

# Development of an integration model of scientometric systems for effective knowledge management in Ukrainian universities

*Viktor Zinchenko*<sup>1\*</sup>, *Vasyl Levkulych*<sup>2</sup>, *Mykola Popovych*<sup>3</sup>, *Oksana Bulvinska*<sup>4</sup>, *Olena Polishchuk*<sup>5</sup>, *Natalia Lakusha*<sup>6</sup>, and *Lesya Chervona*<sup>1</sup>

<sup>1</sup>Institute of Higher Education of the National Academy of Educational Sciences of Ukraine, Kyiv-city, Ukraine

<sup>2</sup>Uzhhorod National University, 88000 Uzhhorod, Ukraine

<sup>3</sup>Higher Educational Institution Podillia State University, Kamianets-Podilskyi, Ukraine

<sup>4</sup>Borys Grinchenko Kiev University, 04053 Kyiv, Ukraine

<sup>5</sup>Khmelnyskyi Humanitarian-Pedagogical Academy, 29013 Khmelnytskyi, Ukraine

<sup>6</sup>Kyiv National University of Construction and Architecture, 03037 Kyiv, Ukraine

**Abstract.** The article highlights one of the leading goals of scientometric indicators and data in the context of the internationalization of higher education and scientific institutions – the inclusion in the international, global scientific and educational system of the greatest possible number of relevant scientific communities, teams of scientists, researchers and their scientific works, developments, innovations, and rating them according to certain objective indicators. The emergence of scientometric bases (systems, platforms) is a natural phenomenon in the development of society as an attempt to measure something that, on the one hand, is abstract, and, on the other hand, is characterized by certain quantitative features as a result of deep analysis. Scientific research leads to the accelerated development of technologies, therefore, at a certain stage, it became necessary to evaluate, that is, to measure the importance of a scientist's research contribution to the development of a certain field of research. Since this need was felt in different countries with a relatively small time difference, various scientometric technologies were invented and developed.

## 1 Introduction

### 1.1 Global systemic institutional transformations in the context of the needs of sustainable development of society and higher education and science

The revolution in technological processes, in turn, is the cause of significant shifts in the hierarchy of the nation, the prerequisite for which is institutional transformations for the sustainable development of society in the context of the internationalization of higher education and science [1].

---

\* Corresponding author: [dozent3000@gmail.com](mailto:dozent3000@gmail.com)

A country's place in the modern world today is increasingly determined by the quality of human capital, the state of education and the degree of use of science, education and technology in production.

The wealth of labor force and raw materials can be considered less and less as a competitive advantage in accordance with how the share of these factors in creating the value of all products decreases. Because of this irreversible development, it appears increasingly likely that developing countries can succeed solely on the basis of their minerals and, accordingly, cheaper labor [2]. However, this process is still far from identical to the real universalization of the global community.

In other words, in addition to certain realities of globalization, institutional transformations for the sustainable development of society in the context of internationalization of higher education and science, equally real trends of regionalization, dissociation, and even asocialization coexist in the world.

When researching the social future and institutional transformations for the sustainable development of society in the context of the internationalization of higher education and science, the emphasis should be placed equally on the analysis of values and on the analysis of social institutions, which will allow understanding the real mechanisms of the practical construction of a new society taking into account globalization processes.

Turning to the immanent content of the problems of institutional transformations for the sustainable development of society in the context of the internationalization of higher education and science, it should be noted that scientific reflection has always been present in the depths of globalist knowledge in a decisive way, since the discovery of its content was connected with the discovery of the understanding of the unity of natural and social being, and within the latter, of the unity of educational-scientific, political, economic, etc. existence. Such unity implements the target function and provides a controlling influence in relation to society in the form of practical-transformative activity or social, economic and political power over space.

In today's conditions, the "contradictions of globalism and imperialism" cannot be reduced to general formulas, such as "universal contradictions between labor and capitalism", and even more so cannot be resolved by them.

Therefore, the main goal in this context is to analyze the state of research of the perspectives and strategies of sustainable development of society in the processes of institutionalization of the world global system as a whole and multi-level sphere of interaction of economies, societies, states, social institutions, cultures, peoples, nations, worldviews and people in the context of internationalization of educational and scientific space for the purpose of developing theoretical and applied tools.

