

Analysis of Digital Tools for Educational Quality Assessment at the University^{*}

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Abstract

The paper is dedicated to studying issues related to the quality assurance of higher education, its accessibility, and the safety of the university's educational environment. Based on the analysis of international regulatory documents concerning education quality assurance and the methodologies of international and Ukrainian rankings, key indicators affecting quality have been identified, along with relevant internal evaluation metrics, the relationship between which provides a comprehensive assessment of higher education quality considering safety requirements under martial law. Ensuring high quality at the university relies on conducting internal evaluations of key indicators using digital tools across main areas: for real-time data collection and analysis, big data analysis, organizing the educational process, assessing the quality of higher education, supporting decision-making, management, administration, and, in general, for visualizing the results of educational outcomes. According to the defined areas, a tentative sample of digital tools is presented, facilitating practical analysis and assessment of higher education quality, improving ranking indicators, and enhancing competitiveness in the educational space.

Keywords

higher education quality, quality indicators, digital tools, university rankings, safety, educational environment

1. Introduction

In the current context of digital transformation in higher education, the practical assessment of education quality is becoming increasingly important. The rapid development of digital technologies opens up fundamentally new opportunities for transforming traditional approaches to evaluation and creating innovative methods for monitoring the educational process. Growing demands for education quality in global competition intensify the necessity to ensure compliance with European standards and international practices. Developing effective mechanisms for assessing education quality within blended and distance learning frameworks becomes especially significant. In this regard, digital tools for evaluating education quality are gaining greater importance, offering new data collection, analysis, and interpretation opportunities. They allow for the automation of assessment processes, provide timely feedback, enable real-time monitoring of students' progress, and facilitate the generation of analytical reports for decision-making [1]. The relevance of this research is also underscored by the objective need for higher education institutions to optimize resources and enhance the effectiveness of management decisions based on a comprehensive analysis of educational data. It highlights the necessity for developing scientifically justified approaches to selecting and implementing digital tools for assessing education quality.

In the reports of the International Network for Quality Assurance Agencies in Higher Education [2], significant attention is devoted to the creation of quality standards and criteria, the

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independence of assessment, the involvement of external experts, the transparency of the higher education quality assurance process, and its ongoing monitoring to enhance both external and internal quality assurance. In particular, the quality assurance policy stipulates that higher education institutions must develop and implement published quality assurance policies officially, and the standard regarding teaching staff includes the use of fair and transparent procedures for recruitment and staff development [3].

The issues surrounding the quality of higher education, its accessibility, and safety are at the forefront of research for many scholars. In general, several key areas of their research can be identified: quality management in education and evaluation systems, the organization of information system security in higher education institutions, the impact on sustainable development and social aspects, the use of digital technologies and data analytics, and the analysis of the experiences of educators and students in terms of educational quality. P. Skladannyi, et al [4] analyze the threats and challenges to the security of educational information systems and the quality and accessibility of higher education. The authors propose specific approaches to improving security through traffic analysis and access control to data. S. Chen, H. Wang, and K. Yang [5] have developed a performance indicator system for universities in Taiwan using a balanced scorecard of quality education indicators. K. Jermstittiparsert [6], A. Nugrahaa and R. Jabeenb [7] have studied how quality management in higher education institutions in Thailand contributes to sustainable development goals by improving welfare and reducing inequality. L. Yang, X. Qin, and W. Liu [8] have proposed a method for managing the quality of higher education based on intellectual data analysis. R. Wang, M. Li, F. Zhang, Y. Pan, and Z. Zhang [9] have developed a method for assessing the quality of university education using machine vision with single-valued neutrosophic hesitant fuzzy sets. The proposed method provides an accurate and standardized approach to assessing the quality of education at the university level. It allows for objectively measuring student behavior while offering new opportunities to enhance learning effectiveness. H. Xu [10] emphasizes the importance of objective analysis of the factors affecting learning efficiency and the necessity of using digital technologies such as cluster analysis and big data analysis to enhance overall educational outcomes. Authors L. Vnoucková, H. Urbancová and H. Smolová [11] studied the factors influencing students' perceptions of education quality standards, identifying the factors that affect their views. The authors believe that assessing education quality in higher education institutions should be a continuous and dynamic process that responds to changes in students' preferences and the challenges of the modern educational environment. Researchers J. Liu, Z. Chen, J. Zhou and C. Hu [12] indicate that the quality of teacher training is a key aspect for universities, and exploring ways to improve teacher qualifications is an important method and means of ensuring the quality of university education. M. Zagirnyak, V. Lugovyi, Z. Talanova, S. Serhiienko, and D. Zagirniak [13] examine the standardization of the quality assurance system in education in Ukraine in the context of the Bologna Process and European experience. Specifically, the authors explore the opportunities presented by leading global university rankings for assessing education quality, such as ARWU, THE World University Rankings, and QS World University Rankings. A key issue is the lack of mechanisms for evaluating the quality of education across a wide range of academic disciplines.

