



# Between Excellence and Sustainability: A Critical and Bibliometric Review with a Neutrosophic Approach to Academic Quality and Financial Health in Chilean Higher Education

Herminia Gavilán<sup>1</sup>, Claudio Ruff<sup>2</sup>, Luis Benites<sup>3</sup>, and Alexis Matheu<sup>4\*</sup>

<sup>1</sup> National University of Trujillo, Doctorado em Ciencias e Ingeniería Peru. [hgavilan@ubo.cl](mailto:hgavilan@ubo.cl)

<sup>2</sup> Bernardo O'Higgins University, Institutional Research Center, Chile. [cruff@ubo.cl](mailto:cruff@ubo.cl)

<sup>3</sup> National University of Trujillo, Peru. [lbenites@gmail.com](mailto:lbenites@gmail.com)

<sup>4</sup> Bernardo O'Higgins University, Institutional Research Center, Chile. [alexis.matheu@ubo.cl](mailto:alexis.matheu@ubo.cl)

**Abstract.** This article develops a critical and bibliometric review of academic quality and financial health in Chilean higher education, within socio-academic contexts in which current Latin American social problems simultaneously jeopardize equitable access, institutional sustainability, and quality standards. The review covers 63 documents indexed in international databases between 2010 and 2025, systematized under a neutrosophic stance detection methodology. The results highlight the risks of high tuition dependence, the positive effects of income diversification, and the relevance of governance, retention, and faculty profiles for financial and academic sustainability. In addition, demographic decline and increased competition emerge as contextual threats. The study integrates neutrosophic triplets (T, I, F) to quantify the degree of consensus, indeterminacy, and contradiction across the literature. The conclusions of the literature review are coherent and consistent with the results of stance detection, which provides validation and formalization of the patterns that already emerged in the state of the art.

**Keywords:** Financial Health, Academic Quality, Higher Education, Free Education, Chile, Institutional Sustainability.

## 1. Introduction

In recent decades, the higher education system has faced increasing challenges in maintaining its academic quality in a context of financial constraints, institutional reforms, and pressures to ensure long-term sustainability. This tension between quality and financing is not exclusive to any particular country, but takes on specific nuances in regions such as Latin America, where higher education systems are highly segmented, heavily dependent on private financing, and display critical structural gaps [1], [26]. Indeed, since the structural reforms implemented in the early 1980s, higher education in Chile has undergone exponential changes in the increase in its coverage, which has brought with it a series of challenges around essential issues, such as those related to ensuring the quality of education and guaranteeing forms of financing that enable social progress based on the values of equity and equality.

In this context, the relationship between academic quality and financial health in higher education institutions (HEIs) has sparked growing interest in both the international literature and public debate. Several studies suggest that educational quality cannot be sustained without adequate financial balance [11], [34], while others warn that the pursuit of profitability can negatively affect the academic

principles and social mission of universities [29]. This duality raises the need for comprehensive analyses that go beyond sectoral approaches and allow us to understand how both dimensions are articulated in different models of university governance and financing.

In the Chilean case, the university system has been characterized by a strong privatization process since the 1980s, an accelerated expansion of enrollment and a growing state intervention through financing mechanisms such as the partial universal free education implemented since 2016 [7], [23]. These transformations have generated new risk and sustainability configurations, especially in non-traditional private universities, which depend heavily on fee collection and lack diversified sources of income [37].

Within this framework, this review seeks to critically examine the existing literature on the structural links between academic quality and financial health in higher education, with a special emphasis on the Chilean context. To this end, it analyzes academic studies that address institutional sustainability, the impact of public policies such as tuition-free tuition, and the use of multivariate methodologies to explore these complex relationships. Furthermore, this article incorporates an innovative methodological approach based on neutrosophic stance detection to explore causal relationships between quality and financial health, complementing the narrative and bibliometric analysis with a theoretical perspective on necessary conditions and critical thresholds.

This article is organized into three parts. The first focuses on defining a conceptual framework associated with the notions of quality, financial health, and institutional sustainability. The second describes the methodology used to conduct the literature review. The third discusses the landscape of comparative public policies and financing models, followed by a thematic review of the main findings from the literature on the interaction between the academic and financial dimensions. The fourth and last part identifies research gaps, proposes future lines of analysis, and makes recommendations for public policy and institutional management.

## **2. Conceptual framework.**

This section develops the concepts necessary to understand the relationship between academic quality and financial health in higher education institutions, also addressing the broader concept of institutional sustainability. These three conceptual axes are closely related, and their articulation is crucial for the design of effective public policies and strategic decision-making at the institutional level.

Academic quality has been defined from various perspectives. According to Harvey and Green [19], it can be understood as excellence, perfection, value for money, transformation, or fitness for purpose. In the contemporary university context, these dimensions converge in a multifactorial vision that encompasses faculty quality, student retention and progression, curricular relevance, research, and institutional infrastructure [25], [8]. In turn, according to Rodríguez [33], the main models for evaluating quality in university education comprise two systemic fields: human resources and capital. In this model, quality has been emphasized based on the demands of the labor and production markets [24]. Other definitions have argued that quality in higher education is related to indicators that reflect users' satisfaction with the educational services provided by university institutions [30]. To this conception of quality, we would add the model that integrates users' own decision, since the variables of prestige and reputation would mediate the options for entering university, understood as a reflection of institutional quality.

In other proposals, it has been suggested that quality is linked to the integrity and harmony of the internal functioning of the institution, based on quality criteria imposed by the internal government of the university, as well as by indicators validated by the academic community. Finally, it has been suggested that quality is the product that arises from the relationship between users (students) and the production of educational and research services [33]. Likewise, based on Ruff et al. [30], the concept of

educational quality is related to the offer of educational services provided by the university, and it is feasible to evaluate it qualitatively based on the degree of satisfaction of the students, as priority actors.

As can be seen, the previous definitions do not refer to financial health as a fundamental pillar of university quality models. In fact, in the Chilean case, there is a certain academic consensus on the need for the Chilean higher education system to have better and more efficient mechanisms to measure and ensure quality, both in institutional management and in the educational services offered by the country's various universities. In this sense, universities have become more complex, in line with the development and diversification of societies, which makes the design of methods and procedures to measure the quality of university institutions even more difficult. Therefore, the challenge lies in creating scientific and holistic procedures for measuring institutional quality, which allow the comprehensive and daily functioning of the different entities that comprise the university to be represented on a standard map and, thus, project its continuous improvement.

In Chile, quality measurement has been strongly influenced by accreditation systems. In fact, the National Accreditation Commission (CNA) uses five criteria: institutional management, undergraduate teaching, graduate teaching, research, and community engagement [8]. Among the most widely used indicators are first-year retention, the percentage of academics with graduate or doctoral degrees, the ratio of students to full-time faculty (FTE), and the availability of infrastructure per student [36].

