The Use of Electronic Open Journal Systems in Scientific and Pedagogic Research: Results of Experiment

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Abstract. The article deals with the problem of the use of electronic open journal systems in scientific and pedagogical research as well as the formation of ICT competence of researchers on the use of such systems. The concepts of electronic journal system (EJS) are considered. The most common kinds of electronic journal systems are revealed (proprietary, local (in-house), open and cloud journal systems). The criteria for accessing the effectiveness of the electronic open journal systems (EOJS) use in scientific and pedagogical research are described (normative, organizational and communication, effective), as well as their indicators. The organizational and pedagogical model of EOJS use in scientific and pedagogical researches is developed. The definition of "ICT competence of researchers on the use of EOJS in scientific and pedagogical research" is provided; its components are described; criteria (axiological, cognitive, praxeological, adaptive) and indicators of its formation are defined. The model of formation of this competence is provided. The main stages of the experimental process (2010–2018) are described. The results of the formation of ICT-competence of researchers and information-analytical monitoring of the scientific journals of the National Academy of Educational Sciences of Ukraine are presented.

Keywords: Open Journal Systems, Scientific E-Journal, ICT Competence, Researchers.

1 Introduction

The traditional model of scientific communication is based on a system of printed scientific publications (journals, monographs, collections of conference materials). Today the scientific content is presented mainly in electronic format. The central element of the modern model of scientific communication is the electronic scientific journal. That's why, the information and communication technologies (ICT) for the deployment and support of scientific periodicals on the Internet are becoming widespread. The type of such ICT is the electronic journal system (EJS). It supports the processes of user's registration, submission and initial review of manuscripts for adherence to editorial requirements; the appointment of reviewers, double-blind scientific review, monitoring of review process, collective editing of manuscripts, editing metadata, maintaining text, graphics and video files, creation and publishing of collections of articles, their long-term storage, collection of usage statistics, control of access levels, subscription, etc.

Moving the publishing process to the online environment should be achieved by a careful selection of the service that will best meet with the needs of individual researches, scientific institutions and journal editors. In the same time, a sufficient level of researchers' ICT competence to use such systems should be the key to effective scientific and pedagogical research.

Analysis of recent studies and publications. The problem of electronic journal systems using for support electronic scientific periodicals has been partially investigated in the following areas:

– the definition of the concept of electronic journal systems [1]–[5];
– a description of the design, development and practice of the use of individual EJS samples [2], [3], [6]–[16]; comparative analysis of EOJS [4], [21], [22], [37].
– functional aspects of EOJS [1], [3], [10], [12], [17]–[20];
– use of the Open Journal System (OJS) software platform to create and support university e-repositories and of scientific journals collections [5], [23]–[29];
– support for educational publications on the base of Open Journal System [30], [31], as well as the socio-psychological aspects of this process [32];
– teaching of master's students the basics of scientific activity [33]:
– automation of data export from OJS to scientometric databases [34].

The research hypothesis: implementation of the specially developed method in the process of training and in service training of researchers will increase the level of formation of their ICT competency on the use of electronic open journal systems as well as the level of efficiency of these systems use in scientific and pedagogical research. The **purpose of the article** is to present the results of experimental verification of this hypothesis.

2 Theoretical Background

The analysis of scientific sources shows that there is no agreed position on the established name of technologies to support the editorial and publishing process. Scientists use about twenty synonymous terms: electronic journal management systems [1], [9], [18], [19]; e-journal management systems [11]; e-journal publishing systems [11]; web-based journal management systems [17]; electronic publishing systems [21]; open-source electronic publishing systems [21]; e-publishing systems [6]; open-source online publishing systems [7]; online peer review systems [7]; computerized review systems [20]; online submission and peer-review systems [12]; web-based manuscript submission and peer-review system [9]; online journal systems [36]; online publishing systems [36]; digital publishing systems [37]; journal publishing systems [38]; journal management systems [38]; los sistemas de gestiyn editorial [38]; electronic management systems of the peer review process [39]; electronic journal publishing systems [40]; web-publishing systems [41], web-based peer-review systems [42]; open source journal management systems [43].

Summarizing the interpretation given in these sources, we offer the following definitions:

− **electronic journal system (EJS)** is the software that automates the support and management of the editorial and publishing process of scientific journals;
− **electronic open journal system (EOJS)** the open-source software platforms that provide organizational and decentralized remote management of the full cycle of the electronic scientific journals editorial and publishing process: submission, review, copyediting, proofreading, layout and articles publication, as well as their preservation, dissemination, and indexing in the Internet.

2.1 Types of electronic journal systems

In the early 2000s, Wood D. [13], Shapiro K [3], Ware M. [12], McKiernan G. [10] performed a comparative analysis of popular electronic **proprietary journal systems**, such as *PeerTrack™, Bench>Press™, EdiKitSM (bepress), ESPERE, Manuscript Central™, Rapid Review®, Editorial Manager, eJournalPress (EJPress), FontisWorks, XpressTrack*. Notwithstanding the slight differences in the interface, functionality and cost of licenses, a "virtual publishing office" with appropriate mechanisms for receiving, processing, distributing and revising manuscripts was implemented in all the above-mentioned platforms.

