



Влияние цифровизации на конкуренцию между университетами

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АННОТАЦИЯ

Введение. Сегодня университеты стремятся повысить свою конкурентоспособность, их результаты в международных рейтингах становятся особенно важными и показывают эффективность их работы. Эти рейтинги, часто рассматриваются как стандарт качества образования.

Цель статьи – определить влияние цифровизации на повышение конкурентоспособности университетов.

Методы. Были использованы два основных источника данных: академические статьи, опубликованные в период с 2013 по 2023 год и данные с официальных сайтов основных международных рейтингов, таких как Webometrics, ARWU (Академический рейтинг мировых университетов), QS и THE (Times Higher Education). Для анализа связи цифровизации университетов и их рейтингами был проведен корреляционный анализ с использованием коэффициента корреляции Пирсона. Критерии включали количество программ онлайн-обучения, объем произведенного цифрового контента (например, статей, мультимедийных ресурсов) и онлайн-видимость университетов, измеряемую внешними ссылками на веб-сайты и количеством цитирований. Данные рейтингов были изучены на предмет позиций в рейтингах Webometrics, ARWU, QS и THE, с особым акцентом на цифровые показатели, такие как присутствие в сети и доступность академических ресурсов.

Результаты исследования. Значительные корреляции были обнаружены между рейтингами университетов в Webometrics и других крупных международных рейтингах, включая ARWU, QS и THE. В частности, значимая корреляция ($r = 0,738$; $p < 0,01$) наблюдалась между рейтингами Webometrics и ARWU, который в первую очередь измеряет результаты исследований. Кроме того, корреляция была обнаружена между Webometrics и THE ($r = 0,58$; $p < 0,01$), который подчеркивает качество исследований, указывая на то, что университеты с сильным цитированием в Интернете показывают лучшие результаты в рейтингах, основанных на исследованиях. Дальнейший анализ показал, что производство цифрового контента (например, количество академических публикаций и мультимедийных ресурсов) и онлайн-видимость (измеряемая внешними ссылками и количеством цитирований) были значимыми предикторами общего рейтинга университета.

Заключение. Университеты, характеризующиеся обширным цифровым контентом, надежной онлайн-видимостью и интеграцией передовых цифровых инструментов, постоянно показывают лучшие результаты как в исследовательских, так и в более широких международных рейтингах. Результаты подчеркивают важность согласования институциональных стратегий с тенденциями цифровизации для обеспечения и поддержания высоких рейтингов. Чтобы повысить конкурентоспособность, университеты должны отдавать приоритет цифровизации образовательных и административных процессов, включая внедрение инновационных технологий, разработку платформ онлайн-обучения и улучшение своей цифровой инфраструктуры.

КЛЮЧЕВЫЕ СЛОВА

университет, цифровизация, цифровая трансформация, международный рейтинг, конкурентоспособность

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Influence of digitalization on inter-university competition

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ABSTRACT

Introduction. The The relevance of the study is driven by the growing impact of digitalization on higher education. As universities strive to enhance their competitiveness, their performance in international rankings becomes particularly important, serving as a benchmark for educational quality.

The aim of this article is to determine the impact of digitalization on improving the competitiveness of universities.

Methods. To analyze the impact of digitalization on university competitiveness, a combination of qualitative and quantitative methods was used. Two main data sources were utilized: academic articles published between 2013 and 2023, and data from the official websites of major international rankings such as Webometrics, ARWU (Academic Ranking of World Universities), QS, and THE (Times Higher Education). A correlation analysis using Pearson's correlation coefficient was conducted to explore the relationship between university digitalization and rankings. The criteria included the number of online learning programs, the volume of digital content produced (e.g., articles and multimedia resources), and online visibility measured by external links to university websites and citation counts. Ranking data were examined for positions in Webometrics, ARWU, QS, and THE, with a particular focus on digital metrics such as web presence and the availability of academic resources. Statistical significance was assessed using a threshold of <0.05 to determine the strength of the relationship between digital engagement and university rankings.

Results. Significant correlations were found between university rankings in Webometrics and other major international rankings, including ARWU, QS, and THE. In particular, a strong positive correlation ($r = 0.738$; $p < 0.01$) was observed between Webometrics and ARWU rankings, which primarily measure research outcomes. Moreover, a moderate correlation ($r = 0.58$; $p < 0.01$) was identified between Webometrics and THE rankings, emphasizing research quality and indicating that universities with strong online citations tend to perform better in research-based rankings. Further analysis revealed that the production of digital content (e.g., the number of academic publications and multimedia resources) and online visibility (measured by external links and citation counts) were significant predictors of a university's overall ranking. Universities that actively engaged in creating and disseminating digital content, including open-access resources and online courses, scored higher in Webometrics rankings, which in turn positively influenced their positions in traditional rankings like QS and THE.

