

Designing a rating system based on competencies for the analysis of the university teachers' research activities

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Abstract. One of the indicators of the influence and competitiveness of university is participation in international and local rankings. In the methodologies of the most authoritative rankings, the quality and transparency of Universities is assessed by indicators of the university teachers' publishing activity. The article analyzes the experience of designing systems that analyses university teachers research activities, tools and components of evaluating the effectiveness of research, designed a structural and functional model of rating system for the analysis the university teachers' research activities taking into account research and digital competencies. The developed model provides performance of the basic functions and allows for systematic monitoring of openness, transparency, efficiency of the research component of university teachers' professional activity. The model was based on key indicators for evaluating the effectiveness of research – citation indicators of the three most important scientometric databases – Scopus, Web of Science, Google Scholar. The connection between the indicators presented in the model forms a portrait of the university teachers' scientific activity, gives an overall assessment of productivity, influence and contribution to the research direction of the university as a whole. The article describes 1 stage of implementation of the presented model by developing a “Rating of Transparency of Structural Units”, the effectiveness of experimental ranking. The study has established the positive impact of the implementation of the rating system, identified the main activities to increase the visibility, presence, dissemination of research results, the systematic implementation of which contributes to the optimal representation of the scientist in the rating evaluation of the research component of the university teachers professional activities, improving the digital competence of teachers and positively affects the quality indicators of the university scientific work in local and international rankings, as the existence of the system and the formation of ratings is an incentive for university teachers to present and disseminate their own publishing activities in the international online scientific community.

Keywords: publication activity, scientist profile, scientometric databases, rating system, research activity, research competence, digital competence

1. Introduction

The main priority of each university is to provide quality educational services, increase competitiveness in the educational market and to attract the most promising students. Participation in international and domestic rankings is an important tool for measuring the competitive-

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ness of Universities. In the methodologies of the most authoritative rankings, the quality and transparency of Universities are assessed by indicators of publishing activity of researchers. Indicators of the scientific citations' quality according to Google Scholar Citations and citations in influential scientific journals are taken into account in international rankings – “Academic ranking of world universities” (ARWU), “QS Top University Ranking”, webometric ranking of world universities “Webometrics”, “Transparent ranking: Top Universities by Google Scholar Citations” and Ukrainian – “University ranking by Scopus indicators”, “Top-200 Ukraine”, “Consolidated rating of higher education institutions of Ukraine”, “Bibliometrics of Ukrainian science” [2]. To ensure optimal representation of the university in international and Ukrainian rankings, it is necessary to develop and implement a rating system for the analysis the research activities of university teachers to monitor and qualitatively analyze the effectiveness of research activities of university teachers and timely develop systemic measures to increase openness, transparency results of research activities, wide dissemination in the international scientific network communities for popularization and collaboration.

The purpose of the study is to build a structural and functional model of a rating system for the analysis the research component of university teachers' activities based on key indicators of research and digital competencies.

2. Research of the experience of the analysis of research activity of the university teachers in the European space of higher education

Bykov and Spirin [3], Bykov et al. [4], Delgado López-Cózar, Orduña-Malea and Martín-Martín [7], Martín-Martín et al. [14], Semerikov et al. [20], Vakarenko [24] studied the features of the analysis of research results using open scientometric and bibliometric systems.

Theoretical bases of rating assessment of teachers' activity of the Ukrainian Universities were studied by Dzoba [8], Reheilo [19], Yaroshenko [25]. Yaroshenko [25] emphasized the need to modernize indicators of the teachers' research activities, in accordance with the modern realities of university education, summarizes the main characteristics of the rating assessment of the teachers: purpose, objectives, functions and ranking principles. Reheilo [19] considered the main conceptual principles of evaluating the effectiveness of the teachers' research activities, analyzed the principles, structural components and indicators of evaluation of the teachers' scientific activities in the European higher education area.

Issues of assessing the quality of research results were studied by Gasparyan et al. [9], Kostenko, Symonenko and Zhabin [11], Shynenko, Kilchenko and Tukalo [21].

Hohunskyi et al. [10] determined that the use of profiles by scientists in Google Scholar, ORCID, Mendeley, Academia, ResearchGate increases the visibility of publications in the information space and has a positive effect on increasing citation rates.

