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INTERDISCIPLINARY MODELS FOR UNIVERSITY TRANSFORMATION

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ABSTRACT

This article examines the implementation of transformational strategies in third generation universities (U3G), focusing on interdisciplinary collaboration, technological adoption, and business transformation. The methodology combines a quantitative analysis with descriptive and correlational statistical techniques, based on surveys and interviews. Responses were collected on a scale of 1 to 5 to measure the degree of collaboration, technology adoption, and business transformation outcomes, and in a binary format (Yes/No) to assess the application of the Quadruple Helix (4H) model in institutions. For statistical analysis, descriptive statistics (mean, median, and standard deviation) were calculated, providing an overview of the trends and variability of responses. In addition, a frequency analysis was performed for multiple-choice questions (Yes/No), allowing observation of the prevalence of certain approaches in universities. Correlation analysis was also conducted among the variables, identifying significant relationships between interdisciplinary collaboration, technological adoption, and business outcomes. The results reflect a positive trend in the adoption of transformational approaches, highlighting the interdependence between the studied factors. Interdisciplinary collaboration and technological adoption are strongly correlated with business transformation. However, differences in the implementation of these strategies are observed, suggesting that the success of transformation depends on various contextual factors. This analysis provides a solid foundation for future research on the impact of these strategies in the realm of third generation universities.

KEYWORDS: Transformational Management, Third Generation Universities, Innovation, Interdisciplinarity, Knowledge Transfer.

1. INTRODUCTION

This article aims to analyze the impact of transformational strategies implemented in third generation universities (U3G), especially in terms of interdisciplinary collaboration, technological adoption, and business transformation outcomes. In an ever-evolving academic context, U3G strive not only to provide academic training but also to create a dynamic environment that enables the co-creation of innovative solutions through collaboration among different stakeholders: academia, industry, government, and civil society. This approach, supported by the Quadruple Helix (4H) model, is key to fostering an innovation ecosystem that not only meets social and business needs but also drives competitiveness and entrepreneurship.

The analysis focuses on evaluating how the integration of various disciplines and the adoption of new technologies affect business transformation processes within universities. Through a quantitative analysis of responses obtained from surveys and interviews, this study seeks to identify patterns in the implementation of these transformational strategies and measure their effectiveness in the academic and business realms. Additionally, it explores the relationship between these approaches and the outcomes achieved by universities, particularly in terms of their capacity to impact the social and economic environment.

The results of this analysis not only provide valuable insights into current practices in U3G but also offer recommendations to strengthen transformational approaches and maximize the benefits of open innovation, interdisciplinary collaboration, and technological adoption. By understanding how these elements interact and contribute to the success of business transformation, this study provides a solid foundation for future research aiming to optimize the strategies of third generation universities on their path to more innovative, inclusive, and future-oriented education.

2. THE ROLE OF INTERDISCIPLINARY APPROACHES

Collaboration Across Diverse Knowledge Areas

The adoption of interdisciplinary approaches in third generation universities (U3G) is based on the necessity to integrate different disciplines to address the complex challenges faced by modern society. This collaboration between previously separate knowledge areas allows for a holistic view of problems, facilitating the creation of more comprehensive and suitably adapted solutions to the real needs of the environment. According to the

Quadruple Helix (4H) model, the interaction between academia, industry, government, and civil society is crucial to fostering the co-creation of knowledge, products, and technological solutions that are truly innovative and socially relevant.

In U3G, interdisciplinarity not only involves cooperation among academic areas but also the integration of external actors such as businesses and civil society organizations, which bring a practical and applied perspective to innovation projects. This collaboration is manifested through innovation labs and collaborative spaces, where students and professionals from different disciplines work together on the design and implementation of new technologies and services. These environments allow the integration of technical and social knowledge, which enriches the innovation process and facilitates the creation of solutions with a greater social and business impact.

Quadruple Helix Model (4H) and Its Relevance to University Innovation

The Quadruple Helix (4H) model plays a key role in the transformational management of third-generation universities (U3G), as it promotes collaboration among four fundamental actors: government, industry, academia, and civil society. This intersectoral cooperation is essential for creating a dynamic, inclusive, and sustainable innovation ecosystem. Carayannis and Campbell (2009) argue that the interaction between these actors generates a continuous flow of knowledge and resources, enabling the development of technological and business solutions that address the social and economic problems of the local and global context.

