

Digital Transformation of Educational Processes in Higher Education: Tendencies and Consequences

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Abstract

Proper management decisions are essential to ensure that the digitalization processes in education are beneficial, smooth, and sustainable, providing value to students, faculty, and the higher education system. This paper discusses the challenges and issues of digital transformation of educational institutions processes and analyzes ways to manage these processes in the most effective way to enhance the sustainable competitiveness of the education system. It addresses how the constantly changing digital environment is altering teaching and learning processes, evaluates the impact of national digitalization on university management and operational efficiency, and examines how the digital transformation of educational processes is linked to the overall national level of digitalization. The potential relationship between the position of higher education institutions in the QS World University Rankings and the country's level of digitalization is identified and analyzed. From this study, further trends of research should be identified to enhance the management of digital transformation in education, ensuring its efficiency and long-term sustainability in higher education institutions.

Keywords: *digitization, digital transformation, education processes, management, challenges, competitiveness, sustainable education system.*

JEL Classification: I23, M15, O32, O33

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1. INTRODUCTION

Digital transformation is one of the most significant changes of organization in the modern world, to which the education institutions must respond. Providing students with the digital skills they need to apply digital technologies critically, purposefully and effectively in the future is essential for an inclusive and high-quality learning process. Inadequate management of digital transformation can lead to inequality in education, hindering students' acquisition of essential competences, limiting access to educational resources, affecting personalized learning and promoting social exclusion or even cause stagnation of digital transformation in the higher education institution. Additionally, it reduces student motivation to learn, creates challenges in maintaining academic integrity, and negatively affects the development of teacher qualifications as well as the ability to use digital tools effectively in teaching. Well-coordinated digital transformation processes in education ensures that students acquire not only the necessary digital skills, but also the ability to think critically, to creatively address future

challenges, to adapt to the ever-changing technological environment and to collaborate effectively in the global digital environment (Yu et al., 2024). In order to effectively manage the digitalization of education, it is necessary to have a clear understanding of the nature of the educational process itself, its goals and values, and to ensure a holistic approach to studies, which includes not only the use of technological tools, but also the adaptation of pedagogical methods, the development of teachers' competences, and the involvement of all educational actors in the implementation of digital innovation.

The educational process is an activity through which individuals acquire knowledge, skills, values, and abilities necessary for personal development, professional activity, or social integration. This process involves interaction between instructors, students, and the learning environment, utilizing various teaching and learning strategies. Educational processes occur in different contexts: formal settings, such as schools and universities, as well as informally and non-formally - through daily life, family, work, or self-directed learning. Scholars studying educational processes describe them as a complex, multi-component system that encompasses the interaction of instructors, students, the learning environment, and various methods.

It has been asserted that the education system is a complex social mechanism that encompasses not only teachers and students but also the broader society (Williams, 2022). Similarly, it is argued that the educational process includes the transmission of knowledge together with the development of critical thinking, creativity, and social skills (Vincent-Lancrin, 2023). The education system is a dynamic structure that constantly adapts to changing social, economic, and technological conditions (Jiang, 2024). Technological advancements have created a demand for new skills. The transformation of the higher educational process is essential to meet the challenges and opportunities of the 21st century, promoting innovation, social equality and sustainability (Leal Filho et al., 2018). Balalle (2024) emphasizes that the integration of technology into educational processes can create new opportunities, offering students interactive and individualized experiences that are essential in the learning environment of the 21st century. The integration of technology into educational processes has become particularly important. Technology in education helps students prepare for lifelong learning and fast robust environments of the digital age. These technologies provide students with a virtual world and the freedom to access knowledge according to their learning styles and preferences (Haleem et al., 2022). Digital technologies have great potential to transform teaching and learning methods but understanding this process and its effective implementation and management requires thorough investigation.

This paper systematically assesses the challenges of digital transformation in higher education institutions and highlights opportunities, justifies the importance and relevance of managing these digitalization processes, and outlines potential directions for future research on the management of educational digitalization processes that would ensure the improvement of the sustainable competitiveness of institutions in a global context. Digital transformation is a key driver of competitive advantage for higher education institutions, allowing them to effectively respond to the needs of a globalized, knowledge-based economy.

2. THEORETICAL BACKGROUND

2.1 Digitalization in Higher Education: Learning Processes and Pedagogical Shifts

Higher education institutions can have different structures, ranging from centralized ones, where management and decision-making are concentrated in the central administration, to decentralized ones, where faculties or departments have greater autonomy. The integration of technology into educational processes provides opportunities to create new forms of learning, such as distance learning and interactive platforms (Haleem et al., 2022). Additionally, the integration of technology into education not only facilitates access to knowledge but also encourages active student engagement in the learning process, allowing them to explore and create independently (Kalyani, 2024). Balalle (2024) emphasizes that the integration of technology into education not only facilitates access to knowledge but also stimulates student activity in the learning process. He argues that independent exploration and creativity are essential aspects of modern education, and he examines how technology transforms the role of educators, highlighting that teachers must become facilitators, helping students navigate the vast amount of information. This means that educators will need to adapt their teaching methods in order to effectively work in a technology-based learning environment. Technology changes the learning experience of students together with transforming the role of teachers, requiring them to become facilitators who help students navigate complex information spaces (Wang et al., 2024). Other researchers draw attention to the challenges of distance learning, particularly regarding student motivation and self-regulation. In their view, while distance learning offers significant opportunities, it requires greater student engagement and discipline (Li et al., 2023). Distance learning has become an essential part of education, providing students with the opportunity to learn anywhere and anytime and creating a more accessible learning experience, but it also poses challenges related to student motivation and self-regulation (Li et al., 2023).