In [11] the information-analytical system “Bibliometrics of the Ukrainian Science”, developed by Social communication research center, which is the register of bibliometric profiles of researchers and research teams in the most authoritative scientometric databases, as Scopus, Web of Science and Google Scholar. The system allows to analyze the local scientific potential, to carry out a comparative analysis of the effectiveness of Ukrainian scientists in the fields of

science, cities, affiliation, agencies, etc. by constructing rating tables on the value of h-indices in Scopus, Web of Science or Google Scholar databases [1]. Open profiles of a scientist in scientometric databases are a passport of a scientist in the European space of higher education, which reflects his authority and influence on the development of a particular field.

Spivakovsky et al. [23] describes the experience of designing an information system to analyze the research activities of university teachers, tested on the basis of Kherson State University and Kherson State Maritime Academy. The system implements tools for constructing teachers' ratings by the main indicators of scientific citation in the databases Scopus, Web of Science, Google Scholar, Semantic Scholar, Tutor Network. Ratings are built in the context of structural units, departments and scientific journals. The rating of departments is based on the maximum value of citation profiles of all employees in the department in these databases [18].

The project Open Ukrainian Citation Index (OUCI), developed by the State Scientific and Technical Library of Ukraine, was studied by Nazarovets [16]. OUCI is a search engine and database of scientific citations that contains meta-data of all publications that use Cited-by service from Crossref and support the Initiative for Open Citations. The OUCI database contains metadata of scientific publications that receive DOI from Crossref and takes into account citations between publications. OUCI is designed to simplify the search and analysis of research results and expand the presentation and visibility of Ukrainian scientific publications in international search engines, such as Dimensions, Lens.org, 1findr, Scilit, etc [17]. The implemented analytical tool allows to assess the state and dynamics of the development of scientific potential in terms of fields of knowledge, years, to select the appropriate scientific journal for publication.

A common practice among universities is the implementation of rating systems to assess the professional activity of university teachers, as part of the system of quality assurance in education, one of the areas of which is research. Borys Grinchenko Kyiv University has introduced the "E-portfolio" system, which reflects the detailed picture of the teacher's activity with certain quantitative and qualitative indicators of activity. The system allows not only to create an e-portfolio of the teacher, but also to form rating tables of indicators for assessing the main activities of each university teacher [15].

Borys Grinchenko Kyiv University has introduced the Corporate Standard of Research Activity of Employees and the Corporate Standard of Digital Competence of Teachers, which present and correlate the performance indicators of university teachers' research activity and their corresponding indicators of the levels of formation of teachers' digital competence (figure 1).

One of the indicators of university teacher's compliance with the Corporate Standard of Research Activities of the staff of Borys Grinchenko Kyiv University [6] is the indicator of scientific recognition, which is determined by the values of citation indices in the scientometric databases Scopus, Web of Science, Google Scholar. The key to optimal presentation of research results in scientometric databases is a sufficient level of digital competence, which lies in the ability to effectively use open digital systems in own research, create, update, supplement the articles of the scientist profile in scientometric databases, distribute research results in scientific web-communities and social networks [5] (table 1).

Analyzing the experience of developing rating systems for the analysis the activities of university teachers, it was determined that the most common quantitative indicators of evaluation of research activities are publications in journals included in influential scientometric databases; values of citation indices in scientometric databases – Scopus, Web of Science, Google Scholar,

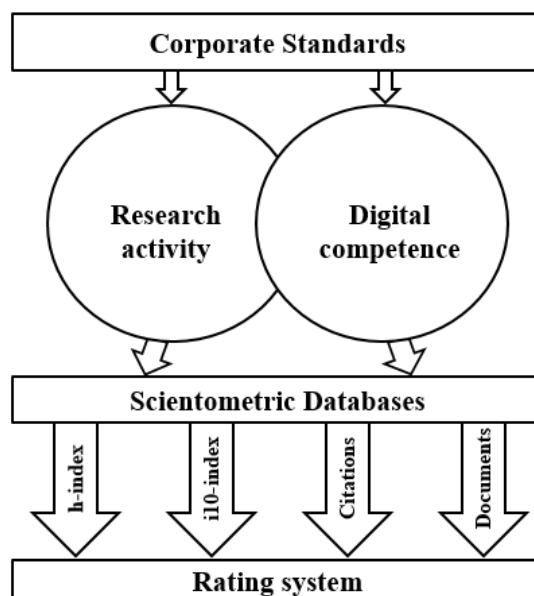


Figure 1: Correlation of indicators of the Corporate Standard of Research Activity and the Corporate Standard of Digital Competence of the staff of Borys Grinchenko Kyiv University.

