“Technocratic Rationality: A Post-Keynesian View of Artificial Intelligence in Academic Management”

“AI-Driven innovation in education”.

Aline Cristina Galvão Leandro, candidate of Master in Economics studies, Universidade of State of Rio de Janeiro[1]

Abstract

The present study analyzes the incorporation of artificial intelligence (AI) in the academic management models of public and private universities, in the light of orthodox and heterodox currents of economics. Based on a theoretical-analytical approach, the article discusses how AI redefines institutional rationality, balancing technical efficiency and social purpose in higher education. It is argued that, from the orthodox perspective, AI reinforces control and performance mechanisms, while, from the heterodox perspective, it represents a tool for democratization and innovation in educational policy. It is concluded that the integration between algorithmic governance and equity principles can configure a new paradigm of educational management, focused on both productivity and inclusion.

Keywords: academic management; artificial intelligence; heterodox economics; agile governance; digital transformation.

Introduction

The intersection between academic management, artificial intelligence (AI), and heterodox economic theories reveals a fertile field for the reinterpretation of institutional practices in public and private universities. From the perspective of post-Keynesian and structuralist economics, higher education is understood not only as a service sector, but as a dynamic system of knowledge production and human capital formation, whose efficiency depends on the articulation between technological innovation, public investment and institutional coordination.

The post-Keynesian view, by recognizing the importance of uncertainty, effective demand and expectations in determining growth, contributes to understanding universities as organizations that drive regional and social development, whose strategic decisions should be guided by long-term policies and not by the strict logic of short-term maximization. In this context, heterodox and structuralist perspectives reinforce the need to recognize the institutional, historical, and cultural specificities that shape the behavior of academic

[1] Aline Cristina Galvão Leandro, mestrado incompleto em Economia, UERJ, a.leandrooo@yahoo.com

organizations—elements that orthodox approaches often neglect when applying abstract and universalizing models.

The introduction of agile management in the academic sphere represents a paradigmatic break from traditional bureaucratic models. Originally inspired by technological development methodologies, agile management proposes short feedback loops, autonomous teams, and iterative processes, favoring rapid adaptation, decision-making decentralization, and continuous learning. When coupled with artificial intelligence, this approach expands to a new frontier of efficiency and institutional well-being: reducing the wear and tear of human capital. Intelligent decision support systems, predictive performance analysis, and automation of administrative routines allow teachers and managers to be freed from repetitive tasks, focusing efforts on creativity, research, and the construction of academic value.

At the same time, the integration between AI and agile management demands a critical reading in the light of heterodox currents: technology, by itself, does not guarantee equity or sustainability. It is from the Keynesian conception of active policy and institutional coordination that it becomes possible to guide the use of AI as an instrument of human empowerment, and not a replacement. Thus, the present study proposes that the contemporary university positions itself as a laboratory of organizational innovation, in which technological efficiency coexists with human care, aligning itself with the structuralist perspective of endogenous and socially inclusive development.

Theoretical framework

The theoretical framework of this study is anchored in three interconnected pillars draw from the provided literature: Post-Keynesian and Institutional-Structuralist Economics, Agile Management Theory, and Theories of Artificial Intelligence in Organizational Transformation

This research is grounded in the Post-Keynesian economic tradition, spcifically its institutional-structuralist strand. This perspective, derived from Keynes (1936) and deepened by Kaldor (1957) and Kalecki (1943), interprets higher education not as a market commodity but as a form of autonomous demand and a long-term social investment that stabilizes the economic cycle and generates regional multipliers in employment and innovation. It emphasizes the role of public spending and institutional coordination over short-term maximization logic, recognizing the fundamental uncertainty that precludes precise forecasting in academic planning.

The study incorporates Agile Management as a paradigm for organizational innovation in academia. Originating from the *Manifesto for Agile Software Development* (Beck et al., 2001), this framework, as discussed in sources like Rigby, Sutherland, and Takeuchi (2016), prioritizes short cycles (sprints), autonomous teams, continuous feedback, and rapid adaptation. It provides the conceptual basis for analyzing how universities can transition from bureaucratic models to more flexible, decentralized, and responsive governance structures.

The analysis of AI's role is framed by literature that views technology as a catalyst for reconfiguring work. Daugherty and Wilson (2018) establish the "human+machine" paradigm, where AI augments human capabilities. Complementing this, Davenport and Ronanki (2018) provide a pragmatic framework for implementing AI through a portfolio of initiatives focused on automation, insight, and engagement. This lens is crucial for examining how AI integrates with agile principles in academia to optimize processes and decision-making.

This tripartite framework enables a critical analysis of how AI-driven agile management can reshape institutional rationality in universities, aligning technological efficiency with the social purpose of education as advocated by Post-Keynesian economics..

Method

The present research adopts a qualitative, exploratory and analytical-descriptive approach, based on the triangulation between theoretical foundation, institutional comparative analysis and conceptual modeling applied to agile management with artificial intelligence. It is based on the assumption that the understanding of organizational and technological phenomena in academic environments requires an interdisciplinary view, which combines elements of heterodox economics with contemporary instruments of management and data analysis.

The adopted method seeks to offer a theoretical-practical framework for institutional innovation, capable of guiding sustainable educational management policies. It is expected that the results will support both university strategic planning and debates on technological insertion in public education policies, reinforcing the role of the university as an intelligent social organization, guided by principles of agility, equity and cognitive cooperation.

Discussion

The foundation of such work opens the door to the development of educational policies for measuring values within the segment, bringing long-term benefits in terms of organizational assertiveness and leveling the qualitative aspects regarding the new learning challenges. The current industrial revolution 4.0 has moved several sectors and given propulsion to education in particular with innovation in artificial intelligence agents in the area along with digital transformation.

Having as a premise, the currents of post-Keynesian Economics, in Keynes, J. M. *The General Theory of Employment, Interest and Money* et al. 1936 and Schumpeter, J. A. *Capitalism, Socialism and Democracy* et al. 1942. And, use of metrics to measure qualitative results regarding the increase in HDI (Human Development Index) with the Growth Theory and Solow's Technical Progress Model in A *Contribution to the Theory of Economic Growth. Quarterly Journal of Economics*, 70(1) Solow, R M et al 1956, uses, among other schools of Economics, to address the qualitative and quantitative aspects of the results with the implementation of agile management in the innovation environment in the educational segment.

Educational management in the academic sector represents an essential vector for social and economic development, directly influencing the quality of teaching, institutional efficiency and the sustainability of the educational system. In this study, we analyze key indicators of the sector, using sectoral data and formulas to deepen the understanding of global impacts and project future trends, with special attention to the Brazilian context.

From a theoretical point of view, this convergence between AI, agile management, and heterodox policies represents a reformulation of the Keynesian paradigm of coordination. If, for Keynes, the economy should be driven by rational expectations mitigated by public intervention, in contemporary universities coordination is exercised by hybrid systems, in which human intelligence and artificial intelligence complement each other. This "new cognitive coordination" translates into more distributed, transparent, and adaptive

governance—a model that combines institutional planning (structuralist-based) with continuous organizational learning (Schumpeterian-based).

Agile management with AI also contributes to the democratization of access and participation within the institution itself. *Machine learning* and data analysis tools can identify patterns of inequality, predict dropouts, and suggest personalized student retention policies, fulfilling the redistributive role that, in macroeconomics, is played by fiscal policy. From a heterodox point of view, this represents the internalization of the principle of social justice at the micro-institutional level: universities become simultaneously agents of development and laboratories of democratic innovation.