The literature has indicated that universities with greater investment in academic quality tend to have better results in terms of reputation, retention, employability of their graduates and attraction of resources [11], [28]. Likewise, other research has shown that the combination of an autonomous university government, solid financial health and an efficient management model is a factor that positively affects the quality of educational services provided by institutions [30]. However, it has also been pointed out that these improvements usually require sustained investments, which poses tensions when there is no solid financial base [34].

At this level, financial health acquires a previously undervalued relevance in quality models, given that the financial health of an HEI refers to its ability to meet its financial obligations, maintain stable operations, and make the necessary investments for its solid academic and strategic development over time. Specifically, financial health is measured by indicators such as current liquidity, gross margin, leverage, operating cash flow, and the ratio of fixed assets to total assets [37].

In contexts where self-financing of private universities predominates, such as in Chile, the dependence on tuition revenues and the lack of core funds expose many private universities to high levels of financial vulnerability, especially in the face of demographic declines or regulatory changes [7], [26]. Thus, financial health should not only be assessed from an accounting perspective, but also considering coherence with the educational project and long-term sustainability [11]. Salmi [34] has coined a concept that integrates financial health and quality through the principle of institutional sustainability: this notion articulates academic quality, financial health and strategic governance. Salmi [34] defines it as the capacity of a university to maintain its mission and adapt to changes in the environment without compromising its viability.

Sustainability requires a dynamic balance between three dimensions: (1) academic performance (retention, teaching quality, research), (2) financial health (liquidity, solvency, investment capacity) and (3) governance (planning capacity, accountability and strategic adaptation) [40]. The mismatch between these dimensions can erode institutional legitimacy and jeopardize the continuity of the educational offer [29].

In short, this notion in Chile has recently been incorporated into the evaluation of institutions, particularly in the reports of the Superintendency of Higher Education (SES), which since 2023 classifies universities according to financial risk profiles associated with both accounting and academic variables [37].

### 3. Methodology.

This research adopts a narrative review approach, complemented by an exploratory bibliometric analysis, to critically examine the literature on the relationship between academic quality and financial health in higher education institutions. This methodological combination allows for the integration of qualitative and quantitative approaches, identifies conceptual gaps, and visualizes emerging thematic clusters from the reviewed documents.

#### 3.1 Type of review.

Given the objective of this work—to critically analyze the available literature on the relationship between academic quality and financial health in higher education institutions—a structured narrative review was chosen, with an emphasis on identifying key concepts, methodological approaches, and theoretical gaps. This type of review is advantageous when seeking to integrate knowledge from various disciplines, theoretical approaches, and institutional contexts [2], [12]. Unlike a systematic literature review, a structured narrative review allows for the synthesis of a large body of literature without the formal restrictions of a systematic review. However, it maintains explicit search, selection, and analysis criteria [18]. A combined strategy incorporating thematic, geographical, and methodological criteria was used to narrow down the relevant studies.

#### 3.2 Search strategy and corpus expansion.

The bibliographic search was carried out between April and June 2025 in recognized academic databases such as Scopus, Web of Science, ERIC, Scielo, Redalyc and Google Scholar. Combinations of English and Spanish keywords were used, such as:

**Table 1.** Search criteria.

| English          | Spanish                                               |
|------------------|-------------------------------------------------------|
| Higher education | Sustainability financial ( sustainability financial ) |
| Health financial | education ( higher education )                        |
| Quality academic | Retention ( retention )                               |
| Tipping Policy   |                                                       |
| Retention        |                                                       |
| Governance       | Chili                                                 |

Source: Prepared by the authors.

Filters were applied by year (2010–2025), document type (peer-reviewed articles, institutional reports, and academic books), and thematic relevance. In a second stage, non-academic texts, such as news articles and non-peer-reviewed columns, were excluded. Likewise, studies focusing solely on the financial aspects of HEIs were excluded. In a third stage, bibliographies of key articles were reviewed to identify additional relevant literature using the snowball method [4]. Finally, the final corpus consisted of 63 publications, including scientific articles (46), books and chapters (7), institutional reports (6), and theses or academic papers (4). An analysis matrix was developed in which the following aspects were coded:

**Table 2.** Coding matrix.

|                                                            |
|------------------------------------------------------------|
| Author, year and country                                   |
| Type of study (theoretical/empirical)                      |
| Methodological approach (quantitative, qualitative, mixed) |
| Variables addressed (financial, academic, institutional)   |
| Key contributions and identified gaps                      |

Source: Prepared by the authors.

### 3.3 Bibliometric analysis.

Cooccurrence of key terms was carried out using the VOSviewer software , in order to visually identify thematic clusters and semantic relationships between the most relevant concepts in the reviewed literature.

To this end, the metadata of the 63 selected articles were exported, and a network of terms was constructed based on their frequency of occurrence in titles, abstracts, and keywords. A minimum threshold of three occurrences was established for inclusion in the analysis, and a terminological standardization process was applied to unify synonyms and variants. The result was a bibliometric map composed of five main clusters, color-coded to reflect thematic groupings with high semantic co-occurrence:

- Cluster 1: Multivariate methods (e.g., principal components analysis; HJ-Biplot).
- Cluster 2: Matrix optimization and decomposition (e.g., DEIM, tensor analysis).
- Cluster 3: Supervised prediction (e.g., supervised learning, panel data models).
- Cluster 4: Institutional recommendation and analysis.
- Cluster 5: Academic foundations and assessment (e.g. academic quality, governance).

The generated visualization shows that terms related to advanced statistical techniques occupy a central place, reinforcing the growing importance of multivariate approaches in institutional sustainability studies. It also reveals the existence of subfields that still present poor articulation with each other, confirming the theoretical fragmentation identified in the qualitative analysis.

### 3.4. Neutrosophic Stance detection

Firstly, each of the hypotheses raised was subjected to a stance detection process, from which triplets (T, I, F) were assigned as in [45, 49]:

- **T ( truth-membership )** : proportion of studies that support the causal relationship.
- **I ( indeterminacy-membership )** : proportion of ambiguous, partial or contradictory evidence.
- **F ( falsity-membership )** : proportion of investigations that refute the hypothesis.

This procedure allows the construction of a neutrosophic causal graph [46, 47], where the edges reflect the degree of support, ambiguity, or rejection of each link. In this way, a theoretical prior is generated that serves as a starting point for subsequent theoretical testing. Table 3 presents an initial estimate of how the 18 hypotheses were represented in neutrosophic terms, based on the consensus of the literature analyzed in the 63 documents, subject to refinement with subsequent analyses, the stance detection process was supported by the Manus algorithm [50].