Multiple studies discuss interactive learning platforms, stating that they can significantly improve the development of students' practical skills. They emphasize that these technologies are particularly useful for teaching technical specialties, as they allow students to acquire real-world skills through simulations. Interactive learning platforms, such as virtual classrooms and simulations, help students gain practical skills and knowledge, which is especially important in the training of technical specialties (Josué et al., 2023). The general view of scholars suggests that technology-based learning is a two-way process, providing both significant opportunities and substantial challenges.

The general academic consensus suggests that technology-enhanced learning is inherently a dual process—it provides substantial benefits, including accessibility and skill development, while simultaneously introducing new challenges that require pedagogical adaptation and institutional support.

2.2 Strategic Management and Institutional Challenges in the Digital Transformation of Higher Education

In recent years, universities have undergone numerous significant changes driven by technological and social digitalization trends (Dexter et al., 2024). Currently, the adoption of

technology in universities is linked to a paradigm shift, where technology is perceived as a complex yet interconnected environment that enables digital learning. The digitalization of educational processes is important for several reasons: efficiency - when processes are optimized and automated, accuracy - aiming to avoid errors, data analysis - facilitating the processing of large datasets, and process monitoring - opening new opportunities by enabling continuous data collection and transformation. The educational process in higher education consists of several essential components that together form the entire study experience and ensure students' academic development and readiness for the labor market.

The EDUCAUSE 2020 study on digital transformation in higher education highlights the centrality of students in driving this process. IT leaders and professionals identified “improving the student experience” as a key motivator for institutional investment and planning in digital transformation efforts (Farias-Gaytan et al., 2023). A structured approach to digitalization is essential for ensuring the effective integration of technologies within higher education institutions. This progression typically unfolds in five distinct stages, each representing a maturity level in the digital transformation journey. The first stage involves converting physical data into digital formats, enabling swift access to critical information and providing a foundation for more advanced processes. In the second stage, information is categorized and structured for seamless access and management, emphasizing tools that enhance searchability and usability. The third stage focuses on automation, reducing manual intervention in repetitive tasks, improving operational efficiency, and freeing up resources for higher-order functions. In the fourth stage, workflows are optimized by eliminating redundant steps, ensuring smooth and efficient operations across systems. The fifth stage represents full integration, where digital technologies are strategically aligned with organizational goals to drive innovation and continuous improvement. At the final stage, digital technologies become integral to institutional functions. This phase fosters comprehensive, adaptive changes that position institutions to meet evolving market demands and student needs (see Fig. 1) (Farias-Gaytan et al., 2023; Christopher et al., 2020).

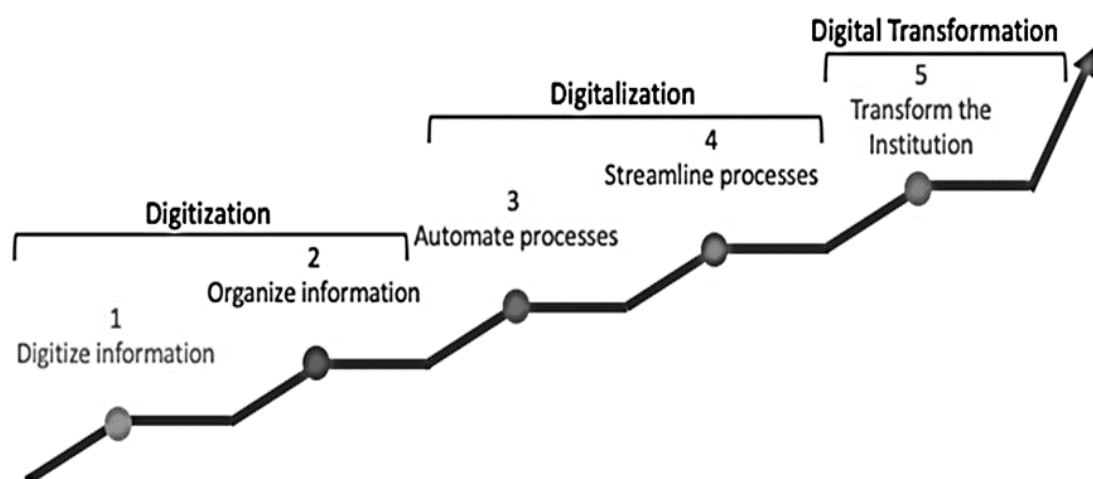


Fig. 1 – Digital Transformation. Source: Christopher et al. (2020).

By following these stages, higher education institutions can ensure a gradual and coherent adoption of digital technologies, improving daily operations and driving long-term modernization.

Despite structural differences, all higher education institutions carry out the educational process, which has become inseparable from the use of digital technologies. Various digital tools, including teaching platforms, virtual learning environments, electronic resources, and advanced data management systems, are increasingly used in the educational process. Currently, numerous digitized processes are being implemented in higher education institutions, such as tracking student progress, digital administrative systems, and curriculum management. These changes require purposeful and effective management decisions to ensure operational efficiency and high-quality teaching. The management of digitalization processes becomes especially important for optimizing teaching resources, improving teaching methods, and ensuring that digital technologies effectively contribute to achieving educational goals. During digital transformation, various management challenges arise.