The obtained and presented results will enable the further complex and sectoral development of various aspects of the sustainable development of society, the internationalization of science and higher education systems in the conditions of institutional globalization, the appropriate methodology not only within the limits of individual scientific directions and educational disciplines, but also at the level of general scientific, philosophical and educational and pedagogical, socio-philosophical and socio-economic, political and public management analysis, may be used in developments in the fields of social, pedagogical, political, economic sciences, public administration.

## 2 Methods

### 1.2 Scientometric systems as the basis of scientific and educational internationalization

In order to identify, position and improve scientometric indicators, which are used to quantitatively evaluate and compare the scientific activity of authors and scientific institutions, it is necessary to publish works in foreign and domestic journals included in known scientometric databases, register and create author profiles in international scientometric systems.

Scientometric indicators are indices of publication activity of authors or organizations, significance of publications depending on the scientific weight of the journal, etc. It is a tool for assessing the importance of the quality of scientific work, the influence of a scientist, scientific periodicals, the possibility of attracting the best scientists to cooperation in certain areas or on a certain topic, forming the scientific image of a scientist and his or her demand in the chosen scientific field. They are used to assess the state and prospects of scientific research activities of authors and organizations, their comparison and ranking in various ratings.

The purpose of scientist identifiers is to connect scientists and their various research and innovation achievements. For this, the scientist has to create profiles and register in ORCID, Google ScholarID, ResearcherID, and preferably in social scientometric networks LinkedIn, Researchgate, Academia.edu, etc. If a scientist has publications published in scientific periodicals that are part of the Scopus scientific reference database, a corresponding ScopusID profile is created.

The emergence of scientometric bases (systems, platforms) is a natural phenomenon in the development of society as an attempt to measure something that, on the one hand, is abstract, and, on the other hand, is characterized by certain quantitative features as a result of deep analysis. Scientific research leads to the accelerated development of technologies, therefore, at a certain stage, it became necessary to evaluate, that is, to measure the importance of a scientist's research contribution to the development of a certain field of research. Since this need was felt in different countries with a relatively small time difference, various scientometric technologies were invented and developed [3, 4, 5, 6, 7; 8].

In order to increase scientometric indicators, according to which quantitative assessments and comparative analysis of the scientific activity of authors and scientific institutions are carried out, it is necessary to publish works and results of studies in foreign and domestic journals that are included in known scientometric databases, register and create author profiles in international scientometric databases.

## 2 Results

### 2.1 Problematic aspects of the development of scientometric systems in the educational and scientific space of developed and transitive countries and the prospects of strengthening their efficiency and openness as a factor of sustainable development

1. Decision of the Committee on Science and Education of the Verkhovna Rada of Ukraine dated March 18, 2015 (Protocol No. 8): "The requirement to publish in publications indexed in the leading international scientometric databases Web of Science and (or) Scopus does not take into account industry specificity of knowledge. The above-mentioned requirements require substantial financial support."

The Elsevier publishing concern and its scientometric division Scopus offer two types of distribution of articles and other scientific results: a traditional subscription (Subscription) and a payment for the publication of an article (Article Processing Charge) in case if the author wants his or her work to be in open access. Prices listed on the publisher's website range from \$500 to \$5,000. Articles the publication of which is paid for under this model are published on the ScienceDirect platform.

The Scopus classification system includes:

- 1) Natural and technical sciences (32%).
- 2) Medical sciences (31%).
- 3) Biological, agricultural, neurophysiological sciences (20%).
- 4) Social and humanitarian sciences (only 17%).

2. We also would like to note that the commercial nature and corresponding goals of these databases (to a greater extent – Scopus, to a lesser extent – Web of Science) do not allow to fully ensure

- 1) free (free of charge) access even for viewing the materials posted in them, which in turn
- 2) cannot provide effective and comprehensive citing, and, as a consequence, ranking and indexing of both these materials and their authors.

We would like to give just one example: the world's largest international scientometric and bibliometric search system Google Scholar, according to which the most complete scientometric profile of a scientist is formed regardless of his or her continental, linguistic, national, state and other affiliation – the Hirsch index (h-index) – is unable to rank (evaluate citations, demand, use, etc.) materials posted in Scopus and Web of Science.