Conclusion. The study demonstrates the significant impact of digitalization on shaping inter-university competition and enhancing the global competitiveness of higher education institutions. Universities characterized by extensive digital content, robust online visibility, and the integration of advanced digital tools consistently achieve better outcomes in both research-specific and broader international rankings. The findings underscore the importance of aligning institutional strategies with digitalization trends to maintain and improve high rankings. To enhance competitiveness, universities should prioritize digitalizing educational and administrative processes, including the adoption of innovative technologies, the development of online learning platforms, and improvements to their digital infrastructure.

KEYWORDS

university, digitalization, digital transformation, international ranking, competitiveness

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INTRODUCTION

Today, supranational management in higher education is gaining more importance. This level is formed by international networks of agents ensuring the quality of education, international associations, student unions, accreditation consortia, and structures providing standards for the global educational policy (UN Educational, Scientific, and Cultural Organization, Organisation for Economic Co-operation and Development) or acting as advisory organizations (Global Association of Transnational Education). Through adapted pedagogical approaches, digital transformation offers innovative means to facilitate personalised, flexible, learner-centred environments that promote mobility, flexibility and lifelong learning. When embedded in contexts that promote democratic values and overcome any biases accentuated by technology [1].

The feature of the contemporary development of higher education is the overlapping of global and regional institutional changes. At the global level, the main institution that implements the functions of regulating the education system is a specialized UN agency – UNESCO. UNESCO has six institutes and two centers directly focused on education. Their priorities are to ensure quality inclusive education for all and promote lifelong learning [2]. In higher education, UNESCO supports national efforts to reform education systems. To this end, UNESCO establishes international and regional networks to share best practices, support leadership programs for female educators, improve teacher qualifications and credential recognition, assist member states in planning and developing policies on the use of information and communications technology (ICT) in education, and provide lifelong learning opportunities.

UNESCO also develops international projects, programs, and measures to build the foundations of a quality and competitive education system, develop mechanisms for its regulation and policy, prepare relevant information and analytical materials, etc. In the institutional structure of UNESCO, the International Institute for Educational Planning (IIEP) supports the quality of educational policies. To assist educational policymakers in assessing the quality of programs and their improvement and to share experience in educational management, IIEP has created a special educational portal [3].

For instance, In Singapore a study on information literacy showed that children and youth without internet access at home tended to be less proficient in selecting and synthesizing information. Some 12,500 devices were loaned out to ensure all students were connected during the school closure. The COVID-19 pandemic led to the institutionalization of home-based learning. Since 2021, lower and upper secondary school students have been able to choose to study remotely two days a month. The practice has also been piloted in selected primary schools. As a result, all 144,000 secondary students were to be provided with a personal learning device to study from home on a regular basis, bringing the target date to the end of 2021 instead of 2028 as originally planned [4].

The International Association of Universities (IAU) is a non-governmental organization that unites higher education institutions in 150 countries worldwide and cooperates with regional and national authorities. The main objectives of the IAU are to create a flexible legal framework regulating the relations of higher education institutions and to represent and protect their interests in the global arena. The organization provides financial support to its members through a system of grants and premiums. Information and analytical publications issued by the IAU include the World Higher Education Database, the Higher Education Policy journal, the IAU gazette, the Higher Education Issues analytical collection, and annual reports on the Association's activities [5].

The leading role in the implementation of EU education programs is played by the European Education and Culture Executive Agency (EACEA). Since 2011, the EACEA has published thematic reports, special studies, and surveys on higher education and related policies [6]. The European Association for Quality Assurance in Higher Education (ENQA) implements external quality assessment of European higher education. One of the main results of ENQA's activities in recent years is the adoption of Standards and Guidelines for Quality Assurance in the European Higher Education Area. The second step in the practical implementation of the standards was the creation of the European Quality Assurance Register for Higher Education (EQAR) to develop a database of reliable quality assurance agencies operating in Europe and to increase trust in higher education institutions [7].

The competitiveness of universities is based on their ability to occupy and consistently hold strong positions in the educational segment of the global market, which ensures dynamic growth in innovation and integration. The ranking of a university refers to its position in the ranked order of a group of universities. University rankings target different audiences, including employers, students, investors, and educational institutions.

The International Ranking Expert Group (IREG) coordinates international work in this area. It was established in 2002 with the participation of the UNESCO European Centre for Higher Education and leading experts in university rankings. The organization has developed the Berlin Principles on Ranking of Higher Education Institutions [10] that reflect internationally recognized approaches to university rankings. Since December 15, 2011, IREG has conducted voluntary audits of regional, national, and international university rankings and held international conferences that bring members of the academic community to the table to discuss the development and improvement of university rankings. In the first years of their existence, the ratings were mainly focused on assessing research activity. Today, the efforts are aimed at finding universal indicators to assess the quality of university education [11].

