities. In Brazil, however, the consolidation of quality public education continues to encounter historical, institutional, political, and organizational barriers that affect not only the availability of resources, but, crucially, their effectiveness (Apple et al., 2015; Saviani, 2008, 2008, 2021).

In the country's most vulnerable regions, such as the Brazilian Amazon, these obstacles take on especially acute dimensions. Despite the expansion of educational funding through intergovernmental transfers over recent decades, chronic problems persist: precarious infrastructure, systemic undervaluation of teachers, and fragile administrative management (Araújo, 2024; Araújo, 2017; Câmara et al., 2022; Matos et al., 2022). Municipalities in these areas, highly dependent on external resources, see their administrative weaknesses undermine the consistent implementation of policies, generating erratic trajectories in educational indicators (da Cruz, 2012; Gonçalves, 1998; Oliveira & Oliveira, 2024).

The dominant literature explains this situation primarily through budgetary constraints and historical legacies, operating under the assumption that greater public investment will yield proportionally better outcomes (Synergos, 2017). This interpretation, however, proves fragile when confronted with recurring empirical evidence from peripheral contexts: the expansion of resources, even through redistributive mechanisms, does not consistently translate into gains in the Basic Education Development Index (IDEB) or in the FIRJAN Municipal Development Index, Education component (Araújo et al., 2023; Araújo, 2017; Matos et al., 2022; Silva et al., 2021).

This inconsistency points to a central theoretical gap. By privileging linear relationships between inputs and outputs, a significant portion of the literature treats local governments as homogeneous units, obscuring the internal governance processes that condition policy effectiveness (Araújo et al., 2023; Gouveia & Polena, 2016; Silva et al., 2021). Municipal administrations are thus treated as black boxes, as though the mere influx of resources were sufficient, in itself, to guarantee performance, while the reality that public spending effectiveness depends on how resources are organized, coordinated, and deployed over time goes largely unexamined.

In light of this, we propose an analytical shift: understanding variation in educational indicators requires incorporating an organizational perspective, one in which institutional capacities, particularly those related to the coordination of public action, occupy a central role. In contexts of administrative fragility, the absence of coordination across sectors and services (education, transportation, food supply, infrastructure) compromises the integrated implementation of policies, impeding the conversion of financial resources into effective teaching conditions (Araújo, 2017; Matos et al., 2022; Silva et al., 2021).

The situation resembles an organism whose vital organs have ceased to communicate: the

heart pumps blood (the resource), but a failure in neural signaling (coordination) prevents it from reaching the tissues that need it. The result is discontinuity, inefficiency, and, ultimately, the deterioration of educational indicators, indirectly, yet systematically.

We acknowledge that such capacities are not directly observable, which limits the identification of definitive causal relationships. Nevertheless, variations in outcomes over time can be interpreted against the backdrop of these institutional weaknesses: patterns of progress, stagnation, or regression prove consistent with greater or lesser degrees of coordinating capacity in local Governance (Araújo et al., 2023; Gouveia & Polena, 2016; Santos, 2017; Silva et al., 2021). Institutional coordination thus emerges as a robust theoretical explanatory mechanism, one capable of accounting for empirical patterns without resorting to unidimensional causal determinism.

Within this landscape, Amazonian municipalities constitute privileged analytical laboratories, combining structural constraints, high fiscal dependency, and persistent coordination challenges. The municipality of Alenquer (PA) fits this profile precisely: its recognized weaknesses in the organization and delivery of public services, including education, make it a paradigmatic case for analyzing the dynamics of educational indicator variation over time (Costa et al., 2020; De Paula et al., 2023; Garcia et al., 2021; Silva et al., 2021; Sousa et al., 2021).