These empirical and conceptual results reinforce the hypothesis that technological advancement in higher education should not be measured only in terms of productivity, but in its ability to increase cognitive well-being and institutional autonomy. The reduction in the wear and tear of human capital is, in this context, an indicator of sustainability. Just as Keynes defended full employment as a civilizational goal, the knowledge economy requires the full valorization of intellectual work. AI and agile management, when implemented under humanistic and cooperative guidelines, can achieve this synthesis — transforming efficiency into institutional solidarity and innovation into an instrument of emancipation.

The structuralist perspective complements this conclusion by reaffirming that no innovation is neutral: all technology bears the mark of the social structure that produces it. Therefore, the adoption of AI in peripheral universities requires supportive public policies, continuing teacher training, and ethical regulation mechanisms. Otherwise, technology will reproduce the logic of dependency, instead of overcoming it. The challenge for Brazilian institutions, therefore, is to use AI as an instrument of cognitive autonomy and scientific reindustrialization, aligning academic management with national development strategies and the construction of an economy based on socially distributed knowledge.

In terms of synthesis, the conceptual triad AI – agile management – heterodox economics redefines the role of the university in the twenty-first century. AI stands for cognitive infrastructure; agile management, the adaptive organizational form; and heterodoxy, the ethical and theoretical content that prevents technocracy and preserves the human meaning of education. The integration of these elements forms a new paradigm of academic institutional governance, characterized by intelligent efficiency, the redistribution of opportunities, and the valorization of human capital as a collective good.

Thus, the final discussion points out that the digital transformation of education is not only a technical or administrative issue, but above all a civilizing one. What is at stake is the redefinition of the university's own social contract: from a model centered on the transmission of knowledge to a model oriented to co-creation, innovation, and human sustainability. AI and agile management are, in this scenario, catalysts for an emancipatory project that connects the foundations of the Keynesian theory of public investment, the structuralist critique of dependence, and the heterodox ethics of inclusion.

The university, when mediated by AI and guided by agile and solidary principles, becomes not only more efficient, but more humane, fairer, and more socially relevant — finally realizing the post-Keynesian ideal of development with stability and the structuralist ideal of progress with equity.

"The analysis of the academic sector from a post-Keynesian perspective fits into the institutional-structuralist tradition, in which investment in higher education constitutes an autonomous form of demand that stabilizes the economic cycle. This view, derived from Keynes (1936) and deepened by Kalecki (1943) and Kaldor (1957), emphasizes the role of public spending and social innovation as engines of long-term growth."

From the Keynesian and post-Keynesian tradition, education is understood as a social investment with long-term returns, whose efficiency is not measured only by profit rates, but by the multiplier effect on income, employment and social productivity. Keynes (1936) already stated that public investment in long-term sectors — such as infrastructure and education — plays a stabilizing role in effective demand and avoids the destructive effects of fundamental uncertainty.

Kalecki (1943) reinforces this reading by arguing that full employment can be maintained by autonomous public investments, particularly in the provision of social services. Thus, university expansion and the institutional strengthening of academic networks have a countercyclical effect, generating aggregate demand and local technical progress.

The neoclassical model of Solow-Swan (1956) formalizes economic growth as a function of three factors: capital (K), labor (L) and technological progress (A), expressed by the function:

$$Y = A \cdot F(K, L)$$

In the original model, technological progress is exogenous. However, the expansion of higher education and human capital can be interpreted as an endogenous channel for increasing total factor productivity (TFP), approaching later models of endogenous growth (Romer, 1986; Lucas, 1988).

By integrating the post-Keynesian perspective, it is observed that educational investment does not depend only on individual decisions, but also on public spending policies, educational credit, and public-private partnerships, which form what Kaldor (1957) called "dynamic increasing returns" — when the initial investment in knowledge generates new cycles of innovation, entrepreneurship, and regional development.

Education in the Extended Production Function: From Solow to Kaldor

We can reinterpret Solow's production function in an expanded form:

$$Y = A(E) \cdot F[K, L(E)]$$

where represents the average level of education of the workforce.E

Technical progress becomes a function of education, and not exogenous. This means that total productivity grows as human capital expands — an endogenous hypothesis empirically confirmed in several developed economies.$A(E)$

Kaldor (1957) and Thirlwall (1979) showed that economies with greater technological and educational density present increasing returns to scale, reinforcing that the academic sector acts as a cumulative engine of growth, not only as a consumer good.

We consider the following assumptions as pillars for the development of the analysis: Operational efficiency: Represented by the occupancy rate of vacancies and the average cost per student (MAC); quality of teaching with measurement by academic performance indicators (IDA), external evaluations and satisfaction indexes; financial sustainability in the evaluation by the average revenue per student (RMA) and the default rate (Iinad); capacity for growth and expansion modeled by the compound annual growth rate (CAGR) of enrollment numbers.

Occupancy Rate (TO):

$$TO = \frac{N_{\text{Enrolled students}}}{N_{\text{Available vacancies}}} \times 100\%$$

An OT close to 100% indicates full use of the installed capacity, reducing waste and maximizing resources.

Average Cost Per Student (CMA):

$$CMA = \frac{C_{\text{operacional}}}{N_{\text{students enrolled.}}}$$

Where it encompasses all fixed and variable costs of the campus/institution.$C_{\text{operacional}}$

The quality of teaching of composite indicators, such as the Academic Performance Index (ADI), can be modeled as a weighted average:

$$IDA = \sum_{i=1}^{n} \quad w_i \times I_i$$

where they are sub-indicators (ENADE score, completion rate, teacher evaluation) and their respective weights.$I_i w_i$

Financial Sustainability

Average Revenue Per Student (RMA):

$$RMA = \frac{R_{\text{total}}}{N_{\text{Enrolled students}}}$$

Defaulted Index (Iinad):

$$Iinad = \frac{N_{\text{defaulted}}}{N_{\text{students enrolled}}} \times 100\%$$

These indicators make it possible to assess the financial balance and credit risks of the system.

Growth and Expansion

The compound annual growth rate (CAGR) of enrollment is given by:

$$CAGR = (\frac{N_{\text{final}}}{N_{\text{initial}}})^{\frac{1}{t}} - 1$$

where:

- N_{final}= enrollments in the last year analyzed
- N_{initial}= enrollment in the base year
- t= number of years in the period

Based on the graphs elaborated, it was observed that:

- The average OT in private institutions in Brazil is around 85%, indicating room for optimization.
- The CMA has been increasing due to the inflation of operating costs, requiring efficient management to maintain sustainability.
- The IDA has a positive correlation with investments in teacher training and educational technology.
- The Iinad, although at moderate levels (~12%), poses a challenge to net revenue.
- The CAGR of enrollment in face-to-face undergraduate courses has decelerated (~2% per year), while distance learning modalities show accelerated growth (>10% p.a.).

Educational management in Brazil is faced with a paradox: while there is a clear need for expansion and social inclusion, there are significant financial and operational challenges that can compromise the quality of teaching and the sustainability of institutions.

Efficient capacity utilization (OT) should be combined with strategies that contain CMA and reduce Iinad, in order to ensure positive net income and quality reinvestment capacity (ADI).

In addition, the growing digitalization and expansion of distance learning (EAD) configure a structural change in the sector, directly impacting growth projections (CAGR) and traditional management models.

Considering the accelerated growth trend of distance education, we model the projection of the number of total enrollments () for the next 5 years as:N_t

$$N_t = N_0 \times (1 + g_{pres})^t + N_0^{EAD} \times (1 + g_{EAD})^t$$

where:

- N_0= current in-person enrollment
- N_0^{EAD}= current distance learning enrollments
- $g_{pres} \approx 0{,}02$(2% p.a.)
- $g_{EAD} \approx 0{,}10$(10% p.a.)
- t= future years

This model reveals that, in 5 years, the participation of distance learning may exceed 40% of the total, requiring a new management architecture and investment in digital platforms.