Rankings are one of the tools for evaluating the quality and competitiveness of higher education institutions at both international and national levels. Essential indicators in global and Ukrainian rankings include education quality metrics, encompassing various aspects of the educational process. These include the level of academic programs, the quality of teaching, student support, and performance and effectiveness indicators of learning.

The research aims to identify key indicators and their corresponding metrics that enable a comprehensive evaluation of the quality of higher education based on the analysis of methodologies from leading international and Ukrainian rankings to compile a selection of digital tools designed to ensure the assessment of the quality of higher education.

We analyzed the methodologies of leading international and Ukrainian rankings to achieve the set goal, highlighting key metrics and their corresponding indicators that allow for a

comprehensive assessment of the quality of higher education. A selection of digital tools effective for evaluating the quality of education at the university has been analyzed and formed.

Method description. In the research, we applied general scientific methods, including systematic analysis of scientific literature and regulatory documents, comparative study of leading international and Ukrainian rankings methodologies, existing digital assessment tools, classification methods, and generalization techniques for systematizing the obtained results. Based on the research findings, we selected digital tools to ensure the quality of higher education while considering security requirements in the context of martial law.

2. Research results

An essential tool for analyzing and evaluating the effectiveness of universities is their standings in international and Ukrainian rankings focused on assessing the quality of education. Leading academic university rankings employ various methodologies and indicators to evaluate education quality, which makes it essential to identify a system of indicators that will provide a comprehensive assessment of education quality at the university [14]. Key international rankings that rank universities based on quality indicators include the Academic Ranking of World Universities, QS World University Rankings, Times Higher Education World University Rankings, and Times Higher Education Online Learning. These rankings' methodologies consider all areas of university activities, but this study focuses only on quality indicators.

One of the most influential global university rankings is the Academic Ranking of World Universities (ARWU). The ranking is based on six key indicators that assess the quality of educational and research activities of higher education institutions, the contributions of universities to the development of science, and is based on the number of Nobel laureates among the faculty and alums of the university, the evaluation of academic reputation, citation metrics of scientific publications, and so on [15]. One of the key indicators for assessing the quality of education in the ARWU ranking is the presence of Nobel laureates among the faculty and alums of the university, which indicates a high level of teaching, research, and a favorable academic environment for the development of outstanding scholars, thereby enhancing the university's international reputation and helping to attract talented students and researchers from around the world.

One of the most influential international university rankings is the QS World University Rankings. It evaluates higher education institutions worldwide based on indicators that reflect their academic reputation, research impact, and attractiveness to students and employers [16]. Academic reputation is a key indicator of the ranking aimed at assessing the quality of education. This indicator is determined through expert surveys of scholars and educators and reflects the level of trust the academic community has in a particular institution of higher education. Another important indicator of the ranking is the student-to-faculty ratio, which demonstrates the effectiveness of the educational process's organization and the workload on the faculty. No less important is the employer reputation indicator, which is obtained through surveys of employers and allows for evaluating the quality of university graduates' training and the relevance of educational programs to market needs. Additionally, the international mobility indicator plays a significant role in assessing the quality of education, which considers the ratio of international students and faculty and indicates the global integration of higher education institutions and international cooperation.

The Times Higher Education World University Rankings evaluates institutions using a comprehensive approach that includes teaching quality, research activity, international collaboration, and the university's impact on society. Teaching quality assessment is a key factor in determining the level of student preparation. The indicator includes a reputational survey of teaching quality, the student-to-faculty ratio, the proportion of graduate students, and the income level per faculty member [17]. The combination of academic reputation, faculty qualifications, and the level of financial support for the educational process provides a comprehensive evaluation of

the quality of educational services. It allows universities to identify areas for improvement and enhance their competitiveness.

