

EVALUATION OF THE ACTIVITY-BASED COSTING (ABC) METHOD AS A COSTING TOOL FOR PROGRAM MANAGEMENT IN HIGHER EDUCATION INSTITUTIONS: A SYSTEMATIC REVIEW

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Summary

Introduction. The efficient management of resources in higher education institutions (HEIs) requires costing tools that overcome the limitations of traditional methods. The activity-based costing (ABC) model has been consolidated in sectors such as health, agribusiness and engineering, showing advantages in the precision of cost allocation and in the identification of activities that add or consume value. However, its adoption in the university environment remains limited, despite its strategic potential for the management of academic programs.

Objective. To evaluate the ABC method as a costing tool for program management in higher education institutions, through a systematic review of the literature indexed in Scopus and Web of Science.

Methodology. A systematic review was developed following the guidelines of the PRISMA declaration. A total of 67 articles were identified, of which 12 met the inclusion criteria and were analysed in depth. The purification was due to the fact that a large part of the studies focused on sectors such as medicine and engineering, where the ABC has been more consolidated, although its models offer possibilities of extrapolation to higher education.

Results. The findings show that ABC improves visibility into hidden costs, optimizes margins, and allows for more accurate allocation of resources. Methodological innovations were identified, such as TDABC, integration with life cycle analysis (ABC-LCA), the use of BIM and the incorporation of artificial intelligence, all with the potential to adapt to the university environment. Only one study directly addressed educational institutions, while the others offer transferable models.

Conclusions. The ABC is a viable and strategic tool to strengthen the competitiveness, sustainability and transparency of academic programs in HEIs. It is recommended to promote its progressive adoption, complemented by new technologies, and to promote applied research that consolidates its relevance in university contexts.

Keywords: ACTIVITY-BASED COSTING (ABC), Management accounting, Higher education, Cost management, Academic programs, Systematic review.

1. INTRODUCTION

The effective administration of financial resources in universities has acquired great relevance in the current global context, where there is a need to optimize the use of both public and private funds, ensure the quality of education and comply with the demands of transparency and competitiveness. According to Borges, Alves, and Silva (2024), "one of the recommended management accounting methods for higher education institutions is Activity-Based Costing (ABC)" (p. 19). This observation highlights the growing interest in costing models that manage to more accurately reflect the real expenditures linked to academic training and research. Conventional costing methods, which are based on the general allocation of indirect costs, have relevant limitations, especially in complex institutions where teaching, administrative, research and extension activities

are combined. Ismail (2010) points out that "the application of the ABC technique can lead to a considerable improvement in the information received by university administrators" (p. 40). This emphasizes that traditional costing approaches are no longer adequate to meet the current challenges facing universities.

The ABC model is presented as a mechanism that allows costs to be assigned according to specific activities, providing a clearer and more strategic vision of the resources used. According to Hashim (2013), "the cost determined through the ABC turned out to be lower than that of the traditional method, evidencing that the latter distorts information within the university environment" (p. 1090). This discovery validates that the implementation of the ABC is not simply a methodological trend, but a practical necessity in the educational field.

At the European level, Klaus-Rosińska and Kowalski (2018) state that "it is imperative to seek solutions based on cost management, where activity-based costing (ABC) plays a crucial role in higher education institutions" (p. 51). Their study showed that the ABC facilitates the more accurate identification of areas of expenditure in college education, which in turn improves the basis for both academic and financial decision-making.

The specialized literature indicates that the ABC approach offers strategic advantages for analyzing hidden costs. Gaidule-Logina and Zvirbule (2017) highlight that "the ABC method can assist educational institutions in obtaining detailed cost data and in identifying possible hidden costs of which they were not previously aware" (p. 324). This contribution is essential for universities that seek greater sustainability and efficiency in the management of their programs.

However, there are also obstacles in the adoption of this system. Abu-Tapanjeh (2009) mentions that "the ABC is a system that facilitates the monitoring of the costs generated by each activity according to its demand or frequency, but it has limitations in environments where the products are not clearly defined" (p. 77). This observation highlights one of the main difficulties in adapting the ABC method in non-profit entities, where the results are not always evident in monetary terms.

Another crucial point is provided by Roztocki (2001), who indicates that "the ABC approach examines a part of the course as a basic service and identifies the indirect activities related to its planning, development and delivery, and then assigns cost drivers that reflect the actual use of resources" (p. 13). This focus on academic courses shows how ABC can be used to improve budget distribution in higher education.

Notable contributions have also been made in Latin American nations. Rodríguez-López (2021) argues that "the implementation of the ABC in higher education institutions in Latin America not only helps to identify activities that add value, but also highlights those that consume resources without contributing to learning" (p. 87). This perspective favors a more strategic and results-focused university administration.