Background

The concept of digitalization has become incredibly topical for contemporary society. The study of the definition of digitalization and its derivatives proves that it has established in the scientific setting recently, is associated with the large-scale penetration of ICT in everyday life, and has evolved into many distinct areas, considering its aspects. Scientific developments reflect issues pertaining to the scientific understanding of this category [10], its structure [11], and specific features [12] resulting from the rapid development of ICT.

The saturation of the real world with electronic-digital devices, tools, and systems and the establishment of electronic communication exchange between them leads to the digitalization of education as a component of society [13]. As suggested by L. Seres et al. [14], the digitalization of education is associated with its modernization, reform, and transformation, as well as problem-solving and decision-making using digital technologies. Researchers argue that digital technologies should be embedded in all areas of education, including teacher training, educational infrastructure, methodology (pedagogy), teaching and learning resources, leadership, and management [6]. Digital technologies provide an opportunity to intensify the educational process and improve the level and quality of knowledge perception, understanding, and assimilation [15]. Digital technologies offer new opportunities for teachers and students, including the pleasure of an engaging process of communication and learning [16]; automation of most of the teaching work, which frees up time for inquiry, communication, self-improvement, individual work with students, and individual adjustment of student development [17]; the provision of feedback and improved efficiency of educational management [18].

Researchers consider the main directions of digitalization in higher education to be the creation of educational resources and digital platforms supporting interactive and multimedia content for shared access by higher education institutions and students, particularly tools to automate the key processes of university operations [19]; the development and implementation of innovative computer, multimedia, and computer-oriented learning tools and equipment to create digital learning environments (multimedia classrooms, STEM research centers and laboratories, inclusive classrooms, blended learning classrooms) [20]; free access to the Internet for students in classrooms [21]; the development of distance education using cognitive and multimedia technologies [22].

The theory and methodology of university rankings are explored in academic discourse just as actively as digitalization. M.G. Roth and W.P. McAndrew [23] report that there are more than a thousand scientific publications devoted to university rankings and suggest that this considerable body of literature can be divided into two groups: 1) research on the methodology of university rankings and 2) theoretical understanding of the phenomenon of university rankings.

D.L. Kuznetsov [24] suggests that the emergence and rapid development of international university rankings in the 21st century can be perceived as a peculiar mechanism for creating an appropriate legitimization tool. C. Perez-Esparrells and E. Orduna-Malea [25] note that the main task of rating compilers is to rely on the most important, fundamental criteria. The same aspect is stressed by C. Daraio and A. Bonaccorsi [26] who argue that any rating system is conditioned by the purpose that the researchers have in mind and therefore relies on the beliefs and values that shape the methods of comparison and evaluation.

Rankings compare HEIs using a range of different indicators, which are weighed differently according to each ranking system. Information is generally drawn from three different sources: independent third party sources, e.g. government databases; HEI sources or survey data of students, employers or other stakeholders (Table 1).

Table 1

What features are used by analytical centers to rank the higher educational institutions

Ranking System	Indicator Dimension	Weighting
SJT Academic Ranking of World Universities	•Quality of Education	10%
	•Quality of Faculty	
	•No. Nobel Prize/Field Medal	20%
	•No. HiCi Researchers	20%
	•Research Output	
	•No. Articles in Nature/Science	20%
	•No. Articles in Citation Index	20%
	•Size of Institution	10%
Times QS World University Ranking	• Peer Appraisal	40%
	• Graduate Employability	10%
	• Teaching Quality/SSR	20%
	• International Students	5%
	• International Faculty	5%
	• Research Quality/Citations per Faculty	20%
Performance Ranking of Scientific Papers for Research Universities	• Research Productivity	
	•No. Articles in last 11 years	10%
	•No. Articles in current year •Research Impact	10%
	•No. Citations in last 11 years	10%
	• No. Citations in last 2 years	10%
	•Aver. no Citations in last 11 years •Research Excellence	10%
	•HiCi index of last 2 years	20%
	•No. HiCi Papers, last 10 years	10%
	•No. Articles High-Impact Journals in Current Year	10%
	• No. Subject Fields where University Demonstrates Excellence	10%

Source: [27; 28]

However, such rating systems reflect the realities of higher education in full (for example, the success of university research does not say anything about the real state of business education or the teaching of specialized technical disciplines) and have a margin of error. Not all experts in the education industry unreservedly accept the idea of developing university rankings, not to mention the harsh criticism of specific methodologies. C. Daraio et al. [29] note that many university administrations perceive rankings as a reference point in their daily work. According to M. Jarocka [30], representatives of the academic community are critical of rankings, as they are often misleading regarding the true essence of modern universities and have numerous methodological limitations.