In addition to its leading ranking in the World University Rankings, Times Higher Education publishes specialized rankings that assess universities based on specific aspects of educational and research activities. THE World University Rankings by Subject analyzes universities by field of study, allowing for the evaluation of their academic and research capabilities in specific disciplines. THE Impact Rankings assess universities' contributions to sustainable development based on the 17 Sustainable Development Goals of the United Nations. THE Young University Rankings evaluate the best young universities (under 50 years old) rapidly developing and demonstrating dynamic growth in research and teaching. THE Online Learning Rankings assess universities on the quality of distance learning, which has become particularly important following the COVID-19 pandemic, including the accessibility and quality of online courses, the level of digital support for students, the interactivity of learning, and student evaluation of the online learning experience.

At the same time, Ukrainian university rankings are of great importance as they assess educational accessibility, employment outcomes for graduates, and academic achievements, considering the specifics of the national context. It allows for evaluating the alignment with the needs of the Ukrainian labor market and the contribution to developing the national economy and science. The key Ukrainian rankings include the Consolidated Ranking of Higher Education Institutions of Ukraine, TOP-200 Ukraine, the University Ranking by Scopus metrics, and the Ranking of Accreditation of Educational Programs of Higher Education Institutions in Ukraine.

The consolidated ranking of higher education institutions in Ukraine combines the results of three leading Ukrainian rankings: "Top-200 Ukraine," "University Ranking by Scopus Indicators," and the ranking based on admissions campaign indicators "the National Multi-Subject Test Score for Contract." The ranking methodology is based on summing up the positions of higher education institutions in the three specified rankings. Each of these rankings uses its evaluation criteria, providing a comprehensive assessment of the universities' performance, considering both academic achievements and popularity among applicants, and offering relevant information about the quality and competitiveness of Ukrainian universities [18]. However, the study does not consider the indicators from the "University Ranking by Scopus Indicators."

The methodology of the TOP-200 Ukraine rating is based on a multi-criteria approach that relies on analyzing large data sets from open sources that can be easily verified. The rating methodology takes into account both international and national aspects of the university's activities and is based on 10 key indicators, five of which are the results of international rankings and five national indicators. The assessment of the international component of university activities considers results from the QS World University Rankings, Webometrics ranking of the world's universities, Times Higher Education World University Rankings, Times Higher Education University Impact Rankings, and QS World University Rankings Sustainability. Including the results of international rankings in the "TOP-200 Ukraine" rating methodology evaluates the university's global competitiveness, shows how Ukrainian universities meet international standards of education quality and principles of social responsibility, and encourages Ukrainian universities to develop according to international standards. National indicators consider the university's results in the "University Rankings by Scopus metrics," "Rating of higher education program accreditations in Ukraine," participation in scientific project competitions, the number of patents obtained by university scholars, the indicator for the number of applications submitted by entrants, and the average competitive score, which reflects the evaluation of the quality of the educational and research components of the university's activities, innovative potential, and the contribution of universities to the economy and technological development of the country [19].

"The Rating of Accreditation of Higher Education Institutions' Educational Programs in Ukraine" reflects the compliance of university educational programs with national standards and considers the performance indicators of the accreditation of educational programs by the National Agency for Quality Assurance in Higher Education (NAQA) at all levels of higher education (bachelor's, master's, doctoral). The indicators for forming the rating include the total number of

accredited educational programs, the number of exemplary accredited educational programs, the number of conditionally accredited educational programs that received a certificate of accreditation for 1 year, and the number of unaccredited educational programs [20]. "The Rating of Accreditation of Higher Education Institutions' Educational Programs in Ukraine" is an essential tool for ensuring transparency and quality in higher education in Ukraine, reflects the actual state of education quality at the university, and stimulates universities to improve their educational programs continuously.

Rankings are essential for evaluating universities; however, their results must be analyzed considering methodological limitations [21]. University ranking methodologies primarily focus on assessing specific aspects of higher education institutions' activities, such as research activity, number of publications, level of international collaboration, and reputation among employers and the academic community [22]. Therefore, applying a comprehensive approach to evaluating the quality of education is essential, which includes analyzing various rankings in conjunction with other information sources to obtain an objective assessment of educational processes and higher education institutions. A crucial aspect of ensuring educational quality and improving a university's ranking position is the implementation of internal evaluation mechanisms based on key indicators from international and Ukrainian rankings, covering various aspects of university activities [23]. The main components of the internal quality assurance system include evaluating the quality of teaching and educational materials in distance learning systems, considering their accessibility, interactivity, and compliance with modern educational standards, and assessing student performance. Internal evaluation of educational quality is a key tool for continuously improving the educational process, as it allows universities to respond flexibly to challenges and promptly implement changes [24].