Composite indicators such as the FIRJAN Municipal Development Index, Education, which integrates data on early childhood enrollment, dropout rates, grade-age distortion, teacher qualifications, instructional hours, and IDEB scores, offer a detailed portrait of local educational conditions, enabling the identification of critical areas for intervention (Federation of Industries of the State of Rio de Janeiro [FIRJAN], 2018). More than a static snapshot, their evolution over time reveals the dynamics of policy: cycles of advancement, plateaus of stagnation, or sharp declines serve as empirical traces of the presence or absence of institutional coordination.

This study therefore proposes to assess the trajectory of education in Alenquer between 2005 and 2018, as measured by the IFDM Education indicators, with three interrelated objectives: (1) to describe the evolution of these indicators over the period, identifying inflection points and trends; (2) to connect observed variations to possible explanatory factors, with emphasis on weaknesses in public management coordination; and (3) to provide evidence-based inputs for the design of more effective policies by distinguishing potentially successful practices from those that are ineffectual or counterproductive.

This analysis is not justified by its descriptive value alone. It is a necessary condition for breaking the cycle of inertial resource allocation. Understanding why indicators advance or decline makes it possible to replicate what works, correct what does not, and, above all, introduce responsiveness into public management. In a region marked by profound educational inequalities, such as the Amazon, this analytical intelligence is an instrument of equity (Apple et al., 2015; Silva et al., 2021). By illuminating the past and diagnosing the present, this research aims to equip administrators and civil society with the information and method needed to build a more promising educational future, for Alenquer and for

municipalities confronting analogous challenges.

Beyond this introduction, the article includes a methodology section, results and discussion, and concluding remarks.

2. Method

Understanding the dynamics of educational development in the Brazilian Amazon requires careful attention to its territorial, demographic, and economic particularities. It is within this context that the municipality of Alenquer is situated, located in the mesoregion of Baixo Amazonas, in the state of Pará. With a territorial area of 23,645 km², comparable in size to several small European nations, and an estimated population of 57,390 inhabitants, Alenquer immediately reveals its first major structural challenge: a population density of just 2.4 inhabitants per square kilometer (Brazilian Institute of Geography and Statistics [IBGE], 2021). This demographic dispersion, in itself, imposes significant logistical and financial barriers to the universalization and quality of education, serving as a quiet but telling indicator of the difficulties that lie ahead.

Economically, the municipality records a Gross Domestic Product (GDP) of R\$691 million, with a per capita figure of approximately R\$12,114.02. Agriculture and livestock raising are not merely the leading economic activities; they constitute the backbone of the local economy, accounting for R\$264.6 million, followed by the services and industrial sectors (FAPESPA, 2021; IBGE, 2022). This dependence on a primary sector historically vulnerable to climatic fluctuations and market instability provides a crucial backdrop for interpreting the municipality's capacity for public investment in education.

In national educational rankings, Alenquer holds the 5,196th position, with 223 schools serving 17,202 enrolled students (Amazon Foundation for the Support of Studies and Research [FAPESPA], 2021; FIRJAN., 2018). Taken in isolation, these figures merely describe; placed in context, however, they provoke a deeper question: how can a municipality of continental dimensions and an agrarian economy build consistent pathways toward educational progress?

To address this question, the present descriptive study adopts as its central analytical instrument the FIRJAN Municipal Development Index (IFDM), an analytical compass that transcends mere statistical reporting by integrating three inseparable dimensions of socioeconomic progress: Education, Health, and Employment & Income (FIRJAN, 2018). The focus falls on the Education component, whose methodological architecture, grounded in official data from the National Institute for Educational Studies and Research Anísio Teixeira (INEP), functions as an accurate mirror of the educational reality of Brazilian municipalities (Brazil, 2020).

The IFDM Education component measures development on a continuous scale from 0 to 1, a conceptual gauge in which the closer the score is to 1, the higher the level of educational progress: low (0–0.4), regular (0.4–0.6), moderate (0.6–0.8), and high (0.8–1.0) (FIRJAN, 2018). Transitions between these bands are far more than statistical nuances; they represent qualitative inflection points in the life of a community. Moving from regular to moderate is

equivalent to breaking through a structural glass ceiling, signaling that public interventions are beginning to yield lasting results. A regression, by contrast, triggers a systemic warning signal about institutional failures.