Likewise, Cokins (2016) has underlined the relevance of integrating activity-based management into university planning, noting that "activity-based management (ABM) is the natural continuation of ABC, and its combination provides a holistic vision to improve processes and increase institutional efficiency" (p. 112). In this way, the conception that the ABC should not be considered as an isolated system, but as part of a broader management strategy, is reinforced.

However, the adoption of ABC requires strong technological backing. As Garrison, Noreen, and Brewer (2018) warn, "the effectiveness of ABC is linked to the ability to systematically collect, process, and analyze detailed data, which requires advanced information systems" (p. 274). This requirement represents a challenge in institutions that do not have a solid digital infrastructure.

Another vital element is internal resistance to change. According to Kaplan and Anderson (2004), "although the ABC offers more accurate cost information, its implementation may face resistance due to the perception of complexity and the adjustments in administrative processes that it entails" (p. 135). This conclusion coincides with experiences in universities where the institutional culture makes it difficult to adopt new management systems.

Despite the existing obstacles, the literature agrees that the ABC facilitates greater financial clarity. Cooper and Kaplan (1992) pointed out from the outset that "activity-based costing helps managers better understand how resources are used, which improves accountability and strategic decision-making" (p. 4). This approach has been relevant in subsequent research and supports the rationale for applying this model in higher education.

Today, the accumulated evidence indicates that the ABC method transcends being a simple accounting technique, since it is presented as a strategic management tool that can assist in accreditation processes, budget allocation and academic planning. As mentioned by Borges et al. (2024), "future research should focus on adapting the ABC to particular educational contexts, ensuring its effectiveness in increasingly complex institutional environments" (p. 35). This consideration underscores the need to conduct studies that organize the model's advances and limitations.

In this context, a systematic review using the PRISMA methodology is particularly pertinent, since it allows identifying patterns in scientific production, analyzing trends, evaluating the main findings, and highlighting areas where there is still a knowledge gap. The objective of this article is to critically evaluate the application

of the ABC method as a costing tool for program management in higher education institutions, offering a comprehensive overview of its development, limitations, and future prospects.

2. General objective

To evaluate the activity-based costing (ABC) method as a management tool for programs in higher education institutions, through a systematic review of the scientific literature indexed in Scopus and Web of Science, in order to identify its benefits, limitations and prospects for application in the academic field.

3. THEORETICAL FRAMEWORK

The management of expenditures in higher education institutions has acquired an increasingly important role as a result of changes in education and budget limitations. According to Cooper and Kaplan (1992), "activity-oriented cost accounting allows managers to have a better understanding of how resources are used, which enhances responsibility and strategic decision-making" (p. 4). In both public and private universities, a correct distribution of resources is closely related to institutional viability and the ability to offer high-quality academic programs.

Conventional costing systems, which are based on the volumetric distribution of overheads, have disadvantages that complicate the real understanding of costs in complex environments. In this regard, Ismail (2010) stresses that "traditional costing systems do not provide sufficient information to make appropriate decisions in higher education institutions, which highlights the need to adopt alternative approaches such as ABC" (p. 40). This highlights that traditional methods are inadequate in the face of the demands of efficiency and transparency in the educational field.

The activity-based costing (ABC) system appeared at the end of the twentieth century as a solution to these limitations. Kaplan and Anderson (2004) define it as "a system created to allocate costs according to the time and resources used in specific activities, providing a more accurate measurement of resource consumption" (p. 135). This approach departs significantly from traditional costing, as it concentrates on value-generating activities and cost drivers that reflect the reality of organizational processes.

The evolution of this model has given rise to variants such as Time-Oriented Activity-Based Costing (TDABC), which facilitates the collection of information. Cokins (2016) mentions that "the inclusion of time as the main variable in costing helps to reduce the complexity of the system while maintaining a high precision in the allocation of resources" (p. 112). This adaptation has proven to be beneficial in educational institutions, where processes can be numerous and difficult to trace.

The use of ABC in higher education institutions has been documented in various scenarios. Hashim (2013), in a study carried out in Malaysia, determined that "the cost calculated using the ABC was lower compared to the conventional method, evidencing distortions in traditional systems" (p. 1090). This discovery illustrates how ABC can increase the accuracy of universities' financial statements.

In Europe, Klaus-Rosińska and Kowalski (2018) formulated a model related to the costs of teaching and pointed out that "it is essential to seek solutions supported by cost management, where ABC has a key role for educational institutions" (p. 51). Their research showed that this system not only optimizes budget control, but also reinforces strategic planning of education.

The benefits of ABC include detecting value-generating activities and identifying those that use resources unnecessarily. According to Rodríguez-López (2021), "the implementation of ABC in Latin American universities helps to identify activities that generate value and those that use resources without contributing to learning" (p. 87). This capability makes the ABC a key tool for directing academic programs toward greater efficiency.