Higher education institutions face various challenges in implementing the digitalization of education. Scholars emphasize that a major issue is outdated technological infrastructure: In large higher education institutions, the biggest problem is outdated technological solutions that are no longer suitable for modern use (Wang et al., 2024). Smaller institutions often lack the human resources needed to effectively implement and maintain new technologies. Another challenge is cultural resistance to change and organizational inertia. It is argued that university leadership must focus not only on the implementation of technology but also on strategic changes to ensure that the implementation of innovations aligns with the institution's culture and needs (Laufer et al., 2024).

The first aspect of a successful transformation process is a clear and consistent strategy led by highly qualified leaders. Leaders must not only promote the implementation of technologies but also clearly define the objectives and pursue a shared vision of how digital tools can improve the quality of education (Davidavičienė et al., 2020). Effective digital transformation requires strong and visionary leadership capable of integrating new technologies into the institution's long-term goals, involving all stakeholders from faculty to students (Weber, 2022). Another crucial condition for the success of the transformation is the development of digital skills among faculty and students. The use of new technologies will not be effective if there is a lack of competencies and knowledge on how to use these tools. Scholar Haleem notes that the success of digital education depends on the ability of faculty and students to effectively use technology, which is why it is important to invest in consistent skills development (Haleem et al., 2022). Therefore, institutions must pay special attention to staff training and development to ensure that technologies are not used merely superficially but contribute to the real improvement of the teaching process. One of the most challenging aspects is managing cultural change, which is linked to resistance to innovation and established work practices. It is stated that cultural resistance to change among faculty and administration can become the greatest obstacle to the success of digital transformation. Therefore, university leaders must proactively prepare change management strategies, including communication, learning, and motivation programs, which will help ensure the engagement of all employees in the transformation process. The use of digital technologies generates vast amounts of data about student activities, and therefore institutions must address data management and security issues. Ensuring the security of student data is essential not only from a legal standpoint but also for strengthening trust in technology (Prinsloo, 2022). Higher education institutions must ensure that data protection measures meet

the highest standards and establish a clear policy on how data will be collected, stored, and used. Technologies provide the opportunity to implement innovative learning methods such as blended learning, personalized learning platforms, and interactive online seminars. It is emphasized that the use of technology should directly reflect innovations in learning methods that focus on student success and active engagement in the study process (Balalle, 2024). It is important to promote collaboration between different institutions to share best practices and learn from each other's experiences. This can help address challenges more effectively and ensure that digital transformation is as successful as possible. According to scholars, collaboration between different institutions provides an opportunity to adapt to changes more quickly and learn from other successful experiences (Green et al., 2024).

In summary, technology integration in higher education must be accompanied by strategic leadership, inclusive planning, ongoing skills development, and clear governance structures, if institutions are to fully realize the transformative potential of digitalization.

2.3 The Role of National Digitalization in Shaping the Competitiveness of Higher Education Institutions

The level of digitalization in higher education institutions has a significant impact on their quality and prestige, as it directly influences the effectiveness of teaching, the student experience and the visibility of the institution internationally. Digital transformation improves the accessibility and personalization of learning, enabling students to use advanced learning tools and data-driven teaching methods, thereby enhancing the quality of studies (Köpsell et al., 2025). Digital transformation improves the accessibility and personalization of learning, enabling students to use advanced learning tools and data-driven teaching methods, thereby enhancing the quality of studies (McCarthy et al., 2023). A high level of digital transformation also helps institutions to conduct research more efficiently and to collaborate with international academic communities. This contributes to improving the quality of scientific publications and increasing citation rates, which are one of the main criteria for international university rankings (Lazić et al., 2021). The prestige of higher education institutions comes from their higher visibility, modern infrastructure and ability to attract talented students and teachers. Modern digital platforms and virtual learning environments allow universities to differentiate themselves internationally by emphasizing innovation and quality educational experiences (Alenezi et al., 2023).

The extent of digitalization within a country plays a crucial role in shaping the reputation of higher education institutions and influencing the overall quality of academic and research activities. The advancement of digital infrastructure, accessibility to technology, and digital literacy are key factors that determine the sustainability, inclusivity, and competitiveness of educational establishments. Digital transformation in higher education is essential for institutions to adapt to rapid technological advancements and maintain their competitive edge (Antonopoulou et al., 2023). The overall digitalization level of a country is a key factor in determining the competitiveness and sustainability of higher education institutions in the global context, yet there is limited empirical evidence to substantiate this claim (Gorbunov et al., 2022;

Wang et al., 2024). Gorbunov et al. (2022) argue that digital transformation plays a crucial role in maintaining the socioeconomic and managerial effectiveness of higher education institutions. Moreover, Gorbunov et al. (2022), Ivanova et al. (2021), and Wang et al. (2024) emphasize that the level of digital transformation in a country directly influences the competitiveness of higher education institutions, particularly in the context of population mobility and digital economy development. Therefore, further research is necessary to substantiate and empirically validate the claim that digital transformation plays a decisive role in ensuring the socioeconomic and managerial efficiency of higher education institutions (Gorbunov et al., 2022; Ivanova et al., 2021; Wang et al., 2024). Recent research suggests that digital transformation serves as a propelling force in building competitive advantages for universities (Hashim et al., 2022). The active integration of digital technologies in higher education plays a crucial role in enhancing universities' competitiveness in the global market. However, empirical insights into how digital transformation directly contributes to competitive advantages for universities remain limited (Astratova et al., 2021). Higher education institutions are adopting digital transformation to varying degrees across their systems, processes, and services, which is crucial for maintaining competitiveness (Barrett & Williams-Shakespeare, 2024).