**Table 3.** Neutrosophic representation of the hypotheses

| No. | Hypothesis                                                               | T    | I    | F    |
|-----|--------------------------------------------------------------------------|------|------|------|
| 1   | Greater institutional liquidity improves academic quality.               | 0.7  | 0.2  | 0.1  |
| 2   | Higher academic quality improves financial performance.                  | 0.8  | 0.15 | 0.05 |
| 3   | A heavy reliance on tuition increases financial risk.                    | 0.9  | 0.05 | 0.05 |
| 4   | Income diversification improves financial sustainability.                | 0.85 | 0.1  | 0.05 |
| 5   | The free tuition policy increased access for low-income students.        | 0.6  | 0.3  | 0.1  |
| 6   | The free policy reduced operating margins.                               | 0.65 | 0.25 | 0.1  |
| 7   | Higher retention rates improve financial stability.                      | 0.8  | 0.1  | 0.1  |
| 8   | More teachers with doctorates increase enrollment.                       | 0.3  | 0.3  | 0.4  |
| 9   | Fewer students per teacher improves retention and graduation.            | 0.3  | 0.4  | 0.3  |
| 10  | Greater infrastructure per student improves academic results.            | 0.8  | 0.1  | 0.1  |
| 11  | Strong strategic governance improves academic-financial alignment.       | 0.9  | 0.1  | 0.0  |
| 12  | Using institutional analysis reduces financial risk.                     | 0.6  | 0.3  | 0.1  |
| 13  | Non-traditional private universities are more financially vulnerable.    | 0.8  | 0.1  | 0.1  |
| 14  | Population decline reduces university enrollment.                        | 0.8  | 0.1  | 0.1  |
| 15  | Increased local competition reduces prices and tuition margins.          | 0.7  | 0.2  | 0.1  |
| 16  | Including financial indicators in accreditation improves sustainability. | 0.75 | 0.15 | 0.1  |
| 17  | Academic support programs reduce dropout rates.                          | 0.8  | 0.1  | 0.1  |
| 18  | University-industry collaboration increases income and employability.    | 0.85 | 0.1  | 0.05 |

#### 4. Results of the narrative literature review.

The analysis was organized thematically, allowing the literature to be grouped around five axes: (1) public policies and financing structures in higher education; (2) links between quality and finance; (3) effects of free education; (4) methodological approaches; (5) institutional risk profiles; and (6) tensions between academic and financial logics.

##### 4.1. Public policies and financing structures in higher education.

Higher education financing is a key component for the institutional sustainability of universities. The way systems fund their institutions determines not only their financial strength, but also their ability to maintain academic quality, promote equity, and respond to social demands.

A comparison of university funding models shows that OECD countries use a variety of public and private funding schemes to support their university systems, combining direct subsidies to institutions, student aid, scholarships, and loans. While in countries such as Norway or Finland, higher education is entirely state-funded, in systems such as the United States or the United Kingdom, mixed funding predominates, with high fees and student loan schemes [27], [20]. Thus, three main funding models have been identified [35], [34]:

- **Basal model of public financing**, based on direct allocations according to enrollment, strategic careers or results;
- **Competitive model**, which provides resources through calls for innovation, research or institutional improvement projects;
- **A student-centered funding model**, where money follows the student through scholarships or loans.

Several studies have suggested that the most resilient systems combine these mechanisms in a balanced way, ensuring sustainability and long-term planning capacity [11]. At the same time, the literature warns that systems with excessive dependence on self-financing tend to reproduce inequalities, generate pressure on quality, and increase student debt levels [22], [28]. In this sense, these previously mentioned ideal models are, in practice, intertwined in the Latin American region. To understand the financing mechanisms, it is necessary to examine the historical trajectory of universities in the region.

At the beginning of the 1980s, a new type of non-university higher education institutions emerged in the region, with a more markedly vocational-labor tendency, with low or no academic selectivity, intensive in the use of hourly teachers, and which together promote mass enrollment, serving students from the lower and upper middle groups of society [24].

The creation of these types of institutions has diversified the methods of financing higher education. In this sense, the co-participation system has contributed to the two-way intervention of state higher education financing policy. On the one hand, the state subsidizes enrollment demand (i.e., students); on the other, it can subsidize universities, thereby injecting them with funds to promote development, research, and innovation.

Regarding the first form of subsidy (demand-based subsidy), the 2016 education reform in Chile implemented free access to higher education by subsidizing demand for lower-income sectors. This reform transfers the cost of university tuition, previously borne by families, to the state. However, the fiscal expenditure allocated to subsidize tuition and monthly fees for 789,000 students who benefited from free education has affected the allocation of state resources for the promotion and development of research. Furthermore, of the total number of beneficiaries of free education, 68,776 have lost the benefit due to dropping out, resulting in the loss of the state's investment [36].

The introduction of free tuition in the Chilean university system has generated a complex transition from the State as a welfare agent to a benefactor, which has introduced a new agent into the education market. In the particular case of Chile, the majority of undergraduate students enroll in private universities, with resources from their own families, as well as from government and private loans. In short, the long-term consequences of free tuition are still uncertain (with regard to the education market and free education).

The example of Chile's free education policy shows how universities find themselves between the market and the State. In this sense, for Brunner [5], the phenomenon of diverse financing evidences a form of academic capitalism: a concept that explains "university activity" linked to markets, to the income obtained through commercial channels and, in general, to the economic valuation of knowledge products and services [24]. Thus, universities in Latin America have had to sell their educational services as a form of self-financing, becoming organizations that generate income from the sale of knowledge products (Wheaton, 2002. Cit., [24]). Likewise, HEIs seek to attract public and private resources through competitive funds for quality initiatives, which allow the development of research in its different facets.

According to recent OECD figures, Latin America is one of the continents where the United States spends the least on education compared to the rest of the organization's member countries. Specifically, Chile is one of the countries that has most diversified its financing options, to "balance the presence of various models: negotiated, input-based, outcome-based, and quality-based" [17, p. 76]. This phenomenon of diversification in financing methods has led to the expansion of university offerings occurring primarily through the market and civil society (i.e., private institutions) rather than the State: the latter has maintained its old institutions, and, in the Chilean case, the State has recently created only two institutions (the Universities of Aysén and O'Higgins in 2015). In contrast, since the General University Law of 1981, there has been a growing expansion of private universities and technical training centers (CFTs).

In Chile, most HEI resources are private, and most undergraduate students enroll in private universities and vocational training centers to better integrate into the labor market [24]. The Chilean university system has undergone a complex and contradictory process of expansion, privatization, and recentralization of funding. Since the 1981 reform, the creation of private institutions, many of them for-profit, has been promoted, generating an exponential increase in enrollment without an equivalent correlation in public investment [5].