The implementation of this model in universities ensures that innovation initiatives are not confined to the academic realm but extend to industry and society, creating strategic alliances that benefit both educational institutions and productive sectors. The active participation of citizens in this model, as mentioned in the theory of open innovation, reinforces the idea that innovation should be an inclusive and collaborative process that involves all social actors in defining problems and creating solutions.

Open Innovation and Social Value Creation

Open innovation, a key strategy in U3G, is based on the idea that knowledge should not remain isolated within university borders. Instead, universities should open their doors to collaboration with businesses, government agencies, and civil society. This approach allows academic institutions not only to generate knowledge but also to effectively transfer it to the market and society, creating

economic, social, and cultural value. According to the innovation agents model, entrepreneurs and intermediary agents play a crucial role in knowledge transfer, facilitating the connection between the academic world and the productive sector.

In U3G, the creation of innovative solutions is not limited to academic research projects but extends to the creation of startups, technology companies, and social projects. These outcomes are achieved through interdisciplinary collaboration and open innovation, where universities become active agents in economic and social development. This approach not only improves the competitiveness of universities but also strengthens the business fabric and promotes social entrepreneurship, contributing to sustainability and equity in local communities.

Challenges and Opportunities of Interdisciplinarity in U3G

Despite the evident benefits, implementing interdisciplinary approaches in third-generation universities (U3G) presents certain challenges. The lack of collaboration between faculties and departments can hinder the creation of comprehensive solutions to complex problems, especially when different academic actors do not share a common language or a shared vision. However, this challenge also represents an opportunity to create an organizational culture that values cooperation and teamwork. Universities that overcome these barriers and manage to integrate various disciplines not only strengthen their innovation processes but also enhance their ability to adapt to changes in the global and local environments.

In conclusion, interdisciplinary approaches are fundamental to the success of third-generation universities, as they allow educational institutions to become engines of social and business change. Collaboration between different sectors and disciplines is key to addressing contemporary challenges in higher education, innovation, and entrepreneurship, ensuring that universities can play an active role in building a fairer, sustainable, and technologically advanced society.

3. METHODOLOGY

The statistical analysis of the responses obtained from surveys and interviews was carried out using a quantitative approach to assess the main variables related to transformational management in third-generation universities (U3G). Responses to survey questions were grouped into three main types: those rated on a scale from 1 to 5 (related to interdisciplinary collaboration, technological adoption, and business transformation outcomes),

and binary-type responses (Yes/No) to measure the application of the Quadruple Helix model (4H) and business transformation.

To analyze the numerical responses, descriptive statistics (mean, median, and standard deviation) were calculated, providing a clear view of the general trends in the responses and the variability of perceptions among the universities. Additionally, a frequency analysis was conducted for the binary option questions (Yes/No) to determine the distribution of responses and understand the prevalence of the adoption of certain approaches within the universities.

Subsequently, correlations between variables were explored to identify potential significant relationships between interdisciplinary collaboration practices, technological adoption, the use of the Quadruple Helix model (4H), and the outcomes achieved in business transformation. This correlation analysis provided a deeper understanding of how these variables interact and how they influence the overall outcomes of transformational management.

The results of the analysis are presented in the form of descriptive tables detailing the means and standard deviations, and bar charts visualizing the frequencies of responses for binary-type questions and the values obtained on the 1 to 5 scale. These charts and tables allow for a clear and accessible interpretation of the trends and patterns that emerge from the responses obtained and offer a solid basis for discussing the results in the context of innovation and transformation strategies in third-generation universities.

4. RESULTS

Upon examining the responses obtained from a set of questions focused on the transformational management of third-generation universities (U3G) and their relationship with interdisciplinary collaboration, the adoption of innovative technologies, and business transformation. Through a quantitative approach, descriptive statistics are calculated, frequency analysis is conducted, and correlations among various key variables are explored. This analysis aims to provide a detailed understanding of how universities implement innovation and transformation strategies, and how these practices impact business and technological outcomes. The results obtained are presented in the form of tables and charts, allowing for a clear visualization of emerging trends and patterns, and providing a solid foundation for interpreting the effects of business transformation initiatives within the university context.