Within the research framework, key aspects of ensuring the quality of higher education have been systematized. Key education quality indicators have been identified based on the Standards and Guidelines for Internal Quality Assurance in Higher Education [3] analysis. Since participation in rankings is an effective tool for assessing the quality of an institution's educational activities, key indicators have been selected from the methodologies of international and Ukrainian rankings that evaluate educational quality, compliance with international standards, and competitiveness. Relevant internal assessment indicators have also been identified, allowing for effective monitoring and analysis of the educational process and improving the quality of education. The interconnection between these elements ensures a comprehensive approach to providing educational services (Fig. 1).

Thus, practical assessment of the quality of education requires a comprehensive approach that includes various tools and methods for evaluating different aspects of the educational process and covers key components such as checking the compliance of educational programs with national and international standards and accreditation requirements, meeting the needs of students and employers, assessing the quality of teaching, evaluating students' academic achievements, measuring students' satisfaction with the educational process, and the quality of learning materials. The use of various data collection and analysis methods, including both quantitative and qualitative indicators, allows for the creation of a multidimensional picture of the educational process; in particular, the use of testing, expert assessments, surveys of participants in the educational process, and analysis of academic achievements provides a deeper understanding of the actual state of education. Such a comprehensive approach not only enhances the reliability of the assessment but also helps to reveal hidden interconnections between different aspects of the educational process that may be overlooked when using only one source of information. Therefore, a comprehensive evaluation of the quality of education, including external ratings and internal assessments, guarantees sustainable development for universities and increased competitiveness.

To ensure high quality education, it is essential to conduct internal evaluations of key indicators that influence quality. Digital tools play a significant role in this process, significantly optimizing data collection, processing, and analysis.

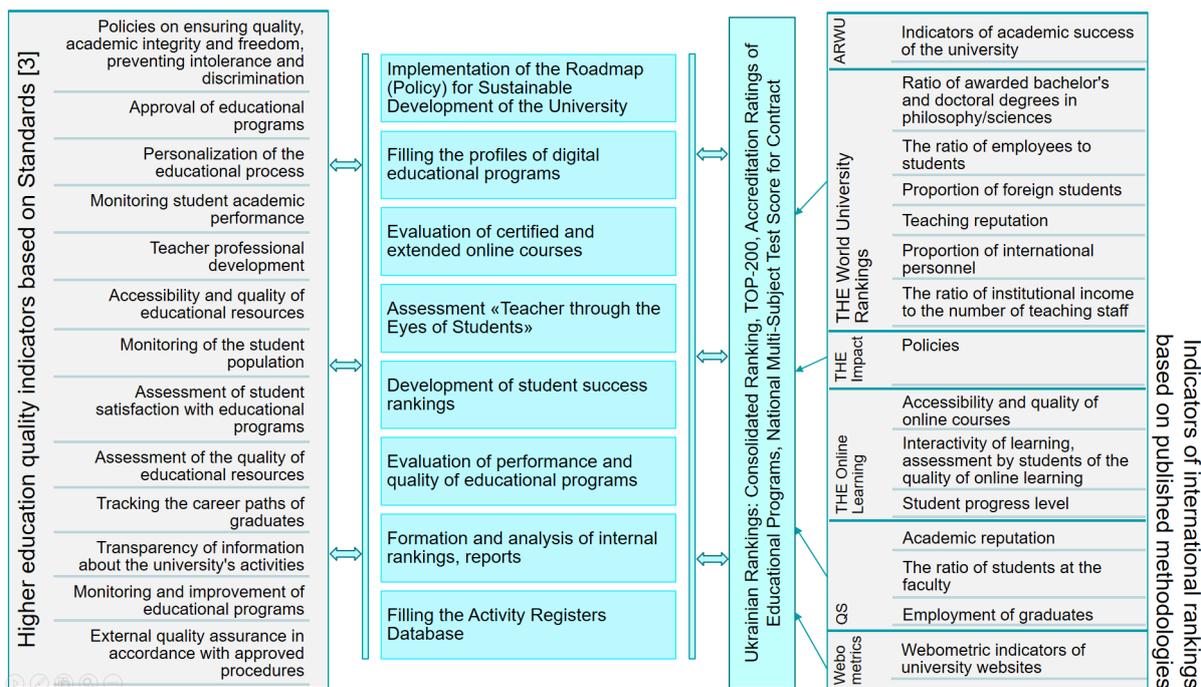


Figure 1: The interrelationship between higher education quality indicators, global and Ukrainian rankings, and internal evaluation metrics

Using such tools promotes increased transparency, objectivity, and reliability of assessments, which, in turn, allows for the timely identification of problematic aspects and the implementation of practical solutions to address them. It enables the creation of detailed analytical reports, tracking changes over time, and comparing results at different stages of learning.