Further, some scientific institutions and publishers made experimental attempts to develop **local (in-house) systems** [2], [7], [9], [11], [14], [18] for the support of their own electronic journals. Such systems become customizable to the specific needs of the publisher, adaptable to any workflow changes in the future and are independent of a third-party developer. Samples of local electronic journal systems are *EJMS – Electronic Journal Management System; SXC-JMS (St. Xavier's College – Journal Management System); BMIF's Online Peer Review System; BMIF – Mathematics, Informatics, Physics Series – Bulletin of PG University of Ploiesti»; IAJIT OpenConf Journal Management System (IAJIT JMS); Electronic Journal of University Malaya (EJUM); Электронная редакция журналов СПбПУ; Elsevier Editorial System (EES); ACS Paragon Plus Environment; Begell House Journals Online Submission System; Independent Journal Program*.

Developing countries do not have sufficient financial support and the necessary technical facilities to publish scientific periodicals, and therefore cannot incur significant software acquisition costs. That is why, over the last decade, numerous attempts have been made to develop freely distributed software platforms to support electronic scientific periodicals, such as electronic **open journal systems** [4], [5], [21], [22]. The most popular examples of EOJS are *EPublishing Toolkit; GAPworks; SOPS (SciX Open Publishing Services); Topaz; DiVA (Digitala Vetenskapliga Arkivet); Érudit; DPubS (Digital Publishing System); HyperJournal; E-Journal; Ambra; Open Journal Systems (OJS).*

Using such systems allows for simplified setup, more powerful functionality and reduced costs for publishing a scientific product. However, for the functioning of the entire above electronic journal systems, it is crucial to have a database located on a web server with constant uninterrupted access to the Internet. This involves acquiring or leasing by scientific institution a web server by a scientific institution and ordering the services of a competent system administrator.

A new trend to support the publishing of scientific periodicals is the development of so-called **cloud journal systems** [6], [8]. They allow users to use the service over the

Internet. Namely, to move all editorial processes to remote servers that will deliver the publishing environment to a large number of clients continuously using a single platform. Examples of cloud EJS are projects *Scholastica; Cloud Publications; Cloud Journals*.

Based on detailed comparative analysis [30], practical experience and wide geographic of use we conclude that the best way to support electronic journals is to use open electronic journal systems. In particular, Open Journal Systems can be recommended to scientific institutions and editorial boards, as it enables the editorial team to automate and simplify technological tasks to the greatest extent possible.

2.2 The organizational and pedagogical model of EOJS use in scientific and pedagogical researches

The **author's method** is based on the organizational and pedagogical model of EOJS use in scientific and pedagogical researches (see Fig. 1). It consists of target, procedural, evaluation and result components as well as the model of formation of the researchers ICT competence on the use of EOJS in scientific and pedagogical research. (Fig. 2). The procedural component of this model describes the seven stages of the procedure of the electronic scientific journal implementation by using EOJS (predictive, organizational, technical and technological, preparatory, practical, generalizing and perspective). The evaluation component of the model reveals **the criteria of efficiency of the electronic open journal systems use in scientific and pedagogical research** – the indicators for the evaluation of the efficiency of the EOJS use in scientific and pedagogical research. The criteria and indicators we propose are presented in the Table 1:

Table 1. Criteria and indicators of efficiency of the electronic open journal systems use in scientific and pedagogical research

Criteria	Indicators
Normative	Compliance with regulations on the functioning of electronic scientific journals. Compliance with the requirements for the structure, design, and content of electronic periodicals. Compliance with international publishing standards.
Organizational and communication	Time for preparing, publishing and distributing published content. The number of registered users/authors/readers and their geographical distribution. The number of manuscripts received/reviewed/published per month (including English). Percentage of accepted/rejected manuscripts. Availability of tools for supporting scientific communication during the editorial and publishing process participants.
Productive	The developed ICT competence of researchers in the use of electronic open journal systems in scientific and pedagogical research. Inclusion of an electronic scientific journal in the leading international scientometrics and abstract databases; growth of scientometric indicators of journals, articles, authors and editors.