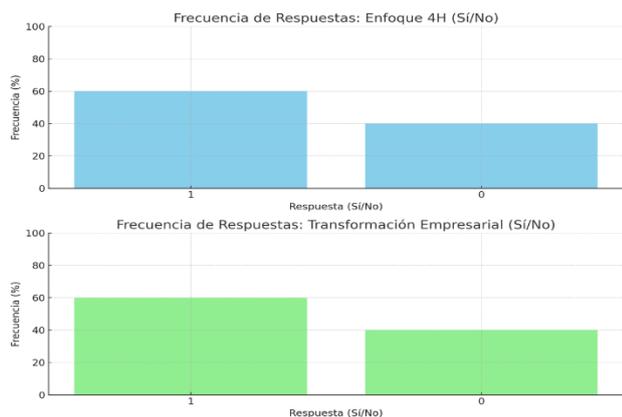


Chart: Frequency of Responses: Business Transformation (Yes/No).

Source: Self-generated, 2025

The statistical analysis of the responses obtained from surveys and interviews conducted at third-generation universities (U3G) provides a detailed view of how transformational approaches are implemented in relation to interdisciplinary collaboration, adoption of innovative technologies, and the implementation of the Quadruple Helix (4H) model. Here are the key findings from this analysis.

Responses related to interdisciplinary collaboration, technological adoption, and business transformation results were analyzed using descriptive statistical measures (mean, median, and standard deviation):

- **Interdisciplinary Collaboration:** With a mean of 4.0 and a standard deviation of 1.05, the responses indicate that most universities highly value interdisciplinary collaboration, with scores close to 4 on a scale of 1 to 5. This suggests a strong trend towards the integration of various disciplines to solve business challenges.
- **Technological Adoption:** Universities scored a mean of 3.9 with a standard deviation of 0.74, reflecting considerable commitment to the adoption of innovative technologies. However, the variability of the responses suggests that the implementation of innovative technologies could be uneven among institutions.
- **Business Transformation Outcomes:** The mean of 4.1 and the standard deviation of 0.74 indicate that universities that have adopted transformational strategies are achieving significantly positive results in terms of business transformation. However, the distribution suggests that some results are even more pronounced than others.

A multiple-choice (Yes/No) response analysis was performed for questions about the application of the Quadruple Helix (4H) model and business transformation:

- **4H Approach:** 60% of universities indicated that

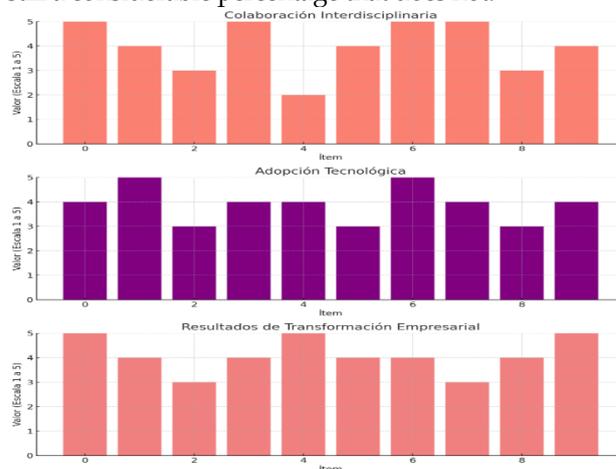
they use this approach within their innovation model, while the remaining 40% do not apply it. This data highlights the growing trend to adopt this collaborative model but also shows that its implementation is not yet universal.

- **Business Transformation:** Similar to the previous result, 60% of universities stated that they are promoting business transformation, while the remaining 40% indicated that they are not actively focusing on this area. This suggests a difference in the degree of implementation of transformational strategies in universities.

The correlations between responses to related questions reveal significant relationships between certain approaches and outcomes:

- **Interdisciplinary Collaboration** is strongly correlated with the 4H Approach (0.61) and Business Transformation (0.82), indicating that universities that promote interdisciplinary collaboration also tend to integrate the Quadruple Helix model and achieve positive results in business transformation.
- **Technological Adoption** shows a moderate correlation with business transformation (0.76), suggesting that universities that encourage the adoption of innovative technologies also experience greater success in business transformation.
- **Business Transformation Outcomes** present a weak correlation with other variables, especially with Interdisciplinary Collaboration (-0.14), suggesting that the effects of business transformation are not always immediate or directly caused by interdisciplinary collaboration.