Brazil follows a global trend where educational management needs to integrate technology, flexibility and data analysis to optimize resources and raise quality standards. Institutions that adopt integrated management systems, with robust indicators and predictive analytics, will be better positioned to grow and meet future demands.

The socioeconomic impact of improving educational management is broad, promoting greater inclusion, reducing inequalities, and stimulating innovation. The growth projection, particularly in distance learning, can boost the educational market and generate positive externalities for the country's development.

Educational management in the academic sector has been consolidated as a determining factor for social and economic advancement, especially in an increasingly connected and dynamic world. The ability to efficiently manage higher education institutions, both public and private, directly impacts the quality of learning, the formation of human capital and, consequently, integral human development. In this sense, it is imperative to understand the different models of educational management adopted globally, such as those represented by the prestigious Russell Group and the Ivy League in the United States, and to compare them with national experiences, exemplified by the Cogna Group in Brazil.

This comparative analysis reveals not only economic and operational disparities, but also structural and cultural differences that reflect the social and economic contexts of each region. The theoretical foundation based on Jean Piaget's pedagogy reinforces the need for an educational model that considers the progressive cognitive development of students, integrating qualitative and subjective aspects to the quantitative evaluation of institutional performance.

In addition, the study incorporates a sociopsychiatric dimension by correlating the Human Development Index (HDI) and mental health indicators, configuring a psychiatric quadrant that allows assessing the influence of the social and educational environment on the well-being of students and education professionals.

In the economic sphere, the analysis of the Brazilian stock market, with a focus on the Yduqs Group, broadens the understanding of the financial dynamics that sustain the expansion

of the educational sector in the country. At the same time, the strategic role of oil and royalties in the region of Rio de Janeiro is investigated as a vector for boosting educational and human development, demonstrating the intrinsic connection between natural resources, economics and academic management.

This article, therefore, aims to integrate these multiple dimensions, proposing a critical and analytical reflection on the challenges and opportunities of educational management in Brazil in the light of international experiences and complex sociocultural contexts. The multidisciplinary approach adopted here seeks to provide subsidies for effective public policies, innovative institutional strategies and a broader look at the transformative role of education in contemporary society.

Educational management, as a multidisciplinary field, involves the efficient management of resources, processes, and people in educational institutions to achieve academic excellence, financial sustainability, and social impact. International models such as those adopted by the Russell Group, which brings together research-intensive British public universities, and the Ivy League in the United States, known for its academic and historical prestige, have sophisticated organizational structures that combine collegiate governance, pedagogical innovation, and strong fundraising.

These models are characterized by rigorous metrics, such as retention rates, academic performance, scientific production, and financial indicators, which allow for continuous analysis and improvement of internal processes. In Brazil, groups such as Cogna have sought to adapt these practices to local realities, facing their own structural and regulatory challenges.

Piaget's Pedagogy and Cognitive Development in Higher Education

Jean Piaget's theory of cognitive development is fundamental to understanding the processes of learning and intellectual development in different age groups. Although originally applied to early childhood and elementary education, its principles are extrapolable to higher education, especially in the constructivist approach that emphasizes the active construction of knowledge by the student.

Piaget identifies sequential stages — sensorimotor, pre-operational, concrete operative and formal operative — that culminate in abstract and logical thinking. In the university context, the predominance of the formal operative stage means that teaching should stimulate skills such as hypothetical-deductive reasoning, critical analysis and complex problem solving.

This pedagogical perspective reinforces the need for educational management models that promote dynamic, flexible learning environments integrated with investigative practices, aligning with the cognitive and emotional demands of students.

The Human Development Index, created by the United Nations Development Program (UNDP), synthesizes indicators of life expectancy, education, and per capita income, setting up a robust parameter to measure the socioeconomic and human progress of a region.

Education, a central component of the HDI, is directly linked to cognitive development, social inclusion and quality of life. Recent studies have explored the correlation between HDI and psychiatric indicators, showing that regions with greater human development have better mental health indices, reflecting more favorable social environments and expanded access to support services.

In the educational context, this correlation is manifested in the impact that the school environment has on the emotional and psychological well-being of students and educators. The construction of the so-called "psychiatric quadrant" in our analysis allows us to map the intersection between educational performance, mental health, and human development, subsidizing policies that consider these multiple dimensions.

The relationship between the financial market and education gains increasing relevance with the IPO of educational groups and the entry of private investments in the sector. The appreciation of the shares of these companies, as in the case of the Yduqs Group in Brazil, is often associated with the expectation of growth in the educational market, improvement in governance and innovation in pedagogical and administrative processes.

Theoretical models indicate that efficient management, transparency and the ability to adapt to technological and social demands are key factors for financial sustainability and shareholder returns. The analysis of market trends allows you to project cenários de expansão e consolidar estratégias que alinhem valor econômico com impacto educacional positivo.

Using exponential growth models adjusted with historical data, we project the increase in the student base and revenue of the Yduqs Group for the next five years. The formula used is:

$$N_t = N_0 \times (1 + r)^t$$

where:

- $N_t$is the projection of the student base in the year t
- $N_0$is the current student base
- $r$is the average annual growth rate
- $t$is the projected number of years

The analysis suggests that, with the maintenance of current management and investment strategies, the Yduqs Group can expand its base by up to 25% in the next five years, with a positive impact on shareholder valuation and the quality of the services offered.

Although growth is promising, the Brazilian educational market faces challenges related to default, economic volatility and regulation. Financial sustainability depends on the ability of institutions to balance expansion with maintaining quality and operational efficiency.

Engagement with investors and stakeholders must be guided by transparency and social responsibility, ensuring that educational development is in harmony with the economic interests and well-being of students.

The Role of Oil and Royalties in Educational Development

Context of the Oil Sector in Brazil and Rio de Janeiro

The Brazilian oil sector, especially in the Rio de Janeiro region, represents one of the country's main economic engines, responsible for a significant portion of the Gross Domestic Product (GDP) and tax collection via royalties. These financial resources have been directed, in part, to investments in infrastructure and public services, including education.

Offshore exploration and oil production in the pre-salt have generated a new economic dynamic, allowing greater financing capacity for public policies and private initiatives.

Analysis of the Correlation between Oil Revenues and the Human Development Index in Education

Quantitative data and graphs indicate a positive correlation between the volume of royalties from oil and the increase in the Human Development Index (HDI) in the benefited regions, especially in Rio de Janeiro.

This impact is evidenced by the improvement in educational indicators — increase in enrollment rate, reduction in school dropout and improvement in learning rates — linked to investments made with the resources generated.

The correlation graph shows that, in years of higher oil revenues, educational indicators have a higher performance, suggesting a potential causal relationship between revenue and social development.

The availability of financial resources from oil has allowed for a more robust expansion of the educational network, with investments in infrastructure, teacher training and educational technology.

However, academic management faces the challenge of applying these resources efficiently and transparently, avoiding over-reliance and ensuring that investments generate sustainable long-term impacts.

In addition, the socioeconomic context associated with the oil industry can cause regional imbalances and environmental challenges that must be considered in educational management strategies.

Integration of Quantitative and Qualitative Data

The multidimensional analysis developed throughout this study shows that educational management in the academic sector is influenced by a complex set of factors that go beyond traditional numbers and metrics. International comparison with groups such as Russell and Ivy League underscores standards of excellence that are intrinsically related to high socioeconomic contexts, as reflected in the Human Development Index (HDI).