It should be noted that, starting from 2015-2016, the management apparatus of WoS, understanding this problem and striving for scientific openness and global distribution, carries out active integration with national and continental-regional scientometric bases, forming joint scientometric platforms for placing the best materials from them (and not necessarily English-speaking materials) with the subsequent transfer of them to the so-called "WoS Core Collection".

Unfortunately, we have to state that the Scopus database does not implement such a strategy, but on the contrary, reinforces the policy of scientometric "closedness" and obtaining commercial benefits even for a review of any material. Of course, under these conditions, access, use in research activities, citation, etc. of the materials posted in Scopus is available only to a separate group of (well-funded) institutions, organizations, scientists. And this in no way contributes to the objective display of the citation index and the index formed on its basis, the rating of the scientist.

3. As a result, more and more representatives of the scientific community, scientific and educational institutions, organizations of developed countries of the EU, OECD refuse to cooperate with Scopus.

In order to get closer to the goal set by the governments of the EU countries in the strategy of the general practice of the publication policy of the EU scientific programs (full open access to scientific research), Sweden and other states refused to continue any agreements with this corporation and its structures.

Also, since 2012, the leading representatives of science in Europe and the USA have formed a community and are sending information to the world scientific environment that physicists and technical scientists at their meeting in GSI Darmstadt on May 25, 2012 decided to ask all representatives of these sciences to join the initiative of a group of leading mathematicians to boycott "Elsevier" and to join the declaration: "<http://thecostofknowledge.com/>" The cost of Knowledge, which aims to implement open access for research users and readers of scientific articles and against unreasonable payments from authors or their institutions. The movement asks individual scientists to refrain from publishing articles in Elsevier journals (and, accordingly, in the Scopus database). This

movement at the global level has already achieved notable success and currently tens of thousands of leading scientists of developed countries have joined the action. Medical scientists, including Nobel laureates, also joined the movement.

Many EU member states are opposed to Elsevier and its scientometrics products because of its closed business, high and ever-increasing prices, and the potentially dangerous number of commercial publishers. A number of countries have resorted to boycotting Elsevier and withdrawing their journals and products such as Scopus.

Research institutes in Sweden and Germany have said they are refusing any subscriptions to Elsevier due to concerns about sustainability, unfair pricing mechanisms and a general lack of moral values (for example, Elsevier's metric data in the form of CiteScore, which is an indicator of the influence of journals that compete for an impact factor based on citations from Scopus, is not honest: as evidenced by an unbiased analysis, periodicals published by Elsevier's competitors receive 40% lower metrics, and Elsevier publications score 25% higher using CiteScore than other journal impact factor systems [9]).

Also, due to the constant increase in the price for using Scopus access services and for subscriptions to journals owned by Scopus - the publishing concern "Elsevier" - only in the USA, there was a refusal to use its services by: the world's largest Library of Congress, Harvard University, Massachusetts Institute of Technology, Cornell University, Florida State University, North Carolina State University, University of California, etc., leading universities in Western Europe, a significant number of the Academies of Sciences of these countries (in particular, the Max Planck Society [German Academy of Sciences], the Association of Universities of the Netherlands (VSNU), a consortium of universities and institutes DEAL of Germany and many other institutions and organizations of developed countries.

4. Officials declare an increase in the Hirsch index, quartiles of publications and impact factors as almost a panacea for science and education in Ukraine. Meanwhile, in science, results are important, not ratings.

Back in 2012, the Declaration on Research Evaluation [10] was adopted in San Francisco, the main recommendation of which is: "Do not use journal-based metrics - in particular, such as impact factors - as a surrogate measure for evaluating the research articles of an individual scientist, for judging the contribution to science or when hiring, promoting, or making funding decisions," as these are attempts to replace scientific criteria for evaluating research with bibliometrics. The declaration was signed by dozens of scientific organizations and institutions, many editors of scientific journals, and hundreds of scientists. Among the first are the American Association for the Advancement of Science, the European Mathematical Society, the Howard Hughes Medical Institute, the Czech Academy of Sciences, the American Society of Petrochemists, the United States Agricultural Society, the Association of Australian Medical Research Institutes, the European Society for the History of Science, and others.

The editor-in-chief of the world's leading scientific journal "Science" Bruce Alberts, an outstanding biochemist, president of the US National Academy from 1995 to 2009 and one of the co-authors of DORA, in this connection published an article "On distortions associated with the impact factor". The main point of the article is "the impact factor mania is pointless" [11].