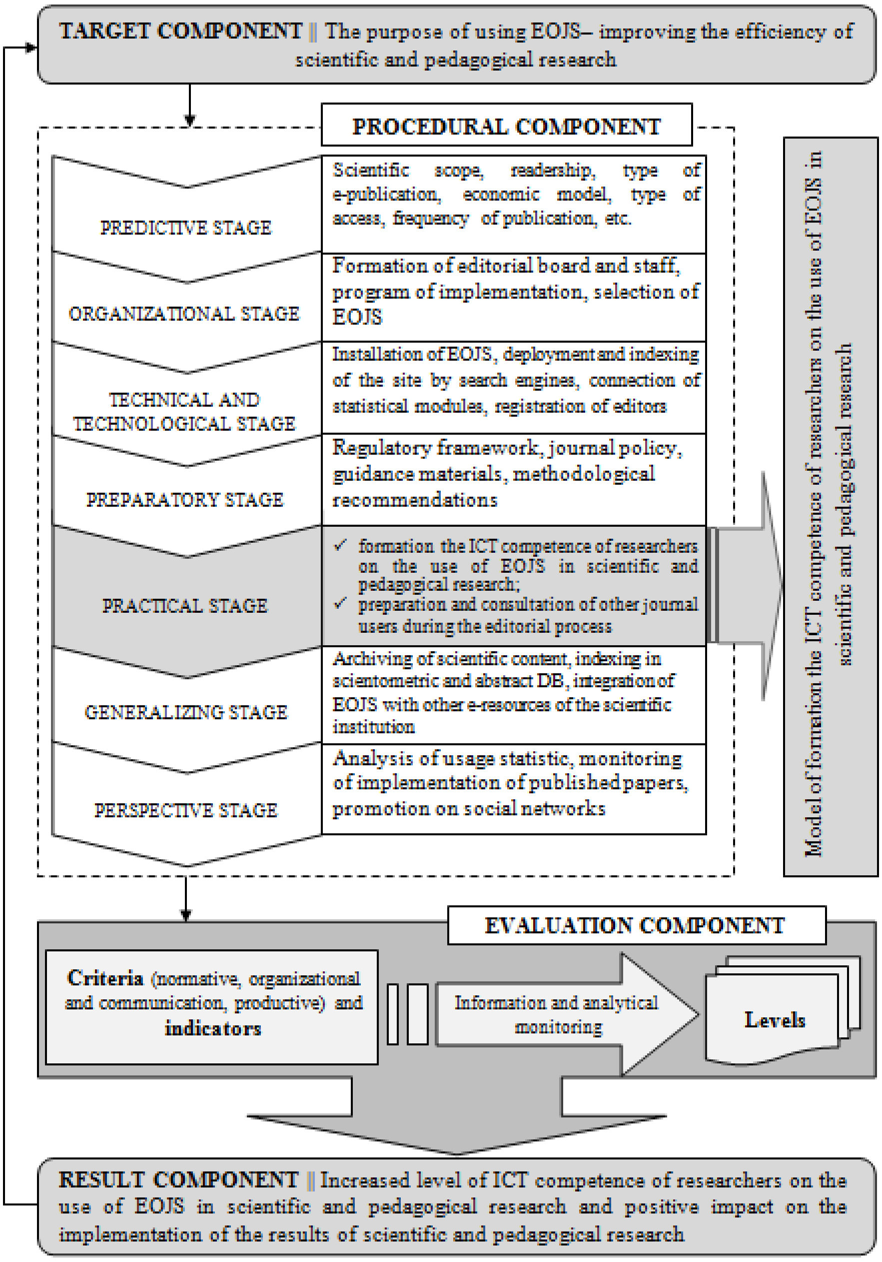

Fig. 1. The organizational and pedagogical model of EOJS use in scientific and pedagogical researches

2.3 ICT competence of researchers on the use of EOJS

ICT competence of researchers on the use of EOJS is the proven ability of a person to use such systems to solve professional problems in the process of scientific and pedagogical research, implementation and information and analytical monitoring of their results, as well as scientific communication and cooperation with colleagues based on acquired knowledge, skills and competences with the EOJS (Fig. 2).