For decades, university funding in Chile has relied on tuition fees paid by families, supplemented by targeted state scholarships and the controversial Public Credit (CAE), introduced in 2005. This instrument has been harshly criticized for its high financial costs and its impact on youth indebtedness, with more than 350,000 people still carrying active debt by 2023.

In 2016, free university tuition was implemented, initially for students in the most vulnerable 50% of the population and progressively extended to 60%. This measure entailed a structural change in the financing logic, replacing individual payments with direct state transfers to accredited non-profit institutions [23], [37].

However, free education has generated ambivalent effects. On the one hand, it has improved access and reduced the financial burden for thousands of students. On the other hand, it has generated excessive pressure on institutional budgets, particularly in universities with less revenue diversification. According to the report of the Superintendency of Higher Education [37], many universities face difficulties maintaining their operations with the amounts transferred for free tuition, which do not cover all operating costs or consider territorial or disciplinary differences.

At the same time, a reform of the financing system is currently being debated through the creation of the Higher Education Financing Funds (FES), the objective of which is to replace the CAE with a mixed system that includes partial debt forgiveness, co-payments, and subsidies. This proposal has raised concerns among private institutions that rely on tuition fees as their primary source of income, due to the risk of structural underfunding.

These challenges are aggravated by the projected demographic decline, which anticipates a sustained reduction in university enrollment by 2035. According to recent data, 28 of the 58 Chilean universities present levels of financial risk, with greater emphasis among non-traditional private universities [37], [7].

This background reveals that the Chilean system faces a structural tension between quality, equity, and financial sustainability, reinforcing the need for research that integrates academic, financial, and contextual variables to guide public policy.

#### **4.2 Relationship between academic quality and financial performance.**

Numerous studies agree that there is a structural interdependence between the academic quality of an institution and its financial performance [34], [11], [25]. The logic is recursive: universities with better infrastructure, qualified faculty and student support programs tend to attract higher enrollment, improve their retention rates and access competitive funding, thus strengthening their financial position [28], [40].

In contrast, financially vulnerable institutions tend to cut programs, limit recruitment, or reduce investment in research and teaching, which can lead to a progressive deterioration of their quality and reputation. This dynamic has been documented in various contexts, such as in the United Kingdom after the 2010 reforms [10], in state universities in the United States [44], and in Latin American systems where funding is segmented and regressive [22], [6].

Studies such as those by Marginson [29] highlight the importance of considering academic indicators as explanatory variables of institutional financial performance. In particular, the retention rate, the number of students per professor, and the percentage of academics with a doctorate are emerging as relevant factors for projecting sustainability. Likewise, Kehm [21] suggests that the

relationship between academic quality and financial performance would vary depending on the type of university financing model. For example, public universities with results-based financing systems, such as those that use academic quality criteria to determine resources, tend to be more aligned with optimizing financial performance.

From another perspective, Greenhalgh et al. [18] postulate that competition in the education market is key when measuring quality and financial performance. The authors determine that educational institutions that maintain high levels of academic quality and teaching standards can attract more national and international students, which translates into higher tuition revenues. This competitiveness can also influence long-term financial stability.

While the contribution of Greenhalgh et al. [18] is significant, we consider their analysis to be focused on the US case, given that donations and philanthropy do, in fact, determine a significant financial contribution. However, in the Chilean case, given the prevalence of self-financing and state support, acquiring status to attract donations and philanthropy is a method far removed from the local reality. Nevertheless, Brunner's [5] study on the Chilean case showed that universities with strong educational quality not only achieved better academic results, but also more efficient financial management. Investment in research, improved student performance, and educational innovation increased alternative sources of income (such as scholarships, research projects, and corporate alliances).

#### **4.3. Impact of state funding on quality and financial health.**

The implementation of direct state funding programs, such as free tuition, has had mixed effects across countries. In Germany, the reintroduction of free tuition in 2014 led to increased tuition and financial relief for families, with no clear evidence of a decline in academic quality [9]. In contrast, in South Africa, the funding program has been criticized for its limited impact on equity and for creating budgetary strains [42].

In the Chilean case, studies indicate that free tuition has improved access for vulnerable students, but has generated significant budgetary pressures, especially in universities with low income diversification [23], [37]. The lack of core funding and the absence of territorial adjustments in the state transfer have been widely criticized.

Ruff et al. [32] show that, in Chile, free tuition has served as a financial stabilization factor in public and affiliated institutions. However, it has not been sufficient to reverse structural vulnerabilities. Unaffiliated universities, mainly private, have more volatile financial trajectories, high levels of debt, and dependence on the financial system.

#### **4.4. Use of multivariate techniques.**

Another theme that emerged in the literature review was the use of multivariate techniques to analyze the interaction between quality variables and financial health. Multivariate analysis has become increasingly relevant in studies on institutional sustainability, as it allows the integration of multiple academic and financial variables into robust explanatory models [3]. Therefore, principal component analysis (PCA) has been used to reduce the dimensionality of complex data sets and generate synthetic indices of institutional quality or risk.

Likewise, Ruff et al. [32] have applied the dynamic HJ-Biplot, which allows to visualize universities and indicators simultaneously in a factorial space, representing temporal trajectories. On the other hand, another procedure used is the regression models for panel data (fixed effects, random effects), which allow to estimate causal relationships between academic and financial variables, controlling for unobservable individual effects [43], [37].

In recent studies in Chile, these techniques have shown that variables such as retention, infrastructure per student and the proportion of teachers with postgraduate degrees significantly explain financial indicators such as liquidity, leverage and gross margin [32], [7].

#### **4.5. Types of institutional risk.**

The literature has developed various institutional risk classifications that combine financial, academic, and governance dimensions. In the European context, the EUA proposed a typology based on financial autonomy, size, and revenue diversification [11]. In Latin America, studies by Ganga et al. [14] have classified HEIs according to levels of structural vulnerability. On the other hand, in Chile, the Superintendency of Higher Education has created risk profiles based on six financial indicators: leverage, liquidity, cash flow, gross margin, fixed assets, and fee dependence [37]. These classifications have been used to prioritize supervision, but they do not yet systematically incorporate academic variables.

Recent studies propose integrating cluster models with discriminant analysis to define sustainability typologies, which allow guiding differentiated policies according to the type of institution, location, size or business model [32].

#### **4.6. Tensions between academic and financial logics.**

A recurring theme in critical literature is the tension between academic logics (focused on training and research) and financial logics (oriented toward efficiency and profitability). This dichotomy has been the subject of numerous studies that warn about the risks of the commercialization of higher education [15], [38].

In Chile, Ruff et al. [31] have documented how this tension manifests itself in the CRUCH regional institutions. Despite having good academic indicators and a high social value, they face persistent financial weakness due to a lack of basic funding and dependence on tuition fees. In this sense, Ruff et al. [31] demonstrate that there is no linear relationship between the perception of quality and financial strength, indicating that institutional evaluation frameworks should incorporate indicators that reflect strategic coherence, not just economic performance.