What, precisely, does this index comprise? More than a set of numbers, it is woven from indicators that are sensitive to local realities. First, the enrollment rate in early childhood education (ages 0 to 3) serves as an early equity marker, since it is at this stage that the foundations of cognitive and social development are established. Next, primary education is assessed not merely by enrollment, but by the regularity of student progression, measured through dropout rates and age-grade distortion, a sobering diagnostic of those whom the school system leaves behind (FIRJAN, 2018).

The quality of the teaching and learning process is gauged through two critical parameters: the adequacy of teacher qualifications (the proportion of teachers with subject-specific credentials) and instructional time (average daily class hours). Finally, student outcomes are synthesized through the Basic Education Development Index (IDEB), encompassing both the early and final years of primary School (Brazil, 2020; FIRJAN, 2018; QEdU, 2019). It is worth noting that, while this data is collected from both public and private schools, it is predominantly concentrated in municipal school networks, the true institutional protagonists of primary education in Brazil. The IFDM Education score, therefore, is not an abstract portrait; it is a direct and unvarnished reflection of municipal governance.

The scientific robustness of the index rests on a two-stage process, comparable to calibrating a precision instrument before a critical measurement. The first stage is normalization: a procedure that converts variables measured on disparate scales, such as dropout rates and IDEB scores, into a common metric ranging from 0 to 1, where 0 represents the worst historical performance and 1 the best. Without this standardization, any comparison would amount to an incoherent mixture of incompatible units.

The second stage involves aggregating the indicators through a weighted average, with weights determined by Principal Component Analysis (PCA) in combination with the practical and contextual relevance of each variable (FIRJAN, 2018). The result is a composite score that allows for both diachronic comparisons (across years) and synchronic comparisons (across municipalities), functioning as a historical series that narrates the developmental trajectory of a community.

Drawing on this methodological framework, IFDM Education data for Alenquer were retrieved for the period from 2005 to 2018. To extract meaningful insights from this dataset, the study employs a statistical toolkit combining descriptive analysis, inferential procedures, and predictive modeling. Regression analysis was also applied, as it is a statistical technique designed to establish a relationship between a dependent variable (y) and one or more independent variables (x). This relationship is expressed through a mathematical equation that can then be used to predict the value of the dependent variable based on the values of the independent variables.

Polynomial regression was specifically chosen (Marôco, 2011), precisely because the

relationship between time and educational development is rarely linear. More often, it takes the shape of a curve, accelerating in certain periods, slowing in others, or even declining, thereby capturing nonlinear trends, seasonal fluctuations, and long-term patterns. Beyond modeling phenomena, polynomial regression also makes it possible to estimate the relative weight of different contributing factors, although in this methodological framework, time functions as the primary independent variable.

The predictive value of the model, however, is not a futuristic exercise in speculation; it is a planning tool. By anticipating potential scenarios, it enables policymakers and researchers to respond proactively, rather than simply react to the past. In essence, this study does not confine itself to describing numbers. It constructs a rigorous quantitative narrative: one that begins with the singular context of Alenquer, applies a validated analytical lens (the IFDM), dissects its locally sensitive components, and ultimately employs a statistical toolkit that moves from description to predictive modeling.

Polynomial regression, in particular, serves as the guiding thread that reveals the hidden curvature of reality, the one that, in a simplistic linear analysis, would remain invisible. The outcome is a diagnostic capable of informing not only whether education in Alenquer has advanced, but how, when, and under what conditions that advancement, or setback, has manifested, thus providing concrete evidence to support more intelligent, timely, and, above all, genuinely effective public policy.