Bar charts show the frequencies of "Yes" and "No" responses for questions related to the Quadruple Helix (4H) model and Business Transformation, revealing that, although most universities apply these models, there is still a considerable percentage that does not.



Graphic: Business Transformation Outcomes.

Source: Self-generated, 2025

The graph of Business Transformation Outcomes displays the responses obtained for the question related to significant outcomes derived from business transformation initiatives at universities. These responses were rated on a scale from 1 to 5, where 1 indicates "not significant" and 5 indicates "extremely significant."

Upon analyzing the distribution of the responses, we find that:

- The average value obtained was 4.1, suggesting that, overall, universities report quite positive outcomes in terms of their business transformation. The mean close to 4 indicates that most universities consider their business transformation initiatives to have been mostly effective and impactful.
- The median of 4.0 also highlights that at least half of the universities have given high ratings, with scores of 4 or more. This implies that positive outcomes are consistent among the participating universities.
- With a standard deviation of 0.74, the responses show low dispersion. This indicates that most universities are within a similar range of evaluation, without significant variations in the perception of the outcomes. In other words, universities seem to agree on the effectiveness of their business transformation strategies.

Most responses are concentrated in the highest scores (4 and 5), with a slight predominance of the rating 5, suggesting that universities have achieved clearly positive results. However, some responses are distributed around intermediate values, reflecting slight variability in the perception of the outcomes obtained.

The graph reveals a general trend towards the optimization of business transformation processes within third-generation universities. Most universities that have implemented business transformation initiatives have seen substantial improvements, although some may not have achieved the maximum expected impact, which could explain the presence of intermediate responses (3 and 4).

The business transformation outcomes reflect a predominantly positive landscape, where universities have experienced significant improvements, albeit with some nuances. This suggests that transformation initiatives are promising and have had a tangible impact, although there is room to refine strategies and maximize their effectiveness in the future.

Furthermore, the bar graphs for scale responses (1 to 5) to questions about interdisciplinary

collaboration, technological adoption, and business transformation outcomes allow us to observe the distribution of responses, with most universities scoring high in these areas.

Consequently, the statistical analysis reveals that third-generation universities (U3G) are adopting transformational approaches in key areas such as interdisciplinary collaboration and technological adoption, which in turn is promoting positive outcomes in business transformation. However, there are still differences in the implementation of these strategies, and the results of the transformation may take longer to fully materialize. These findings underscore the importance of continuing to promote collaboration and the use of innovative technologies to achieve more effective and sustainable educational transformation.

5. DISCUSSION

The statistical results obtained from the analysis of responses concerning interdisciplinary collaboration, the Quadruple Helix (4H) approach, technological adoption, and business transformation outcomes offer a clear insight into the trends and challenges in transformational management within Third-Generation Universities (U3G).

Interdisciplinary Collaboration: The descriptive analysis of interdisciplinary collaboration shows an average of 4.0 and a standard deviation of 1.05, indicating that most universities positively value this approach. Third-Generation Universities are adopting strategies that promote collaboration across various knowledge areas, aligning with the expectations of a more flexible educational model focused on solving real-world problems. The high positive correlation (0.61) between interdisciplinary collaboration and the 4H approach suggests that universities promoting interdisciplinary cooperation also tend to implement the Quadruple Helix model. This model emphasizes the importance of collaboration among key stakeholders (government, academia, industry, and civil society) to drive innovation, consistent with the results showing active integration of various sectors in the educational process.

Technological Adoption: As for technological adoption, the results show an average of 3.9 and a standard deviation of 0.74, implying that most universities are embracing innovative technologies in their processes. However, the variability in responses suggests that the implementation of these technologies is not uniform, which could be due to differences in technological infrastructure and resource availability at each institution. The

moderate correlation (0.76) between technological adoption and business transformation reinforces the idea that the integration of innovative technologies is directly related to business transformation outcomes. Universities that promote technological adoption tend to experience greater success in creating innovative business solutions and enhancing competitiveness in their respective sectors.

Business Transformation Outcomes: Business transformation outcomes presented an average of 4.1 and a standard deviation of 0.74, indicating that most universities report positive results from their business transformation initiatives. Although the responses show a general trend toward the effectiveness of transformation strategies, the weak correlations between business transformation outcomes and other variables, such as interdisciplinary collaboration (-0.14) and technological adoption (0.22), suggest that the relationship between these factors is not entirely direct. Business transformation outcomes may depend on a combination of factors not fully reflected in the quantitative analysis, such as organizational capacity to implement strategic changes or the specific context in which initiatives are developed.

