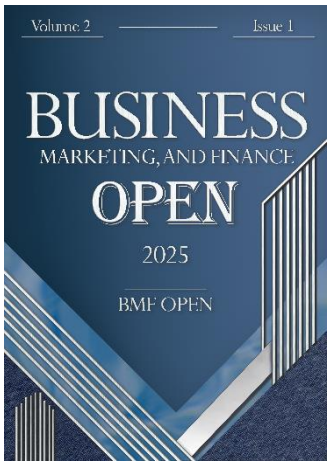
The Latest Indicators of the Higher Education System for Evaluating Universities and Research Institutes (with an Emphasis on Ranking and Knowledge Commercialization)



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Abstract: In recent years, the issue of academic indicators has become one of the significant topics in the fields of scientometrics, evaluation, and econometrics of higher education. Competitive conditions in both the dimensions of scientific production and the knowledge-based economy are rapidly increasing on a global scale, making knowledge-based activities essential for survival more than ever before. Universities are expected to play a strategic role in the comprehensive economic, social, and cultural development based on knowledge. This requires them to monitor the quality of their performance and present their credibility for public and expert judgment, which is made possible through evaluation. A precise understanding and determination of the efficiency and effectiveness of the higher education system are only possible when its components and sub-systems are meticulously analyzed. Among the tools commonly used to assess the quality and performance of the higher education system, particularly in evaluating scientific production within a knowledge-based economy, are indicators. Indicators articulate the issues and challenges of the educational system through the collection of clear and objective evidence and serve as a basis for holding the educational system accountable. Additionally, indicators can be employed to identify the causes and factors behind the failures of the higher education system. This article aims to examine the latest indicators in the field of higher education, employing a library-based review method and document analysis. It is evident that these indicators have practical applications for studies and research in the field of higher education.

Keywords: Indicator, Evaluation, Performance Quality, Demand-Driven Higher Education, Scale, Knowledge-Based Economy.

1. Introduction

The process of science, technology, and innovation has been a subject of extensive studies since the early 1980s, gradually giving rise to two main approaches in its evaluation. The first approach focuses on assessing this process from the perspective of its activities, while the second approach emphasizes its outcomes and outputs. Additionally, the evaluation of this process is conducted at both micro and macro levels [1]. Research and higher education are among the most critical pillars for the survival, development, and advancement of societies, especially in a world where life and the economy are increasingly becoming knowledge-based [2, 3]. The question

now is how the performance of the scientific and higher education system can be continuously monitored and evaluated by academics themselves with the active participation of internal and external stakeholders. This is where the significance of indicators becomes apparent. The existing weaknesses and gaps in the indicators of the research and higher education system prevent academics and internal and external stakeholders from adequately monitoring the current status and performance of the scientific and educational system, determining its gap with the desired state, and ensuring its quality [4].

The transformations of the current era have made the existence of an evaluation system inevitable, to the extent that the absence of an evaluation system is considered a sign of organizational dysfunction, hindering growth, development, and improvement of organizational activities [5]. Organizations evaluate performance to achieve various objectives. For example, performance evaluation systems are often used as primary tools to convey organizational messages, as managers can translate organizational goals, expectations, norms, and values into measurable performance indicators [6]. The main purpose of evaluation is to collect essential information about the organization and make it accessible to managers and key stakeholders so they can make timely and necessary decisions to enhance the organization's quantity and quality. Therefore, the ultimate goal of monitoring and evaluation is to increase organizational efficiency and effectiveness [7].

In recent decades, with the emergence of knowledge-based economies, the importance of science, technology, and innovation in the development of various countries has increased. Given the nature of this field, policymaking and budget allocation for research, technology, and innovation by governments have become essential. Additionally, with research and technology entering the national budget lines, the issue of accountability regarding how funds are spent by various responsible organizations and their subsidiaries has emerged. This has led to the design of systems, guidelines, and models for evaluating research, technology, and innovation [8]. Over the past two decades, there has been increasing attention to innovation policy, with numerous policy tools developed to achieve specific objectives through both supply-side and demand-side policies. These policy tools have continuously evolved and can be distinguished based on relevant theoretical principles [9].

