Factors of Sustainability of the Modern Ecosystem for the Dissemination of Scientific Knowledge in the Digital Age: A System Analysis

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ABSTRACT:
Introduction The digital revolution has created novel opportunities for the active facilitation of scientific research and the expansion of scholarly communication across national boundaries. The increased velocity and scale of interaction afforded by digital technologies are fostering qualitative transformations in the functioning of scholarly periodicals. The aim of the present study is to examine the sustainability factors of the scientific knowledge dissemination ecosystem, with particular emphasis on the capabilities of the contemporary scholarly journal as a self-improving system. Methodology. The methodological framework integrates systems, network, cluster, and interdisciplinary approaches, complemented by sustainability assessment methods—specifically the Herfindahl index and the Matthew effect—and a bibliometric analysis of the content of a modern scholarly journal over the period 2020–2025. Results. Four groups of sustainability factors are identified and characterized: structural-organizational, communication-network, adaptive-digital, and reputational-metric. The findings indicate that the sustainability of the system is determined by a complex of factors, including openness of scholarly communication, transparency of editorial processes, organizational adaptability, and well-developed network interaction. Scientific Novelty. The scientific novelty of this work lies in the formulation and resolution of the task of identifying the key mechanisms and structural components that constitute the ecosystem of the modern scholarly journal in the digital era, with a specific focus on self-improvement factors. Practical Significance The findings of this article can be applied in the practical activities of specialists involved in developing and implementing ecosystem models in the humanities, as well as for diagnosing the sustainability of scholarly publications

Keywords: scholarly journal ecosystem, sustainability factors, knowledge dissemination, digital transformation, scientific communication, peer review, open access, feedback loops, stakeholder synergy, adaptation.

INTRODUCTION

At present, the scientific and publishing communities are witnessing substantial changes affecting access to scientific information, the bibliometric evaluation system, and scientific communication itself. A widespread view holds that science in the modern world is no longer the preserve of a narrow circle of professionals but is becoming part of the general communicative environment (Popova et al., 2017). As those authors emphasise, "even at the level of goal-setting, a scientist always strives to publish, not only to make the results of their work available to the scientific community but also to consolidate their own position in their chosen field of research." In this context, the ongoing digital revolution creates new opportunities not only for economic and technological development but also for actively supporting scientific research and expanding scholarly communication among researchers from different countries. The scale of change is such that one may speak of a "civilisational shift" and a paradigm change in development – the emergence of a "new universal mode of producing public goods" (Smorodinskaya, 2013).

The increased speed and scale of communication enabled by digital technologies create conditions for qualitative changes in the activities of scholarly peer-reviewed journals, which play an important role in the formation and dissemination of new scientific knowledge. An essential element of this transformation is the formation by scholarly journals of their own ecosystems, which support the development of scientific publications in the emerging digital world.

However, under conditions of information overload, the growth of predatory publishing, changing open access policies, and sanctions-related restrictions, a fundamental question arises: what factors ensure the sustainability of a scholarly journal's ecosystem as a knowledge dissemination system? (Mabe & Mulligan, 2011). By sustainability of the ecosystem for disseminating scientific knowledge – manifested in the formation of a scholarly journal's ecosystem – we understand the ability of a scholarly journal to preserve its target functions (quality peer review, timely distribution, reproducibility of scientific communication) and to adapt to external perturbations (technological, economic, political) without losing stakeholder trust (Waltman & van Eck, 2015). Unlike mere viability, sustainability implies not simply survival but self-improving development through the formation of positive feedback loops (Bramer, Rethlefsen, & Mast, 2021). In the digital age, new factors are added to traditional sustainability factors (peer review quality, reputation): data openness, publication speed, compatibility with digital platforms, network effects, diversification of citation sources, and geographical distribution of authors (Izotova & Gavrilyuk, 2022; Vetchinova, 2022).

The aim of this study is to analyse the sustainability factors of the ecosystem for disseminating scientific knowledge through the capabilities of the modern scholarly journal as a self-improving system in the new reality. To achieve this aim, the study intends to identify the structural components of such an ecosystem, determine the stages of its construction, and assess the potential effect of its implementation in order to enhance the journal's reputation and facilitate its integration into the global information space. *Hypothesis:* The effectiveness of the ecosystem for disseminating scientific knowledge through the capabilities of the modern scholarly journal is determined by the degree of synergy among its key actors – the editorial office, editorial board, authors, and reviewers. The sustainability of a scholarly journal's ecosystem is determined not by a single indicator (e.g., impact factor) but by a set of interrelated factors, among which openness of communication, adaptability of editorial processes, and network distribution of stakeholders play a key role. It is assumed that through the purposeful formation of feedback loops among these groups, a self-sustaining and self-improving system emerges in which their interaction mutually reinforces the quality and sustainability of the scholarly

publication's functioning. *Limitations.* This study is based on an analysis of articles from the peer-reviewed scholarly journal *Education and Science* for the period 2020–2025. This imposes limitations on the generalisability of the findings: the journal belongs to the field of education, whereas ecosystems of journals in the natural, technical, or humanities disciplines may have specific characteristics. Furthermore, the conclusions are based on the analysis of a single publication, which warrants caution when extrapolating the results.