A separate pool of studies focuses on assessing the level of university digitalization. V.G. Khalin [31] raises the issue of indicators responsible for the competitiveness of universities (including digital ones) that can be used to assess the quality of services, which serves as a key competitive advantage. V.G. Khalin [31], E.V. Plotnikova et al. [32] and E.V. Brodovskaia [33] formulate criteria for developing a comprehensive assessment that can be used as a basis for evaluating the level of university digitalization. Using these criteria, A.G. Izotova and E.S. Gavriluk [34] analyze the level of digitalization of several Russian universities as one of the main factors in the competitiveness of higher education institutions.

Modern researches on university rankings indicates that these metrics have evolved from focusing on research output to incorporating broader indicators that reflect institutional quality, inclusivity, and innovation [35]. Discrepancies between different ranking methodologies highlight the need

for nuanced criteria that accurately represent the diverse roles and contributions of universities worldwide. Scholars emphasize the importance of digital indicators such as online presence and digital infrastructure as core components of competitiveness in the education environment [36]. This underscores that universities committed to digital transformation are more likely to secure favorable positions in rankings, enhancing their visibility and appeal to global stakeholders.

Thus, *the purpose of this article* was to analyze the influence of digitalization on inter-university competition.

METHODS

In the first stage of the research, the information sources needed to realize the purpose of the study were selected. The study data were represented by two information arrays.

The first array included articles and reviews published in journals indexed by Scopus and Web of Science. The search criteria were the topics of digitalization of higher education, university competition, and international university rankings. The databases searched included Google, ResearchGate, and Springer Nature. The date of publication was restricted to no earlier than 2013. The search was performed based on keywords in English and Russian in the title, abstract, and keywords. As a result, 55 unique publications were recognized as relevant, including 47 English-language and five Russian-language articles.

The second array included information obtained from the official websites of international university rankings.

The second stage involved the analysis of information sources. The analysis of the source base was conducted using theoretical generalization, comparative analysis, and synthesis. A targeted approach was applied to the selected materials. As the materials were reviewed, additional search was performed to build a complete picture. Two factors were used to determine whether to include a document in the analysis: (1) each document had to contain data pertinent to the research questions, and (2) each document had to be authenticated.

A quantitative assessment of the relationship between the level of digitalization and university rankings was carried out using correlation analysis.

The analysis involved calculating Pearson's correlation coefficients to determine the strength and direction of the linear relationship between universities' digital presence, as measured by Webometrics rankings, and their positions in other rankings, such as the Academic Ranking of World Universities (ARWU), the Quacquarelli Symonds World University Rankings (QS), and the Times Higher Education World University Rankings (THE). Correlation coefficients were calculated to determine the degree of association between variables, which showed significant correlations suggesting a strong relationship between digitalization efforts and improved university rankings.

To assess the statistical significance of the correlations, the analysis included hypothesis testing using p-values. This study used a threshold of $p < 0.05$, which is a common criterion for statistical significance in social science and educational research.

RESULTS

Digitalization and the digital transformation of universities

Higher education is an area demonstrating the intensification of the use of digital tools. Universities actively shaped the digital environment at the early stages of its development.

In Russia, this potential is not utilized to the fullest. On the one hand, scientists and universities actively create projects to develop digital solutions. On the other hand, the success of these efforts requires their coordination and stable financial and institutional support. The success of universities' digital transformation hinges, among other things, on the level of digital competence of all staff, their knowledge of the potential of digital solutions, and the existence of clear rules that ensure the safe

and effective use of digital tools [31]. These factors relate not only to the technological solutions but also to the processes and organization.

Digitalization understood as the transition from analog to digital formats is only one element of the changes underway. To fully capture the nature of the change, its technological, process, and organizational dimensions must be considered. The changes detected in universities due to the ongoing digitalization and the adoption of new technologies allow us to identify key features of digital transformation. First, the complexity of the digital transformation exceeds that characteristic of the introduction of new IT solutions because the digital transformation implies a deep transformation of all areas of the organization and its environment, not just the IT infrastructure. Second, we are now dealing with the combined effects of different technologies, as each innovation uses the potential of another and amplifies the effect of its impact, resulting in a blend of solutions at the physical and digital levels. Third, the effects of digital transformation and its potential benefits are much more significant than classical digitalization, as they contribute to changes in the functioning of institutions, actors, and recipients of the given value [19]. Digital transformation refers to improved operational efficiency, productivity, or cost reduction (e.g., through process automation) and often a transformation of the way universities operate.