In the context of Iran, the conventional approach to evaluating science, technology, and innovation has mirrored the control processes of all government projects, equating budget allocation with project progress and considering successful research projects as those attracting more funding. Naturally, such an approach disregards the effectiveness of science, technology, and innovation activities [10-12]. In recent years, the issue of academic and institutional indicators has become a key topic in scientometrics and higher education. Higher education institutions are increasingly being defined globally in terms of new commercial and business dimensions, facing significant challenges in balancing traditional academic and research performance with the new market-driven global competition. Public higher education institutions are increasingly gaining competitive advantages in national and international markets to establish and maintain their competitive positions [13].

In evaluating research institutions, the primary focus should be on the purpose of the evaluation—whether the aim is to improve the research system or to assess the position of research institutions compared to each other and international centers. In Iran, defining the objective of research evaluation is crucial for enhancing research quality. Once the objective is clarified, it will be evident who the evaluation stakeholders are, how the results are expected to be used, which organizations should utilize the results, and for what purposes [14].

An organization’s mission defines its reason for existence and indicates its business activities (David, 2017). A research institute broadly includes any research center, research institute, research complex, or any research establishment, whether independent or affiliated with a higher body, focusing on research in specific scientific or technological fields [15]. Research institutes play an unparalleled role in enhancing countries' scientific and technological standing, applying knowledge, and advancing science and technology. In Iran, these institutes have achieved valuable accomplishments by focusing on specialized scientific and technological topics over the past decades. Therefore, continuous attention to their effectiveness within the national innovation system and strengthening the necessary infrastructure are priorities for policymakers [16].

Research institutes also serve facilitative and dissemination functions, connecting with industries and businesses, promoting entrepreneurship, fostering collaboration with other national innovation system players,

supporting technology companies, encouraging human resource mobility, establishing spin-off companies, investing in and financing research, collaborating with various industries, and developing research and technology infrastructure (such as incubators, accelerators, and research laboratories) [17].

Today, research institutions are moving towards autonomy and independence, rejecting governmental interference. In response to this paradigm shift, governments have transitioned from detailed intervention to macro-level oversight, replacing the concept of management (and governance) with governance [14]. Consequently, new indicators must be designed based on epistemic governance criteria tailored to the specific activities of research institutions. The increasing number of policymaking systems for funding, mechanisms and tools used for policy implementation, and organizational players involved in supporting research institutions necessitate considering a multi-layered, distributed system comprising strategic players such as research funding bodies, universities, public research institutes, and individual researchers [18]. Multiple policy rationales have also been added to the main objectives of research policy (such as promoting scientific excellence, strengthening economic innovation, supporting academic careers, and addressing social issues), requiring diverse funding mandates [17].

Due to the ambiguity regarding the roles and responsibilities of research institutes and their inadequate positioning within the national innovation system, many have failed to meet their expected functions. Additional challenges include equating the roles of research institutes with universities, lack of distinction between various types of research institutes, and structural, legal, and infrastructural barriers hindering their performance in Iran [12]. Moreover, the need for agility in executing research projects suggests minimizing vertical and horizontal complexity beyond the operational core. Thus, part of the structural reform of research institutes should focus on reducing unnecessary organizational positions and levels [19].