There is still a lack of definitive empirical evidence supporting a direct link between national digital transformation levels and the long-term sustainability of higher education institutions. While digital transformation is widely recognized as a key factor in ensuring global competitiveness, further research is needed to identify specific links between a country's digital infrastructure and the resilience of its higher education sector.

The development of the country's digital infrastructure, availability of technology, and level of digital literacy directly influence universities' ability to provide quality education, implement innovative teaching methods, and achieve broader access for students and research. The Digital Economy and Society Index (DESI), which includes indicators such as internet usage prevalence, mobile broadband network development, and the availability of e-services, is a primary tool for assessing a country's digitalization progress and revealing how digitalization can impact various sectors, including education. When evaluating the sustainable competitiveness of universities, it is particularly important to assess how the level of digitalization in a country can affect higher education institutions' positions in international rankings. The progress of digitalization at the national level often directly correlates with a university's ability to implement advanced technologies, optimize educational processes, and attract international students and researchers, which in turn improves universities' positions in global rankings. Therefore, it is important to evaluate the potential relationship between the position of higher education institutions in the QS ranking and the country's level of digitalization (Scimetrica, 2024).

The theoretical analysis included a review of the scientific literature on the impact of digital transformation on HEIs' governance, quality and efficiency. Scholarly sources on the importance of digital infrastructure, technological accessibility and digital literacy in the education sector were analyzed. This allowed us to form a theoretical basis for further empirical analysis and to identify the main factors that can influence the performance of universities.

A thorough analysis of the management aspects related to the digital transformation of higher education institutions reveals the main research problem: how to ensure that differently managed higher education institutions successfully integrate digital tools into the study process, taking into account their unique structure, resources, and cultural differences (UNESCO, 2024). Institutions with different management structures face varying opportunities and challenges, which means that addressing this issue requires the adaptation and customization of management strategies to each institution's specific context.

3. RESEARCH OBJECTIVES, METHODOLOGY AND DATA

3.1 Research objectives

The objectives are fourfold: to analyze the relationship between the country's level of digitalization and the efficiency of universities' operations, as well as their positions in international rankings; to argue the importance of research on the management of educational digital transformation processes as a highly relevant field of study that encompasses technological, social, and managerial discourse; to evaluate how various digitalization indicators, such as the prevalence of mobile broadband or the extent of electronic information sharing, affect university administrative and academic activities; to provide recommendations for potential research directions in the management of educational digital transformation processes, aiming to ensure the effective and purposeful integration of technologies into the education system, while strengthening the sustainable competitiveness of higher education institutions in the global context.

3.2 Methodology

A mixed methodological approach was used in the study, including empirical and theoretical analysis methods to assess the factors influencing the digitalization of educational processes. For the theoretical analysis, a review of scientific literature was conducted, analyzing research on the impact of digitalization processes on higher education institutions' governance, teaching quality, and efficiency. For the empirical analysis, correlation analysis was applied to identify statistically significant relationships between the country's digitalization level (DESI indicators) and universities' positions in the QS global ranking. Regression analysis was used to assess the impact of specific digitalization indicators (e.g., mobile broadband usage, electronic information sharing) on university performance outcomes. The choice of correlation and regression analysis was based on their ability to reveal the strength and direction of relationships between variables, and to evaluate the predictive impact of independent variables on a dependent outcome. These techniques are widely accepted and well-established in quantitative research, particularly in studies involving socioeconomic and institutional performance data. The assumptions for linear regression—such as linearity, independence, homoscedasticity, and normality of residuals—were verified through diagnostic plots and statistical checks during data processing. Correlation analysis assumed interval-level data and non-collinearity, both of which were met in the dataset used. Thus, the methodological application adhered to standard empirical research practices, ensuring the robustness of the results without the need for complex model adjustments. Furthermore, due to the high accessibility and transparency of DESI and QS indicators, the analysis is replicable and easily

interpretable for policy-makers and academic stakeholders. The study's results contribute to the development of theoretical and practical knowledge, providing insights into optimizing digitalization processes and strengthening the sustainable competitiveness of higher education institutions in a dynamic digital environment.

The QS World University Rankings is an international university evaluation system that includes several key indicators, such as academic reputation, employer ratings, student-to-faculty ratio, internationalization level, and research quality. The QS ranking reflects not only the academic level of a university but also its ability to adapt to global education trends, including digital transformation, innovation, and the integration of technology into teaching and learning. For this reason, it is important to explore how national digitalization indicators are related to universities' positions or number of highly evaluated universities in the country in these rankings (OECD, 2023).

In order to find out what relationship exists between the level of digital transformation of the country and the positions of the universities in the QS ranking, this study utilized data from the QS World University Rankings for European universities and the Digital Economy and Society Index (DESI) for 2024, calculated by the European Union (European Commission, 2024). The following DESI indicators were used to assess the country's digitalization level: Internet use (% of individuals, 2024), which reflects the spread of Internet usage among the population; mobile broadband take-up (% of individuals, 2024), indicating the extent of mobile broadband network usage; and electronic information sharing (% of enterprises, 2024), which measures the prevalence of electronic information-sharing practices in the business sector. Additionally, population size was included in the analysis as a control factor to evaluate how demographic aspects might influence the country's digitalization level and university performance (Eurostat, 2024).