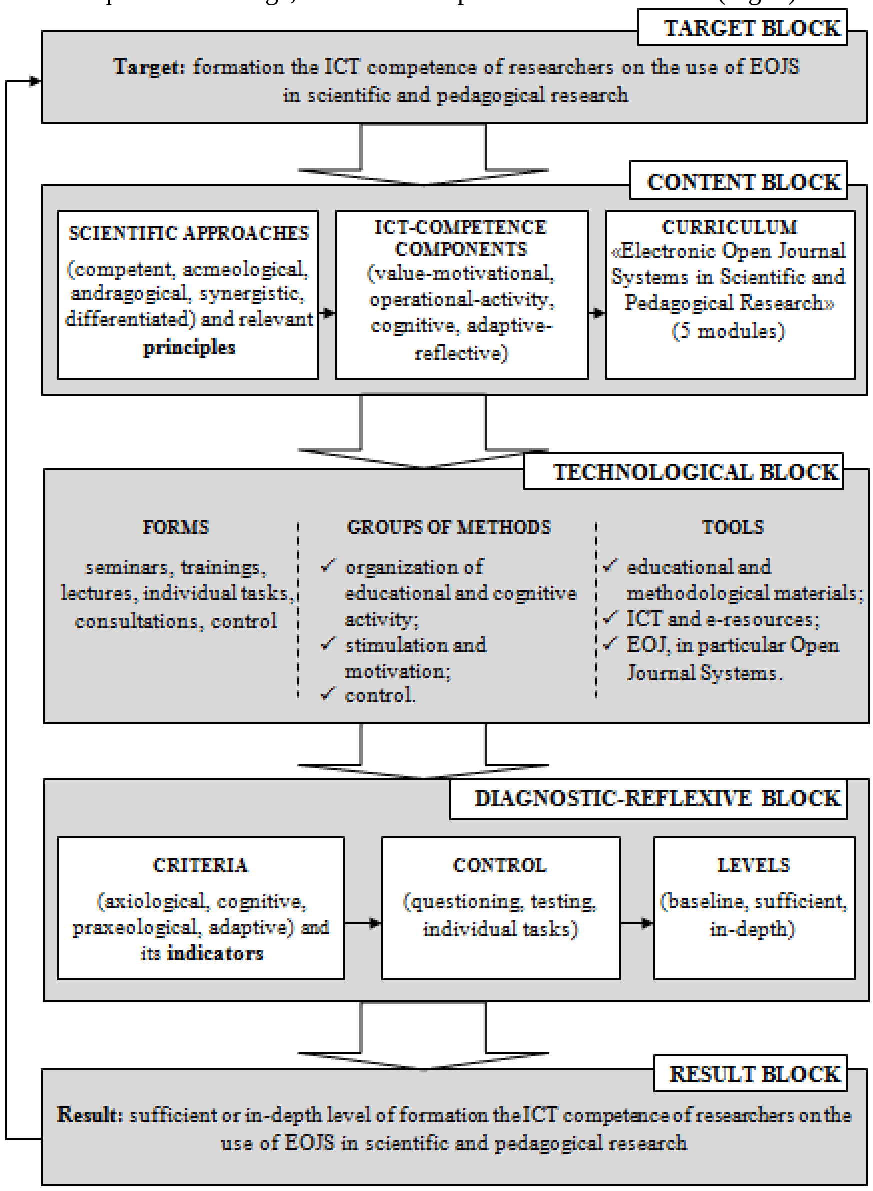

Fig. 2. Model of formation the ICT competence of researchers on the use of EOJS in scientific and pedagogical research

To characterize the ICT-competence of scientists we refer to the DigComp 2.0 - the Conceptual Reference Model, which identifies 5 key competence areas (information and data literacy; communication and collaboration; digital content creation; safety; problem solving). In the same time we take into account the professional needs of the scientists while using the EOJS for the professional needs. The following components are defined:

- *Value-motivational component:* motivation, value attitudes, awareness of digital technologies and its environmental impact.
- *Cognitive component:* the system of knowledge about devices, creation and editing of digital content, personal data and privacy in digital environments.
- *Operational-activity component:* skills and experience of communication and collaboration through digital technologies, creation, location, storage, retrieving, managing and organisation digital data, information and digital content.
- *Adaptive-reflective component:* adaptation, interaction, resolving problem situations in digital environments, usage digital tools to innovate processes and products, being keep up-to-date with the digital evolution.

According to these components we propose to distinguish the following criteria and indicators for assessing the ICT competency of researchers for the use of EOJS (Table 2).

Table 2. Criteria and indicators for assessing the ICT competency of researchers for the use of electronic open journal systems

Criteria	Indicators
Axiological	Striving for self-development and professional self-improvement. Awareness of the need for the use of the EOJS in the professional activity of a scientist. Interest in obtaining current and additional information on the possibilities of using the EOJS in the process of scientific research. Systematic use of the EOJS for finding and presenting research results. Willingness to carry out an impartial review of scientific works using EOJS. Striving to follow the ethical principles of academic virtue.
Cognitive	Knowing the content of the basic concepts regarding the use of the EOJS in scientific and pedagogical research. Awareness of current electronic means of formal and informal scientific communication and modern ICT for supporting the process of presenting the results of scientific and pedagogical research. Knowledge about international standards of educational research ethics and ethics of presenting the results of scientific and pedagogical researches. Awareness of the importance of peer review in the development of science and the benefits of the role of "reviewer" for the scientist.
Praxeological	Ability to search and analyze quality scientific content. Ability to select the best electronic means of disseminating research results in the international scientific and information space. Ability to carry out all stages of the editorial and publishing process using EOJS. Ability to use specialized software tools to prepare the manuscript for printing. Ability to conduct research and publishing ethical standards. Ability to review scientific manuscripts by EOJS. Ability to use open information and analytical systems.

Adaptive	Rapid response to the emergence of new ICTs to support the process of presenting scientific and pedagogical research results. Ability to creativity, criticality and initiative in working with the EOJS. Ability to enhance the knowledge, skills and experience of working with the EOJS functionality at higher levels of user access.