Another significant contribution is their ability to identify hidden costs. Gaidule-Logina and Zvirbulė (2017) state that "the ABC method can be useful for educational institutions by revealing hidden costs that had not been previously recognized" (p. 324). This is especially crucial in universities with complex administrative structures and high indirect costs.

However, the application of ABC also faces important considerations. Abu-Tapanjeh (2009) points out that "ABC has limitations in contexts where products are not clearly defined, which is common in non-profit educational institutions" (p. 77). In addition, resistance to change and lack of technological support can be barriers to its successful implementation.

Kaplan and Anderson (2004) had already argued that "although the ABC offers more accurate information on costs, its adoption may encounter opposition due to the perception of its complexity and the changes in administrative processes it requires" (p. 135). These difficulties indicate that the success of the ABC depends not only on its methodological design, but also on the culture of the university organization.

The literature relates the ABC to strategic management in universities through Activity-Based Management (ABM). Cokins (2016) mentions that "activity-based management (ABM) is the logical extension of ABC, and

together they provide a complete vision to improve processes and increase institutional efficiency" (p. 113). In this way, the ABC is not limited exclusively to accounting issues, but becomes a tool for strategic planning. In this context, Borges, Alves, and Silva (2024) suggest that "future research should focus on adapting the ABC to specific educational settings, ensuring its relevance in scenarios of increasing institutional complexity" (p. 35). Their systematic study shows that there are still great opportunities to enrich knowledge about this model and its uses in higher education.

Thus, the theoretical framework of this study is based on the need to evaluate and systematize the contributions that activity-based costing has offered to the management of programs in university institutions, recognizing its benefits, limitations and strategic potential.

4. METHODOLOGY

The research presented here was carried out following a systematic literature review approach, using as a basis the PRISMA (Preferred Elements for Systematic Review and Meta-Analysis Reporting) methodological guide, with the aim of ensuring a process that is transparent, strict and replicable in the identification, selection and analysis of studies. The focus of the review was on the scientific production documented in the Scopus and Web of Science (WoS) databases, which are recognized for their relevance in high-impact journals and their international reach. The methodology took several stages: the formulation of search strategies, the establishment of criteria for including or excluding studies, the gradual purification of documents and the orderly extraction of information from the chosen articles. In this way, it was intended to create a complete vision of the implementation of the activity-based costing (ABC) method in the field of higher educational institutions, as well as in other sectors whose models can be applied to university academic administration.

4.1 Research design

The research corresponds to a systematic review of the literature developed under the guidelines of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. This approach ensures a rigorous and reproducible process of searching, selecting, analyzing, and synthesizing the available scientific evidence on the use of the ABC method in program management in higher education institutions.