4. RESULTS AND DISCUSSION

Effective management ensures that all processes are consistently integrated and aligned with the institution's overarching goals. By applying effective management decisions, universities can create a more favorable learning environment, which helps improve student satisfaction, reduce dropout rates, and encourage active engagement in the learning process. In this way, proper management of digitalization in education not only enhances the efficiency of university operations but also contributes to its sustainability and competitiveness in the long term, potentially ensuring a higher position in the QS rankings.

The data for this study were collected from the latest available sources to analyze the relationship between a country's level of digitalization and the performance of higher education institutions. Specifically, the study utilizes the DESI for 2024, which provides insights into national digital infrastructure, mobile broadband adoption, and electronic information-sharing practices. Additionally, university performance data were obtained from the QS World University Rankings, focusing on the most recent ranking positions of European higher education institutions. These datasets enable a comprehensive assessment of how digitalization indicators correlate with university rankings, operational efficiency.

The study adopted a mixed methodological approach, combining both empirical and theoretical analyses, in order to provide a comprehensive assessment of the impact of a country's level of digitalization on the performance of HEIs and their positions in international rankings which presents the perceived quality and competitiveness of the unit in the international arena.

The empirical analysis included a correlation analysis to identify statistically significant correlations between a country's level of digitalization (as measured by the DESI index) and the university's position in the QS World Ranking. The DESI indicators examined were mobile broadband usage, electronic information sharing practices and internet usage prevalence. The population of the country was also included as a control factor to assess whether demographics affect university performance.

Regression analysis showed that universities' positions in the QS ranking are significantly related to certain DESI indicators, in particular the use of mobile broadband and the volume of electronic information sharing. These indicators have a significant impact on university performance, but the coefficient of determination (adjusted R-squared) of the regression analysis showed that these factors explain only part of the variation in performance, while other important factors such as academic reputation, quality of research, student mobility, or international partnerships may also be significant.

The results of the study have been presented in figures (see Fig. 2, Fig. 3, Fig. 4, Fig. 5, Fig. 6) and tables (see Tab. 1, Tab. 2), which visually display the results of the correlation and regression analyses, as well as brief summaries of the data. These data reveal that the position of higher education institutions in international rankings is closely related to the level of digital transformation of a country. This suggests that investments in digital infrastructure and technological accessibility are important to strengthen the competitiveness of higher education institutions and to ensure higher quality of studies in a global context.

	Rank	DESI_internet	DESI_mobile	DESI_electronic	Population
Rank	1.00	-0.23	-0.42	-0.48	-0.08
DESI_internet	-0.23	1.00	0.56	0.39	-0.07
DESI_mobile	-0.42	0.56	1.00	0.50	0.23
DESI_electronic	-0.48	0.39	0.50	1.00	0.19
Population	-0.08	-0.07	0.23	0.19	1.00

n= 325

Fig. 2 – Correlation Analysis Results No. 1. Compiled by authors

P					
	Rank	DESI_internet	DESI_mobile	DESI_electronic	Population
Rank		0.0000	0.0000	0.0000	0.1610
DESI_internet	0.0000		0.0000	0.0000	0.1936
DESI_mobile	0.0000	0.0000		0.0000	0.0000
DESI_electronic	0.0000	0.0000	0.0000		0.0005
Population	0.1610	0.1936	0.0000	0.0005	