3 Research Methods

The experimental work was carried out during (2010–2018) and consisted of the following stages:

1. Preparatory stage (2010–2014):

– study of scientific and technical documentation, national legislative framework and international normative documents of using electronic open journal systems in scientific and pedagogical research; identification the components of ICT competence of researchers for the use of electronic open journal systems; clarification the criteria, indicators, and levels of its formation; designing appropriate model and method; implementation of Open Journal Systems for the deployment of a prototype of a scientific e-journal "Information Technologies and Learning Tools" (https://journal.iitta.gov.ua).

2. Experimental stage (2012–2016):

– 2012: 161 participants (132 researchers, 6 administrators, 14 editors of scientific journals, 9 ICT staff) were interviewed about the sources and means of search and publication the results of scientific research in their professional activity.

– 2015–2016: the training was held to develop the ICT competency of researchers on the use of EOJS in scientific and pedagogical research (146 participants). The experimental group (EG) consisted of researchers who were trained under the author's curriculum [35] (69 researchers). The control group (CG) consisted of researchers who were able to use the developed educational, methodological and instructional materials in their activities, attend seminars provided by the Institute of Information Technologies and Learning Tools, and obtain knowledge independently from different sources (77 researchers). The experimental influence on this group of researches wasn`t carried out.

  Diagnostic the level of development of ICT competence of researchers for the use of electronic open journal systems was carried out by input and output evaluation of the levels of its formation (basic, sufficient and in-depth). The questionnaires and description of the evaluation procedure are presented in author's dissertation (https://lib.iitta.gov.ua/716976/, Section 4, Appendixes R, S, T).

3. Interpretation stage (2017–2018):

– collecting and processing empirical data using methods of mathematical statistics, comparing the obtained results with the hypothesis of the study;

– conducting the information and analytical monitoring of the scientific journals of the NAES of Ukraine (see the questionnaire here: https://cutt.ly/tuP41Ya).

4 Findings

4.1 The ascertaining stage of the experiment

As a result of a survey at this stage of the experiment (2012), it was found that researchers typically use journals, monographs, and collections of conference papers, paper-based review literature, e-presentations at conferences, e-mailing, as well as visit research libraries. Bibliographic literature, preprints, scientific e-publications, scientific e-journals and e-monographs, postprints as well as online conferences, electronic scientific repositories, official websites of academic institutions, online video, discussions on Skype and YouTube podcasts are somewhat less used. The data banks, peer-to-peer correspondence, webinars, messenger chats, blogs, scientists' websites, e-portfolios, scientometrics, and abstract databases, Wiki technologies, electronic science forums and social networks are almost unused.

63% of researchers prefer a paper format for presenting their research results. The majority of respondents (72%) are aware of the benefits of publishing research results in scientific e-journals, while at the same time they are partially (38%) aware of the existence of the EOJS to support scientific e-journals. Only a small percentage of scientists (23%) have experience of using EOJS in the process of research: to find the necessary scientific data (33%), to publish their scientific articles (29%), to review the of colleagues papers as reviewer (24%), as editor of the scientific periodical (12%). There was an insufficient level of interest in the use of scientific e-journals based on electronic open journal systems (34%).

In the process of ascertaining stage of the survey it was succeeded to find out the absence of a general strategy for the transferring the scientific journals into EOJS for support the editorial and publishing process; adequate logistical facilities (servers, personal computers), IT-specialists and sufficient funding for the deployment and functioning of the EOJS at each academic institution. There is a lack of manuals on the use of the EOJS, in particular, the in Ukrainian; psychological and technological unpreparedness of researchers to publish their scientific papers and use the means of electronic open journal systems for editor and reviewer tasks; educational and methodological materials (instructions, methodological recommendations, etc.) for the development of ICT competence of researchers; the absence of training the scientists of the National Academy of Educational Sciences of Ukraine, in particular regarding the ways of presenting scientific results.

4.2 The formation of researchers` ICT competence

The results made it possible to conclude that at the beginning of the experiment the level of researchers’ competence was lower than the baseline level in both the CG and the EG, and upon completion of the study it changed to the baseline level in the CG and in-depth level in the EG (Fig. 3). In particular, the *value-motivational* component in CG increased to the baseline level (40%), in EG increased to a sufficient level (71%); the *cognitive* component in CG reached a sufficient level (62%), in EG – in-depth (83%); *operational-activity* component in CG increased to a sufficient level (54%), in EG – to in-depth (92%); the *adaptive-reflective* component in the CG reached the baseline level (33%), and in the EG – reached the sufficient level (62%).