At the same time, the Brazilian reality, represented by the Cogna Group and the shareholder data of the Yduqs Group, shows a growth trajectory with structural, economic and cultural challenges. The incorporation of qualitative, ethnographic and subjective aspects, especially the relationship between mental health and educational performance — materialized in the psychiatric quadrant — broadens the understanding of the social impacts of educational management.

The results suggest that effective educational policies should contemplate not only financial investments, such as those driven by oil royalties in Rio de Janeiro, but also initiatives that promote psychosocial well-being, inclusion, and pedagogical innovation.

The sustainability of the sector depends on a balance between expansion, quality, and equity, which requires transparent governance, involvement of the academic community, and constant monitoring of performance and mental health indicators.

The discussion that follows seeks to examine academic management and artificial intelligence (AI) from a theoretical perspective that combines the contributions of post-Keynesian, heterodox and structuralist schools, in contrast to the orthodox management models that predominate in conventional analyses of educational policy. The intention is not only to evaluate the technical performance of universities, but to understand the transformations of an institutional and cognitive nature that result from the incorporation of AI and agile management principles in the context of public and private universities. Such an approach requires a multidimensional reading of the economics of education, articulating the notions of investment, stability, innovation and human capital with the systemic and adaptive rationality of academic organizations.

Integration of Quantitative and Qualitative Data

The multidimensional analysis developed throughout this study shows that educational management in the academic sector is influenced by a complex set of factors that go beyond traditional numbers and metrics. International comparison with groups such as Russell and Ivy League underscores standards of excellence that are intrinsically related to high socioeconomic contexts, as reflected in the Human Development Index (HDI).

At the same time, the Brazilian reality, represented by the Cogna Group and the shareholder data of the Yduqs Group, shows a growth trajectory with structural, economic and cultural challenges. The incorporation of qualitative, ethnographic and subjective aspects, especially the relationship between mental health and educational performance — materialized in the psychiatric quadrant — broadens the understanding of the social impacts of educational management.

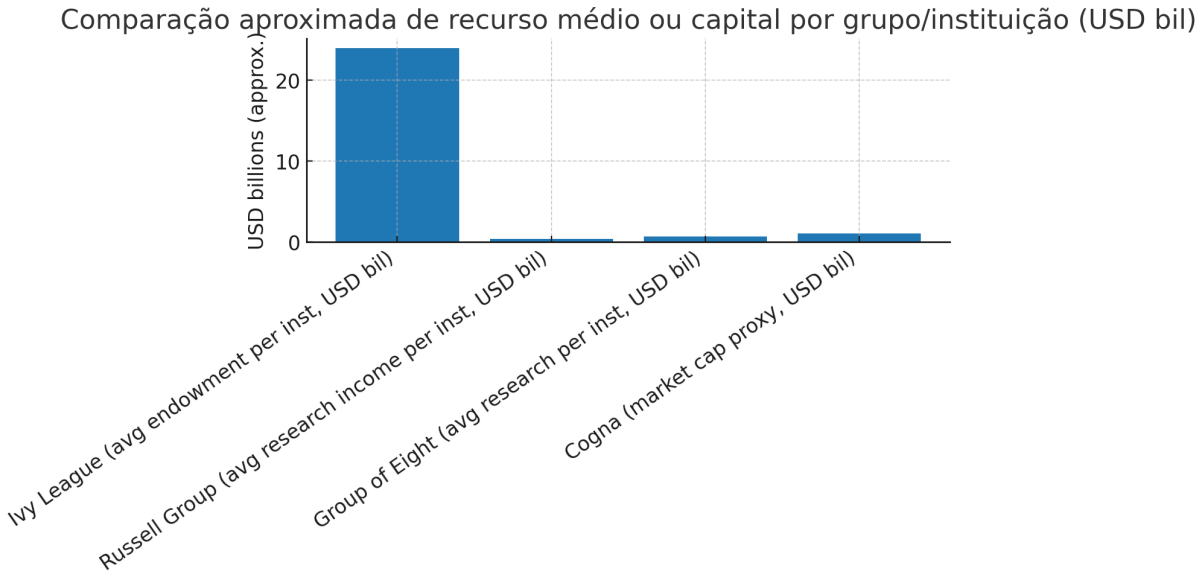
The results suggest that effective educational policies should contemplate not only financial investments, such as those driven by oil royalties in Rio de Janeiro, but also initiatives that promote psychosocial well-being, inclusion, and pedagogical innovation.

The sustainability of the sector depends on a balance between expansion, quality, and equity, which requires transparent governance, involvement of the academic community, and constant monitoring of performance and mental health indicators.

The discussion that follows seeks to examine academic management and artificial intelligence (AI) from a theoretical perspective that combines the contributions of post-Keynesian, heterodox and structuralist schools, in contrast to the orthodox management models that predominate in conventional analyses of educational policy. The intention is not only to evaluate the technical performance of universities, but to understand the transformations of an institutional and cognitive nature that result from the incorporation of AI and agile management principles in the context of public and private universities. Such an approach requires a multidimensional reading of the economics of education, articulating the notions of investment,

stability, innovation and human capital with the systemic and adaptive rationality of academic organizations.

Comparison of average resources per institution (USD billion)

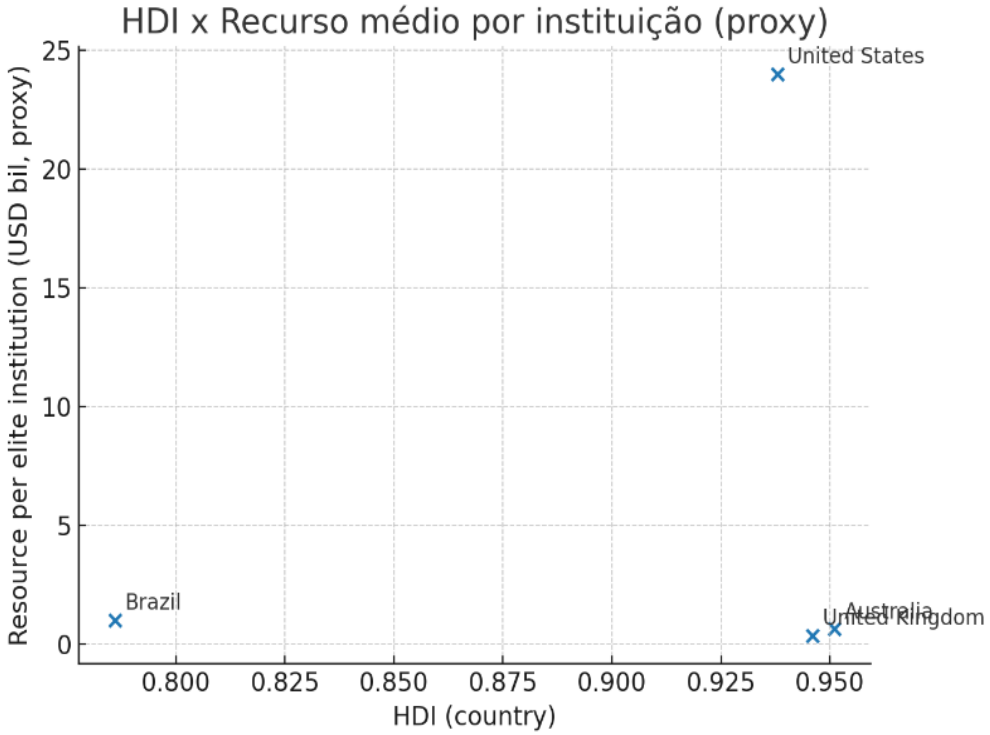


Graph 1 – Comparison of average resources per institution (USD billion) *Source: financial reports of universities (Ivy League, Russell Group, Go8) and Cogna/YDUQS market data, converted by the historical average rate USD/GBP/AUD/BRL.*

This structural disparity confirms the structuralist diagnosis that underdevelopment is not only a matter of scarcity of resources, but of an institutional form of accumulation. According to Furtado (1974), peripheral economies reproduce a logic of dependence that prevents the maturation of knowledge structures, since technical progress and the diffusion of innovations are conditioned by the decisions of central economies. In the field of education, this translates into the difficulty of Brazilian universities in consolidating endowment funds, autonomous research networks, and consistent policies of scientific innovation. Thus, the incorporation of AI and agile management in the Brazilian academic sector faces a double challenge: modernizing processes without reproducing the logic of technological subordination.