LITERATURE REVIEW

According to Moore (2006), the contemporary ecosystem within the social sciences and humanities can be conceptualised as a network of interconnected "niches" that organisations may occupy. To function effectively, these organisations must coordinate the development of their products and services, establish a shared vision to ensure mutually reinforcing activities, and generate synergy from their investments and ongoing operations (Moore, 2006). A critical aspect of such transformation involves the emergence of "different types of ecosystems" operating within the digital environment (Babkin et al., 2021). It should be noted that any ecosystem aims to achieve convergence among existing assets that differ in origin, temporal competencies, and accumulated experience in communicative practices. Furthermore, ecosystems seek to create comfortable environments for interaction and to multiply opportunities that cannot be identified without a systemic, hierarchical approach to resources and the overarching goal of maximising efficiency. Reeves et al. (2016) identify four main characteristics of ecosystems: (1) modularity – individual components of the value proposition are produced independently of one another; (2) adaptation – each participant aligns with the ecosystem's unified ideology; (3) interdependence – each participant relies on others through the value creation network; (4) coordination – in the absence of universally accepted control methods, ecosystem coordination is achieved through rule-following or adherence to common standards.

Significant contributions to the development of the ecosystem approach in the social sciences and humanities have been made by several scholars. J. G. Miller (1978) transferred ecosystem thinking to the social level by demonstrating that all "living systems" exist within their own ecosystems and exchange resources with them. U. Bronfenbrenner (1989) applied the ecosystem approach to the analysis of individual and social development. J. F. Moore (2006) introduced the concept of the "business ecosystem", defining it as "a dynamic structure of communities of economic agents interacting to create goods and services for customers". R. Adner (2016) shifted the analytical focus towards ecosystem structure. H. Chesbrough (2003) showed that individual structures must actively interact with the external environment – that is, for successful development, it is advisable to form alliances, for instance, into knowledge and technology ecosystems. Finally, M. G. Jacobides (2019) was the first to identify the ecosystem as a distinct form of organisation, different from markets, hierarchies, and networks.

It should be noted that current Russian-language publications on this topic are creating a problematic field for discussion among domestic scholars, identifying issues and proposing solutions relevant to the realities of Russia and the post-Soviet space. In particular, G. Kleiner (2019) observes that, in most cases, an ecosystem comprises four main elements – clusters, platforms, networks, and business incubators – which operate within a specific spatial and temporal framework. S. Proskurnin (2017) presented an ecosystem for the social sciences and humanities as an environment in which participants interact to create and promote innovations. J. A. Kovalchuk and I. M. Stepnov proposed an original model of an innovation ecosystem for industry that can be used to diagnose the state of ecosystems at different levels. E. A. Vishnyagova and I. A. Solovyova (2021) connected the ecosystem approach with another global paradigm – sustainable development. N. Volodina, A. Ter-Grigoryants, and N. Davydova (2020), together with their co-authors, propose specific pathways, methods, and stages for managing emerging ecosystems across various industries during the transition to a new technological paradigm. In particular, the relevance of forming educational ecosystems is driven by the rapid

expansion of the educational space and the emergence of new actors and providers of educational services, which indicates a change in the institutional landscape of education (Semenov et al., 2024; Chigbu et al., 2023; Hackenburg et al., 2023).

According to M. G. Jacobides et al. (2018), within scholarly discourse, ecosystems are divided into innovation, entrepreneurial, business, and platform ecosystems, with digital platforms being recognised as the key organisational mechanism for forming contemporary ecosystems. Their functionality is determined by the presence of the following structural components: providing conditions for direct interaction among multiple parties, thereby generating mutual value (Hein et al., 2020); the manifestation of network effects, whereby the value of the platform to a user increases as the number of participants grows (Davydova et al., 2020); the presence of an intermediary that provides the infrastructure for interaction (Quan et al., 2017); and the formation of transaction costs that "tie" participants to the platform through specific investments, making exit economically disadvantageous (Hagiu et al., 2015). Based on the foregoing, initiatives to form ecosystems in the field of scientific communications – using the criteria outlined above – can legitimately be classified as a type of platform ecosystem. These ecosystems coordinate the interaction of multiple parties (authors, reviewers, readers, publishers) through digital platform infrastructure, acting as intermediaries and value creators (M. G. Jacobides, 2019).