Thus, digital transformation is primarily an organizational change implemented through digital technologies to adapt to the requirements of the social environment and stakeholders. The categories of organizational change driven by digital transformation include operational models, organizational structure, people/personnel, processes, technologies used to gather and manage information, the scope of services, and the patterns of collaboration with the environment [21].

The digital transformation of higher education goes beyond implementing technological tools in universities. It is a systemic change that accounts for a transformation of the organizational culture from hierarchical to network culture, the introduction of new decision-making methods based on centralized and standardized data, and the improvement of the digital competencies of all university staff, including teachers and researchers, using the instruments that support and develop didactic innovations and research activities or build relationships with alumni through new communication channels.

The digital transformation of higher education also refers to using virtual environments to bring new areas of university activity to life, for example by offering curricula based on massive open online courses, e-learning, virtual reality, and artificial intelligence. Digital transformation also implies the ability to better monitor operational activities and the consequences of these activities by integrating systems and data sources and therefore accessing real-time information, which facilitates decision-making [16].

Digital transformation has a profound impact on learning processes. Education was once considered a public good, provided only by universities that were not subject to market pressures and fulfilled a social mission. Today, according to the world standard, education is a service provided by different organizations operating in an increasingly complex and competitive knowledge market. State-created regulation and the transfer of funds from public sources give many institutions a sense of stability and immutability in the world of knowledge. However, actors operating in market conditions notice the enormous changes in their daily reality.

The digital transformation of the higher education sector is additionally driven by the changing expectations and behaviors of knowledge consumers. Contemporary youth is widely digitized and focused on quick results. They find it increasingly difficult to accept the traditional hierarchy prevalent in higher education and the classical approach to education understood as knowledge transfer [22]. The requirements for content and learning outcomes are changing, dictated by the progressive digitalization of socio-economic life, labor market expectations, and the threats awaiting humanity (e.g., technological unemployment). Institutions and enterprises operating in economic sectors and managers of these organizations facing the challenges of digitalization need research results that respond to today's challenges, such as those caused by the advent of the age of AI and robotization.

Today's applicants are digital natives who act rationally and consciously when choosing a university [21]. When they begin their studies, the level of their technological development reflects on their approach to the educational process, from the desired forms and channels of interaction with teachers and university administration to the expected content of education and the way it is

delivered. Digital natives approach learning through social media and other convenient digital and multimedia systems that offer immediate and personalized interaction [20].

International rankings as an indicator of university competitiveness

Openness and transparency in higher education today is a societal challenge, a reputation, and a necessity. A step towards solving the issue of improving the quality of higher education is the introduction of internal and external monitoring of the quality of higher education and the presentation of monitoring results in the format of university rankings [25]. University rankings are needed by applicants to choose a university, by university administration for efficient administration, by employers for a quality workforce, and by government and politicians to form a stable regulatory framework and ensure the adequacy of the educational and labor market. Thus, the ranking system must satisfy all consumers of educational services and the organizers of higher education.

The higher education system ranking model reflects the state of reality. Based on the analysis of the functional areas of university activities, the ranking model identifies ten generalizing thematic areas: presentation of achievements at the international level; presentation of achievements at the national level; organizational structure and management; scientific and pedagogical potential; training of research and scientific-pedagogical personnel; integration of higher education and science; training of specialists; financial resources; information resources; and educational and social infrastructure [26].

The first attempts at ranking and evaluating universities were initiated in 1983 by the US News and the World Report, which first published their Best Colleges in America ranking [29]. The ranking of American universities relied on the following criteria: evaluations by representatives of the administration and other universities; the ratio of the number of graduates to the number of freshmen; the results of standardized freshman admission tests; the proportion between the number of applications submitted and the number of students enrolled; the quality of the faculty and faculty salaries; the financial cost of training one student; and graduates' assessment of the quality of instruction [29].

Over the last 10-15 years, various methodologies and approaches to university ranking have been developed and widely applied. The role of global coordinators in developing and applying them has been played by the Institute of Higher Education Policy, Washington, USA and the UNESCO European Center for Higher Education (UNESCO-CEPES), Bucharest, Romania. These bodies study and generalize developments in this field across different countries and regions and hold international conferences, round tables, and meetings [30].

At present, rankings are regarded as an objective integral indicator of quality. They provide an unbiased view of the higher education system, generate healthy competition between universities, contribute to the quality of their work, and largely meet the needs of the labor market, applicants, and their parents. Therefore, improving ranking methodologies has effectively become a global trend, and major studies are aimed at making the rankings as reliable, objective, accurate, and effective as possible.