Banwatt and Deshmukh (2009) evaluated the performance of research and development (R&D) organizations using efficiency indicators defined for assessing R&D outputs, concluding that both quantitative and qualitative indicators must be integrated into monitoring and evaluation for a more comprehensive and accurate assessment [20]. Shan et al. (2010), in developing evaluation frameworks for technology foresight programs based on experiences from the European Union, the United Kingdom, and Sweden, identified eight core components for logical framework evaluation: overall policy objectives, inputs, strategic objectives, foresight activities, outputs, impacts, outcomes, and influences [21]. Mazzucato and Penna (2019) proposed five criteria for selecting research institution missions, emphasizing that missions should be bold, inspiring, and socially relevant; directed, goal-oriented, measurable, and time-bound; ambitious yet feasible, encouraging risk-taking and innovation; interdisciplinary and cross-sectoral; and fostering bottom-up solutions for systemic innovation [22]. Armijos Valdivieso et al. (2022) highlighted prior research publications as the primary determinant of future research output, with factors such as age, academic rank, research time, resource allocation, recognition, and research leadership also significantly influencing research productivity [23]. Maleki and Yazdi (2015) identified six criteria for comparing science, technology, and innovation (STI) evaluation models—comprehensiveness, implementation, simplicity, comparability, objectives, and functionality—highlighting the increasing demand for STI evaluation due to the role of knowledge-based economies in sustainable economic development [24]. Farazkish (2016) designed an STI evaluation model for Iranian public organizations, extracting two main approaches: performance-based evaluation, linking allocated budgets to past or expected performance through expert panels (qualitative approach), and indicator-based evaluation, periodically assessing institutions using input and output indicators (quantitative approach) [8]. Farasatkhah and Bazargan (2017) proposed an evaluation framework for research systems in higher education, encompassing eight main criteria: research policies and strategies, research program leadership and management, research support mechanisms, researcher training, research-education integration, application of research findings, research participation, and research quality improvement, with 27 sub-criteria and defined quality indicators [25]. Nasri et al. (2023) identified key challenges faced by Iranian public research institutes, including unclear missions, lack of systematic performance evaluation, barriers to industry collaboration and international networking, mismatched organizational structures, inefficient financial systems, and inadequate human resource management practices [16].

A critical issue for higher education institutions is establishing a modern monitoring and evaluation system that legitimizes all institutional activities while ensuring quality and dynamism in research and academic systems alongside quantitative expansion. All stakeholders in the higher education system emphasize the need to improve current quality at various levels and components. Enhancing a research system requires addressing its deficiencies, as such deficiencies represent its flaws, preventing desirable outcomes. Diagnosing these deficiencies and their causes is the first step in rectifying them. A key challenge in Iran's higher education institutions is the lack of clear definitions for inputs, processes, and outputs. Research results in one institution may serve as inputs for another's studies, necessitating continuous assessment of input quality, processes, and outputs to improve research activities and provide specialized services to society. In recent years, various institutions have adopted different approaches to evaluate research activities in Iran, but key challenges remain, including the absence of standardized research concepts, fragmented evaluations, multiple evaluating bodies, and insufficient attention to scientific monitoring and evaluation concepts. Despite numerous efforts to evaluate research and research institutions, a comprehensive, structured system for monitoring and evaluating institutions is lacking, making this article particularly relevant.

2. Methodology

This article employs a library-based review method and document analysis to examine and analyze research findings on the latest indicators in the field of higher education, ensuring that these indicators are applicable for studies and research in the domain of higher education.

Table 1. Monitoring and Evaluation in Higher-Level Policy Documents

Legal Document	Subject
General Policies of Science and Technology (September 20, 2014)	Clause 1-2: Knowledge and research management and integration in policymaking, strategic planning, and monitoring in the field of science and technology and continuous improvement of indicators. Clause 3-2: Organizing and strengthening monitoring, evaluation, accreditation, and ranking systems in the fields of science and technology.
Sixth Development Plan (July 16, 2017)	Article 64 – Clause T: Design and implementation of a research and innovation monitoring and surveying system.
Seventh Development and Progress Plan (July 2, 2024)	Article 97 – Clause A: The Ministry of Science is obliged to take necessary measures to review and revise evaluation indicators to achieve civilization-building and wisdom-based higher education institutions, foster mission-oriented and problem-focused research, and attain scientific authority.
Proposed Plan of Dr. Gholami, Former Minister of Science, Research and Technology (October 25, 2017)	Establishment of a comprehensive national system for monitoring, evaluation, accreditation, and quality assurance of higher education.
Proposed Plan of Dr. Zolfi Gol, Former Minister of Science, Research and Technology (August 11, 2021)	Recognition of the diversity of institutions in terms of educational and research functions based on their capabilities and characteristics, and evaluation and monitoring of them according to their functions.
Proposed Plan of Dr. Simayi Sarraf, New Minister of Science, Research and Technology (August 13, 2024)	Efforts to achieve a comprehensive system for monitoring, evaluation, accreditation, and quality assurance of higher education across the country, relying on digital technologies and artificial intelligence.