Ecosystem-specific sustainability factors for scientific communication are examined in the works of M. Mabe (2010), who introduced the concept of "the journal as a quality ecosystem", and A. McGinty (2019), who showed that sustainability correlates with low editorial board turnover and a high proportion of international reviewers. W. Bramer and colleagues (2021) identified open peer review as a critical factor of sustainability. A study by L. Waltman and N. J. van Eck (2019) demonstrated that sustainable journals have a more diversified structure of citing journals (low Herfindahl index). In the Russian context, A. G. Izotova and E. S. Gavrilyuk (2022) identified organisational adaptability and digital maturity of the editorial office as key predictors of sustainability under sanction-related constraints. M. N. Vetchinova (2022) emphasises the role of network partnerships among journals.

It is evident that, despite the substantial development of the business ecosystem concept in general and the active study of its various types – entrepreneurial, sectoral, regional – the issue of forming specialised ecosystems in the field of scientific communications remains peripheral in the current research landscape. The functioning and development of such specific formations as specialised professional ecosystems have clearly been insufficiently investigated to date. This creates a significant gap in understanding how digital platforms can transform the processes of production, peer review, and distribution of scientific knowledge in the field of scientific communications, as well as the potential and limitations of network effects in this highly specialised domain. In this regard, the task of conducting a targeted study of the developing ecosystem of the modern scientific journal as an independent research object becomes particularly pertinent.

RESEARCH METHODOLOGY AND METHOD

The methodological foundation of the work is systems analysis as interpreted by Checkland (1999) and Meadows (2008), which views the ecosystem of a scientific journal as a complex adaptive system characterised by feedback loops, delays, and nonlinear effects. Network, cluster, and interdisciplinary approaches were also employed, enabling the analysis of ecosystem development in scientific communications amid complex socioeconomic and digital transformations. The research relied on theoretical methods of analysing Russian and international literature — including critical content analysis, conceptual analysis, comparative analysis, and thematic content analysis — which allowed us to describe the categorical framework of the problem under study.

Within the systems approach, the following components of the journal ecosystem were identified: inputs (author manuscripts, reviews),

processes (peer review, editing, indexing), outputs (published articles, citations), feedback (author satisfaction, publication speed, reputation), and sustainability factors (both internal and external) (Meadows, 2008). To operationalise sustainability factors, bibliometric methods were applied:

- Analysis of the diversification of citing journals and author affiliations using the Herfindahl index.
- Assessment of network effects using the co-authorship concentration coefficient and the proportion of articles with international co-authorship.
- Analysis of cumulative advantage (Matthew effect) through the correlation between publication age and citation growth rate.
- Cluster analysis of terminological structure (using VOSviewer) to identify the semantic stability of thematic fields.

The proposed research methodology focuses on metrics derived from the comprehensive extraction of high-quality metadata from each publication (and its authors), enabling the measurement of scientific journal ecosystem properties across different bibliometric databases via the Science Index (SI) of the Russian electronic scientific library (eLibrary.ru). The study actively employed bibliometric analysis of keyword co-occurrence combined with network and cluster analysis methods in the VOSviewer software, which allows simultaneous mapping (network construction) and clustering (cluster identification within that network). Thus, both the network structure and its clusters are visualised simultaneously.

Data collection and processing procedure:

1. A comprehensive selection of 485 articles from the journal *Education and Science* for the period 2020–2025 from eLibrary.ru (Science Index).
2. Metadata extraction: keywords, abstracts, author affiliations, reference lists.
3. Construction of a bibliometric co-occurrence network of keywords (occurrence threshold ≥ 15 times) in VOSviewer (version 1.6.18) using the association strength method and the Louvain clustering algorithm.
4. Calculation of the dynamics of the Herfindahl index for citing journals and for author organisations for the years 2020, 2022, and 2024.
5. Qualitative content analysis of the ten most cited articles from each cluster to identify sustainability factors not captured by bibliometrics (e.g., mentions of open access policies, review speed).