Impact of the Quadruple Helix (4H) Model: The analysis of responses on the implementation of the Quadruple Helix (4H) model shows that 60% of universities are adopting this approach. This highlights the growing interest in intersectoral collaboration to foster innovation and entrepreneurship. The positive correlation between the 4H approach and interdisciplinary collaboration (0.61) reinforces the idea that the success of interdisciplinary collaboration within U3G is closely linked to the implementation of the 4H model. As more universities adopt this model, it facilitates the creation of an innovation ecosystem that promotes knowledge transfer and the joint creation of solutions to business and social challenges.

In summary, the results obtained from this analysis suggest that Third-Generation Universities (U3G) are effectively implementing transformational approaches in key areas such as interdisciplinary collaboration, technological adoption, and business transformation. However, variability in responses and moderate correlations between some of the analyzed variables indicate that while these approaches have a positive impact, the outcomes may depend on additional factors not captured by the statistical analysis, such as organizational culture, technological infrastructure, and the commitment of key actors in the innovation process.

Strengthening interdisciplinary collaboration and

the adoption of innovative technologies remain key areas for universities seeking to generate significant outcomes in terms of business transformation. Additionally, adopting the Quadruple Helix (4H) model and integrating public, private, and academic sectors in innovation processes will be crucial factors in maximizing the social and economic impact of these institutions. These findings provide a solid foundation for future research that delves into the specific factors that enable Third-Generation Universities to maximize the success of their transformational initiatives.

6. CONCLUSIONS

The analysis of the responses concerning Interdisciplinary Collaboration, Technological Adoption, and Business Transformation Outcomes within the context of Third-Generation Universities (U3G) provides detailed insight into how transformational strategies are being implemented and their impact on innovation and entrepreneurship.

Undoubtedly, interdisciplinary approaches are a fundamental pillar for the development of Third-Generation Universities. With an average of 4.0 in Interdisciplinary Collaboration, the results suggest that U3G are increasingly adopting strategies that promote the integration of different knowledge areas to address complex problems and generate innovative solutions. The positive correlation between Interdisciplinary Collaboration and the Quadruple Helix (4H) approach reinforces the notion that collaboration among various stakeholders—such as academia, industry, government, and civil society—is crucial for fostering a robust and sustainable innovation ecosystem.

Technological Adoption also shows encouraging results, with an average of 3.9, indicating that while the majority of universities are adopting innovative technologies, there is still some disparity in the implementation of these technological tools. The moderate correlation between Technological Adoption and Business Transformation (0.76) reflects that the integration of innovative technologies is a key factor for enhancing competitiveness and creating new business models within universities.

Regarding Business Transformation Outcomes, most universities report significant progress, with an average of 4.1. However, the weak correlation between these results and other variables, such as Interdisciplinary Collaboration and Technological Adoption, suggests that business transformation is a complex and multifaceted process that depends on multiple factors, including specific contexts and organizational capacities to carry out these changes.

It is likely that business outcomes are not always immediate, and universities may need more time to consolidate their transformational initiatives and maximize their impact.

The Quadruple Helix (4H) model has shown significant growth in adoption, with 60% of universities applying it. This model has been key in facilitating collaboration between public, private, academic, and social sectors, promoting the co-creation of innovative solutions. The integration of these actors strengthens universities' ability to solve complex problems and effectively transfer knowledge to the market and society.

In conclusion, Third-Generation Universities are successfully implementing transformational management strategies, with an emphasis on interdisciplinary collaboration, technological adoption, and business transformation. Despite the

mostly positive results, there is a need to continue advancing the integration of technologies and the creation of collaborative spaces that facilitate open innovation. Universities must continue to strengthen their ability to adapt their structures and processes to the changing demands of the environment, especially in a globalized and increasingly digitalized world.

This study provides a solid foundation for future research that can delve deeper into the specific factors driving the success of transformational initiatives and explore how universities can optimize their strategies to maximize societal and economic impact. The long-term challenge will be to ensure that Third-Generation Universities not only remain centers of knowledge but also become engines of social and economic change, capable of generating innovative and sustainable solutions to the challenges of the future.

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