3. Results and Discussion

Between 2005 and 2018, educational development indicators in Alenquer, as measured by the IFDM Education Index, followed a general upward trajectory, though one marked by fluctuations throughout the period. In 2005, the index stood at 0.3633; by 2006, it had declined slightly to 0.3599, remaining within the low-development range. This initial variation points to a scenario of relative stagnation, with no meaningful shifts in educational performance, as illustrated in Figure 1.

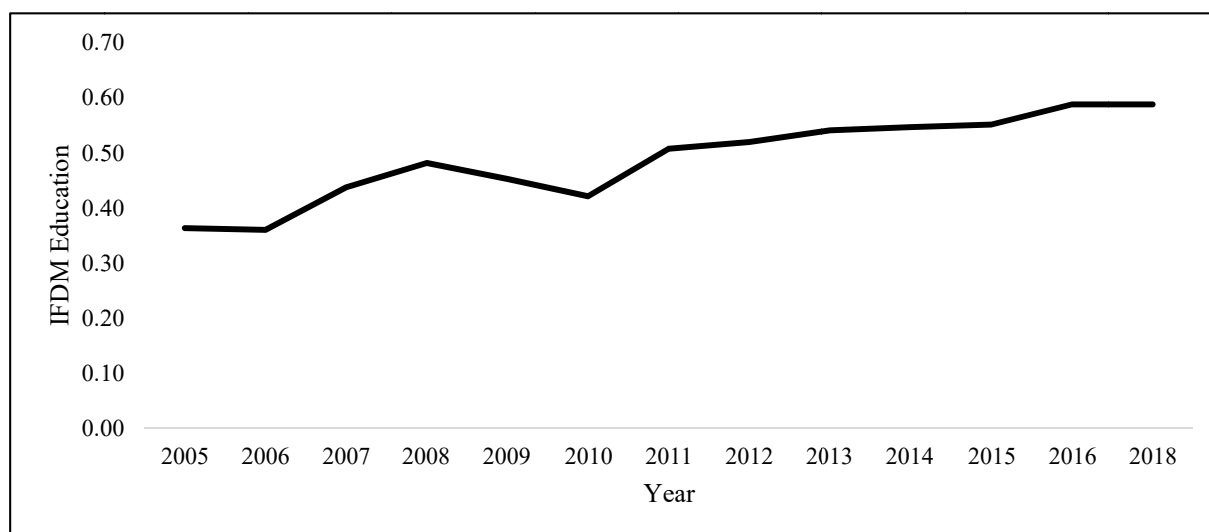


Figure 1. Trend in the IFDM Education Index for Alenquer

Source: Research findings

Beginning in 2007, the indicators shifted course, rising steadily through 2008, when the index climbed from 0.4374 to 0.4813, moving from the low to the moderate classification. This shift signals a change in the pattern of educational performance during the period. One plausible interpretation is that these results reflect the cumulative effects of initiatives and investments undertaken in prior years, effects that tend to materialize with a lag in the education sector. Furthermore, the consistency of this growth may be seen as compatible with periods of greater stability in public policy implementation, in which effective administrative coordination facilitates the conversion of resources into observable improvements in the indicators.

Between 2009 and 2010, however, the index contracted by 0.0315 points, interrupting the preceding upward trend. This reversal reveals the presence of discontinuities in the municipality's educational development. Such a downturn may be interpreted as consistent with contexts of instability in policy execution, in which coordination difficulties and administrative constraints tend to undermine the sustainability of previously achieved gains.

Starting in 2011, the indicators resumed a relatively sustained upward trajectory, suggesting a process of gradual improvement in educational performance over the subsequent years. Rather than reflecting the direct impact of concurrent policy actions, however, this trend may represent both the continuation of earlier efforts and the gradual restoration of enabling conditions for local public policy implementation.

In aggregate terms, the indicators showed relatively modest variation across the period, with a variance of approximately 0.006, a figure that points to a degree of stability in the series, notwithstanding specific periods of progress and setback. Over the full period under analysis, the index rose by 0.378 points between 2005 and 2018, indicating a general trend toward improvement in the municipality's educational development.