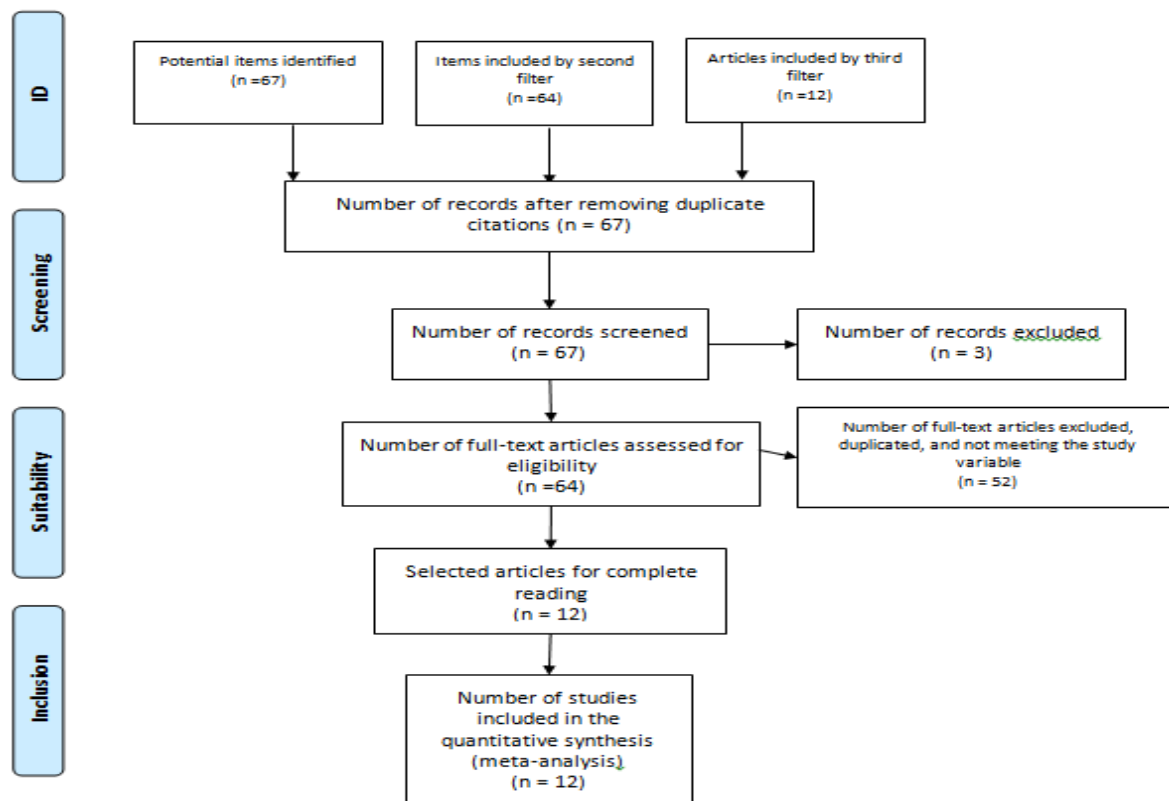


Figure 1. Flowchart of a systematic review carried out under the PRISMA technique (Moher, Liberati, Tetzlaff, Altman, & Group, 2009)

Source: Authors; Based on the proposal of the Prisma Group (Moher, Liberati, Tetzlaff, Altman, & Group, 2009)

4.2 Sources of information and search strategy

The bibliographic search was carried out in two high-impact international databases: Scopus and Web of Science (WoS), since they concentrate publications indexed in reference journals in the areas of management, economics, engineering and social sciences. Combinations of keywords and Boolean operators were used, such as: "Activity-Based Costing", "ABC method", "Higher Education", "Cost management" and "Educational programs".

4.3 Inclusion criteria

- Articles published in scientific journals indexed in Scopus or WoS.
- Studies that explicitly mention the activity-based costing (ABC) method in their design or implementation.
- Publications in English or Spanish.
- Research published between a defined time range (2020-2025)
- Documents with access to full text that would allow detailed analysis.

4.4 Exclusion Criteria

- Documents not indexed in Scopus or WoS (theses, books, chapters, technical reports).
- Articles that, although they mentioned the ABC, did not apply it methodologically in the cost analysis.
- Publications focused exclusively on sectors unrelated to education and without the possibility of conceptual extrapolation (e.g., very specific applications in clinical medicine).
- Duplicate studies between databases.

4.5 Study selection process

In the first phase, 67 publications were identified. After the elimination of duplicates and the application of the inclusion and exclusion criteria, a review was carried out by title, abstract and keywords. The full texts were then reviewed to ensure their relevance to the objective of the review. The process was documented in a PRISMA flowchart, detailing each phase of debugging.

4.6 Search results and justification for the debug

Of the total number of articles identified, a large proportion came from the area of engineering and, especially, from medicine, which reflects the consolidation of the ABC in these sectors rather than in education. As a result, only 12 publications met the requirements for full analysis. Some of these works, although they applied the ABC in sectors other than education, were included because they provided models and frameworks that can be extrapolated and serve as a basis for cost management in academic programs.

5. RESULTS

The following table shows the results after applying the search filters related to the methodology proposed for this research, after recognizing the relevance of each of the referenced works.

No.	RESEARCH TITLE	AUTHOR/YEAR	COUNTRY	TYPE OF STUDY	INDEXING
1	<i>implementation of activity-based costing in laboratory medicine; Implementation of a management control based on activity-based costing in laboratory medicine</i>	Solfanelli, M. (2022).	ITALY	QUALITATIVE	SCOPUS
2	<i>THE ROLE OF COST MANAGEMENT TOOLS IN REDUCING THE COSTS OF SERVICES PROVIDED IN THE POPULAR MEDICAL CLINIC DEPARTMENT</i>	Jali, Z. F. (2024)	IRAQ	QUALITATIVE	SCOPUS