3. Findings and Results

Key Higher Education Indicators in Various Dimensions

Educational Dimension

The educational dimension indicators include the ratio of students to full-time faculty members, the ratio of revised curricula to total curricula, the proportion of faculty members holding associate professorships and above to total faculty members, and the per capita educational and auxiliary spaces. It also encompasses the average of accepted students in the institution in the base year's national entrance exam compared to the national average, the number of courses conducted through team teaching based on provided syllabi at the start of the semester, and the ratio of such courses to total courses in that semester. Additionally, it includes the number of PhD students serving as teaching assistants for at least one semester through faculty grants, categorized by gender, the number of students who left the institution without graduating, including reasons such as major changes and withdrawals,

the proportion of interdisciplinary educational programs to total programs, and the number of courses supplemented by virtual and non-attendance learning environments compared to the total courses in each curriculum. Age distribution of students by gender and field, the share of women in full-time faculty positions, the ratio of postdoctoral researchers to total PhD graduates of the institution over a specific period by gender, and the ratio of accepted PhD students in the base year to master's graduates who participated in the PhD entrance exam of that year are also key indicators. Furthermore, it includes the ratio of graduate students to full-time faculty members holding associate professorships and above, the average years of study for students in each field/program over a specific period by gender, and the ratio of approved graduate-level programs to total approved programs.

Ranking Indicators

Ranking indicators encompass the institution's level in credible national rankings and its grade within that level, the institution's growth rate in terms of promotion from one grade to a higher grade within the same level or transition to a different level over a specific period, and the institution's ranking in reputable international rankings such as Times Higher Education and QS.

National Ranking Methodology of the Islamic World Science Citation Database

The research and scientific production criterion is one of the most significant criteria in the current ranking system, holding the highest weight in the overall evaluation, similar to many international ranking systems. Within this criterion, the quality and applicability of research are highly important. The purpose of employing research quality indicators is to measure the success of institutions in generating knowledge as one of the primary missions of universities and research institutions. Research quality is assessed in comparison with the global average research quality using citation metrics and the number of highly cited and hot papers. Currently, citations are the most critical quantitative indicator for measuring research quality. Citations can occur over various time periods. Highly cited papers refer to articles indexed in the ESI database over the past 10 years that have received a high number of citations. In calculating highly cited papers, normalization is first performed across 22 subject categories in the ESI database based on the year of publication and field. Subsequently, a threshold is determined using the percentile table provided by the Essential Science Indicators (ESI) and Thomson Reuters, specifying highly cited papers that fall within the top 1% in terms of received citations. Hot papers refer to articles published in the ISI database within the past two years that have garnered significantly higher citations compared to other papers.

Research Indicators Dimension

Research indicators include per capita ISI publications, per capita citations to articles based on the h-index, the ratio of industry-related research contracts to the university's total current budget, the number of internationally recognized patents, the ratio of graduate theses with industrial contracts to total theses, and the share of subscriptions to national and internationally recognized scientific databases and documents. They also include the ratio of internationally indexed journals owned by the institution to total journals, the number of faculty members whose scientific articles have received numerous citations over a specific period relative to total faculty members in credible citation databases such as Thomson Reuters and Scopus, and the institution's placement in terms of faculty-produced articles within the top 1% of most-cited papers globally. Other indicators are the publication of faculty-produced articles in prestigious journals like *Nature* and *Science*, the ratio of reputable authored works by full-time faculty translated into other languages by credible publishers to total authored works over a specific period, the number of institution-owned scientific journals with an impact factor (IF) above 1 in globally recognized databases like Thomson Reuters, and the ratio of ISO-certified laboratories to total laboratories within the institution.

Financial Indicators Dimension

Financial indicators include the ratio of dedicated revenues to the university's total approved public current budget, the ratio of research, technology, and entrepreneurship expenditures to the university's total expenses, the ratio of total revenues from research activities to the university's total dedicated revenues, the share of endowments, public donations, and foundation support from total resources and credits, and the share of loans received from banks, funds, and financial institutions relative to the institution's total current credits.

International Indicators Dimension

International indicators encompass the ratio of foreign students to total students, the number of internationally joint degree programs, the ratio of internationally co-authored publications by faculty to their total publications over a specific period, the number of active memberships in international university unions and consortia, the number of active memberships in academic quality and accreditation networks for conducting audits and accreditations, the ratio of full-time international faculty to total faculty, the ratio of faculty supervising defended master's and PhD theses from reputable global universities to total defended theses at the institution over a specific period, the ratio of completed and reported faculty sabbaticals abroad to total faculty, and the number of international specialized conferences held relative to total conferences over a specific period.