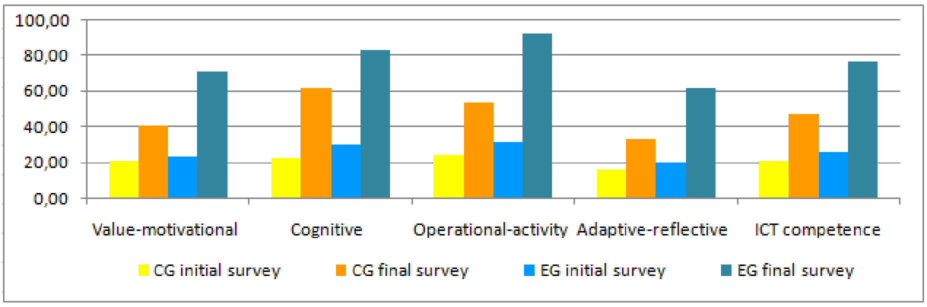

Fig. 3. Diagram of ICT competence levels of CG and EG of researchers at the beginning and end of the experiment

Fisher's angular transformation method was chosen to confirm the validity of the study results. This multifunctional criterion is intended to compare two groups of subjects by the frequency of the surveyed effect occurrence and to assess the shift of effect values. We have taken into account all restrictions on its use [44, p 158].

The following statistical hypotheses were tested:

- *H_0* – at the beginning of the experiment EG-scientists have a level of ICT competence on the use of EOJS in scientific and pedagogical research no higher than CG-researchers.
- *H1* – at the end of the experiment, the researchers who were experimentally influenced by the author's methodology (EG) have a higher level of ICT competence on the use of EOJS in scientific and pedagogical research than the researchers from the CG.

The value of the angle was determined (in radians):

φ_1 (26,05%) = 1,070, where φ_1 – the angle that corresponds to the results in the EG before the experiment.

φ_2 (21,05%) = 0,952, where φ_2 – the angle that corresponds to the results in the CG before the experiment.

$$\varphi^*_{emp} = (\varphi_1 - \varphi_2)\sqrt{\frac{n_1 \cdot n_2}{n_1 + n_2}} = (1{,}070 - 0{,}952)\sqrt{\frac{69 \cdot 77}{69 + 77}} = 0{,}118 \cdot 6{,}032 = 0{,}71,$$

where n_1 – number of participants of EG; n_2 .– number of participants of CG.

The obtained empirical value of the angle is less than the critical values and does not fall within the area of significance. Conclusion: the hypothesis *H0* is confirmed – significant differences of indicators in the control and experimental groups at the beginning of the experiment are absent. (Fig. 4.).

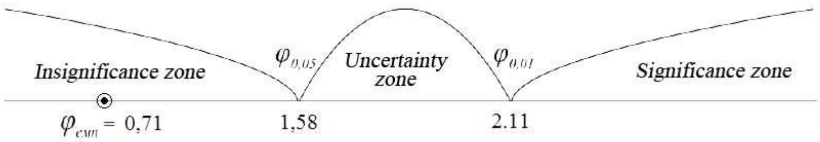

Fig. 4. Significance axis of statistical validity of results by Fisher's angular transformation at the beginning of the experiment

The value of the angle was determined (in radians):

φ_1 (76,84%) = 2,127, where φ_1 – the angle that corresponds to the results in the EG after the experiment.

φ_2 (47,28%) = 1,515, where φ_2 – the angle that corresponds to the results in the CG after the experiment.

$$\varphi^*_{emp} = (\varphi_1 - \varphi_2)\sqrt{\frac{n_1 \cdot n_2}{n_1 + n_2}} = (2{,}127 - 1{,}515)\sqrt{\frac{69 \cdot 77}{69 + 77}} = 0{,}612 \cdot 6{,}032 = 3{,}69$$

The obtained empirical value of the angle is greater than the critical values and falls within the area of significance. Conclusion: the hypothesis H1 is confirmed – significant differences of indicators in the control and experimental groups at the end of the experiment are present (Fig. 5.).

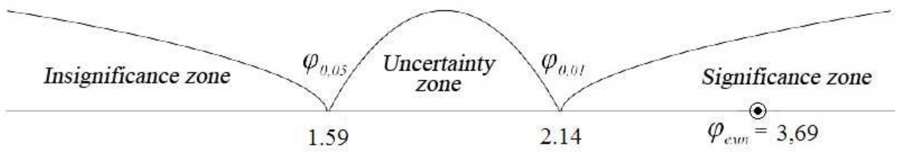

Fig. 5. Significance axis of statistical validity of results by Fisher's angular transformation at the end of the experiment

The results of the experiment confirmed that the proposed author' method of EOJS use in scientific and pedagogical studies increases the level of researchers appropriate ICT competence.

4.3 Information and analytical monitoring of the scientific journals of the National Academy of Educational Sciences of Ukraine

During 2017–2018 the information and analytical monitoring of the scientific journals of the NAES of Ukraine which operate based on the OJS was carried out in the following areas: a) observation of the editorial and publishing activities of scientific journals; b) comparing their sites usage statistics (the number of registered users in each year and the variety of their geographical distribution; the number of site views); c) analysis of their publishing performance (number of published issues per year; the number of published articles per year); d) comparison of scientometric indices of journals, articles, authors and editors (h-index by Google Scholar; Top 10 most cited journal articles by citation; h-index of the authors of the most cited article; h-index of the editorial board members).