3	<i>Towards an evolution of the factors of adoption of the ABC cost model within the wine sector? A qualitative study based on the Sustaincost project; Towards a change in the factors for the adoption of the ABC cost model within the wine sector? A qualitative study based on the Sustaincost project</i>	Jourdaine, M., & Trébucq, S. (2022)	FRANCE	QUALITATIVE	SCOPUS
4	<i>THE SYSTEMATIZATION OF METHODOLOGICAL TOOLS OF THE COST MANAGEMENT SYSTEM OF THE ENTERPRISE</i>	Radionova, N., Skrypnyk, M. I., Matiukha, M., Sayun, A., & Bunda, O. (2022).	UKRAINE	QUALITATIVE	SCOPUS
5	<i>Improving competitiveness in education institutes – ABC's neglected potential</i>	Sorros, J., Lois, P., Charitou, M., Karagiorgos, A. T., & Belesis, N. (2022).	CYPRUS, GREECE	QUANTITATIVE	SCOPUS
6	<i>A novel cost-management system for container terminals using a time-driven Activity-Based Costing approach</i>	Ding, Y., Chen, K., Wei, X., & Yang, Y. (2022)	CHINA, GERMANY	QUALITATIVE	SCOPUS
7	<i>Cost management in the production of leafy vegetables: the impact of the costing method based on activities on the gross margin compared to the absorption costing method</i>	Makosky, H. N., & Lopes, W. S. (2021)	BRAZIL	QUALITATIVE	SCOPUS
8	<i>The ABC-LCA method for the integration of activity-based costing and life cycle assessment</i>	Jourdaine, M., Loubet, P., Sonnemann, G., & Trébucq, S. (2021)	FRANCE	QUANTITATIVE/QUALITATIVE	SCOPUS

9	<i>STATISTICAL ANALYSIS OF SUITABILITY OF THE ACTIVITY BASED COSTING METHOD IN AGRICULTURAL ENTERPRISES</i>	Hudáková Stašová, L. (2020).	CZECH REPUBLIC	QUALITATIVE	SCOPUS
10	<i>Revolutionising cost structure for integrated project delivery: a BIM-based solution</i>	Elghaish, F., Abrishami, S., Hosseini, M. R., & Abu-Samra, S. (2021)	UNITED KINGDOM, AUSTRALIA, CANADA	QUALITATIVE	SCOPUS
11	<i>Cost management in the production of native fish in captivity: the impact of the ABC costing method on the operating margin</i>	Makosky, H. N., Oliveira, M. J. D., & Lopes, W. S. (2023).	BRAZIL	QUALITATIVE	WOS
12	<i>Cost optimization and machine learning-based prediction of waiting time for fault-tolerance machining system with general vacation and F-policy</i>	Sanga, S. S., & Antala, K. S. (2024)	INDIA	QUALITATIVE	WOS

Table 1. List of articles analyzed

Source: Own elaboration

5.1 Preliminary results

From a total of 67 articles located in the Scopus and Web of Science (WoS) databases, 12 investigations were selected that met the necessary criteria for a comprehensive analysis. The reduction in the number of studies was largely due to the fact that in WoS the implementation of the ABC is mainly in the fields of engineering and medicine, where this approach has evolved more rapidly than in the field of higher education. Therefore, the final selection focused on works that had direct or transferable applications to cost management in academic programs, even when such research was carried out in other sectors.

A higher number of articles indexed in Scopus (10 out of 12; 83.3%) was observed, compared to WoS (2 out of 12; 16.7%). Most of the methodological approaches were qualitative (10 out of 12; 83.3%), together with a quantitative study (8.3%) and a mixed study (8.3%). In terms of time, most studies are grouped in the last five years: 2020 (1), 2021 (3), 2022 (5), 2023 (1) and 2024 (2); 2022 standing out with the highest number (41.7%), which coincides with the increase in applications and extensions of ABC (such as TDABC, integration with LCA, and approaches with BIM or ML) in the current literature.

The data show a significant participation of Europe (Italy, France—with two studies—, Ukraine, Cyprus/Greece, Czech Republic, United Kingdom; along with collaborations involving Germany). Contributions from Asia (Iraq, China, India), America (Brazil, Canada) and Oceania (Australia) are also noted. This pattern indicates that the methodological development of ABC and its variants has been transnational in nature, with important production centers in Europe and intercontinental collaborations in sectors such as logistics, construction, and manufacturing.

The 12 articles analyzed cover a wide variety of sectors: health (clinical laboratories; medical clinics), agro/agribusiness (horticulture; agricultural enterprises; aquaculture), advanced manufacturing (fault-tolerant

mechanization and prediction of waiting periods using ML), port logistics (container terminals with TDABC), construction (cost structuring with BIM in IPD), wine/agri-food (factors influencing the adoption of ABC), business management (organization of costing tools) and education (competitiveness in educational institutions). Only one article directly addresses the educational field ("Improving Competitiveness in Educational Institutions – The Forgotten Potential of ABC"), although several offer transferable models that are useful for university programs.

Alongside the "traditional" ABC, approaches are emerging that increase their analytical capacity: TDABC applied to complex operations (container terminals) to measure times per activity in greater detail; integration of ABC and LCA (ABC-LCA) that links costs to environmental effects—fundamental for sustainability-oriented curricula and laboratories; and the use of ABC with the support of digital technologies (BIM in construction; machine learning for cost optimization and waiting predictions in manufacturing), which present opportunities for advanced analytics in budget planning and control in faculties, schools and academic units.