This growth trajectory can be examined alongside changes in specific components of the educational system, including early childhood enrollment, school dropout reduction, the narrowing of the age-grade distortion gap, expansion of teacher qualifications, increases in daily instructional hours, and improvements in IDEB scores. While it is not possible to establish direct causal relationships between these factors and aggregate performance, these dimensions provide meaningful context for understanding the changes observed in the indicators over time.

Qualitative evidence reinforces this interpretation by pointing to variations in governmental effort throughout the period. According to Araújo et al. (2023), education staff in Alenquer reported increased investment in areas such as teaching materials, school transportation, nutrition, healthcare assistance, and school infrastructure during certain intervals. Although these accounts do not permit direct inferences about their effects on the indicators, they are consistent with the hypothesis that periods of greater resource availability and stronger administrative coordination tend to generate more favorable conditions for improvements in educational performance.

At the same time, the literature also highlights that the effectiveness of such efforts depends on the organizational and coordinative capacity of local public management. In this regard, the variations observed in the indicators may be interpreted, within the theoretical framework adopted here, as compatible with contexts characterized by greater or lesser capacity for implementing educational policies. Rather than simply mirroring changes in the volume of resources, the patterns identified suggest that institutional and organizational factors play a mediating role between public investment and educational outcomes.

Qualitative evidence presented by Araújo et al. (2023) indicates that during the periods from 2013 to 2016 and from 2017 to 2018, educational investment in the municipality declined, accompanied by reports of salary payment delays, deficiencies in school infrastructure, and restricted availability of pedagogical resources. These elements signal shifts in the conditions under which educational services were provided over time. While such evidence does not allow for direct causal inferences regarding performance indicators, it offers relevant insight for interpreting the observed variations, insofar as it points to possible discontinuities in the execution of public education policies.

This scenario must be understood in light of Brazilian municipalities' considerable dependence on intergovernmental transfers for education funding (Gouveia & Polena, 2016; Oliveira & Oliveira, 2024). Over the period under analysis, the country underwent significant political and economic shifts (Carvalho, 2018), including phases of expansion, crisis, and recovery, all of which affected the availability and predictability of public resources (Gonçalves, 1998; Gouveia & Polena, 2016; Pessôa, 2009).

Although these macroeconomic dynamics do not bear directly on local educational outcomes, they shape the environment in which policies are implemented and may affect administrative continuity, planning, and the execution of municipal-level actions (Souza & Hoff, 2019). In this context, the federal government's role, predominantly one of complementary support through transfers, underscores the importance of local managerial capacity in effectively deploying available resources (da Cruz, 2012).

Within this context, the variations observed in educational development indicators for Alenquer (PA) over the period under analysis exhibit patterns that broadly align, though not in a strictly linear fashion, with distinct phases of the political and economic cycle. Between 2005 and 2008, a period associated with economic expansion, the indicators registered a cumulative growth of approximately 32%. By contrast, the 2008–2010 period, marked by instability, saw a contraction of roughly 13%. From 2010 to 2012, a renewed upward trajectory emerged, with growth of approximately 8%, a trend that continued through 2016. Over the full period (2005–2018), the total variation in the indicators reached 61.8%.

These movements suggest that educational development in the municipality does not follow a linear trajectory, but rather fluctuates in ways associated with varying conditions of public policy implementation. A plausible interpretation of this behavior is that the effects of educational investments tend to materialize in a lagged and cumulative manner, such that periods of greater resource availability may yield results that extend well into subsequent phases.

Conversely, periods of instability and fiscal constraint may undermine the continuity of these trajectories, particularly in institutional settings characterized by limited public management coordination capacity. Under such conditions, difficulties in aligning resources, services, and administrative processes may reduce implementation efficiency, contributing to the stagnation or reversal of previously observed gains.