The first of the world university rankings was the Academic Rating of World Universities (ARWU), or the Shanghai Ranking, compiled in June 2003 by the Institute of Higher Education, Shanghai University (China) [27]. The initial purpose of the ranking was to assess the level of Chinese universities' lagging behind the world's leading universities. This rating received positive feedback and is now considered one of the most authoritative and accurate world rankings [26]. The ARWU is based on the following criteria and indicators:

- quality of education (total weight of 10%), as measured by the number of graduates who have become Nobel laureates and the number of medals awarded in specific fields of knowledge (e.g., World Mathematical Union medals);
- the level of teachers (40%), which is calculated based on two components: a) the number of teachers who are Nobel laureates and the number of those awarded special marks in specific fields of knowledge (20%); b) citation index in scientific publications in 21 subject categories of the ISI Highly Cited version (20%);

- research performance (40%), which is determined by the number of articles published in prestigious academic scientific journals over the last 5 years and the number of articles with high citation indices in natural and social sciences;
- the so-called "academic density" (10%), which is determined by the ratio of the total number of points from the indicators to the number of full-time academic staff.

Notwithstanding, the compilers do not claim the ranking to be objective. Among the advantages of the Shanghai Ranking, they point out the comprehensibility and universality of the indicators, according to which the assessment is made, and the openness of the data used in compiling the rating. These data are taken from authoritative sources recognized worldwide. This is also supported by the fact that the methodology for calculating the rating has not undergone any significant changes in recent years [37].

In our view, the success of the Shanghai Ranking stems primarily from the fact that it is based on a university's ability to conduct modern research and be a center for producing new knowledge. A university's research potential allows one to assess its real contribution to the knowledge economy and adequately reflect the current realities in the global educational space.

Another widely recognized ranking of world universities is the Times ranking, or the THE-QS World University Rankings, first published in 2004 and covering 200 universities. Unlike the Shanghai Ranking, it uses objective and subjective indicators, particularly assessments by academic peers and employers. The evaluation of research and development activities, which nearly wholly determines the Shanghai Ranking, accounts for only a fifth of the total weight [38]. In compiling the ranking, British researchers relied on the following criteria: image in the academic environment, i.e., the evaluation by scientists, teachers, and administrators of other educational institutions (40%); employers' evaluation of the quality of graduates' education (10%); citation index of employees' scientific works (20%); share of foreign students (5%); share of foreign teachers (5%); student to teacher ratio (20%) [38].

The THE-QS ranking mainly evaluates marketing indicators and status parameters. Effective self-representation in the information space, a successful advertising strategy, a positive image that leads to recognition among colleagues, and real internationalization are the parameters that determine competitiveness in the modern world at the individual and institutional levels. Therefore, building a hierarchy of universities in this sphere, which contributes to the legitimization of elites in the global educational space, is adequate to the present.

Despite the differences in the indicators underlying these rankings, the basic principles of their construction are to some extent identical. Thus, comparing the Shanghai Ranking and the THE-QS ranking, researchers note that "these rankings share common approaches, despite the differences in the proposed indicators. Both rankings evaluate universities and use the principle of a hierarchical table, in which, as in soccer, each team holds a certain position that determines its status. With this approach, it is natural that, for example, the 5th position is better than the 8th or 10th" [26, p. 520].

The situation in international university rankings continues to evolve. Since 2010, the Times ranking as a joint project of the THE and the QS has ceased to exist and two new, potentially influential rankings have emerged on its basis: the Times Higher Education World University Rankings (with Thomson Reuters as a research partner) and the QS World University Rankings. In its ranking of world universities, the QS relies on a methodology developed previously during its cooperation with the Times.

The developers of the new Times (THE) ranking decided to change the methodology radically. Here are the five main comprehensive ranking indicators. The first is the assessment of the teaching and learning environment (30%). It includes the following indicators: a) teaching quality survey (15%); b) faculty/student ratio (5%); c) the ratio of awarded doctoral degrees to other degrees (2.25%); d) the number of doctoral dissertations defended relative to the number of researchers (6%); and e) the university's financial income per researcher (2.25%). The second is the estimation of financial gains from cooperation with industry and innovation on a per-employee basis (2.5%) [39].

The third comprehensive indicator is the evaluation of research activities. It includes a) the average citation index of each printed work (30%); b) a survey to assess the quality of research

capacity (18%); c) financial income from research activities per employee (6%); and d) the number of research papers per employee (6%).

Fourth, there is the assessment of university internationalization. It is calculated based on a) the ratio of foreign students to the total number of students (2.5%); b) the ratio of foreign teachers to the total number of teachers (2.5%); and c) the ratio of scientific papers published in co-authorship with foreign researchers to the total number of scientific papers (2.5%) [39].

Table 2 presents a comparative characteristic of international university rankings based on the analysis of information obtained from their official websites.