Table 1

Comparative table of indicators of the Corporate Standard of Research Activity and the Corporate Standard of Digital Competence of the staff of Borys Grinchenko Kyiv University.

Corporate Standard of Research Activity	Corporate Standard of Digital Competence
<i>Scientific recognition:</i> Scientometric indicators from databases Scopus, Web of Science and Google Scholar • h-index • i10-index • Number of citations • Number of publications	• Actualization of scientist profiles in scientometric databases; • Dissemination of research results; • Systematic use of digital tools in conducting and disseminating research results.

etc. [15].

3. Tools for determining the publishing activity of the university teachers

The most common tools for assessing the publishing activity of the university teachers are the determination of citation indices in scientometric databases. Scopus and Web of Science databases allow scientometric analysis of a scientist's productivity by analyzing the dynamics of

the number of publications in influential international publications, the influence and demand of scientific work, analyzing the dynamics of bibliographic references and citation indices by years [22].

Scopus and Web of Science have powerful analytical tools SciVal and InCites. The tools allow for a comprehensive analysis of the effectiveness of research on a wide range of indicators: impact, productivity, collaboration, open access, the impact of journals, etc. in a visualized form; identify promising areas of research, expand the range of scientific collaboration and cooperation.

An alternative to commercial systems is the free Google Scholar system, which indexes full-text scientific publications from many disciplines in various databases. The main advantage of Google Scholar is its freeness and the fact that its index is not limited to a certain list of journals, unlike commercial scientometric databases like Scopus, Web of Science, but more broadly covers the web space, it indexes publications on sites electronic journals, repositories, electronic conferences, personal blogs of scientists, etc. For efficient indexing, web resources must be based on platforms with special meta tags (EPrints, DSpace, Open Conference System) [12], from which the Google Scholar system receives basic publication metadata or publication files designed according to certain requirements for document formatting, design of titles, personal data of the authors, the main content of the article, the list of sources used, etc [3]. The Google Scholar system allows researcher to create a personal profile and add system-indexed publications to it. The Google Scholar researcher's profile has tools for analyzing statistics on citations of publications by year, allows you to track the total number of citations, h-index and i10-index, which are calculated based on the total number of publications and the number citations of individual indicators for the entire period of scientific work and for the last 5 years in digital form and in the form of a comparative histogram [22].

A comparison of the available indicators for evaluating the effectiveness of the researcher's research activities in the profiles of the most common scientometric databases is given in table 2.

Table 2

Comparative table of scientometric indicators in the scientists' profiles.

	Scopus	Scival	Web of Science	Publons	InCites	Google Scholar	ResearchGate
Number of publications	+	+	+	+	+	-	+
Citation	+	+	+	+	+	+	+
h-index	+	+	+	+	+	+	+
i10-index	-	-	-	-	-	+	-
Average citation value	-	-	+	-	+	-	-
Altmetric indicators (recommendations, readings)	+	-	+	-	-	-	+
Without self-citation	+	+	+	-	+	-	+
Visualization	+	+	+	+	+	+	-
Analysis of indicators	+	+	+	+	+	+	+
Reports	+	+	+	-	+	-	-
Making connections	+	+	+	+	+	+	+

The analysis of indicators confirms that for a full-fledged comprehensive assessment of the effectiveness of research in various areas it is necessary to use a set of indicators of important scientometric databases.