The patterns identified throughout the period under analysis are thus consistent with the interpretation that the evolution of educational indicators in Alenquer reflects not only resource availability but also the institutional conditions that mediate implementation, especially with regard to the coordination of actions at the local level.

That said, interpreting variations in these indicators requires analytical caution, given that the behavior of such indices results from the interplay of multiple factors over time. Rather than seeking to identify direct causal relationships, it is therefore more productive to examine how different dimensions of the educational system evolve and the extent to which their patterns are consistent with particular theoretical frameworks.

Disaggregating the components of the IFDM Education Index reveals that its fluctuations over the period are associated with changes in variables such as early childhood education coverage, school dropout rates, and age-grade distortion. Specifically, the data point to a substantial number of out-of-school children, 825 individuals in total, alongside significant challenges related to school retention. Additional data indicate that approximately 30% of children born in 2003, 18% of those born in 2004, and 10% of those born in 2005 are not enrolled in school, suggesting the presence of structural weaknesses in both access to and continuity within educational pathways (Brazil, 2020; QEDu, 2019).

With respect to academic performance, IDEB results reflect a trajectory of gradual improvement, with scores of 4.3 in the early years, 3.7 in the later years of elementary school, and 3.2 at the secondary level. This pattern points to incremental gains in learning outcomes, even as these figures remain modest by national standards (Brazil, 2020; QEDu, 2019). At the same time, data on school infrastructure reveal significant limitations in the operating conditions of educational institutions.

Only 13% of schools have accessibility features, 4% are equipped with computer labs, and 6% have a library. Basic services such as regular waste collection and sewage access remain limited, while pedagogical and structural resources, including sports courts and broadband internet, are virtually nonexistent. These conditions point to deep structural constraints that may compromise the quality of education offered in the municipality. More specifically, regular waste collection is available in only 1% of schools, and sewage access is restricted to 35%. Although all schools provide meals, the near-absence of resources such as sports courts (7%) and broadband connectivity (0%) further constrains educational development (Brazil, 2020; QEDu, 2019). Taken together, the precarious state of basic sanitation and physical infrastructure exerts a negative effect on the overall quality of instruction in the municipality.

Considered as a whole, these findings reveal an educational landscape defined by isolated advances coexisting with persistent structural deficiencies. This pattern suggests that

improvements in certain indicators may occur even in the presence of weaknesses in other components of the educational system, pointing to the existence of nonlinear dynamics in the process of educational development (Gonçalves, 1998; Gouveia & Polena, 2016).

In light of the theoretical framework adopted here, such evidence may be interpreted as consistent with contexts in which institutional and coordination capacity constraints affect the integration of different dimensions of educational policy (Silva et al., 2021). In these settings, advances in specific areas, such as teacher qualifications or assessment performance, may not be matched by equivalent improvements in infrastructure or school retention, reflecting potential difficulties in the coordinated and integrated execution of public actions.

Political and economic conditions may further compound these variations over time. Periods of greater resource availability and administrative stability tend to favor policy continuity, while contexts of instability are prone to generating disruptions in implementation (Santos, 2017). Although direct causal claims cannot be established, this body of evidence is compatible with interpretations that attribute oscillations in educational indicators to limitations in the coordination and management of local educational policy (Araújo, 2024; Araújo, 2017; Matos et al., 2022; Silva et al., 2021). These dynamics are ultimately reflected in the alternating periods of growth and contraction in the municipality's educational development indicators, as illustrated in Figure 2.