In a number of sectors, ABC: (i) improves the distribution of indirect costs by associating them with specific factors; (ii) identifies hidden costs in support tasks; (iii) allows comparisons between ABC and conventional methods (e.g., absorption), affecting margins and decisions; and (iv) it requires operational data and organizational coherence for its implementation. These characteristics are critical for HEIs seeking to sophisticate their cost structure at the level of programs, courses, internships, and support services.

5.2.1 Evidence by wide areas.

Health (laboratory, clinics)

Detailed analysis of activities (e.g., recording, preparation, analysis, validation of results) and their triggers (number of tests, time per sample, shifts) demonstrates how ABC allows for cost breakdown in high process-intensive environments.

Logistics & Operations (TDABC)

Time-based allocation (minutes/hour per activity) in complex operational chains is useful to illustrate "practical capability" and bottlenecks, a logic that is valuable for academic labs and university service centers.

Construction (BIM/IPD)

The combination of computer models with ABC makes it possible to track changes and control deviations, serving as a methodological approach for curriculum design and updating and management of educational infrastructure.

Agriculture and aquaculture:

The comparison between AUC and absorption in operating margins shows quantifiable effects when adjusting the triggering factors to biocycles and batches; This logic can be extended to cohorts, credits, teaching hours, and internships.

Methodological (ABC-LCA; ML)

The combination with LCA introduces a socio-environmental dimension that links costs with criteria of institutional sustainability; the use of ML shows the potential to forecast demand and improve resource allocation across academic units.

Connection with higher education and possibility of transfer.

Although most studies do not focus on universities, their activity designs and triggers can be adapted to the academic context. For example: (a) health → hands-on teaching/laboratories: "number of tests"/"minutes per sample" ↔ "number of students per practice"/"minutes of equipment use per student"; (b) TDABC terminals → academic services: "minutes per movement" ↔ "minutes for consulting/secretarial attention" or "minutes per library transaction"; (c) agriculture/aquaculture → courses/cohorts: "batch/biomass/season" ↔ "cohort/semester/credit-hours"; (d) BIM/IPD → program management: "change orders/design" ↔ "syllaby/material updates"; (e) ABC-LCA → incorporation of costs and impacts of laboratory practices and workshops; (f) ML → forecasting of peaks in demand (enrolment, procedures, use of laboratories), facilitating the expansion of resources.

Gaps and biases in the evidence. It is noted that: (i) there is a lack of studies that apply the ABC method directly in higher education institutions—only one in the group analyzed; (ii) research has focused on qualitative approaches, with little quantitative or mixed validation; (iii) there is a high concentration of studies in Europe and little presence of research in Latin America except in Brazil; and (iv) there is an asymmetry between sectors, where areas such as health, engineering, logistics and construction show greater maturity compared to education. These gaps indicate the need to investigate how to adapt the inducers and structures of specific activities for academic programs, analyzing the impact on margins per program, costs per learning outcomes and the efficiency of support services.

Synthesis for discussion. The group analyzed supports the idea that the ABC method—and its variations—offer replicable models that, when applied in higher education, have the potential to improve cost tracking, efficiency, and accountability at the program, course, and service levels. Gradual adoption (e.g., testing in laboratories or

service centers using TDABC; combining ABCs and LCAs in subjects that consider environmental footprint; using predictive analytics to manage operational peaks) is presented as a viable strategy to address the difficulties related to data collection and organizational change.

5.3 Discussion of the results

The findings of this systematic review indicate that the activity-based accounting (ABC) system is well established in areas such as medicine, engineering, logistics, and agribusiness, while its use in higher education is still relatively new. However, the comparative study suggests that the principles, techniques and models developed in these sectors offer an adaptable framework that could improve cost management in universities. As has been observed, of the twelve studies reviewed, only one focuses on educational institutions, while the rest come from other sectors in which the ABC has proven to be effective in optimizing resource allocation and strategic decision-making.

In the health field, the results presented by Solfanelli (2022) corroborate that "the implementation of management control through ABC in laboratory medicine allows the costs corresponding to each procedure to be accurately identified" (p. 4). This statement highlights that the meticulous identification of activities and cost factors can be transferred to university contexts, especially in programs that contemplate training in laboratories, clinics or experimental practices, where clarity in the use of inputs is key to sustainability. Likewise, Jali (2024) mentions that "the use of cost management systems, including the ABC, helps to significantly reduce expenditures on popular medical services" (p. 11), which demonstrates the potential of this approach to improve student support services such as university well-being, psychological assistance or health care on campus.