#### **4.7. Bibliometric analysis of co-occurrence of key terms.**

The bibliometric analysis performed allows us to visualize the main semantic and thematic connections in the literature on academic quality and financial health in higher education between 2010 and 2025. Using the key term co-occurrence technique and the VOSviewer software, five distinct thematic clusters were identified, reflecting different analytical approaches in the specialized literature. For this new version of the map, the main authors and the most cited publication years in each cluster were incorporated to enrich the interpretation of conceptual trajectories.

Mapa bibliométrico sobre calidad académica y salud financiera (2010–2025)

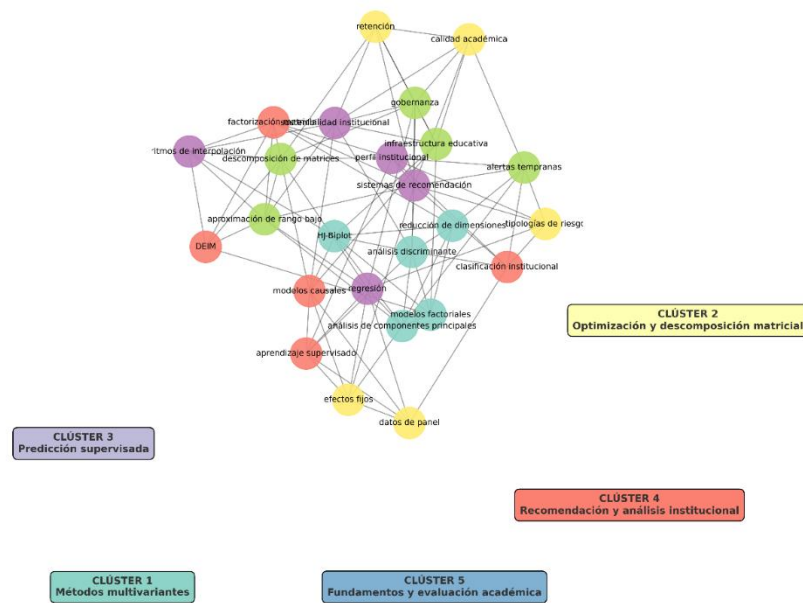


Figure 1. Field of Multivariate Methods.

As can be seen in Figure 1, the field of multivariate methods (water green) is composed of a group of works focused on complex statistical techniques applied to higher education, such as principal components analysis, factor models, discriminant analysis and HJ-Biplot. It is worth noting that authors such as Vapnik [41] have argued that modeling the relationships between academic and financial variables is key to the analysis. This group reflects an emerging trend to use robust tools to reduce the complexity of institutional data and facilitate strategic decision-making.

The second group selected for the field of optimization and matrix decomposition (yellow) focuses on studies that address computational techniques such as matrix decomposition, interpolation of incomplete data, and optimization applied to institutional sustainability. Contributions such as those of Golub and Kahan [16] or Tibshirani [39] are recognized, fundamental for the structural analysis of large databases in education. These approaches allow for the construction of more precise institutional typologies, the identification of risk profiles, and the projection of financial scenarios.

The third group refers to supervised prediction (purple) and is composed of works that apply predictive models to anticipate variables such as student retention, school dropout, or financial viability. The main authors supporting prediction are Hong et al. (2020) and Fowlkes et al. [13], who have proposed prediction models based on supervised algorithms applicable to the educational reality. This group points to a literature oriented towards the development of early warning systems and automated recommendations for university management.

Cluster 4 corresponds to institutional recommendations and analyses (red) and includes studies on institutional recommendation systems, classification, and university governance. The rationale for this cluster is associated with the need to improve the segmentation of public policies and design differentiated strategies for state intervention.

Cluster 5: Academic Foundations and Assessment (light blue): This cluster encompasses studies that address academic quality from a holistic perspective, integrating variables such as governance, infrastructure, institutional profile, and retention. It links the assessment of academic outcomes with financial and mission criteria, articulating traditional quality assurance variables with emerging dimensions of sustainability.

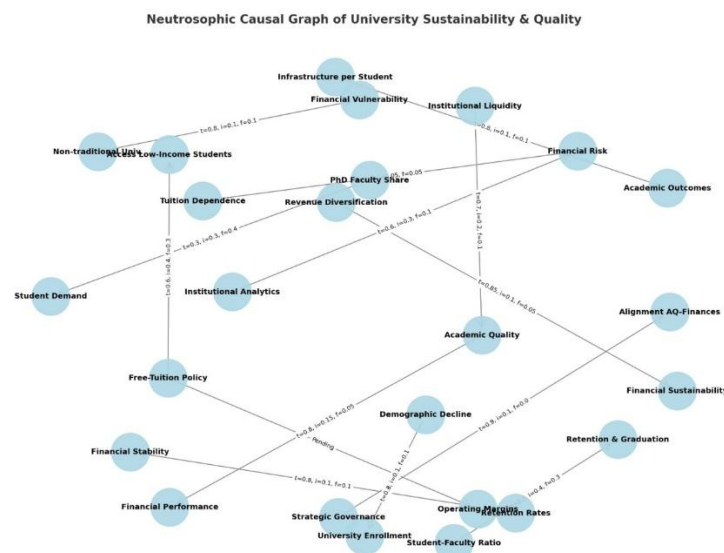
The new visualization of the bibliometric map (Figure 1) allows for a clearer identification of the relationships between methodological approaches and substantive research areas. It confirms the existence of subfields that are poorly articulated, reinforcing the diagnosis of theoretical fragmentation indicated in the narrative review. In particular, it is observed that studies focused on prediction and optimization maintain little connection with those addressing traditional academic evaluation, suggesting the need for greater integration between empirical approaches and regulatory frameworks.

In short, the bibliometric map not only highlights the methodological diversity within the field of study but also offers a roadmap for future work seeking to integrate financial health, academic quality, and institutional governance into more comprehensive analytical models.

#### 4.8 Results from the literature neutrosophic stance detection

Neutrosophic triplets (t, i, f), based on scientific research, reflect the degree of support, indeterminacy, and contradiction in the literature for the following hypotheses:

- **High support (t > 0.8) :**
  - Higher academic quality improves financial performance (t=0.8, i=0.15, f=0.05).
  - Income diversification improves financial sustainability (t=0.85, i=0.1, f=0.05).
  - High dependence on tuition increases financial risk (t=0.9, i=0.05, f=0.05).
  - Strong strategic governance improves quality-finance alignment (t=0.9, i=0.1, f=0.0).
  - Greater infrastructure per student improves academic results (t=0.8, i=0.1, f=0.1).
  - Higher retention rates improve financial stability (t=0.8, i=0.1, f=0.1).
  - Demographic decline reduces enrollment (t=0.8, i=0.1, f=0.1).
  - Non-traditional private universities are more financially vulnerable (t=0.8, i=0.1, f=0.1).
- **Moderate support (t ≈ 0.6-0.7) :**
  - Greater institutional liquidity improves academic quality (t=0.7, i=0.2, f=0.1).
  - Using multivariate analysis reduces financial risk (t=0.6, i=0.3, f=0.1).
- **Mixed evidence (i > 0.3) :**
  - Chilean free tuition policy increased access for low-income students (t=0.6, i=0.4, f=0.3).
  - Lower student-teacher ratio improves retention and graduation (t=0.3, i=0.4, f=0.3).
  - A higher proportion of teachers with PhDs increases student demand (t=0.3, i=0.3, f=0.4).