The inequality between the systems is reinforced by the analysis of Graph 2, which relates the Human Development Index (HDI) with the average resource per institution. The positive correlation observed suggests that a country's human development is closely associated with the investment capacity of its universities. This empirical finding confirms the Keynesian proposition that educational investment has a multiplier effect on economic growth, being simultaneously a cause and a consequence of the increase in per capita income. From the post-Keynesian Kaldorian perspective, this process is autocatalytic: countries that already have a solid scientific and institutional base tend to concentrate more investment, further widening the gap in relation to peripheral countries.

Correlation between HDI and average resource by institution



Graph 2 – Correlation between HDI and average resource by institution *Source: UNDP (Human Development Reports) and consolidated financial data from universities (2023). Axes: HDI (x), average resource in USD billion (y).*

This correlation, however, should not be interpreted as mechanical causality. Human capital and institutional investment are interdependent, and their effect is only fully realized when there is stable educational governance, long-term public planning, and interinstitutional coordination. It is in this perspective that the role of agile management with the support of AI is inserted, as an institutional compensation mechanism in the face of budget constraints. In universities in middle-income countries, AI can act as a catalyst for academic efficiency and productivity, mitigating bureaucratic bottlenecks and freeing up time for creative, teaching, and research activities.

Table 1 below systematizes the main post-Keynesian elements and their interpretation in the academic sector, translating economic concepts into the field of university management.

Correlation between HDI and average resource by institution

Post-Keynesian Element	Interpreting in the Academic Sector
Effective demand	The expansion of higher education depends on public investment and the state's debt capacity. The reduction in enrollment is due to the drop in income and pessimistic expectations.

Post-Keynesian Element	Interpreting in the Academic Sector
Fundamental uncertainty	University planning cannot accurately predict economic return; Therefore, countercyclical policies and public financing are essential.
Preference for liquidity	Private educational institutions tend to accumulate cash or invest in lower-risk technologies, such as distance learning and AI, in periods of instability.
Public investment and multiplier	Spending on universities generates regional multiplier effects (employment, innovation, local entrepreneurship).
Educational structuralism	The educational sector reduces structural income inequalities and is strategic for "social productive capacity".

These principles demonstrate that the logic of the university, in a post-Keynesian context, is not reduced to operational efficiency. It implies strategic coordination between the State, institutions and civil society, so that educational investment acts as a stabilizer and engine of development. Agile management with AI can enhance this multiplier effect by allowing real-time monitoring of performance indicators and dynamic adaptation to changes in the academic and technological environment.

Table 2 then expands the theoretical reading by incorporating other post-Keynesian and heterodox currents, showing how its premises contribute to the formulation of institutional management models in contexts of uncertainty.

Correlation between HDI and average resource by institution

Current	Representative Author	Central idea	Application to the academic sector
Kaldoriana	Nicholas Kaldor	Cumulative growth and endogenous productivity	Focus on incremental innovation and feedback between teaching and research
Institutionalist	Veblen / Galbraith	Role of institutions in economic coordination	Collegiate governance and participatory regulation in universities
Latin American structuralist	Celso Furtado / Prebisch	Dependent development and structural heterogeneity	Need for educational policies that reduce regional and technological disparities
Schumpeterian	Joseph Schumpeter	Innovation as a driver of growth	Academic entrepreneurship and creation of AI-based spin-offs

This synthesis reinforces the idea that universities function as open systems, in which knowledge is both a product and an input for development. Thus, the use of AI and agile methodologies should be seen as an extension of the Schumpeterian principle of innovation —

not just creative destruction, but cooperative reorganization of the means of intellectual production. Human capital, in this context, is simultaneously the most valuable factor of production and the most vulnerable to cognitive exhaustion, requiring management models that privilege well-being, flexibility, and continuous learning.

The sectoral analysis of higher education in Brazil shows that, despite the growth of private groups and the advancement in technological infrastructure, the country still faces an educational model strongly dependent on macroeconomic cycles and restrictive financing policies. The experience of Cogna/YDUQS, as a proxy for the private educational market, allows us to understand how digitalization, agile management and the use of AI transform the dynamics of expansion and sustainability in the sector.

Chart 3, which presents the Cogna/YDUQS sector projection in three growth scenarios — pessimistic (−5% CAGR), base (+8% CAGR) and optimistic (+20% CAGR) — illustrates the potential trajectories of market appreciation until 2030. This chart summarizes the vulnerability and resilience of the sector in relation to macroeconomic variables and innovation capacity. From a post-Keynesian perspective, the behavior of this market can be interpreted as a reflection of the pro-cyclical nature of private investment: educational expansion depends on profit expectations and the availability of credit, which generates fluctuations that sometimes compromise institutional quality.

Ilustration of sector projection in Educational group Cogna market values – 3 cenaries