4. Research results

4.1. Structural and functional model of the rating system for the analysis the research activity of the university teachers

The most important scientometric databases that demonstrate the effectiveness of the university teachers' research activity are Scopus, Web of Science and Google Scholar, in which the values of bibliographic citation are used as quantitative indicators of evaluation and analysis. At the same time, it is important for university teachers to comply with the Corporate Standard of Research Activity and the Corporate Standard of Digital Competence, as the level of research and digital competence directly affects the quality of research and therefore the university's ranking in international and local rankings. That is why the basis of the model of the rating system for the analysis the research activity of the university teachers are these three scientometric databases.

The main principles in developing the methodology of the rating system for the analysis the research activity of the university teachers were objectivity, measurability and transparency. That is why as indicators of the effectiveness of university teachers' research activities were selected indicators of citing scientific publications in open teachers' profiles in Scopus, Web of Science and Google Scholar that is easy to get and check – the number of bibliographic references, the h-index and i10-index.

The rating system for the analysis the research activity of the university teachers performs the following functions:

- informational – the formation of a single information base of indicators of research effectiveness of university teachers for quality assessment;
- visualization – presentation of information in a visualized form to improve perception, reporting;
- motivational – the formation of an atmosphere of healthy competition, activation of the scientific potential of the university;
- competence – encouraging teachers to create, update, actualization information in their own profiles in scientometric databases;
- analytical – analysis of the current state of the research component of the departments and the university as a whole, identification of factors influencing the effectiveness of teachers' research activities, identification and analysis of relationships;
- prognostic – forecasting of perspective trajectories of the university development, system measures development for increasing the indicators of efficiency of the university teachers' research activity;
- managerial – information basis for making managerial decisions.

The implementation of certain functions is possible in the presence of the following structural components of the rating system for the analysis the research activity of the university teachers.

The administrative component provides for the delimitation of access rights to the rating system – administrator, teacher, guest. Administrator rights include the start of rating formation, marking of incorrectly filled profiles, export of reports. The rating is available to university teachers and unauthorized users only for review and analysis.

Organizational component. For each lecturer of the Borys Grinchenko Kyiv University, a profile in the “E-portfolio” system is automatically generated, from which data on affiliation and scientific citation are obtained.

The technological component (figure 2) includes obtaining scientometric indicators from Scopus databases, Web of Science and the Google Scholar system and teachers’ personal data. The “E-portfolio” system of the Borys Grinchenko Kyiv University automatically synchronizes the values of bibliographic references, h-index and i10-index for the last 5 years from the bibliographic profile of the scientist in the Google Scholar system, a link to which the teacher can add to his portfolio.

Scientometric indicators from the Scopus and Web of Science profiles are entered the “Database of activity registers”, the data from which are automatically synchronized in the teachers’ profile in the “E-portfolio” system. The relationship between the systems is implemented through APIs. The values of scientometric indicators from the Scopus, Web of Science and Google Scholar databases available in the profile are obtained during the formation of the “Rating of Transparency of Structural Units”, which is one of the results of the designed model.

Effective component – based on the collected data on the affiliation and scientometric indicators of teachers are formed rating tables of research effectiveness of the university as a whole and in terms of departments and departments, based on which the ability to export reports.

Communication of all components is provided in the Borys Grinchenko Kyiv University Digital Campus.

Thus, the structural and functional model of the rating system system based on competencies for the analysis the research activity of the University teachers will have the following form (figure 3):

4.2. Development of a transparency rating and methodology for its construction

Based on the presented model, a rating was developed, which is one of the indicators of system performance. As a result of experimental implementation, a “Rating of Transparency of Structural Units” by citation indicators in Google Scholar was developed, which ranks teachers according to their indicators of publishing activity (figure 4).

The proposed model of the rating system was implemented as a web-oriented client-server architecture. PHP programming language using the MVC architectural model was used in the development of the server software. The web user interface is implemented using HTML, CSS and JavaScript.