**Figure 2.** Neutrosophic (prior) causal graph derived from stance literature detection.

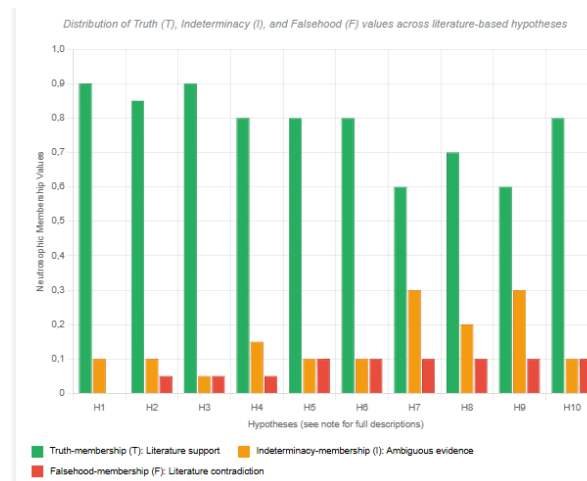


Figure 3. Neutrosophic Stance Detection Results for Key Hypotheses

The derived neutrosophic prior suggests strong support for institutional and financial factors (governance, diversification), with significant uncertainty in the effects of public policies and institutional ratios, aligning with the themes of interdependence and gratuity identified in the review.

## 5. Discussion.

Despite the growing interest in understanding the relationship between academic quality and financial health in higher education institutions, a review of the literature reveals multiple research gaps, both internationally and, especially, in the Chilean context. Many studies analyze the financial or academic performance of universities separately, without incorporating integrated models that explore their structural interaction. While it is recognized that both dimensions are interdependent (Salmi, 2009; Marginson, 2011), a fragmentation in theoretical approaches persists. Only a fraction of the literature proposes conceptual frameworks that articulate financial sustainability, academic quality and institutional governance (Estermann, Nokkala & Steinel, 2011; Vught & Ziegele, 2012). The theoretical results of the neutrosophic analysis confirm this fragmentation, showing a high consensus ( $t=0.9$ ) in the literature on the importance of strong strategic governance for the alignment between both dimensions, while factors such as the free tuition policy exhibit mixed evidence ( $t=0.6$ ,  $i=0.3$ ,  $f=0.1$ ), suggesting the need for more integrative frameworks.

Empirical work applying multivariate methodologies to longitudinal data is still scarce, especially in Latin America. Most available research uses descriptive, correlational, or single-case analyses, without taking advantage of the explanatory potential of techniques such as fixed-effects regression, discriminant analysis, or dynamic biplots. Furthermore, there is a lack of systematization in comparable databases that integrate financial, academic, and contextual variables, which hampers the replication and comparison of findings.

One of the most important empirical problems regarding quality and financial health variables in higher education is the analysis of the impact of public policies, such as free tuition, primarily from the perspective of access and equity. However, few studies analyze their effect on institutional financial sustainability and its link to academic quality. The literature on Chilean higher education reveals a notable absence of analyses linking these dimensions in causal or predictive models. Neutrosophic findings corroborate this gap, showing moderate support ( $t = 0.6$ ) and high indeterminacy ( $i = 0.3$ ) in the impact of free tuition on access, with theoretical estimates suggesting a conditional effect on operating margins ( $t = 0.65$ ,  $i = 0.25$ ,  $f = 0.1$ ), highlighting the need for more robust causal research.

Regarding quality assurance frameworks, publications tend to consider institutional financing as a complementary or external aspect, without integrating it as an evaluable dimension. This perspective has been criticized by several authors who propose a more holistic approach to quality, where economic viability is considered part of the educational mission. Furthermore, in Chile, the CAN (National University of Chile) has not systematically incorporated financial indicators into its accreditation criteria, and the Superintendency of Higher Education has focused its monitoring on accounting aspects without articulating them with academic quality assessments (SES, 2023). Theoretical results support this criticism, identifying the inclusion of financial indicators in accreditation as a necessary factor (theoretical consistency 0.932,  $t$  estimate = 0.75), suggesting its potential to improve sustainability without affecting quality.

Finally, there is a clear marginalization and underrepresentation of non-traditional private universities in existing studies, despite the fact that they account for the largest proportion of enrollment nationwide and present higher levels of vulnerability. Most studies focus on CRUCH or state universities, leaving a critical part of the system unanalyzed in terms of risk and sustainability (Brunner et al., 2021). Neutrosophic analysis confirms this vulnerability with a high consensus ( $t=0.8$ ), while enrollment dependence as a risk factor ( $t=0.9$ ) underscores the need to include these institutions in future analyses.

In addition to the aforementioned background information, a bibliometric analysis revealed the existence of five distinct thematic clusters in the literature, with little articulation between technical approaches such as supervised prediction or matrix decomposition, and more traditional approaches to academic assessment. This methodological fragmentation confirms the need for integrative frameworks that combine multivariate models, institutional analysis, and quality measurement in decision-making. The results of this study, , offer an initial step toward such integration, highlighting the interdependence between financial and academic variables ( $t = 0.8$  for quality and finance), the mixed impacts of free tuition ( $t = 0.6$ ), the relevance of multivariate methods, the exclusion of financial indicators in accreditation ( $t = 0.75$ ), and the vulnerability of non-traditional private universities ( $t = 0.8$ ) as priority axes for future research.

## 6. Conclusions.

This critical review has allowed us to systematize and analyze a wide range of national and international studies on the relationship between academic quality and financial health in higher education institutions, with a special emphasis on the Chilean case. The analysis confirms that this relationship is structural, bidirectional, and highly dependent on the institutional context and public policy. The theoretical results of the neutrosophic analysis support this confirmation, showing a high consensus ( $t = 0.8$ ) in the literature on the improvement of financial performance with higher academic quality, and moderate support ( $t = 0.6$ ) with high indeterminacy ( $i = 0.3$ ) regarding the impact of free tuition, reflecting its contextual dependence.