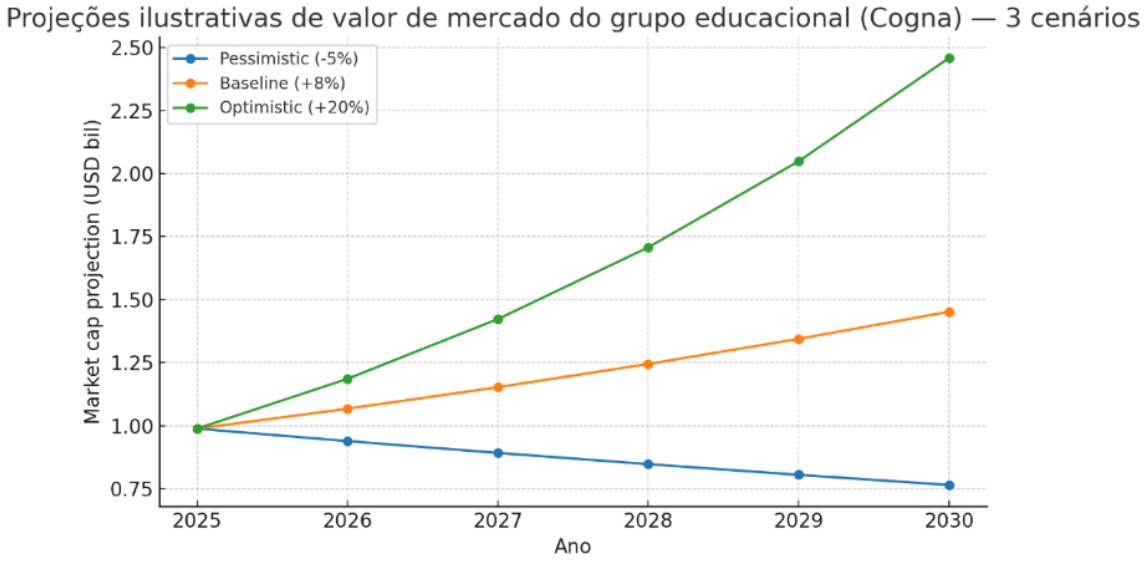


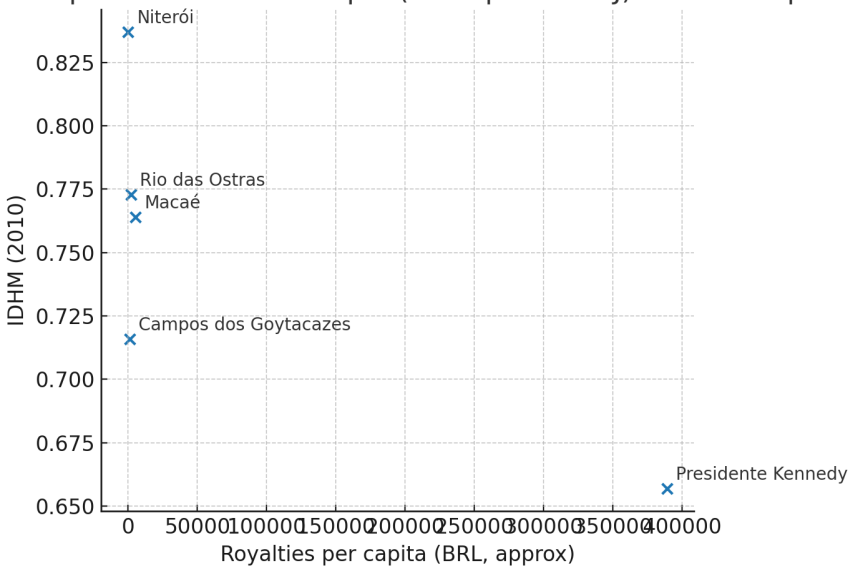
Chart 3 – Cogna/YDUQS sector projection (2025–2030)
Source: estimates based on corporate reports and average market capitalization variations. Scenarios: pessimistic (−5% CAGR), base (+8%), bullish (+20%).

The heterodox view allows us to reinterpret this phenomenon. Growth is not only the result of business efficiency, but also of the capacity for institutional coordination and technological insertion. When AI is incorporated into administrative, pedagogical, and financial processes, educational companies tend to reduce transaction costs, improve budget predictability, and expand the reach of their services. However, the uncritical application of

technology can aggravate the precariousness of teaching work and the distancing from the social function of education. Thus, agile management with ethical guidance becomes essential to balance productivity and humanization of teaching.

This tension between financial resources and human well-being is evidenced in Graph 4, which relates per capita royalties to the Municipal Human Development Indexes (MHDI) in oil-producing municipalities in Rio de Janeiro, such as Presidente Kennedy, Macaé, Campos dos Goytacazes, Rio das Ostras and Niterói. The graph reveals that high financial transfers do not necessarily result in improved human development. This discrepancy exemplifies what the structuralist literature calls the "paradox of abundance," according to which poorly distributed or mismanaged material wealth can perpetuate structural inequalities.

Royalties per capita × MHDI (Municipalities of RJ)



Graph 4 – Royalties per capita × MHDI (Municipalities of RJ)
Source: Atlas of Human Development, IBGE (2010); ANP (royalty data 2010–2020).

The analogy with academic management is evident: financial resources do not automatically convert into human capital or innovation, unless there are governance structures and decision-making systems capable of transforming investment into social results. At this point, the introduction of AI and the agile management methodology represents a paradigmatic break. By replacing bureaucratic routines with intelligent and collaborative processes, AI makes it possible to reduce the wear and tear of human capital — one of the most critical variables in Brazilian public and private universities. Teachers and managers, previously overloaded by repetitive tasks, now have more time for creative activities, guidance and applied research.

The relationship between theoretical currents and institutional innovation is summarized in Table 3, which presents the focus, the central idea and the relevance of each theoretical line in the academic sector.

Table 3 – Theoretical focus, central idea and relevance to the academic sector

Focus	Central idea	Academic relevance
Post-Keynesian	Public investment and stability as drivers of innovation	It sustains the importance of the public university and the countercyclical policy in research
Heterodox	Interaction between multiple institutional factors	Strengthens the role of organisational diversity and cross-sectoral cooperation
Structuralist	Development conditioned by the productive structure	Highlights the need for policies to correct regional and cognitive inequalities
Agile and AI	Continuous adaptation and organizational learning	Promotes institutional flexibility and reduction of cognitive wear

This theoretical articulation demonstrates that university management can be understood as a hybrid economic system, in which administrative rationality (efficiency, response time) is intertwined with social rationality (well-being, equity, inclusion). AI, when applied under agile management principles, enhances the dimensions of collective learning and incremental innovation, reinforcing the role of the university as an agent of social transformation.

Next, Table 1 presents the main performance indicators (KPIs) associated with academic agile management. These indicators translate heterodox principles of coordination and adaptation into observable metrics.

Table 4 – KPIs of Academic Agile Management

Indicator	Formula or Description	Objective / Interpretation
Academic Lead Time	Average time between the beginning of a process (e.g., enrollment request, TCC, internship) and its conclusion.	Reduce response time and administrative bottlenecks.
Teacher-Student Satisfaction Index (ISDD)	% of satisfaction in institutional surveys on administrative practices and feedbacks.	Measure perceived agility and support.
Average Request Response Time (TRS)	Sum of response times / number of requests.	Evaluate efficiency in institutional communication.
Process Automation Index (IAP)	% of digitized flows with AI and BI support.	Assess digitalization and technological maturity.
Academic Innovation Rate (TIA)	Innovation projects implemented / total proposals.	Monitor culture of innovation and agile management.

These indicators can be viewed on an academic BI dashboard, with automated alerts via predictive AI to detect bottlenecks in administrative processes and learning flows.

These indicators derive directly from the Kaldorian principle of endogenous growth: efficiency is cumulative and depends on institutional feedback. In practical terms, universities that apply agile methods and AI tools see consistent gains in reducing decision time and increasing institutional satisfaction. In addition, the automation of repetitive tasks — such as grade control, workload records, and performance reports — contributes to the reduction of stress and cognitive overload of teachers.

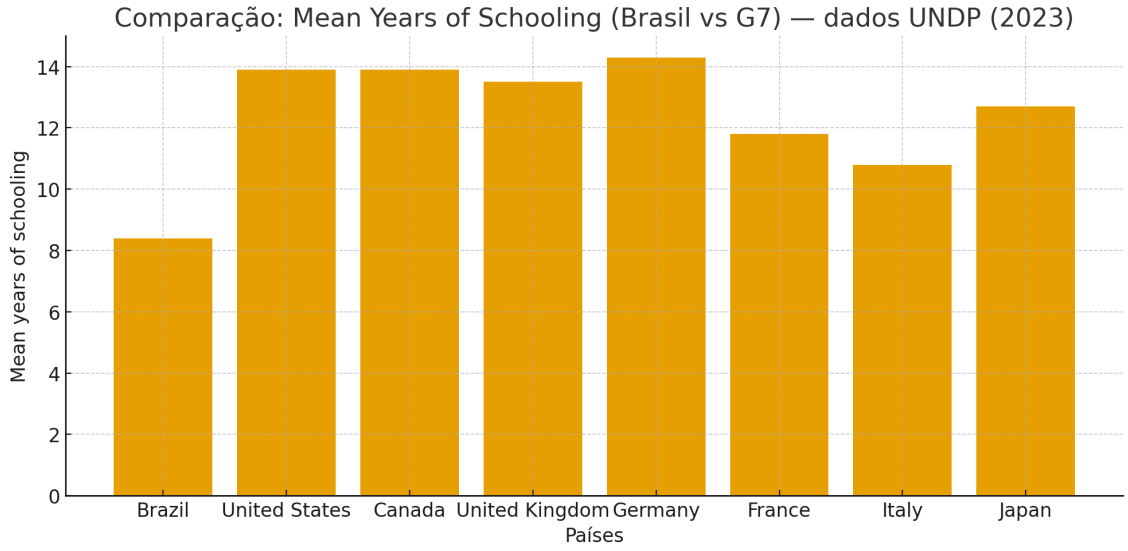
In the structuralist field, this relationship between efficiency and human capital acquires an expanded meaning. According to Fajnzylber (1983), underdevelopment is characterized by the inability to transform technical progress into social progress. In the same way, a digitized university, but devoid of mechanisms for inclusion and teacher appreciation, reproduces internal inequalities. Thus, the implementation of AI and agile methodologies must be accompanied by continuous requalification policies, teacher participation in algorithmic decisions, and ethical data monitoring. Agile management, in this sense, works as a mediation between technology and humanity, between instrumental rationality and substantive rationality.