The average citation rate per university teacher was determined in order to build the ranking of the structural units, as this approach reflects the contribution of each individual teacher to the scientific achievement of the structural unit and the performance of the research team as a whole. The ranking of structural units and chairs in the “Rating of Transparency of Structural Units” is carried out in descending order of the value of the average citation rate per 1 university

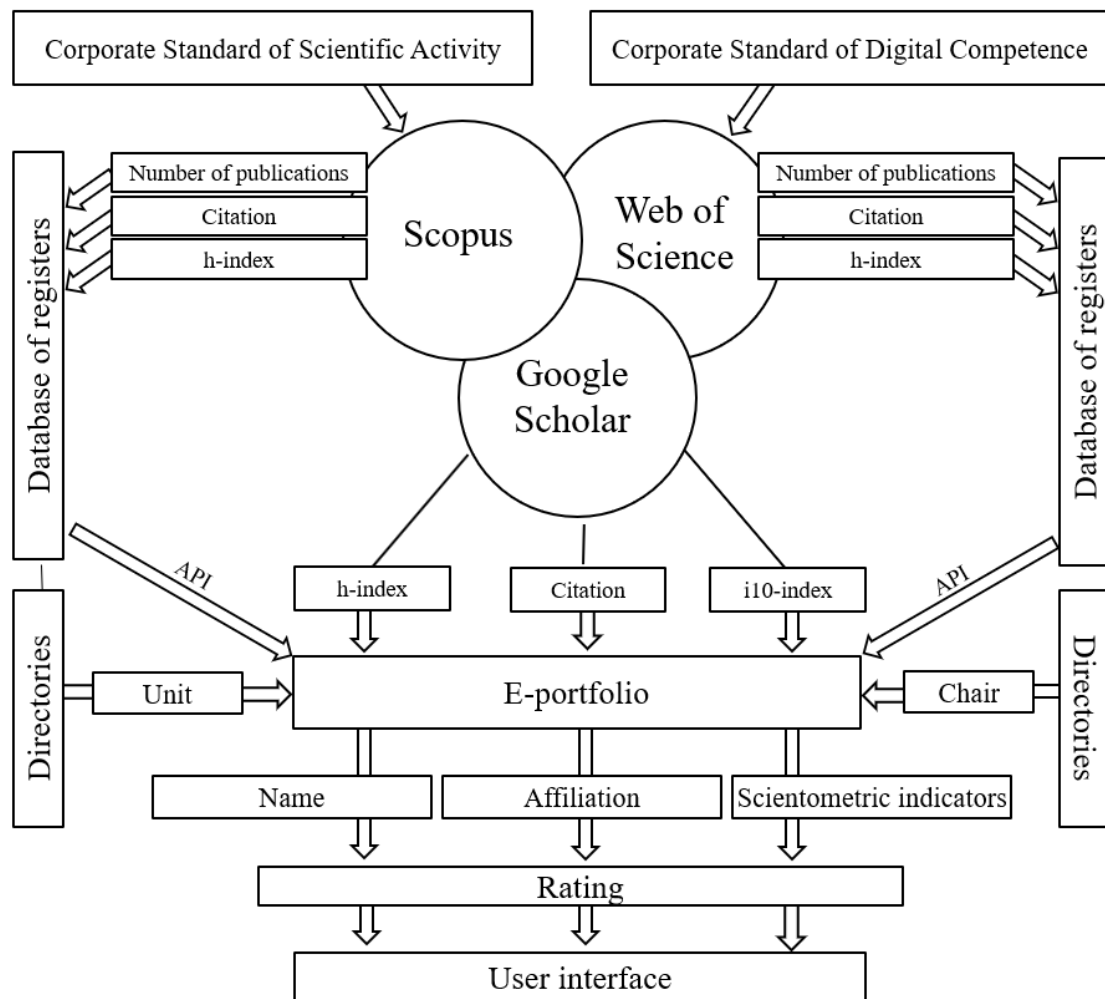


Figure 2: Technological component of the structural-functional model of the rating system for the analysis the research activity of the university teachers.

teacher. In the case of the same average citation rates, the structural units and chairs are sorted in descending order of the total number of citations of teacher profiles. The choice of the Google Scholar system is due to the fact that, unlike the scientometric databases Scopus and Web of Science, it has a wider coverage and includes publications from these databases and has a high level of correlation in citation values with Scopus, Web of Science, which confirmed by the results of research [13, 14], which provides a greater presence of University teachers in the ranking.

In the context of chairs, a list of teachers is displayed, ranked in descending order of the value of the total number of bibliographic references according to the Google Scholar (figure 5). The detailed table of research performance indicators contains the values of the total number of bibliographic references, h-index, i10-index and the link to the profile in the Google Scholar.