The findings of this review identify not only gaps in the literature but also strategic opportunities to guide new research and public policies that articulate academic quality, financial health, and institutional sustainability in higher education. Indeed, one of the main issues that needs to be addressed is the development of conceptual frameworks that integrate academic, financial, and governance variables, adapted to the Latin American context. These models must overcome the dichotomy between quality and finance, recognizing their functional and strategic interdependence. In turn, longitudinal studies with multivariate techniques are needed to expand the use of integrated data, dynamic factor analysis, and techniques such as HJ-Biplot, fixed effects regressions, and discriminant analysis, in order to observe institutional trajectories and generate risk typologies that can inform differential policies.

The literature review revealed a lack of studies focused on demographic factors, the digital transition, and territorial gaps in a highly centralized country. Therefore, it is recommended to promote open data platforms that integrate financial, academic, and outcomes information to support comparative research and enable better decision-making by institutions. Importantly, the data and information gathered through this research could support a proposal to reform Chile's institutional financing system, as the current reliance on tuition fees and transfers for free education is insufficient for many institutions. These institutions face a dilemma between financial sustainability and the need to improve quality standards (Brunner et al., 2021). For example, regional and private universities are critical for access to higher education, but they carry significant risks. Consequently, the State should consider transitional support schemes that depend on institutional improvement plans, as observed in Europe. Neutrosophic analysis confirms the vulnerability of non-traditional private universities ( $t=0.8$ ) and the high dependence on tuition as a risk ( $t=0.9$ ), supporting the need for these transitional schemes.

Consequently, the CNA and the SES must develop evaluation models that incorporate financial health as a quality dimension, beyond simple accounting compliance. This entails creating indicators that link financial management with academic results and institutional coherence. It is also important to establish institutional and governmental mechanisms that detect early warning signs in academic or financial variables, allowing preventive measures to be taken before intervention or closure becomes necessary. The theoretical results suggest that including financial indicators in accreditation ( $t = 0.75$ ) could be a necessary factor, reinforcing the proposal for a more holistic approach.

Research shows that academic quality cannot be maintained without a solid financial foundation. On the contrary, an institution's financial health depends primarily on its ability to offer quality programs, retain students, and build a reputation for excellence. This interdependence presents significant challenges in systems like Chile's, where the funding model has historically relied on tuition payments and, more recently, on a free tuition program with operational limitations and incomplete coverage.

The literature highlights notable advances in the use of multivariate techniques to explore this relationship, as well as in the development of institutional typologies that classify universities according to their levels of risk or sustainability. However, significant gaps remain, particularly in the theoretical integration of these dimensions, the availability of comparable databases, and the development of longitudinal studies to understand institutional trajectories over time.

Meanwhile, the bibliometric analysis indicates that the literature focuses on five poorly interconnected methodological groups, which hinders the development of a comprehensive understanding of university sustainability. Therefore, it is advisable to promote interdisciplinary research that combines advanced statistical methods, institutional analysis, and quality theory to strengthen the link between empirical evidence and policy development. The results reinforce this recommendation by highlighting the relevance of multivariate methods and the need to address uncertainty in factors such as free tuition ( $i=0.3$ ).

In conclusion, from a public policy perspective, this review emphasizes the need to design more balanced financing mechanisms that guarantee not only access but also the quality and sustainability of the system's institutions. It also underscores the urgency of moving toward more comprehensive quality assurance models that explicitly incorporate financial sustainability into their evaluation criteria. The theoretical findings, with a high consensus on governance ( $t = 0.9$ ) and diversification ( $t = 0.85$ ), support these priorities, suggesting that policies based on these factors could mitigate institutional vulnerability ( $t = 0.8$  in non-traditional private institutions).

## 7. References.

- [1] Altbach, P.G.; Reisberg, L.; Rumbley, L.E. Trends in Global Higher Education: Tracking an Academic Revolution; UNESCO: Paris, France, 2009.
- [2] Baumeister, R.F.; Leary, M.R. Writing narrative literature reviews. *J. Gen. Psychol.* 1997, 1, 311–320. <https://doi.org/10.1037/1089-2680.1.3.311>
- [3] Bollen, K.A. Structural Equations with Latent Variables; Wiley: New York, NY, USA, 1989.
- [4] Booth, A.; Sutton, A.; Papaioannou, D. Systematic Approaches to a Successful Literature Review, 2nd ed.; Sage: London, UK, 2016.
- [5] Brunner, J.J. Higher Education: Government Institutions, Markets and Policies; Faculty of Letters, Leiden University: Leiden, The Netherlands, 2009.
- [6] Brunner, J.; Labraña, J.; Álvarez, J. Comparative financing of higher education in Chile with a focus on technical and vocational education. *Policy Focus* 2015, 10.
- [7] Brunner, J.; Labraña, J.; Rodríguez-Ponce, E.; Ganga, F. Circulation and reception of the theory of “Academic Capitalism” in Latin America. In *Approaches to the Sociology and Political Economy of Higher Education: Approximations to Academic Capitalism in Latin America*; Brunner, J., Salmi, J., Labraña, J., Eds.; Digital Education Collection: Santiago, Chile, 2021; pp. 21–71.
- [8] CNA. Institutional Accreditation Criteria 2022; National Accreditation Commission: Santiago, Chile, 2022.
- [9] Dietrich, H.; Gerner, H.-D. The effects of tuition fees on the decision to pursue higher education: Evidence from a German policy experiment. *Econ. Bull.* 2012, 32, 2115–2125.
- [10] Deem, R.; Brehony, K.J. Management as ideology: The case of the “new managerialism” in higher education. *Oxf. Rev. Educ.* 2005, 31, 217–235. <https://doi.org/10.1080/03054980500117827>
- [11] Estermann, T.; Nokkala, T.; Steinel, M. University Autonomy in Europe II: The Scorecard; EUA: Brussels, Belgium, 2011.
- [12] Ferrari, R. Writing narrative style literature reviews. *Med. Writ.* 2015, 24, 230–235. <https://doi.org/10.1179/2047480615Z.000000000329>
- [13] Fowlkes, E.B.; Gnanadesikan, R.; Kettenring, J.R. Variable selection in clustering. *J. Classif.* 1988, 5, 205–228. <https://doi.org/10.1007/BF01897164>
- [14] Ganga-Fontes, S.; Muñoz, F.; Ganga, J.M. Governance, government and management of higher education. *J. High. Educ. Soc.* 2024, 36, 16–21.
- [15] Giroux, H.A. Neoliberalism in Higher Education; Haymarket Books: Chicago, IL, USA, 2014.
- [16] Golub, G.G.; Kahan, W. Computation of the singular values and pseudoinverse of a matrix. *SIAM J. Numer. Anal. Ser. B* 1965, 2, 205–224. <https://doi.org/10.1137/0702016>
- [17] Guadilla, C. Financing of higher education in Latin America. *Sociology* 2007, 9, 50–101.
- [18] Greenhalgh, T.; Thorne, S.; Malterud, K. Time to challenge the false hierarchy of systematic reviews over narratives? *Eur. J. Clin. Investig.* 2018, 48, e12931. <https://doi.org/10.1111/eci.12931>
- [19] Harvey, L.; Green, D. Definition of quality. *Assess. Eval. High. Educ.* 1993, 18, 9–34. <https://doi.org/10.1080/0260293930180102>
- [20] Johnstone, D.B.; Marcucci, P.N. Global Higher Education Financing: Who Pays? Who Should Pay?; Johns Hopkins University Press: Baltimore, MD, USA, 2010. <https://doi.org/10.56021/9780801894572>
- [21] Kehm, B.M. Higher education as a field of study and research in Europe. *Eur. J. Educ.* 2014, 49, 217–232. <https://doi.org/10.1111/ejed.12100>
- [22] Levy, D.C. Higher Education and the State in Latin America; University of Chicago Press: Chicago, IL, USA, 1986.
- [23] Meller, P. Policy and Financing of Higher Education in Chile; RIL Publishers: Santiago, Chile, 2018.
- [24] Pedraja-Rejas, L.; Rodríguez-Ponce, E.; Bernasconi, A.; Muñoz-Fritis, C. Leadership in higher education institutions: An analysis through Bibliometrix R. *Ingeniare.* 2021, 29, 472–486. <https://doi.org/10.4067/S0718-33052021000300472>
- [25] OECD. Education at a Glance 2019: OECD Indicators; OECD Publishing: Paris, France, 2019. <https://doi.org/10.1787/f8d7880d-en>
- [26] OECD. Tertiary Education for Sustainable Development; OECD Publishing: Paris, France, 2021.
- [27] OECD. Education at a Glance 2023: OECD Indicators; OECD Publishing: Paris, France, 2023.