Regarding the harmfulness of overestimating bibliometric indicators and the use of the so-called "indexes", "quartiles" and "impact factor" (which are used by Scopus and Web of Science) as criteria for the "quality" of scientific results and publications, in 2017, this system was jointly opposed by the French Academy of Sciences, Léopoldin (National Academy of Sciences) Germany), the Royal Society (Academy of Sciences of Great Britain), which noted that some expert communities rely too much on bibliometric indicators when assessing the significance of works, which can lead to a superficial, simplified and unreliable assessment

of scientific results. Thus, the predominant use of bibliometric indicators in the evaluation of scientific research has become a cause of serious concern. Of particular concern is the widespread use of journal impact factors, which are more an assessment of the journal itself than an assessment of the scientific significance of the articles published in it.

Also, excessive trust in citation indices as indicators of quality can lead to the formation of groups of researchers who "screw" each other's indicators with the help of cross-citations (in other words, the so-called "citation lovers' clubs" appear). Thus, it is important to focus on the methods, goals and results of scientific activity that contribute to the promotion of qualitative and innovative research in various fields of knowledge [12].

5. Strict enrollment requirements for the awarding of scientific degrees and the awarding of scientific titles of publications exclusively in publications present in the WoS databases, and even more so, Scopus, also violate the principles of academic freedom and academic integrity. They limit scientists' choice of specialized journals for publishing the results of their research, taking into account the relevance of the specialized journal to the issues of their scientific research, and due to the difficulty of fulfilling these requirements, they can stimulate the emergence of so-called "scientific mills" that offer to prepare an article for publication for a scientist for money in journals indexed in the WoS and Scopus databases, and to provide support for such publication. Proposals for the provision of such dubious services are already being received by representatives of the scientific community and "consortia" have already been created that provide such services on a paid basis.

6. The actual strict requirement to publish a significant number of one's articles in a foreign (mainly English) language in foreign journals indexed in closed databases may lead to inhibition of the development of national science, national scientific schools, national scientific journals, and the national scientific language. A high-quality scientific article, if it is of interest to the international community, can be translated into a foreign language and thus become available to scientists around the world.

## **2.2 Internationalization and European integration of the systems of science and universities as a component of the philosophy of the strategy of global sustainable development**

The main priority of Ukraine's development is the integration with the European Union (including the application of research, scientific and publishing approaches).

In this regard, it is necessary to take into account that the so-called "Plan S" is implemented in the EU space.

"Plan S" is an initiative aimed at consolidating efforts to move to such publication models that provide full, immediate, open and free access to the results of scientific research as soon as possible.

The initiative was launched on 4 September 2018 by a number of large national foundations from twelve European countries, as well as the European Research Council. These agencies formed a consortium called "cOAlition S" (in the name: S - science, OA - open access, coalition - association).

The main goal of "cOAlition S" is that after January 1, 2020, the results of scientific research should be published in relevant open access journals or on relevant open access scientometric platforms.

- Under the terms of "Plan S", leading European scientific organizations will be required to publish research results in journals with immediate open access and under a license that grants the right to free, free and re-use and distribution of the material.

- "Hybrid model" of publication is not allowed, as it does not correspond to the above-mentioned principles ("Hybrid model" - involves 1. full or partial payment for publications by authors and 2. payment for its further review or download by scientists).

- "Plan S" leaves copyright in the hands of authors and lifts publishing embargoes on open access publishing.

- These principles apply to all types of scientific publications, however, the achievement of open access for monographs and books began to be implemented from January 1, 2021, as part of the "Open Science" strategy [13].

Under these circumstances, we consider it inexpedient to form strict conditions for the awarding of scientific degrees and the awarding of scientific titles, with the fixation of requirements for the publication of articles in publications that are present only in the WoS and Scopus databases.

There is the proposed classification of international citation systems (scientometric systems and bibliographic databases):

1) universal (trans-scientific, interdisciplinary) abstract databases - Web of Science, EBSCO, Scopus, DOAJ, OCLC WorldCat, MIAR, Genamics JournalSeek, Springer, Open Academic Journals Index, Academic Resource Index (Research Bib), Directory of Research Journals Indexing, Index Copernicus, Global Impact Factor, Genamics JournalSeek, etc.;

2) specialized (branch) databases – Astrophysics, ERIH PLUS, PubMed, MathSciNet, Mathematics, Chemical Abstracts, Agris, GeoRef, etc.