The agro-industrial sector also provides significant evidence. Makosky and Lopes (2021) state that "the ABC method had a positive impact on the gross margin of vegetable production compared to the absorption method" (p. 219), showing that the selection of the costing system directly influences profitability. Later, Makosky, Oliveira, and Lopes (2023) ratify that "the implementation of ABC in captive fish production increased the operating margin compared to traditional methods" (p. 14). These experiences, although they come from production contexts, show that the ABC not only redistributes costs, but also makes them evident, which in higher education can be applied to the calculation of the cost associated with programs, courses or cohorts, identifying which ones exert a greater pressure on the institution's resources.

In the wine industry, Jourdain and Trébucq (2022) highlight that "the progression of the elements that favor the adoption of the ABC cost model is related to the search for sustainability and the need for reliable information for decision-making" (p. 98). Attention to sustainability is becoming increasingly crucial for universities, which are facing a growing demand for transparency in their finances and social responsibility. In addition, the methodological approach proposed by Jourdain, Loubet, Sonnemann, and Trébucq (2021) using the ABC-LCA model shows that "the combination of activity-based costing with life cycle analysis links financial decisions to their impacts on the environment" (p. 66). This opens up a promising avenue for higher education institutions that want to align their management systems with environmental sustainability goals, especially in engineering, natural sciences, and technology programs.

From the approach of methodological systematization, Radionova, Skrypnik, Matiukha, Sayun, and Bunda (2022) argue that "the organization of cost management tools within the framework of the ABC allows for more effective control of business activities" (p. 57). This concept indicates that universities, like companies, need to have well-defined processes to identify activities, register drivers and assign costs that help them improve the traceability of academic and administrative spending.

A fundamental contribution to the field of higher education comes from the study carried out by Sorros, Lois, Charitou, Karagiorgos, and Belesis (2022), who state that "the potential of ABC in educational institutions is still not adequately valued, despite its ability to increase competitiveness" (p. 142). This research, which focuses exclusively on the university context, validates that educational institutions can take advantage of the ABC to identify activities that generate value, eliminate those that consume resources without contributing to learning, and reorganize their academic offerings with efficiency criteria.

In the logistics field, the study by Ding, Chen, Wei, and Yang (2022) presents a methodological improvement through the application of TDABC. The authors highlight that "the use of TDABC in container terminals facilitates a more efficient management of time and resources" (p. 83). This approach can be applied in higher education to more accurately calculate the costs associated with class hours, academic advising, tutoring or administrative services, considering time as a key driver.

In the Czech Republic, Hudáková Stašová (2020) carried out a statistical analysis that showed that "the ABC method is appropriate in agricultural enterprises, as it more accurately reflects production costs" (p. 327). This emphasis on precision can be transferred to the calculation of the cost per academic credit, per student or per university service, fundamental variables in the budget planning of universities.

In the field of construction, Elghaish, Abrishami, Hosseini, and Abu-Samra (2021) state that "the transformation in the cost structure through BIM and ABC changes the management of integrated projects" (p. 211). This finding indicates that higher education, when managing interdisciplinary programs or academic infrastructure

projects, could incorporate digital tools alongside the ABC to facilitate complete knowledge and resource management.

Finally, the contribution of Sanga and Antala (2024) in the area of advanced manufacturing points out that "cost optimization using machine learning together with ABC makes it possible to anticipate waiting times and improve fault tolerance" (p. 33). This combination of costing and artificial intelligence could be implemented in higher education to forecast demand for student services, improve enrollment processes, and optimize resource allocation during periods of high academic demand.

Overall, the evidence reviewed confirms that, although the ABC method has been developed mainly outside the university environment, its methodological and practical contributions are transferable and adaptable to higher education. The articles analyzed show that the ABC allows for cost disaggregation, inefficiencies to be made visible, and processes to be optimized, which is essential for the sustainability of academic programs. The discussion of these findings highlights that the challenge for educational institutions does not lie in the relevance of the model, which has already been proven in other sectors, but in the organizational will, the training of personnel and the availability of information systems that facilitate its implementation.

6. CONCLUSIONS

The systematic review presented here indicates that the activity-based costing (ABC) method is considered a valuable tool for programme management in higher education institutions, despite the fact that most of the studies reviewed were conducted in contexts other than academic. Of the 67 articles initially found in Scopus and Web of Science, only 12 met the inclusion criteria, highlighting the lack of research specifically applied to the university environment. This limitation suggests that the literature related to ABC in higher education is still in an early phase, despite the fact that in other fields the model has proven to be effective and useful in improving cost management.

The results corroborate that the ABC facilitates a more precise allocation of costs and gives visibility to hidden expenses, as evidenced by studies in the health sector (Solfanelli, 2022; Jali, 2024), agribusiness (Makosky & Lopes, 2021; Makosky, Oliveira, & Lopes, 2023) and logistics (Ding et al., 2022). These findings can be applied to the university field, where the indirect costs associated with academic programs, student services, and administrative processes are commonly distributed generically through traditional absorption methods, thus hindering efficiency in decision-making.