It should be noted that 100% of the data on functioning were obtained only on the electronic scientific journal "Information Technologies and Learning Tools", the activity of which was carried out by the author's method. The statistical modules of other editions were either missing or partially connected. Finally, the editors being unable to respond to all survey questions. Comparisons were made for scientific journals where certain quantitative indicators could be extracted from the site. Some of the monitoring results are presented in Fig. 6–11.

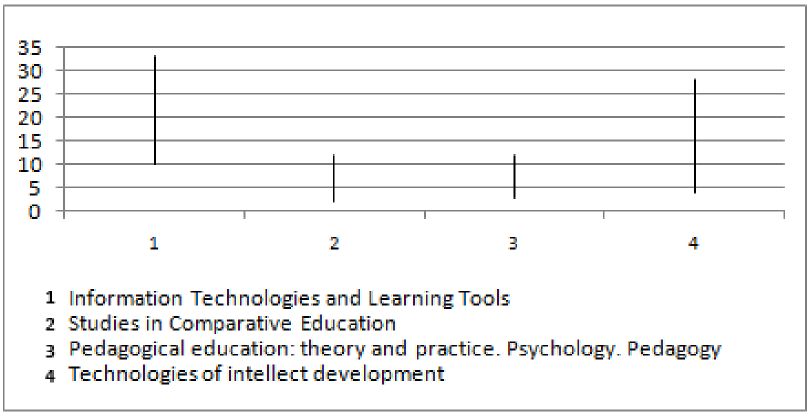

Fig. 6. The h-indexes of the editorial board members of scientific journals

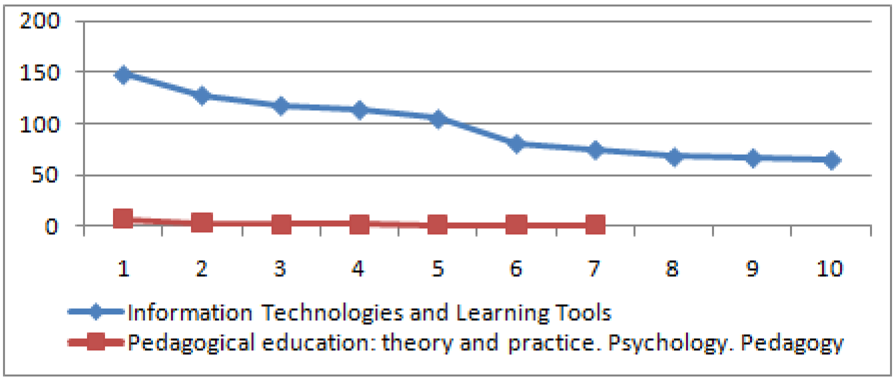

Fig. 7. Top 10 of the most cited journal articles by citation

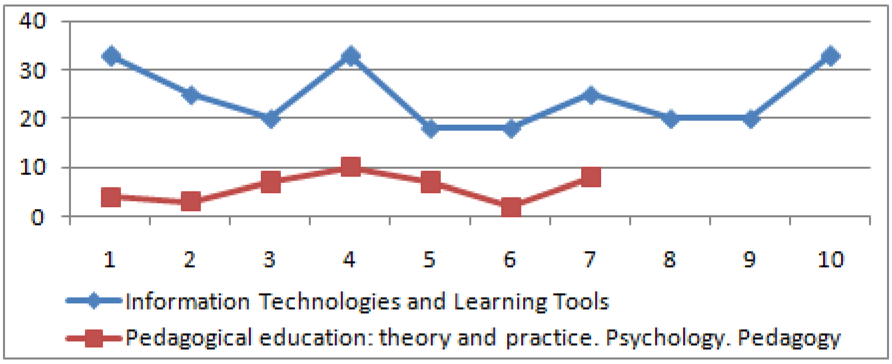

Fig. 8. The h-indexes of the authors of the most cited articles

The following diagrams demonstrate the number of published issues per year (Fig.9.), the number of published articles per year (Fig. 10.) and the number of registered users per year (Fig.11.).