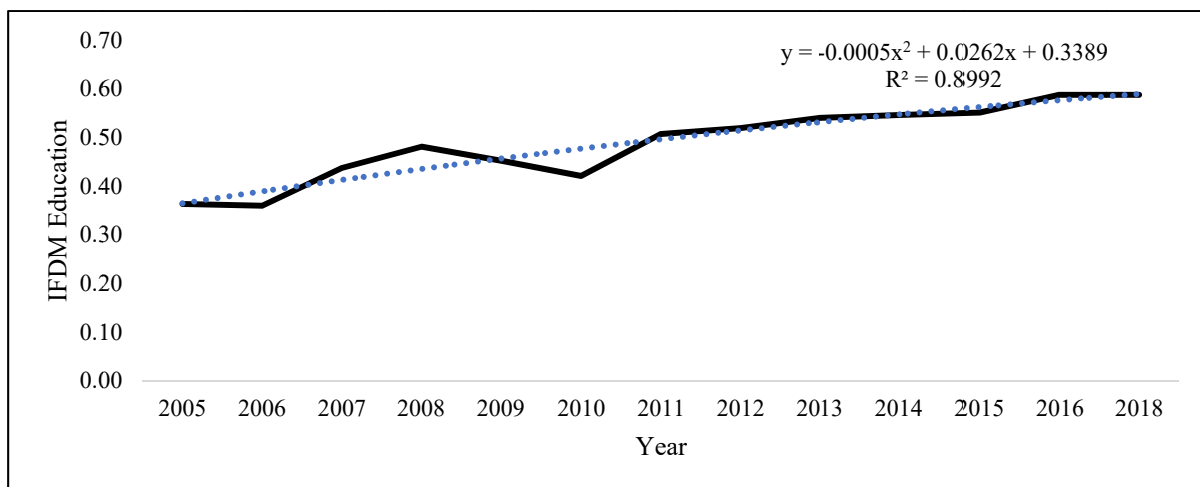


Figure 2. Quadratic trend estimation curve for educational development

Source: Research findings

The results indicate that education in Alenquer underwent a significant shift over the period under analysis, moving from a low development level in 2005 (0.40) to a moderate development range beginning in 2016. This trajectory reflects a broad pattern of improvement in educational indicators, albeit one that was neither linear nor uninterrupted.

Modeling the trajectory of these indicators through a quadratic function ($Y = -0.0005X^2 + 0.0262X + 0.3398$, $R^2 = 0.8992$) reveals that educational development over the period does not follow a linear trend; rather, it exhibits fluctuations over time, with phases of acceleration and deceleration. This pattern supports the interpretation that educational performance is the

product of dynamic and cumulative processes, in which periods of progress may be followed by stagnation or even regression.

Viewed through the theoretical framework adopted in this study, such behavior is consistent with institutional contexts in which the effectiveness of public policies depends not only on the availability of resources but also on the capacity to implement them in a sustained manner. In particular, the observed variability may be understood as reflecting oscillations in the conditions governing the coordination and execution of educational policies, especially in environments characterized by political and economic instability.

The estimated equation also allows for an analytical examination of the index's sensitivity to changes in its constituent components, suggesting that one-point improvements in dimensions such as early childhood education coverage, reduction of school dropout rates and grade-age distortion, teacher qualification, expanded instructional hours, and IDEB performance are associated with gains of 0.3646 points in the overall educational development index. These associations, however, must be interpreted with caution: they do not imply direct causal relationships, but rather signal the relative importance of these factors in shaping the composite indicator.

In this light, the findings suggest that sustaining upward trajectories in educational indicators is linked to the ability to maintain, over time, conditions favorable to the implementation of public policies. Qualitative evidence on the municipal context points to persistent weaknesses in institutional capacity and coordination across various areas of public administration, a finding that lends further credibility to interpretations connecting the observed discontinuities in the indicators to limitations in the organization and execution of governmental action.

While direct causal relationships cannot be established, the patterns identified are consistent with a body of literature that highlights the role of administrative capacity in mediating between available resources and achieved outcomes. In contexts such as Alenquer's, deficiencies in the coordination, planning, and monitoring of public policies may undermine the effectiveness of interventions, making it difficult to translate investments into sustained improvements in educational indicators.