In the context of ensuring the quality of education, integrated digital solutions become essential, encompassing various aspects of educational activities and enabling comprehensive assessment of education quality at the university. Within the study, we identify the main areas of application for digital tools in assessing education quality in higher education institutions that create a holistic quality management system in universities (Fig. 2).

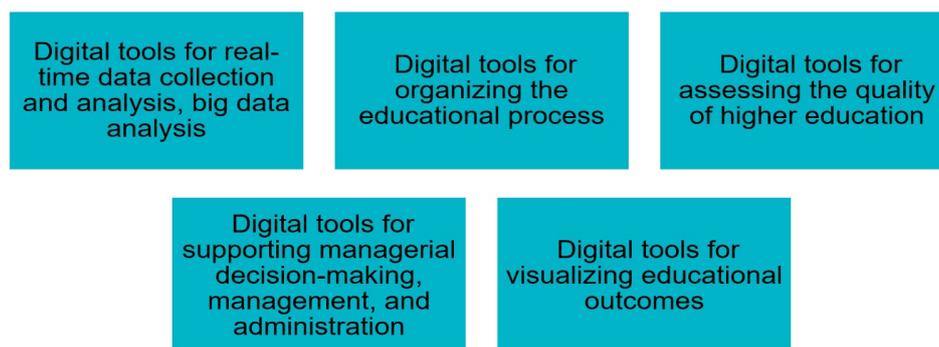


Figure 2: Main areas of application of digital tools for assessing the quality of education in higher education institutions

The choice of these directions for digital tools to assess the quality of education is determined by their strategic importance and a systematic approach to ensuring the quality of the educational process. Let's elaborate on each of the key areas.

Digital tools for real-time data collection and analysis. The use of big data analysis tools allows for identifying trends in learning, predicting student success, and timely detecting problem areas.

Digital tools for organizing the educational process. Plugins in the LMS Moodle and other assessment tools for tracking student progress have become particularly important in the context

of blended learning. They enable the automation of tracking success, ensure transparency in evaluation, and provide detailed statistics on course completion in the LMS Moodle. This helps instructors optimize educational materials and teaching methods based on objective data.

Digital tools for assessing the quality of higher education. Automated survey and questionnaire systems (such as "Teacher through the Eyes of Students") provide regular feedback and assist in preparation for accreditation. They enable the quick identification of deficiencies in the educational process and allow for necessary adjustments.

Digital tools for supporting managerial decision-making, management, and administration. Decision support systems help optimize resource allocation, workload planning, scheduling, and other administrative processes. They provide an objective basis for the university's strategic development planning.

Digital tools for visualizing educational outcomes. The importance of this area is determined by the need to present complex data in a clear and accessible format. Visualization helps to better understand trends, compare indicators, and present performance results [25].

As part of the research, a selection of digital tools has been made that enable effective analysis and assessment of the quality of higher education. The description, capabilities, and data protection of the selected digital tools, according to the defined areas, are presented in Table 1.

Table 1

Selection of approximate digital tools for conducting analysis and assessing the quality of education at the university

| Digital Tool | Description, capabilities | Terms of Use | Direction |
|-----------------------|---|---|----------------|
| Tableau | A powerful tool for big data analysis and dashboard creation. Integration of artificial intelligence (AI) for trend and anomaly detection. High level of cybersecurity: data encryption during storage and transmission, user-level access control. | Free for students and teachers; Paid plans from \$35 to \$115 | I V |
| Looker Studio | Real-time analysis of educational data, data visualization, and creation of interactive reports. Use of AI for automating analysis and forecasting. Data protection through Google Security, including data encryption, multi-factor authentication, and access control. | Free with a Google account; Paid plans available (\$9 per user project) | I IV V |
| Power BI | Analytics of educational processes, integration with various databases, and forecasting. The use of AI for big data analysis and forecasting. Data encryption occurs during transmission and storage, access control through Azure Active Directory, user action auditing, and multi-factor authentication. | Free; Paid plans from \$10 to \$20 | I IV V |
| Google Forms | Surveying students, evaluating instructors, and feedback on the quality of higher education. Data protection through Google Security: encryption, two-factor authentication. | Free with a Google account | III |
| Survey Monkey | Expanded survey capabilities and real-time response analysis. Available encryption, multi-level access control, and user action auditing. | Free; Paid plans from \$38 to \$75 | III |
| Plugins in LMS Moodle | Plugins for analyzing the success of learners, tracking progress, and activity reports. Protection through an authentication system, | Free; Paid plans for plugins | II III V |