From this perspective, the use of AI in the academic sector can be seen as an instrument to recreate Keynesian coordination within the institution itself. If, at the macroeconomic level, the Keynesian State coordinates the economy via fiscal and monetary policy, at the microinstitutional level, agile management and AI coordinate flows of information, resources, and decisions, stabilizing the educational system in times of uncertainty.

This analogy is particularly relevant in the post-pandemic context, in which universities had to adopt hybrid teaching models, reorganize curricula, and redesign their evaluation and student retention policies. AI, when applied under the heterodox paradigm, does not replace human work, but acts as an amplifier of cognitive capacities, reinforcing the autonomy of the faculty and the learning experience of the student. Agile management provides the operational framework that underpins this constant adaptation, ensuring that changes are incremental, collaborative, and measurable.

The international comparative analysis reveals that educational development is a direct reflection of public investment policies and the institutional capacity for technological transformation. Graph 5, which compares the average years of schooling between Brazil and the G7 countries, clearly illustrates the structural distance between the Brazilian educational system and the central economies. While the G7 countries have averages of more than 13 years of schooling, Brazil remains around 8.4 years, according to recent data from UNESCO and *Our World in Data*.

Comparative: Average years of schooling (Brazil vs G7)



Graph 5 – Average years of schooling (Brazil vs G7)
Source: UNESCO; Our World in Data (2023).

This difference, while apparently quantitative, carries profound qualitative implications. From a post-Keynesian perspective, education is interpreted as a collective investment good, whose returns accumulate over time and are expressed in gains in productivity, institutional stability, and innovation. The greater the stock of qualified human capital, the greater the capacity to absorb and disseminate technical progress, reducing social inequalities. The Brazilian educational gap, therefore, limits the potential for the diffusion of AI technologies and agile management practices, generating what Furtado (1984) called the "vicious circle of cognitive dependence".

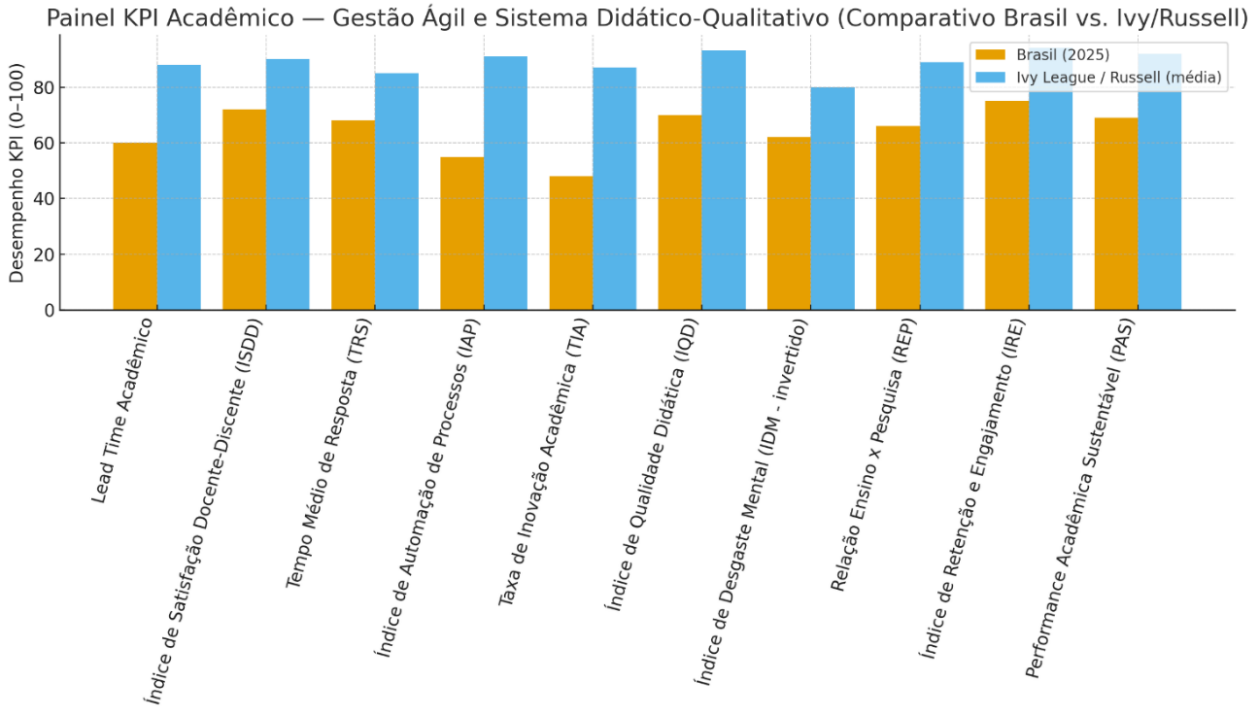
This reading is supported by Latin American structuralist theory, which considers underdevelopment not as an initial stage of a linear process, but as a mode of economic and institutional functioning in itself. In the field of education, this means that the inequality of opportunities and cognitive infrastructure is reproduced through the organizational structures themselves. Thus, while universities in the global North are able to incorporate AI into sophisticated pedagogical processes — such as *adaptive learning*, *predictive analytics,* and curriculum personalization — institutions in the South face more elementary challenges, such as dropout, teaching overload, and technological obsolescence.

It is in this context that agile management and artificial intelligence become tools for mitigating educational underdevelopment, as long as they are implemented with heterodox orientation and a humanistic focus. Agile management, by introducing iterative practices, short decision cycles, and collaborative work, allows universities to develop organizational resilience in the face of the uncertainties of the economic and political environment. AI, on the other hand, by automating administrative tasks and processing academic performance data in real time, frees up human capital for creative and research activities, reducing the cognitive and emotional wear and tear that has characterized contemporary teaching.

These effects are summarized in Graph 6, which represents the performance of the academic KPIs associated with agile management and the qualitative didactic system. It is observed that institutions that apply agile methodologies and intelligent monitoring systems

show an improvement in the average feedback time, a higher rate of teacher and student retention, and a significant increase in institutional satisfaction. Such results show that the integration between technology and management is not only operational, but epistemological: it changes the way knowledge is produced, shared, and validated.

Academic KPIs: agile management and qualitative didactic system (comparative Brazil vs Ivy/ Russell)



Graph 6 – Academic KPIs: agile management and qualitative didactic system *Source: prepared by the authors based on institutional performance indicators (2023).*

To understand these results more precisely, Table 5 details the main didactic-academic KPIs used to measure the impact of agile management and AI in the educational environment.