- [28] Marginson, S. Higher education and the public good. *High. Educ. Q.* 2011, 65, 411–433. <https://doi.org/10.1111/j.1468-2273.2011.00496.x>
- [29] Marginson, S. The global trend towards high-participation higher education: Dynamics of social stratification in inclusive systems. *High. Educ.* 2016, 72, 413–434. <https://doi.org/10.1007/s10734-016-0016-x>
- [30] Ruff, C.; Ruíz, M.; Matheu, A.; Juica, P. Analysis of mixed financing policies in higher education and their effects on social mobility and research: The case of Chile. *Gest. Polít. Pública* 2020, 29.
- [31] Ruff, C.; Gavilán, H.; Vassileva, J.; Gutiérrez, B. Structural equilibrium in universities: Quality, finance and sustainability from an empirical perspective: An integrative analysis with neutrosophic cognitive maps. *Neutrosophic Sets Syst.* 2025, 90, 2331–2365.
- [32] Ruff, C.; Matheu, A.; Ruíz, M.; Juica, P.; Gómez, M. Cost-free education as a new variable of mixed financing policies in Chilean higher education and its impact on student trajectory and social mobility. *Heliyon* 2023, 9, e16372.
- [33] Rodríguez-Ponce, E.R.; Pedraja-Rejas, L.M.; Ganga-Contreras, F.A.; Ferrer, R. Institutional learning in universities: A theoretical model. *Univ. Form.* 2024, 17, 15–24. <https://doi.org/10.4067/S0718-50062024000400015>
- [34] Salmi, J. *The Challenge of Establishing World-Class Universities*; World Bank: Washington, DC, USA, 2009.
- [35] Santiago, P.; Tremblay, K.; Basri, E.; Arnal, E. *Tertiary Education for the Knowledge Society: Volume 1. Special Features: Governance, Funding, Quality*; OECD Publishing: Paris, France, 2008.
- [36] SES. *Annual Report on Retention and Academic Quality*; Superintendency of Higher Education: Quito, Ecuador, 2020.
- [37] SES. *Financial Health in Chilean Higher Education: Exploratory Study 2012–2022*; Superintendency of Higher Education: Santiago, Chile, 2023.
- [38] Slaughter, S.; Rhoades, G. *Academic Capitalism and the New Economy: Markets, the State, and Higher Education*; Johns Hopkins University Press: Baltimore, MD, USA, 2004.
- [39] Tibshirani, R. Regression shrinkage and selection via the lasso method. *J. R. Stat. Soc. Ser. B Methodol.* 1996, 58, 267–288. <https://doi.org/10.1111/j.2517-6161.1996.tb02080.x>
- [40] van Vught, F.A.; Ziegele, F. Multidimensional ranking: The case of university rankings. In *University Rankings, Diversity and the New Landscape of Higher Education*; Springer: Dordrecht, The Netherlands, 2012; pp. 51–78.
- [41] Vapnik, V.N. *The Nature of Statistical Learning Theory*; Springer: New York, NY, USA, 1995.
- [42] Wangenge-Ouma, G.; Cloete, N. South African student finance: NSFAS: A vindication. *J. Educ.* 2008, 44, 7–25.
- [43] Wooldridge, J.M. *Econometric Analysis of Cross Section and Panel Data*, 2nd ed.; MIT Press: Cambridge, MA, USA, 2010.
- [44] Zumeta, W.; Breneman, D.W.; Callan, P.M.; Finney, J.E. *Financing American Higher Education: How It Works, How It's Changing*; Johns Hopkins University Press: Baltimore, MD, USA, 2012.
- [45] Leyva-Vázquez, M.Y.; Smarandache, F. Bridging ancient wisdom and modern logic: Neutrosophic perspectives on body, mind, soul and spirit. *Neutrosophic Sets Syst.* 2025, 82, 7.
- [46] Ragin, C.C. *Redesigning Social Inquiry: Fuzzy Sets and Beyond*; University of Chicago Press: Chicago, IL, USA, 2008.
- [47] Dul, J. Necessary condition analysis (NCA): Logic and methodology of “necessary but not sufficient” causality. *Organ. Res. Methods* 2016, 19, 10–52.
- [48] Smarandache, F.; Ali, M. Neutrosophic triplet group. *Neutrosophic Sets Syst.* 2015, 8, 50–54.
- [49] Avilés-Monroy, J.I.; García-Arias, P.M.; Cun-Laines, E.P.; Zorrilla-Baquero, D.F.; Espinoza de los Monteros-Enríquez, V.I. Study of the impact of emerging technologies on the conservation of protective forests through the plithogenic hypothesis and neutrosophic stance detection. *Neutrosophic Sets Syst.* 2025, 84, 34.
- [50] Manus Team. Manus. Available online: <https://manus.im> (accessed on 8 July 2025).

Received: June 06, 2025. Accepted: August 09, 2025