Table 2

Comparative characteristics of the key international rankings

Characteristics	QS World University Rankings (QS)	Times Higher Education World University Rankings (THE)	Academic Ranking of World Universities, (ARWU)
Research methodology	Expert-analytical research, ranking	Expert survey, statistical analysis, ranking	Statistical analysis, ranking
Direction of research	Research and educational activities		
Types of rankings	Global, by subject, by faculty, by region, among new universities, among campuses	Global, by subject, by region, among new universities	Global, by subject, by discipline
Frequency of research	Annual		
Research organizer	Quacquarelli Symonds consulting company	Times Higher Education, Thomson Reuters	Center for World-Class Universities of Shanghai Jiao Tong University

Compiled based on [37-39]

The impact of digitalization on inter-university competition

The digital transformation of universities hardly ever appears as a factor in university rankings. There are, however, some exceptions:

- U-Multirank – the collected data on universities include the number of online learning programs.
- Web of Universities (Webometrics) – evaluates universities based on their online presence, such as trying to calculate the level of accessibility of research results, visibility as measured by the number of external websites linking to the university's website, or the number of citations of researchers at the given university among the most frequently cited scholars according to Google Scholar [40].

The measures used in both cases are imperfect regardless of whether they focus on the quality of education or the level of digitalization.

Webometrics has been published by a special laboratory under the Spanish National Research Council (SNRC) since 2004. Unlike the previous ones, this ranking has a specific character, because it relies on the degree of universities' online presence. Arguing for the soundness of this approach, the researchers note: "An increasing number of students and researchers turn to the Internet for scholarly information, and academic institutions make increasing efforts to have an online presence. While today the Internet serves as a means of self-presentation for most educational institutions, it can be predicted that in the near future virtual educational institutions will become no less important and influential than real ones. In a world that is becoming increasingly interconnected, the real presence of an academic institution in the global space is contingent on its representation on the Internet" [30, p. 71].

The Webometrics ranking is calculated based on the following indicators: 1) the number of printed web pages (25%); 2) the number of .pdf, .ps, .doc, and .pps files posted (12.5%); 3) the number of articles that appear in Google Scholar (12.5%); and 4) the total number of external citations (50%). A university's representation online and the availability of virtual resources and services also constitute the hierarchy of the global educational space, affect the quality of university education, and legitimize elitism in it. In this connection, the approach proposed by the authors of the rating can be regarded as the Table of Ranks of the virtual space, the expansion of which shapes the present reality [40].

The proposed criteria and principles of Webometrics ranking formation should stimulate the motivation of universities and their employees to maintain a continuous, systematic, and publicly available online presence. According to the authors of the ranking system, this serves as a good reflection of their activities and achievements.

When analyzing competition between universities, it is important to consider the specifics of different rankings and their target audience. To evaluate the impact of digitalization on inter-university competition, we conducted a comparative analysis of the place of universities in the 2021 Webometrics rankings (top 20), on the one hand, and in the ARWU, THE, and QS rankings, on the other (Table 3).

Table 3

Comparative analysis of the place of universities in various rankings in 2023

University	Webometrics	ARWU	QS	THE
Harvard University	1	1	4	2
Stanford University	2	2	5	3
Massachusetts Institute of Technology	3	3	1	5
University of Oxford	4	7	3	1
University of Michigan	5	26	33	23
University of California Berkeley	6	5	10	8
Cornell University	7	12	13	20
University of Washington	8	18	63	26
Columbia University	9	8	23	11
University of Pennsylvania	10	14	12	14
Johns Hopkins University	11	16	28	15
University of Cambridge	12	4	2	3
Yale University	13	11	16	9
University of California Los Angeles	14	13	29	21
University College London	15	17	9	22
University of Toronto	16	24	21	18
University of California San Diego	17	19	53	32
University of Wisconsin Madison	18	35	75	81
Tsinghua University	19	22	25	16
Duke University	20	34	50	25

Correlation analysis confirms a strong correlation between the place of the top 20 universities in the Webometrics ranking and in the ARWU ranking ($r_s = 0.738$, $p < 0.01$), which mainly aims to measure research potential. Furthermore, our correlation analysis confirms a close relationship between the place of the top 20 universities in the Webometrics ranking and in the THE ranking ($r_s = 0.58$, $p < 0.01$), in which the most significant criterion is the evaluation of research activities (60%). This agrees with the opinion of researchers that it is difficult to imagine conducting world-class scientific research and realizing the highest quality of the educational process without the use of ICTs, the development of which has significantly boosted the capacity of universities to create and disseminate knowledge [15]. On the one hand, the virtual environment has increased the number

of available knowledge sources and made access to them easier and quicker, bringing significant benefits to many stakeholders and challenging the current server-based education model [15]. Access to scientific databases and social networks that support scientific discussions together with the research infrastructure in a cloud computing environment allow conducting research faster and more efficiently in an international environment. The non-digital areas of higher education require decision-makers to make quick and appropriate decisions relying on the widest possible access to current standardized data and analytical models.