3) scientometric electronic libraries/repositories/indexing catalogs of international scientific journals and materials - Ulrich's Periodicals Directory, ROAR (Registry of Open Access Repositories), Directory Indexing of International Research Journals, International Scientific Indexing, Directory of Research Journals Indexing, CiteFactor, Kiberleninka, Universal Impact Factor, NewJour, International Scientific Indexing, etc.

4) international systems of academic resources/social scientific and scientometric networks – ResearchGate, SciPeople, Mendeley, LinkedIn, Academia.edu, etc.

5) Google Scholar (Google Academy) is a freely available international scientometric and indexing-rating and search system that indexes full-text scientific publications of all formats, from all research areas and disciplines. Google Scholar indexes most electronic resources (databases, libraries, repositories, storages, etc.), peer-reviewed online journals of the world and the largest scientific publishing houses. Google Academy is a global scientometric search and international indexing system and bibliometric database that indexes metadata of scientific publications from all fields of knowledge, published in various formats. The Google Academy index contains most of the peer-reviewed journals of the largest scientific publishing houses in Europe and America. This product has a toolkit for tracking scientific citations of indexed publications. Although Google does not officially disclose the volume of the Google Academy index, experts estimate this volume to be approximately 160 million documents.

### **3 Discussion**

#### **3.1 Urgent questions and suggestions on the development of integration of higher education of Ukraine in the modern global and international system of scientometric quality tools**

Question:

What should be done for Ukrainian universities to be included in the main world rankings?

What steps should be taken in order to move from the declarative state of implementation of the internationalization strategy at the national, regional, local and institutional levels to the practical implementation of defined ideas, set goals from the use of best practices of national and international scientific spaces in the field of internationalization?

How to direct and encourage domestic scientists to perceive internationalization as the essence of scientific life, an opportunity for professional growth, the formation of an international image, significance and demand in the national and international research world?

Offers:

The institution of higher education should develop an effective comprehensive strategy for the internationalization of the institution with a plan of specific practical measures and principles for evaluating the quality of its implementation and determining the sustainability of the results obtained and further impact.

National research networks of the best scientists and their active cooperation with foreign and global scientific institutions and networks, conducting joint research and joint publication and dissemination of results using the main scientometric databases, should be created.

National scientometric bases using basic scientometric indicators should be created and brought to the international level due to active international scientific cooperation and involvement of foreign scientists in national research projects.

Scientific international mobility should be used to establish new scientific contacts, adopt the best global scientific practices and develop joint scientific products.

A national platform for scientists should be launched, which will carry out the following areas of activity:

- organization of trainings and scientific and practical seminars on specific topics, for example:
- marketing of scientific activities and publication of scientific developments;
- practical steps in the field of international scientific activity and the use of scientometric resources and technologies;
- how to navigate in the world of scientific Internet resources and use the world practice of forming one's own scientific portrait, etc.;
- conducting a forum of scientists for the exchange of best practices, formation of temporary creative teams with the involvement of foreign scientific connections, presentation of scientific developments, implementation of joint scientific projects;
- organization of webinars, scientific Internet bridges for studying and discussing scientific innovations, approaches and methods in the field of internationalization of scientific activity;
- strategic activity for the formation of a critical mass of international scientists capable of advancing national science into the international scientific space and freely using the world's scientometric tools.

1. As the main condition for evaluating the quality of publications for the awarding of scientific degrees and the awarding of scientific titles, an extended list of international scientific metric systems/bases based on clear and non-monopolistic criteria should be defined and indicated on the basis of the following:

- 1.1. The volume, level (global-international) and number of scientific materials (for example, at least 1000 titles of publications presented in the database);
- 1.2. Universality, trans-scientific, interdisciplinary nature of the posted materials - that is, the absence of rigid specialization;
- 1.3. Degrees of its "indexing openness" - possibilities of forming objective indicators of scientometric ratings and citations;
- 1.4. Variety of materials placed in the database (not only periodicals, but also collections of conferences, materials of symposia, collections of inventions, developments, etc.);
- 1.5. Degrees of openness and availability for use of materials placed in the database.