Creating a database of scientific profiles of researchers in Google Scholar allowed to implement

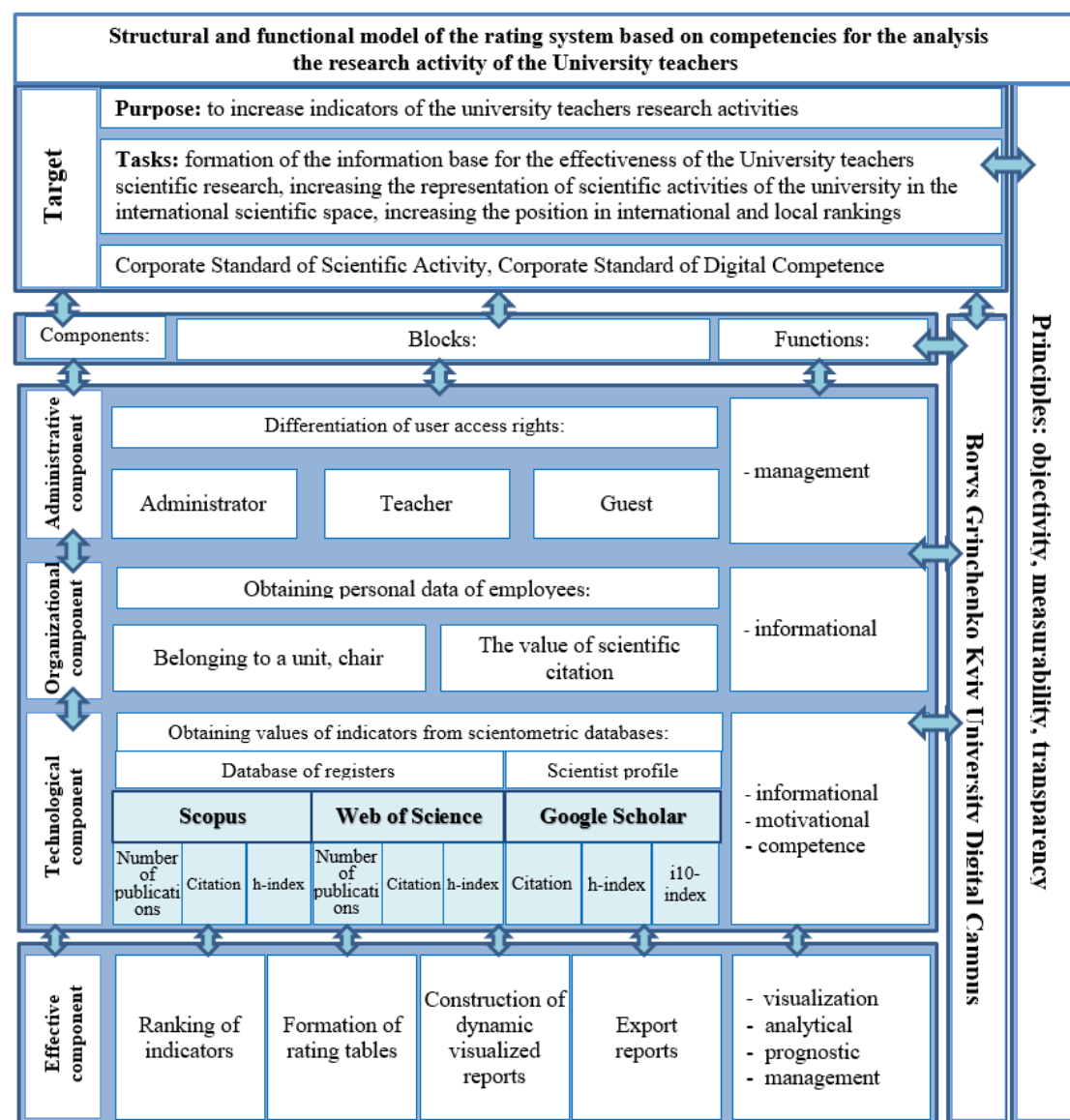


Figure 3: Structural and functional model of the rating system based on competencies for the analysis the research activity of the university teachers.

the designation of incorrectly configured profiles in one place.