The virtualization and technologicalization of the educational sphere also affect science; the topic of the free exchange of knowledge and scientific publications in the open-access model is raised more often. In its extreme form, the virtualization of educational processes (MOOCs) and knowledge sharing (open access) may revolutionize the market for educational services. Many entities benefiting from the current rules of the game will have no reason to exist (universities will be replaced by virtual learning and scientific journals will be replaced by free online knowledge sharing). Practice shows, however, that the potential of the tool itself, although immense, may not necessarily lead to such radical changes. Instead, a hybrid model has become increasingly popular.

Correlation analysis confirms a strong relationship between the top 20 universities' place in the Webometrics ranking and the QS ranking ($r_s = 0.638$, $p < 0.01$). Scholars believe that the socio-economic environment, facing the consequences of digitalization in everyday functioning, also expects universities to develop a new mode of operation, the organization of education, and the preparation of students for modern challenges [17].

DISCUSSION

The findings of this study emphasize the critical role of digitalization and digital transformation in inter-university competition, aligning with prior conclusions on the study of the impact of digital transformation on universities. Our findings agree with the opinions of [41, 42], who concluded that digitalization enhances operational efficiency, institutional visibility, and educational quality and that higher-education institutions lag behind other types of organizations in taking positive actions toward digital transformation.

Our correlation analysis revealed a strong relationship between a university's digital presence, as measured by the Webometrics ranking, and its placement in traditional rankings like the ARWU, QS, and THE. This finding agrees with studies that indicate that Universities with robust digital systems and online engagements, like MOOCs, tend to perform better in global rankings that measure research output [43]. The observed correlation agrees with the opinions of [44], who explored the importance of the digital transformation of a university as a factor in ensuring its competitiveness. Our study also agrees with [45], who conclude that although digital presence may not be explicitly incorporated into some global rankings, it significantly influences the institution's perception and stakeholders' trust. Authors [45] highlighted media (traditional and digital) as a major determinant of the university's reputation.

Our result that the success of universities' digital transformation hinges, among other things, on the level of digital competence of all staff agrees with the opinion of [46], who concluded that organizations must institute comprehensive skill development programs so as to enhance these competencies among employees to ensure they are well-equipped for the evolving demands of the digital era.

Our findings show that the digital transformation of the higher education sector is additionally driven by the changing expectations and behaviors of knowledge consumers who agree with opinions [47].

Notably, our opinions slightly disagree with the opinions of [48], who concluded that although digital transformation has its advantages, it negatively affects universities by leading to an increase in distraction and the gradual nullification of certain critical skills and over-dependence. These call for regulation in the adoption of digital transformation in universities.

Our results highlight the necessity for universities to prioritize digital transformation in their strategic planning. These findings agree with [49, 50], who observed that institutions with a clear vision for integrating digital tools were better positioned to adapt to market demands and

global challenges. Our results also underscore the importance of a balanced approach to ranking methodologies. While digital metrics are valuable, they should complement rather than replace traditional indicators of academic excellence.

Future studies should explore the interplay between digitalization and non-digital factors in shaping university competitiveness. Longitudinal studies could examine the sustained impact of digital investments on academic outcomes and stakeholder satisfaction. We recommend that Policymakers should consider incentivizing digital infrastructure development through targeted funding and regulatory support, as this is integral to enhancing both institutional competitiveness and educational equity. Additionally, comparative analyses across regions could identify best practices for integrating digital tools in diverse educational contexts.

In conclusion, this study affirms the pivotal role of digitalization in enhancing inter-university competition. By aligning their strategies with digital trends, universities cannot only improve their rankings but also contribute to the broader goals of accessibility, innovation, and quality in higher education. However, a nuanced approach is required to balance digital advancements with traditional academic values, ensuring that digital transformation serves as a means to holistic institutional development rather than an end in itself.

CONCLUSIONS

Today, competition between universities is on the rise, and the requirements to increase their competitiveness, level of educational services, research programs, etc. are increasing. This competition relates not only to human and financial resources and creative and entrepreneurial skills but also to the level and possibilities of the digitalization of higher education. To improve their competitiveness, higher education institutions need to join the digitalization of educational and administrative processes and pay attention to updating ICT and development strategies.

The digital transformation of a university will result in the improvement of its internal and external positions regarding its competitive development and realization of competitive advantages. As a result of high international rankings, the prospects for developing new priority areas of scientific research increase, new prospects for obtaining additional financial revenues arise, the brand becomes recognizable, and its reputation improves. On the other hand, low positions in international ratings hurt competitiveness and may result in the loss of applicants, a reduction in funding, etc.

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