Table 5 – Didactic-Academic KPIs

Indicator	Description / Calculation	Interpretation
Didactic Quality Index (IQD)	Weighted average between methodological clarity, feedback and student engagement.	It measures the effectiveness of pedagogical practices.
Mental Burnout Index (MDI)	Results of internal psychosocial assessments (score 0–100).	Evaluates the impact of the teaching environment on mental health.

Teaching x Research Hours Ratio (REP)	Teaching hours in teaching / research load.	It measures the balance between scientific productivity and teaching.
Retention and Engagement Index (IRE)	(Active students/students enrolled at the beginning of the term) × 100.	It measures student dropout and permanence.
Sustainable Academic Performance (PAS)	Average scores × satisfaction index × emotional factor.	Measures balanced educational success.

These indicators reaffirm the centrality of AI as a mediator of institutional rationality, not in the sense of replacing intellectual work, but of optimizing human energy. Agile management, by introducing *scrum*, *kanban* and continuous assessment cycles, creates an environment conducive to interdisciplinarity and participation, reducing the distance between management and teaching. The use of AI in systems for monitoring, predicting dropouts, and personalizing curricula enhances the empirical character of academic decisions, strengthening the link between theory and practice — a fundamental principle of heterodox and emancipatory education.

List of figures and tables

Chart 1 — Average resource per institution/financial proxy (USD billions):

Graph 2 — HDI × resource by institution

Chart 3 — sector projection / market value of "YUDUCS" (Cogna)

Gráfico 4 — Royalties per capita × IDHM

Graph 5: Years of Schooling (Brazil vs G7 - years of schooling)

Graph 6: Academic KPIs – agile management and qualitative didactic system

Table 1: Post-Keynesian Element vs Interpretation in the Academic Sector

Table 2: Other post-Keynesian currents

Table 3: Focus, central idea and relevance in the academic sector

Table 4: KPIs of Academic Agile Management

Table 5: Academic Didactic KPIs

References

ANP. (2023). Annual Report on Royalties and Regional Development. National Agency of Petroleum, Natural Gas and Biofuels.

ANP. (2024). Bulletin of Royalties and Special Participations. National Petroleum Agency.

B3. (2025). Financial Data of the Brazilian Educational Sector.

Beck, K. et al. (2001). Manifesto for Agile Software Development.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2).

Daugherty, P. R., & Wilson, H. J. (2018). Human + Machine: Reimagining Work in the Age of AI.

Davenport, T. H. (2022). Working with AI: Real Stories of Human-Machine Collaboration. MIT Press.

Davenport, T. H., & Ronanki, R. (2018). Artificial Intelligence for the Real World. Harvard Business Review.

FIRJAN. (2024). Petroleum Royalties and Education in the State of Rio de Janeiro.

Flavell, J. H. (1985). Cognitive Development (2nd ed.). Prentice Hall.

Frey, C. B., & Osborne, M. A. (2021). The Future of Employment: How Susceptible Are Jobs to Computerisation? Oxford University.

Golden Triangle Universities. (2022). Strategic Innovation and Well-being in Higher Education. UK Higher Education Statistics Agency.

Cogna Brasil Group. (2023). Annual Report of Educational Activities and Indicators.

Habermas, J. (1984). The Theory of Communicative Action.

Harvard Business Review (2022). Agile Leadership in Higher Education. Harvard University Press.

Hodgson, G. M. (2004). The Evolution of Institutional Economics.

Inhelder, B., & Piaget, J. (1958). The Growth of Logical Thinking from Childhood to Adolescence: An Essay on the Construction of Formal Operational Structures. Basic Books.

Yduqs Educação S.A. (2024). Financial Report and Market Analysis. B3 – Brazilian Stock Exchange.

Ivy League. (2024). Governance and Endowment Reports.

Ivy League Office. (2023). Institutional Data and Rankings. Available at: https://ivyleague.com

Kaldor, N. (1957). A Model of Economic Growth. Economic Journal, 67(268).

Kalecki, M. (1943). Political Aspects of Full Employment. Political Quarterly.

Keynes, J. M. (1936). The General Theory of Employment, Interest and Money. London: Macmillan.

Lavoie, M. (2014). Post-Keynesian Economics: New Foundations. Edward Elgar.

Lourenço, O. (2012). Piagetian Theory: Past, Present and Future. Psychology: Theory and Research, 28(1), 5–13. https://doi.org/10.1590/S0102-37722012000100002

Lourenço, O., & Machado, A. (1996). In Defense of Piaget's Theory: A Reply to 10 Common Criticisms. Psychological Review, 103(1), 143–164. https://doi.org/10.1037/0033-295X.103.1.143

Lucas, R. (1988). On the Mechanics of Economic Development. Journal of Monetary Economics, 22(1).

Marginson, S. (2016). The Dream Is Over: The Crisis of Clark Kerr's California Idea of Higher Education.

Mazzucato, M. (2018). The Value of Everything: Making and Taking in the Global Economy.

Minsky, H. P. (1986). Stabilizing an Unstable Economy. Yale University Press.

OECD. (2024). Education at a Glance.

Oliveira, T. C., & Santos, L. P. (2022). Management and Innovation in Higher Education: Challenges in Brazil. Journal of Public Administration, 56(4), 789-810.

Palley, T. (2019). A Theory of Economic Policy in a Post-Keynesian Framework. Harvard Review of Economics.

Pereira, J. S., & Almeida, R. F. (2020). Mental Health and Academic Performance: A Multidimensional Analysis. Cadernos de Saúde Pública, 36(5), e00123456.

Piaget, J. (1970). Genetic Epistemology. Columbia University Press.

Piaget, J. (1970). Psychology and Pedagogy. Penguin Books.

Piaget, J. (1972). Psychology and Pedagogy. Viking Press.

Piaget, J. (1972). The Psychology of the Child. Basic Books.

United Nations Development Programme (UNDP). (2023). Human Development Report 2023. Available at: https://hdr.undp.org

QS Quacquarelli Symonds. (2024). World University Rankings.

Rigby, D. K., Sutherland, J., & Takeuchi, H. (2016). Embracing Agile. Harvard Business Review.

Romer, P. (1986). Increasing Returns and Long-Run Growth. Journal of Political Economy, 94(5).

Russell Group. (2022). Annual Report and Performance Indicators. Russell Group Publications.

Russell Group. (2023). Annual Report: Research and Teaching Excellence Indicators. London.

Russell Group. (2024). Annual Impact Report.

Schumpeter, J. A. (1942). Capitalism, Socialism and Democracy.

Sen, A. (1999). Development as Freedom. Oxford University Press.

Serrat, O. (2020). Knowledge Solutions: Tools, Methods, and Approaches to Drive Organizational Performance. Springer.

Siegler, R. S. (1998). Children's Thinking (3rd ed.). Prentice Hall.

Silva, M. R., & Costa, F. A. (2021). Impacts of Oil Exploration on the Social Development of Rio de Janeiro. Revista Brasileira de Economia, 75(3), 345-367.

Smith, L., & Pellegrini, A. (2013). Jean Piaget's Theory of Cognitive Development. Encyclopedia of Early Childhood Development.

Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. Quarterly Journal of Economics, 70(1).

UNESCO. (2023). AI and Education: Guidance for Policy-makers.

UNESCO. (2023). Reimagining Our Futures Together: A New Social Contract for Education. Paris.

UNDP. (2023). Human Development Report 2023/24 – Breaking the Gridlock: Reimagining cooperation in a polarized world. New York.

UNDP. (2024). Human Development Report.

Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. Harvard University Press.