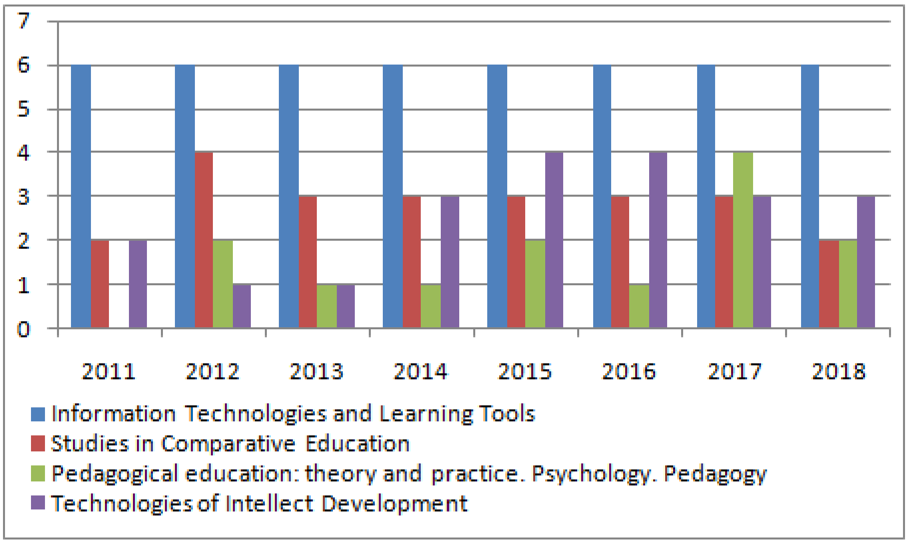

Fig. 9. The number of published issues per year

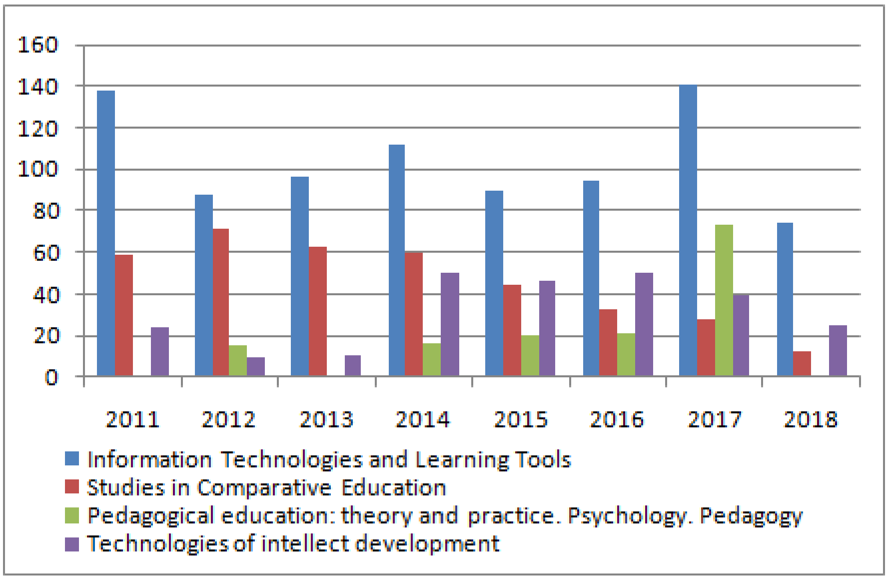

Fig. 10. The number of published articles per year

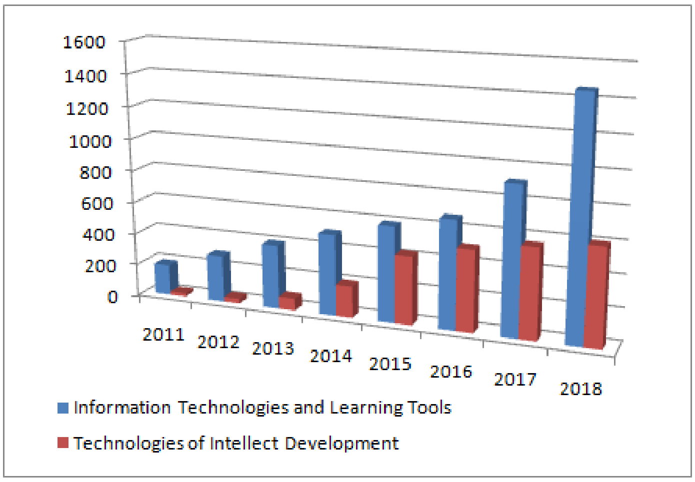

Fig. 11. The number of registered users per year

5 Conclusion

The results of the comparative analysis of initial and final data combined with the methods of mathematical statistics (Fisher angular transformation) confirmed the positive dynamics of the development of researchers' ICT competence in the use of EOJS. It allows us to conclude on the positive impact and effectiveness of the author's method.

As a result of the information-analytical monitoring, a positive difference in the values of scientometric indicators of articles, authors and editors of the experimental journal was found, in comparison with the indicators of other editions of the National Academy of Educational Sciences of Ukraine.

The results of this research can serve for the deployment and supporting the electronic journals of scientific institutions and institutions of higher education, as well as for teaching the scientific and pedagogical workers, postgraduate and doctoral students, masters and bachelors.

The further research should be done in the sphere of teachers in service training to develop their ICT competency on the use of EOJS.

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