An examination of the thematic focus of publications over the five-year period was conducted using VOSviewer, which constructs a terminology map based on the co-occurrence of terms in article titles and abstracts. A constraint was applied: a term must appear at least 15 times. It should be noted that in the visualisation of the bibliometric network in VOSviewer, the size of an object (keyword on the map) indicates its total link strength, while the line thickness and distance between two keywords reflect the strength of links between those objects (terms). The network constructed in this manner represents cumulative knowledge of the subject area and, to a certain extent, helps reveal significant knowledge components based on element interaction and the strength of links between keywords (Radhakrishnan et al., 2017; Davydova et al., 2016). Furthermore, the division of information into clusters facilitates the logical distribution of information into sets and subsets, their systematisation, and ordering (Van Eck et al., 2017; Krasnov et al., 2019).

In addition, scenario analysis (Hekkert & Negro, 2020) was introduced to assess sustainability under changing conditions (e.g., a 30 % drop in the share of international citations or a transition to a platinum open access model). The scenarios are not empirically implemented within this article but are proposed as a perspective for subsequent research.

Justification for journal selection: The scientific journal *Education and Science* is a peer-reviewed publication indexed in Scopus, WOS ESCI, SJR, and the White List of Russian Scientific Journals, with a stable positive trend in its metrics (the five-year impact factor increased from 1.929 to 3.334 over 2020–2024), making it a suitable case for studying sustainability factors using the example of a successfully developing ecosystem.

RESULTS

The functioning of a scientific journal's ecosystem can be conceptualised as a self-sustaining organisational system. A necessary condition for its emergence is the establishment of stable positive feedback loops among its structural components—namely, the editorial office, editorial board, authors, and reviewers. Specifically, consistent and transparent actions by the editorial office and board enhance author and reviewer satisfaction and loyalty. This, in turn, leads to an increased inflow of high-quality manuscripts and thorough peer reviews, which further strengthens the journal's reputation and facilitates the editorial team's efforts towards its development. Consequently, reputational capital emerges as a key driver of journal growth, as it is effectively generated and accumulated within the ecosystem through feedback mechanisms.

Feedback is defined as the transmission of information from a system's output back to its input. As demonstrated by Merton (1968), the citation rate of a scientific article depends more substantially on the author's prominence and recognition than on the intrinsic content of the work. This phenomenon, known as the "Matthew effect," reflects a principle of cumulative advantage: an initial advantage—such as fame, prestige, resource availability, or, conversely, early setbacks—tends to amplify over time, thereby creating a positive feedback loop. Evidence supporting this observation is presented in Fig. 1, which illustrates the dynamics of the increase in the journal's article citation counts.

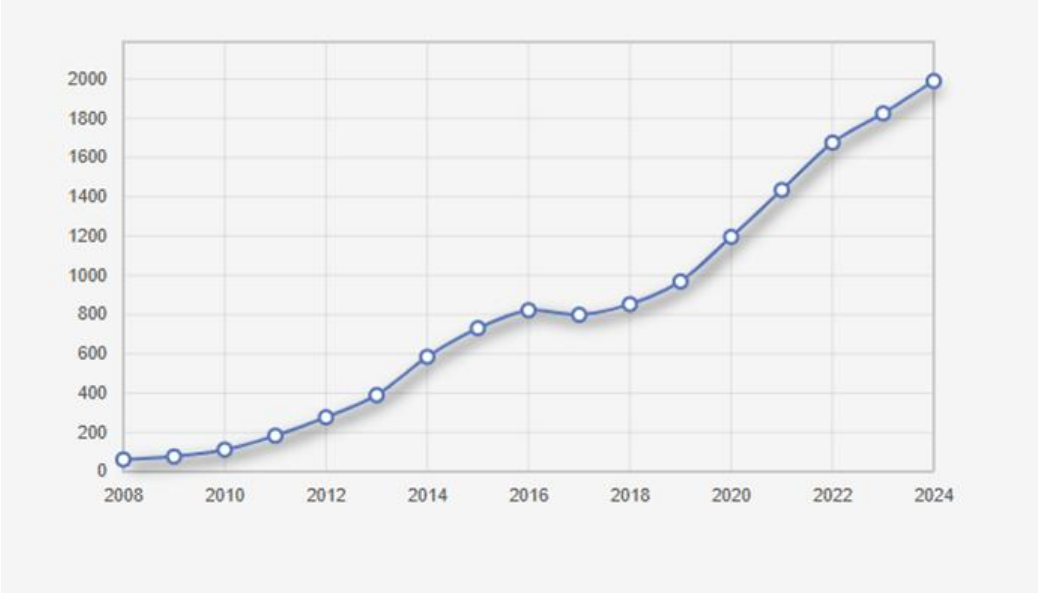

Fig. 1. Timeline of changes in the number of citations of articles from the journal.