Final considerations

This research began with the premise that the traditional view of educational development in the Amazon, centered almost exclusively on the linear infusion of resources and historical legacies, is insufficient to explain the erratic trajectories of municipalities like Alenquer. This study starts from a deliberately provocative stance: this conventional perspective, focused on the linear provision of inputs, is not merely insufficient but misleading. It treats educational development as an ascending straight line that requires only a steady diet of funding to sustain itself. The empirical reality of Alenquer, however, defies this naive geometry.

The data demonstrate that the expansion of funding, when isolated, does not guarantee the sustainable evolution of indicators. What the classical approach lacks is an excavation of what we term the black box of local management, that opaque space where resources enter, but learning does not necessarily emerge. The most parsimonious explanation, and the one

most consistent with the evidence for the observed plateaus and setbacks, lies in a factor hitherto underestimated: institutional coordination capacity.

While previous literature treated poor performance as an inevitable byproduct of scarcity, this study reveals that administrative discontinuity and the fragmentation of vital services, school transportation, infrastructure maintenance, pedagogical supervision, and nutrition programs, act as a genuine synaptic blockage. Without coordination, the educational system resembles an organism whose neurons fail to communicate: the resource (the nerve impulse) arrives, but it is not transformed into effective learning action.

This article redefines the analytical model for municipal educational development by introducing variables and causal relationships that have been marginalized until now. The traditional understanding of causality in educational policy suffers from a foundational flaw: the belief that increasing financial resources will automatically and linearly improve learning outcomes.

In contexts of high structural vulnerability, such as the sprawling Amazonian municipalities of continental dimensions, this relationship proves to be not a linear trend, but a quadratic one. Such curvature implies a law of diminishing returns, where initial growth, if not anchored by two critical variables, institutional coordination and execution stability, gives way to abrupt regressions. Without the musculature of management, the educational system does not progress; it spasms.

The metaphor of construction is apt: investing without coordination is like pouring concrete onto shifting foundations. Two variables, therefore, mediate the relationship between the amount invested and the effective impact: Institutional Coordination, the intelligence that aligns sectors, prevents overlaps, and ensures that school meals, transportation, and the curriculum are in active dialogue. Execution Stability, the administrative continuity that withstands the turbulence of political cycles, allowing policies to reach maturity.

However, even these pillars fail if basic structural factors, accessibility, sanitation, and connectivity, are ignored. These function like a riverbed: they can either guide the pedagogical flow or swallow it whole. Isolated pedagogical improvements in territories without roads or potable water do not float; they sink.

The progress observed in Alenquer is not the result of contemporary actions or an episodic shock of resources. Rather, it is an epiphenomenon of organizational integrity, the ability of a local government to sustain continuous administrative flows that allow for the accumulation of results over time. In other words, educational effectiveness cannot be bought; it must be institutionalized.

This causal logic is particularly powerful where local government is the primary, and often sole, provider of basic services. In municipalities with extreme fiscal dependence, educational performance pulses to the rhythm of intergovernmental transfers, becoming hypersensitive to national political and economic cycles. The theory of coordination as a driver of development, therefore, finds its natural laboratory in the brutal geographic dispersion of the Amazon.

It should be noted, however, that this model loses explanatory power in urban centers characterized by financial autonomy and a diverse private sector. In those contexts, municipal capacity is not the only bottleneck; but here, in the deep interior, it is the very throat of the system.

This diagnosis demands a radical shift in public management: moving away from the inertial allocation of resources (the mere fulfillment of budget line items) to focus on building administrative intelligence and process integration. If coordination is the mechanism that validates investment, then researching education without auditing the management structure is not an oversight; it is a grave methodological error that perpetuates inefficiency under the guise of science.

We conclude, therefore, that the path for future investigation must shift from the analysis of synthetic indicators (average grades, student flow) to the mapping of internal communication networks within municipal secretariats. The central academic challenge becomes: how can we institutionalize what is termed here as the neural flow of management, that web of orders, reports, controls, and decisions, so that it survives changes in administration? The answer to this question will determine whether educational development remains a succession of spasms or finally becomes a sustained trajectory of the State.

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