Fig. 3 – Correlation Analysis Results No. 2. Compiled by authors

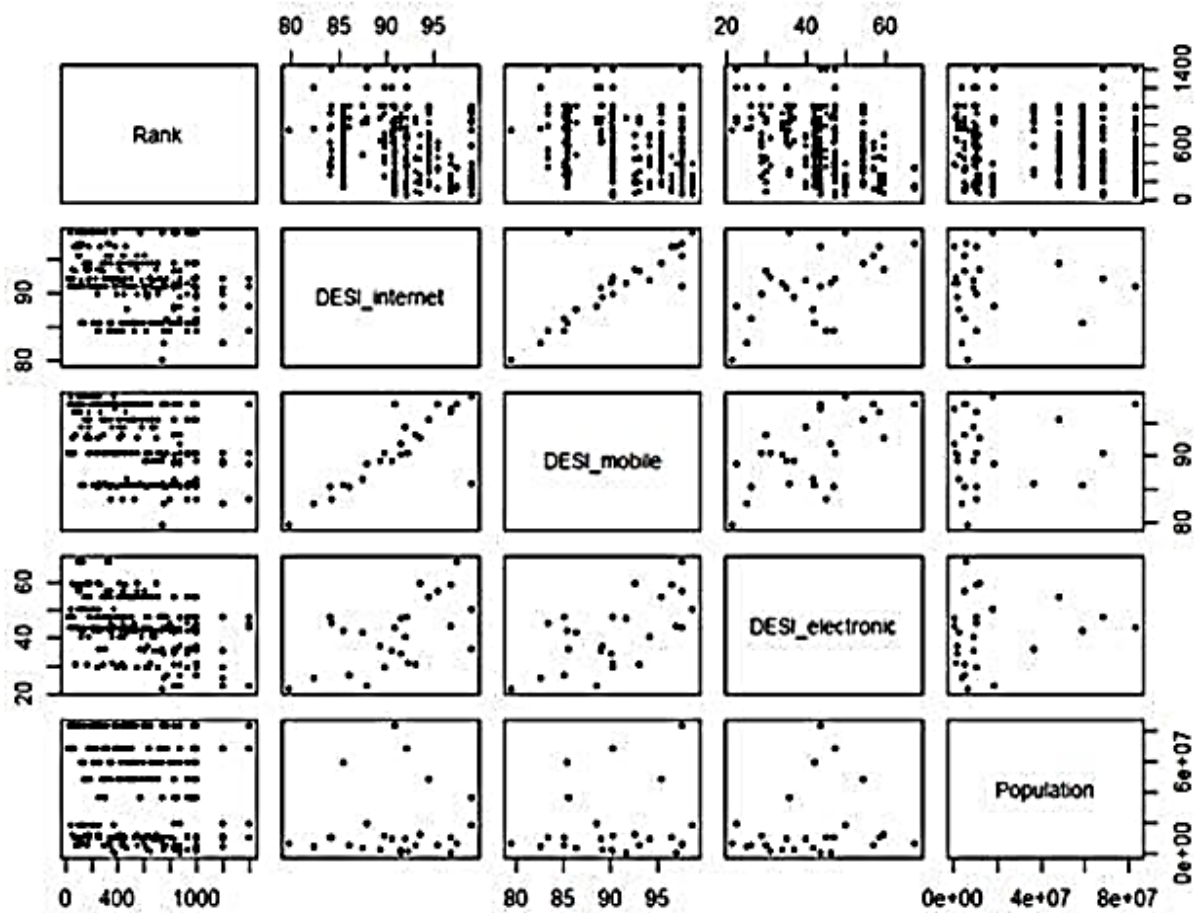


Fig. 4 – Correlation Analysis Results No. 3. Source: own research

The ranking, i.e., the university's position in the ranking, is significantly correlated with DESI indices ($p < 0.05$), but not with the population ($p > 0.05$). After performing the regression analysis, the following results were obtained.

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	2801.324	328.405	8.530	5.81e-16	***
Dat\$DESI_mobile	-17.691	3.972	-4.453	1.17e-05	***
Dat\$DESI_electronic	-12.938	2.024	-6.392	5.74e-10	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 307.3 on 322 degrees of freedom

Multiple R-squared: 0.2706, Adjusted R-squared: **0.2661**

F-statistic: 59.73 on 2 and 322 DF, p-value: $< 2.2e-16$

Fig. 5 – Regression Analysis Results No. 1. Compiled by authors

The best model is obtained when the ranking value, i.e., the university's position in the QS ranking, is predicted based on the DESI mobile broadband take-up (% of individuals, 2024) and

DESI electronic information sharing (% of enterprises, 2024) indicators. This indicates that these indicators have a significant impact on the ranking value.

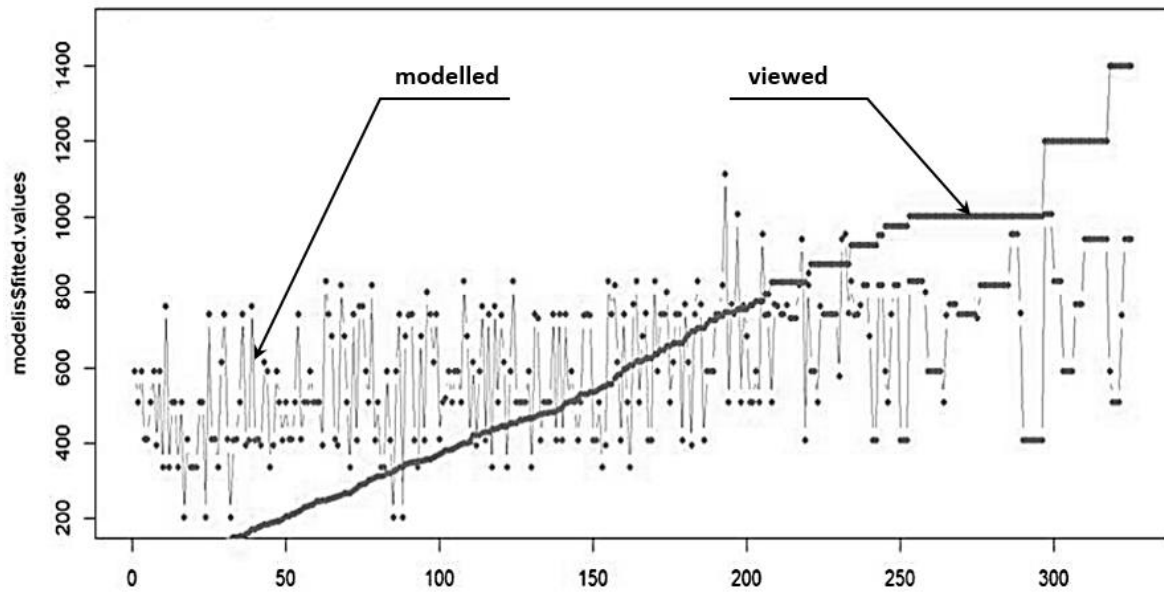


Fig. 6 – Regression Analysis Results No. 2. Compiled by authors

Since the adjusted R-squared value of 0.2661 is relatively low, this indicates that the university ranking position in the QS ranking depends significantly on other factors that were not included in this analysis. A summary of the results from the correlation analysis is provided in Tab. 1.

Tab. 1 – Summary of the Results of the Correlation Analysis. Compiled by authors

Results	Commentary
Significant correlation between DESI indices and university rankings ($p < 0.05$)	This result indicates that the country's digitalization indicators, measured by the DESI indices, have a significant correlation with university positions in the QS ranking. It suggests that the country's digital infrastructure and level of digitalization contribute to the international competitiveness and performance efficiency of universities.
No correlation with population ($p > 0.05$)	The lack of effect from population size indicates that the country's size is not a crucial factor in determining university rankings in the QS rankings. This emphasizes that investments in digital infrastructure and technologies are more important than demographic indicators.