2. According to these criteria, we propose to expand the list of international scientometric bases (along with the currently present WoS and Scopus), publications in the journals present in the following resources should be recognized:



2.1. Universal, transdisciplinary and interdisciplinary scientometric resources, the presence of publications in which is mandatory for all holders of scientific degrees/academic titles.

2.2. Professionally specialized scientometric resources.

Taking into account sectoral, scientific, research specialization, form and include the "List of specialized and sectoral international scientometric systems/bases" in accordance with the list of specialties approved by the Ministry of Education and Culture.

We give an example of such specialized branch systems of indexing/scientometric databases - Astrophysics, PubMed, Mathematics, Chemical Abstracts, Agris, GeoRef, etc.

2.3. Additional scientometric resources.

Based on the fundamental principle of educational and scientific autonomy, specialized academic councils and academic councils of higher education institutions and scientific institutions should be allowed to add (on a permanent or temporary basis) to items 1-2 of this List a group (up to 3-5) of international scientometric systems/bases, which, from the point of view of the leading specialists of this institution, can be considered as those that additionally qualitatively reflect the level of scientific achievements of this scientist.

3. A national scientific ranking and information scientometric system, connected to international scientometric databases, should be developed and the requirement of representation of all publications of the acquirer in this system should be recorded.

## 5 Conclusions

Integration with the European Union (including in the application of research, scientific and publishing approaches) is determined as the main development priority for many countries of the world and for Ukraine in particular.

Recent decades have seen the growth of integration processes in the world, the development of tendencies towards joint solutions by countries of their economic tasks. Another difference is related to the scientific and technical revolution and the formation of the "information society". Since universities (and the entire system of higher education - both in the world and in Ukraine) strive to achieve high positions in ratings and quality indicators, and among the evaluation criteria, the scientific achievements of the teaching staff, including the quantitative and qualitative indicators of their scientific publications, occupy important positions, the availability of mastering scientometric technologies becomes an urgent problem. Persistence of management and forcing the process of increasing "scientific quality" lead to a) low quality of publications; b) demotivation of teachers; c) personnel decisions. The question (problem) is how to facilitate the process of mastering the skills of using scientometric bases by the academic staff of higher education institutions.

Considering the existence of a large number and variety of scientometric systems, it would be worthwhile to create a single international scientometric resource to which already existing platforms would be connected or integrated. The simplicity and accessibility of the interface in many languages, the involvement of the maximum number of indices and other evaluation indicators, as well as the ability to set the necessary indicator or ratio according to certain, individually defined parameters would facilitate and speed up the research of scientists all over the world.

Also, the creation, development and introduction of a worldwide global non-commercial scientometric bibliometric and search system of an open type, reinforced at the legislative level, deserves research and justification in the academic space.

However, it should be integrated into the international system and meet the criteria and possibilities of the "Open Science" strategy.

## References

1. H. Newby, Persp.: Pol. and Prac. in H. E., **3(4)**, 106-113 (1999)
2. V. Zinchenko, M. Boichenko, M. Popovych, IOP Sc.: Ear. and Env. Sc. **635**, 012012 (2021)
3. A. Biloshchic'ki, Inf. tekhn. v osv., nauc. ta virob. **4(5)**, 198-203 (2013)
4. V. Burkov, Upr. rozv. skl. sist. **15**, 134-139 (2013)
5. V. Zinchenko, IOP Conf. Ser. Ear. and Env. Sc. **635**, 012012 (2021)
6. V. Levkulych, L. Chervona, M. Iehupov, O. Mozolev, SHS Web Conf. **141**, 03012 (2022)
7. V. Zinchenko, M. Debych, M. Popovych, I. Mukhin, SHS Web Conf. **141**, 01021 (2022)
8. D. Shotton, Nature **502**, 295-297 (2013)
9. C. Straumsheim, *How to Measure Impact. Inside Higer ED* (2016)
10. San Francisco Declaration on Research Assessment (2012), <https://sfdora.org/>
11. B. Alberts, Impact Factor Distortions. Science **340(6134)**, 787 (2013)
12. Royal Society. Royal Society, Leopoldina and Academie des Sciences call for more support for research evaluators, <https://royalsociety.org/>
13. Towards a Plan S gap analysis? <https://101innovations.wordpress.com/>