For further analysis of rating positions and indicators of the university teachers' research activities, construction of visualized reports on the effectiveness of research activities, it is planned to implement the 2nd stage of research – expanding the rating for other indicators presented in the model – the number of publications and citation indices in Scopus and Web of Science databases, establishing relationships to increase the university teachers' publishing activity.

1. Faculty of Information Technology and Management (Citation on 1 NPP - 137.21, total citations - 7958)

+ Department of Computer Science and Mathematics

(Citation on 1 NPP - 175.87, total citations - 4045)

+ Department of Finance and Economics

(Citation on 1 NPP - 169.56, total citations - 1526)

+ Department of Management

(Citation on 1 NPP - 127.64, total citations - 1787)

+ Department of Information and Cyber Security

(Citation on 1 NPP - 50, total citations - 600)

2. Faculty of History and Philosophy (Citation on 1 NPP - 83.32, total citations - 3916)

+ Research Institute of Archeology

(Citation on 1 NPP - 233.8, total citations - 1169)

+ Department of Philosophy

(Citation on 1 NPP - 88.86, total citations - 1866)

Figure 4: “Rating of Transparency of Structural Units” by citation indicators in Google Scholar.

– Department of Computer Science and Mathematics

(Citation on 1 NPP - 175.87, total citations - 4045)

No	Name	Citation	h-index	i10 index	
1	Morse Natalia Viktorivna	2249	21	63	Link to a Google Scholar account
2	Lytvyn Oksana Stepanovna	689	14	23	Link to a Google Scholar account
3	Wember Victoria Pavlovna	357	10	12	Link to a Google Scholar account
4	Boyko Maria Anatoliyivna	133	7	3	Link to a Google Scholar account
5	Proshkin Vladimir Vadimovich	122	6	2	Link to a Google Scholar account

Figure 5: Ranking of the university teachers by citation indicators in Google Scholar.

4.3. Influence of the rating indicators on the improvement of the university teachers’ research activity

The research took place in several stages: preparatory, design, experimental (implementation).

At the preparatory level, the theoretical foundations of rating of evaluation the university teachers’ activity were investigated. At the design stage, a structural and functional model of the rating system for the analysis the research activity of the university teachers was designed, “Rating of Transparency of Structural Units” by citation indicators in Google Scholar was developed and a preliminary rating was built. For two months, the administration and university

teachers had the opportunity to review and analyze the data of the previous rating, after which an experimental rating was built.

The analysis of preliminary and experimental ratings (figures 6, 7), built with an interval of 2 months, confirmed the positive dynamics of research performance. The availability of the system and the formation of ratings is an incentive for teachers to update their e-portfolio profiles, create profiles in scientometric databases, in the absence, update information in scientometric profiles, including Google Scholar, supplement indexed publications, dissemination of research results, their discussion in the international online scientific community, thus developing skills in using digital technologies in organizing research and disseminating results.

Unit	Average citation rate per 1 teacher			Total number of citations		
	April	June	Dynamics	April	June	Dynamics
FITM	137,42	137,21	-0,21	7558	7958	400
HIS	63,95	76,28	12,33	3709	4348	639
FHP	60,8	83,32	22,52	2736	3916	1180
FHPES	57,26	49,2	-8,06	2634	2263	-371
PI	56,06	62,24	6,18	3532	3921	389
Research Laboratory	50,71	52,86	2,15	710	740	30
IJ	20,82	22,16	1,34	1145	1263	118
IIST	20,57	22,76	2,19	1111	1252	141
FLIR	20,49	19,12	-1,37	881	822	-59
IP	13,83	15,83	2	2255	2628	373
IA	10,18	12,47	2,29	1059	1235	176
University	46,55	50,31	3,76	27330	30346	3016,00

Figure 6: Google Scholar citation rates in preliminary and experimental ratings.

According to the results of the study, it was found that the optimal presentation of the results of university teachers' research activities in ranking is facilitated by:

- implementation of open access, transparency, openness of research results;
- preference for publications, assigning articles a unique DOI identifier, which facilitates publication identification and provides a permanent publication link, regardless of changes in the publication web address;
- creating profiles and periodically adding new scientific developments to scientometric and bibliometric databases such as Google Scholar, ResearchGate, Mendeley, and the like;
- use of ORCID scientist identifier to correctly identify the affiliation of the article to the author's profile;
- implementation of dissemination activities to increase visibility and presence in the international online scientific community.