Cultural Indicators Dimension

Cultural indicators include the ratio of students participating in cultural activities to total students and the number of annual free-thinking chair sessions held.

Entrepreneurship, Market Responsiveness, Social, and Economic Indicators Dimension

These indicators include the ratio of defended PhD dissertations with specific sponsors or clients to total defended PhD dissertations over a specific period, the ratio of completed and contracted research projects with external organizations, executed by full-time faculty, to total full-time faculty, and the ratio of research projects aligned with national science and technology priorities to total executed research projects within a specific period.

Innovation and Technology Indicators Dimension

Innovation and technology indicators include per capita registered patents, licenses, and royalties by full-time faculty over a specific period, the ratio of high-tech innovations and registered inventions by full-time faculty to their total number, and science and technology entrepreneurship through the establishment and operation of knowledge-based companies by faculty members.

University Autonomy Indicators Dimension

These indicators include the ratio of institutional presidents appointed with credible faculty consensus prior to their appointment to total presidents over a specific period, the ratio of faculty recruited independently by the institution with faculty and departmental participation to total existing faculty, and the ratio of executed and achieved institutional action plans on key topics of autonomous and self-regulating university management to total institutional council or board resolutions.

Reputation, Awards, and Scientific Honors Indicators Dimension

These indicators include the ratio of students winning prestigious scientific, artistic, and cultural awards to total students and the ratio of alumni winning such awards to total students.

Spin-off Companies, Incubators, Innovation Centers, and Knowledge-based Companies Indicators Dimension

These indicators include the ratio of institution-derived research units to total such units in the country and the ratio of institution-derived research and technology companies to total such companies in the country.

Evaluation and Accreditation Indicators Dimension

These indicators include the ratio of institutional departments that have undergone external evaluations and audits by credible national and international accreditation bodies and received approvals to total departments, and the ratio of registered institutional action plans that implemented internal and external evaluation recommendations and provided performance reports to total registered action plans.

Faculty Prestige, Participation, and Staff Quality Indicators Dimension

These indicators include the ratio of full-time faculty responding to periodic surveys on faculty work-life quality conducted by the institution with published reports to total full-time faculty during the same period, and the per capita hours of full-time faculty participation in high-quality and innovative capacity-building programs organized by the institution annually with prior needs assessment and faculty participation.

4. Discussion and Conclusion

This article analyzed higher education indicators. Initially, indicators were comprehensively defined, and subsequently, higher education indicators were categorized into educational, research, ranking, economic and financial, international, cultural, entrepreneurship and innovation, university autonomy, reputation and awards, spin-off companies, evaluation and accreditation, and faculty prestige and participation dimensions. Self-assessment and internal auditing within universities, utilizing these key indicators, serve as a foundation for self-regulation and self-governance towards improving and enhancing university quality. This process is the best guarantee for maintaining academic integrity and independence and, most importantly, enhancing the university's social and economic image, stakeholder trust, and institutional credibility.

It is evident that when a university successfully establishes, maintains, and continuously improves the necessary quality standards within its system using these key indicators, it becomes a nationally and internationally accredited institution of global stature in both internal and external evaluations. To achieve quality enhancement in the higher education, research, and technology system, it is essential to make informed decisions by recognizing the existing gaps between the current state and the desired state. Selecting key and critical indicators for continuous quality monitoring and improvement, especially in the current context where demand-driven education has replaced supply-driven education, is imperative for universities.

However, one important point remains: higher education is a qualitative, complex, and multidimensional activity with various internal and external stakeholders, and it cannot be fully assessed and evaluated solely through quantitative indicators. Public judgment of higher education requires deep and qualitative criteria, particularly with a critical approach and consideration of its economic impact on society. Qualitative indicators are far more significant than quantitative indicators and can better reflect the state of higher education, particularly regarding universities' social responsibility. Therefore, for the improvement, enhancement, transformation, and excellence of higher education, there is an urgent need for these qualitative indicators.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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