A summary of the results from the regression analysis is provided in Table 2.

Tab. 2 – Summary of the Results of the Regression Analysis. Compiled by authors

Results	Commentary
The best regression model includes the "DESI mobile	Mobile broadband availability is significant because it is related to students' and faculty's access to learning

broadband take-up” and “DESI electronic information sharing” indicators:	resources, facilitates distance learning, and ensures smooth communication. The electronic information sharing indicator reflects advanced business and institutional technologies, which can directly affect the digitalization and efficiency of university administrative and teaching processes.
Adjusted R-squared value (0.2661)	This low value indicates that the selected DESI indicators explain only about 26.61% of the variance in university rankings in the QS ranking.

The “DESI mobile broadband take-up” and “DESI electronic information sharing” indicators statistically significantly predict university positions in the QS ranking. However, considering the low adjusted R-squared value (0.2661), it can be concluded that other important factors were not included in this analysis. These could include indicators such as academic reputation, research quality, student mobility, international partnerships, or financial investments in higher education.

Based on the research results, it has been established that a university’s position in the QS ranking is related to the DESI indices. The QS ranking position can be predicted based on the DESI mobile broadband take-up (percentage of individual users, 2024) and DESI electronic information sharing (percentage of companies, 2024) indicators. These indicators significantly influence the university’s rank value. Therefore the management of educational digitalization processes is a relevant and significant research direction, influencing institutions’ competitiveness in the global ranking system. Flexible management allows institutions to adapt to constantly changing conditions and ensures that various departments and units work together to achieve a common goal. Scholars’ views on the management of educational digitalization highlight different yet interrelated aspects.

Evaluating the opinions of scholars and the results obtained from the research, the following table presents the challenges of managing the digitalization of education processes in higher education and the directions for further research (see Tab. 3).

Tab. 3 – Challenges of Managing Educational Process Digitalization in Higher Education and Directions for Future Research. Compiled by authors

No.	Direction of Operational Challenges	Possible Research Directions
1.	Adapting Management Structures:	Research is needed to explore how educational institutions can adapt their management structures for more effective integration of new technologies. This includes process optimization and developing new competencies among administrators and faculty members.
2.	Creating Digital Strategies	It is important to develop and assess digital transformation strategies that encompass all educational processes. Research could help identify best practices and effective methods for implementing

		digitalization in a way that benefits all participants in the learning process.
3.	Resource Management	Digitalization processes require effective resource management, including both financial and human resources. Research could explore how to make better use of available resources and ensure that technology implementation is economically sustainable.
4.	Ensuring Quality	Further analysis is needed to understand how digitalization can impact the quality of education. Research could focus on developing and evaluating quality standards to ensure that technologies are used effectively and align with educational goals.
5.	Support Systems for Students and Faculty	It is important to identify the ways to provide support for students and teachers to reduce the stress associated with digitalization and increase their confidence in using technologies. This may include training, consultations, and continuous support systems.

Ensuring the quality of education is one of the key challenges and priorities in the process of digital transformation. In this context, educational quality refers not only to academic outcomes, but also to the relevance, accessibility of latest scientific research findings, and inclusiveness of the learning experience, sustainable management of HEIs. Digitalization affects quality through several interrelated dimensions: by enabling more personalized and flexible learning, enhancing the availability and diversity of learning resources, and supporting innovative teaching methods that increase student engagement. Moreover, quality is closely linked to the digital competences of educators, the adaptability of curricula, and the strategic integration of technology into educational processes. Therefore, the successful management of digital transformation must ensure that technological tools are not implemented in isolation but rather aligned with pedagogical goals and supported by systemic institutional change. This integrated approach is essential to achieving meaningful improvements in the quality of higher education in a digitally evolving environment.

Studies conducted in other European and global contexts reveal similar patterns, confirming the importance of digital infrastructure in strengthening the competitiveness of institutions. For example, Hashim et al. (2022) highlighted that higher education institutions that adopt strategic digital transformation initiatives tend to demonstrate better academic performance and global visibility. Similarly, Gorbunov et al. (2022) highlighted that digital infrastructure and the integration of advanced digital tools are positively correlated with administrative efficiency and research productivity in universities across Central and Eastern Europe. These findings are in line with this study, where indicators such as mobile broadband use and electronic information sharing showed significant associations with university rankings.

Furthermore, Alenezi (2023) and Antonopoulou et al. (2023) argue that countries with strong digital policies and investments in e-learning platforms outperform others in terms of student engagement, research output and international collaboration. This supports the conclusion that digital transformation is not only a local institutional concern but also a global strategic imperative for higher education governance.

In order to effectively manage the digitalization of educational processes, it is essential to further research related issues and opportunities. These studies will help not only optimize the digitalization processes but also ensure that the education system is prepared to meet contemporary challenges and opportunities. Only by thoroughly analyzing management aspects can a successful transformation of education through digital tools be achieved.

5. CONCLUSIONS

The overall level of a country's digitalization directly impacts the quality and effectiveness of higher education, as digital tools, infrastructure, and services provide opportunities to enhance teaching content, accessibility, and student engagement. Digitalization facilitates the integration of advanced technologies into educational practices, enabling institutions to offer more interactive and personalized learning experiences. For instance, digital platforms can support a variety of teaching methods, including blended learning, online courses, and virtual classrooms, which cater to diverse learning styles and needs.