| | | | |
|---|---|--|----------|
| | access control, and data backup. | | |
| Kibana + Elasticsearch | Analysis of large educational data and visualization of learning effectiveness. Use of AI for detecting anomalies and trends. Existing configuration of access roles, data encryption, and query control. | Open source requires server-side configuration | I V |
| Microsoft Excel (with analytics modules) | Analysis of student performance, preparation of reports and charts. Data protection through Microsoft Security: encryption, access rights management, and file change auditing. | Paid plans from \$10 to \$13 | I V |
| IBM SPSS Statistics | Statistical analysis of educational data, correlation analysis of performance. Use of AI for automated analysis of large data sets. An existing authentication system, access management, and encryption. | Paid plans from \$79 to \$99 | I III |
| Trello | Management of educational processes and organization of work for teachers and students. Use of AI for process automation. Two-factor authentication, access control, and data backup are available. | Free; Paid plans from \$5 to \$17,5 | IV |
| Microsoft PowerPoint / Canva | Visualization of evaluation results and creation of presentations. Use of AI for automatic design and content generation. Data protection through restricted access and file encryption. | Microsoft PowerPoint: paid plans from \$10 to \$13 Canva: free; paid plans from \$10 to \$15 | V |
| Plickers | Interactive assessment of students in real-time. Data protection through encryption, limited access to results. | Free; Paid plans from \$9 | III |
| Mentimeter | Interactive surveys, testing, and real-time result visualization. Available data encryption and multi-level access control. | Free; Paid plans from \$12 to \$25 | III V |
| Notion | A service for note-taking, managing educational projects, and integrating with other platforms. The use of AI for automating notes and organizing data. Two-factor authentication and encryption are available. | Free; Paid plans from \$10 to \$15 | IV |

Digital tools allow for effective monitoring of indicators of education quality assurance in defined areas, specifically for collecting and analyzing data in real-time, big data analysis; for organizing the educational process; for assessing the quality of higher education; for supporting managerial decision-making, management, administration, and overall for visualizing the results of educational outcomes.

Research on a holistic approach to ensuring the quality of higher education, including the relationships between the aforementioned quality indicators and selected digital tools, is subject to further investigation. At the same time, existing digital assessment tools require the integration of cybersecurity systems. It is at the intersection of cybersecurity issues and the use of education quality indicators that the problem of data privacy, proper setup of access systems, and ensuring the reliability of stored results arises. Thus, universities face the need to develop holistic approaches to quality assurance in education that combine the assessment of internal indicators with the requirements of international standards while also considering cybersecurity aspects.

Conclusions

Within the framework of the research, key aspects of ensuring the quality of higher education have been systematized, allowing for the identification of main indicators important for assessing the quality of higher education based on key international documents. The combination of internal quality assessment of education with external evaluation through participation in international and Ukrainian rankings serves as the foundation for enhancing the quality of higher education and meeting modern international standards.

During the research, a correlation was established between the indicators of higher education quality and global and Ukrainian ranking systems, based on which indicators for internal quality assessment of education at the university were identified. To conduct a comprehensive assessment of education quality and form an integrated quality management system at the university, digital tools have been categorized into various areas: for collecting and analyzing real-time data, big data analysis for organizing the educational process; for assessing the quality of higher education; for supporting decision-making, management, administration, and overall for visualizing the results of educational outcomes.

The obtained results provide a foundation for further improvement of the education quality assurance system based on a comprehensive approach, as the integration of data from various sources allows for a more objective and holistic assessment than the analysis of individual indicators. This approach enhances the reliability of results and provides a deeper understanding of educational processes.

Promising directions for further research include exploring a holistic approach to ensuring the quality of higher education, including the relationships between the quality indicators mentioned above and selected digital tools, the development of integrated assessment systems, the improvement of data protection mechanisms, and the expansion of the functionalities of existing digital tools in response to new challenges and needs of contemporary higher education.

Declaration on Generative AI

While preparing this work, the authors used the AI programs Grammarly Pro to correct text grammar and Strike Plagiarism to search for possible plagiarism. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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