In addition, it is underlined that the ABC has evolved with the incorporation of hybrid models and methodological extensions, such as the ABC-LCA (Jourdain et al., 2021), which unites cost accounting with environmental sustainability; TDABC (Ding et al., 2022), which makes time a key inducer; and its integration with digital technologies such as BIM (Elghaish et al., 2021) and machine learning (Sanga and Antala, 2024). These innovations represent a significant path for universities to modernize their management systems, aligning with the challenges of digitalization, sustainability, and operational efficiency.

In the educational context, Sorros et al. (2022) highlight that "the potential of ABC in educational institutions continues to be underestimated, despite its ability to increase competitiveness" (p. 142). This conclusion is aligned with the objective of the present research: to demonstrate that the ABC is not only an accounting method, but also a strategic management tool that can help improve the quality and sustainability of academic programs.

Therefore, the main contribution of this review is to show that, although the scientific production on ABC in the field of higher education is still scarce, the approaches used in other sectors provide a valuable and transferable framework. Its adaptation would allow universities to more accurately calculate costs per program, identify activities that add value and optimize the use of resources, fundamental aspects for strategic planning and accountability.

Finally, the importance of carrying out additional research that explores in detail the application of the ABC in specific university environments is accepted, considering not only its technical feasibility, but also the organizational and cultural elements that influence its implementation. The combination of ABC with emerging technologies and sustainability concepts creates a promising area for research that aspires to establish clearer, more effective management models that respond to the current needs of higher education.

7. RECOMMENDATIONS

The findings of this systematic review provide an opportunity to suggest a set of guidelines for both administrators of higher education institutions and researchers seeking to deepen the analysis of the activity-based costing (ABC) method. These recommendations are based on the information reviewed and respond to the need to improve financial management systems in the university environment, making them more accurate, sustainable and strategic.

Recommendations for university management

First, higher education institutions are advised to implement the ABC method gradually, starting with pilot projects in certain academic programs or in support areas where there is a high burden of indirect costs, such as laboratories, university clinics, or student care centers. What Solfanelli (2022) and Jali (2024) have shown is that the use of ABC in the health sector made it possible to calculate the costs for each activity more accurately and considerably reduce operating expenses; Similar situations can be replicated in faculties with a high need for internships.

Second, it is proposed to adopt the TDABC approach in sectors where time is a fundamental resource, such as teaching, academic guidance and enrolment management. According to Ding et al. (2022), the TDABC improves resource management in port terminals by relating costs to minutes of operation; In the university context, this logic can be applied to credit-hours, tutorials or administrative processes.

A third suggestion is to move forward with the fusion of ABC with digital tools and sustainability approaches. The ABC-LCA model, proposed by Jourdain et al. (2021), offers an environmental vision that is relevant for programs that have sustainability commitments. In addition, Elghaish et al. (2021) and Sanga and Antala (2024) demonstrate how the combination with BIM and machine learning transforms the ability to track costs and allows for more accurate projections. These experiences can motivate universities to integrate ABC into digital academic management platforms and sustainable campus initiatives.

Finally, institutions are suggested to employ ABC not only as a method of accounting, but as a strategic management tool. As Sorros et al. (2022) indicate, "the potential of ABC in educational institutions continues to be underestimated" (p. 142); Its implementation could allow universities to increase the competitiveness of their programs, identify activities that add value and eliminate those that consume resources without improving the learning process.

Recommendations for future research

In the scientific field, this review highlights the need to extend studies on ABC in higher education. Of the 67 articles that were initially identified, only 12 met the inclusion criteria and only one focused directly on the university context. Therefore, it is suggested to carry out empirical research that analyzes the implementation of the ABC in real academic programs, evaluating its effect on efficiency, quality, and financial sustainability. Likewise, the development of hybrid models adapted to the university environment, which integrate the ABC with methods such as TDABC, LCA or artificial intelligence, is established as a research priority. These modifications could make it easier for institutions to more accurately calculate costs per student, per group, or per learning outcome, as indicated by studies by Makosky and Lopes (2021, 2023) in the field of agribusiness and by Sanga and Antala (2024) in advanced manufacturing.

Finally, it is suggested to promote scientific production in Latin American environments, where literature is still limited, except in some examples from Brazil (Makosky & Lopes, 2021; Makosky et al., 2023). Considering that universities in the region face specific economic challenges, it would be useful to carry out local research that supports the usefulness of ABC in undergraduate and graduate programs, considering the different financial and cultural realities referred to in Europe or Asia.

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