Moreover, the higher the country's digitalization level, the greater the likelihood that students will have access to modern technologies and skills necessary for the contemporary labor market. These technologies not only facilitate the learning process but also strengthen the competitiveness of higher education institutions, as they can offer globally accessible resources, innovative teaching methods, and international collaboration networks. Access to cutting-edge technologies such as artificial intelligence, machine learning, and big data analytics equips students with the skills required to thrive in a rapidly evolving job market. Additionally, digitalization fosters a culture of continuous learning and adaptability, which is essential for professional success in the digital age.

The correlation and regression analysis methods used in this study allowed for an assessment of the overall relationship between the country's digitalization level and universities' positions in the QS ranking, as well as the identification of key indicators that have the greatest impact on university competitiveness. The analysis revealed that the country's digital infrastructure, particularly mobile broadband and electronic information sharing indicators, are significant factors that can contribute to improving higher education quality. The results also highlight that those investments in digital infrastructure, especially in mobile technologies and digital services, can have a direct impact on higher education and its competitiveness, making these areas a priority in national strategies.

These results lay the foundation for conducting further research in the field of management of digitalization of education process, with the aim of developing strategic decisions for the expansion of digitalization policies, ultimately enhancing university performance and their international competitiveness. Management of the digitalization process is a crucial scientific issue that requires further investigation. Future studies could explore in more depth how digitalization management practices can be applied in various education systems, taking into account national specifics and technological development.

Future research could investigate the role of leadership in driving digital transformation in higher education and its impact on competitiveness. Strong and visionary leadership is essential

for setting a clear direction, fostering a culture of innovation, and ensuring stakeholder engagement. Leaders must be proactive in addressing challenges such as resistance to change and the need for continuous professional development.

Furthermore, it is important to analyze how digital technologies can contribute to increasing the administrative and academic efficiency of educational institutions. Digital tools can streamline administrative processes, reduce operational costs, and improve data management and decision-making. Future research directions could include a more detailed analysis of the relationships between digitalization indicators and university outcomes, as well as the inclusion of additional factors such as international partnerships, research funding, or academic mobility of communities. These factors can significantly influence the success of digital transformation initiatives and should be considered in the development of comprehensive digitalization strategies.

At the same time, it is important to delve into the impact of digitalization policies in different countries on the effectiveness of education systems, considering local contexts and cultural differences. Comparative studies could provide valuable insights into best practices and common challenges, helping to inform policy decisions and implementation strategies. Future studies could contribute to the development of sustainable digitalization management models, ensuring high-quality education in the globally changing digital environment. These models should be adaptable to different educational contexts and capable of evolving in response to technological advancements and changing societal needs.

In conclusion, the digitalization of higher education is a complex and multifaceted process that requires careful planning, strategic investment, and strong leadership. By addressing the challenges and leveraging the opportunities presented by digital technologies, higher education institutions can enhance their competitiveness, improve the quality of education, and better prepare students for the demands of the modern workforce. Future research should continue to explore the various dimensions of digital transformation, including its impact on institutional culture, leadership practices, and the overall effectiveness of education systems in different contexts.

While this study provides insights into the relationship between national digitalization indicators and university performance in global rankings, several limitations should be acknowledged. First, the analysis is limited to selected European countries and is based only on QS World University Rankings and DESI indicators. The generalizability of the findings to other regions or ranking systems may be limited. Second, the relatively low adjusted R-squared value in the regression analysis suggests that a significant portion of the variance in university rankings remains unexplained. This suggests that additional variables such as research funding, faculty quality, academic reputation or international partnerships may play a crucial role in determining institutional success, but these were not included in the current model. The study focuses on quantitative indicators and does not assess qualitative aspects such as institutional culture, leadership practices or user experiences with digital tools. Incorporating these dimensions into future studies could provide a more comprehensive understanding of digital transformation in higher education.

Digital transformation acts as a strategic enabler of institutional competitiveness, promoting innovation, adaptation and responsiveness to global trends. The concept of competitiveness is becoming increasingly important in the context of the digital transformation of higher education. Institutions that successfully integrate digital technologies into their educational and administrative processes can significantly improve their reputation, attract international students and faculty, and improve their positions in global rankings. Digital transformation acts as a strategic enabler of institutional competitiveness, fostering innovation, adaptation, and responsiveness to global trends. Universities that invest in a robust digital infrastructure and prioritize the digital literacy of their stakeholders are better equipped to meet the evolving needs of the knowledge economy. Furthermore, competitive higher education institutions are not only technologically advanced, but also flexible in aligning their strategies with broader societal and labor market changes. This ability to adapt allows them to thrive in an increasingly connected and digitized academic environment. Therefore, competitiveness in the digital era depends not only on resources or scale, but also on strategic vision, institutional leadership, and a commitment to inclusive, technology-enabled education.

Additionally, it would be beneficial to analyze how digital technologies can contribute to increasing the administrative and academic efficiency of educational institutions. Future research directions could include a more detailed analysis of the relationships between digitalization indicators and university outcomes, as well as the inclusion of additional factors such as international partnerships, research funding, or academic mobility of communities. At the same time, it is important to delve into the impact of digitalization policies in different countries on the effectiveness of education systems, considering local contexts and cultural differences. Future studies could contribute to the development of sustainable digitalization management models, ensuring high-quality education in the globally changing digital environment.

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