Currently, work is underway to refine and expand the rating for other indicators of Scopus, Web of Science, presented in the model to obtain a full rating system; systems of analytics and statistics with the formation of dynamic visualization of the effectiveness of the scientific potential of the university.

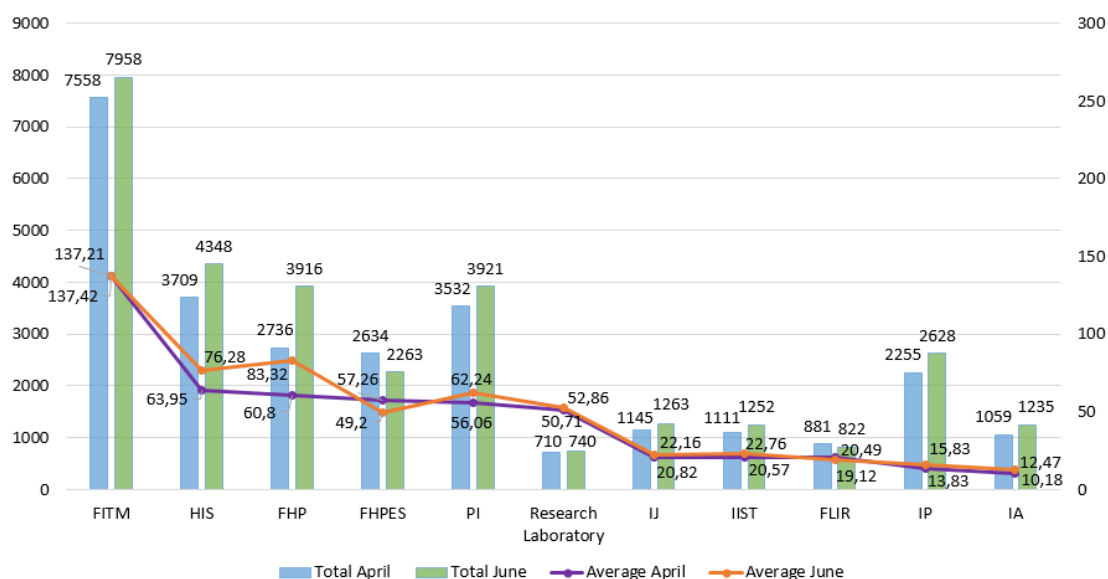


Figure 7: Diagram of indicators of preliminary and experimental ratings.

5. Conclusions

For optimal presentation of the university's activity in international and Ukrainian rankings, ensuring the competitiveness of the university, it is important to systematically monitor the openness, transparency of the effectiveness of the university teachers' research activities. An effective tool for monitoring is the development and implementation of a rating system for research analysis.

The system is based on the three most important scientometric databases – Scopus, Web of Science, Google Scholar and provides the main functions – information, visualization, motivation, competence, analytical, prognostic and managerial. The rating system is implemented as a web-oriented client-server architecture. One of the components implemented in the system at the 1st stage of the study is “Rating of Transparency of Structural Units” by citation indicators in Google Scholar. According to the results of the study, recommendations were developed to improve the quality of research activities. The formation of the ranking has confirmed the importance of designing a system to analyze research activities, improve the quality of scientific research, disseminate research results in the international educational space, to analyze teachers' own professional development, monitor the scientific growth of university teaching staff and obtain visualized analyses in real time. The prospects for further research is considered in the adding other research activity indicators to the ranking, realisation of real-time updates to the rating system, integration of modern business intelligence systems to build visualised statistics to analyse the effectiveness of the research component of the university's activities.

The systematic implementation of measures to ensure open access to own research results, to increase the visibility, transparency and dissemination of the results of research activities in the Internet space contributes to the optimal representation of the scientist's activities in the

rating evaluation of the research component of the professional activities of university teachers, improving the professional competence of teachers and positively influencing on the indicators of quality of university's scientific work in local and international rankings.

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