The results of the growth of the journal's indicators (according to Science Index), characterizing the development of the journal's ecosystem, are presented in Table 1.

Table 1. Dynamics of the journal's indicators over the past five years (according to Science Index).

Below is the academic English translation of the table and its entries, with decimal commas converted to decimal points and terminology standardised.

Indicators of the journal ecosystem development

Indicator	2020	2022	2024
Ten-year h-index	36	45	54
Five-year self-citation rate (%)	5	7	5

Indicator	2020	2022	2024
Average age of authors	11.2	11.3	10.5
Five-year Herfindahl index of citing journals	94	96	94
Herfindahl index for authors' organisations	349	258	319
Five-year Russian Science Citation Index	1.929	2.960	3.334

Interpretation in Terms of Sustainability Factors:

- **Diversification factor:** The decrease in the Herfindahl index for author organizations (from 349 to 319) and the consistently low index for citing journals (94–96) indicate a broad citation base and low dependence on a single source, thereby enhancing resilience to external shocks (Checkland P., 1999).
- **Cumulative advantage factor:** The increase in the ten-year Hirsch index (from 36 to 54) and the rise in the impact factor (from 1.929 to 3.334) confirm the operation of the Matthew effect (R. K. Merton, 1968; Danaa H. M., 2022).
- **Adaptability factor:** The consistently high level of collaboration among authors from different universities points to the development of networked forms of cooperation.

The cluster analysis method enabled the identification of basic semantic fields formed around the most relevant key terms of educational discourse. The keyword co-occurrence map (Fig. 2), obtained through bibliometric methods, serves as a reduced model that visualizes the structure of scientific topics represented in the journal.

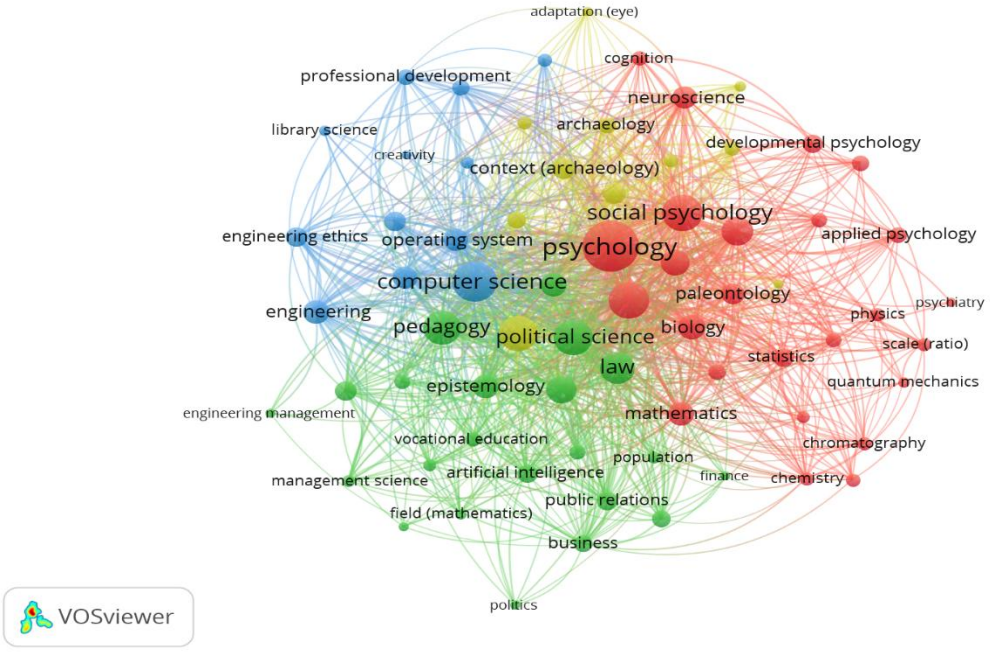

Fig. 2. Terminological map of the ecosystem based on term co-occurrence in scientific articles.

As a result of the cluster analysis, four main thematic clusters were identified, formed on the basis of the semantic proximity of key concepts (see Table 2).

Table 2. Representation of thematic dominants verbalizing the key vectors of modern education development within the framework of a content analysis of journal publications.

Cluster	Authors
Methodological Framework and Analytical Tools for Research on the Paths of Educational Development in the Realities of Uncertainty in the Modern World. The overarching line for this cluster of articles is the transformation of the education system from knowledge-oriented, mass, and conservative to competence-oriented, personalised, flexible, and closely integrated with the digital environment and the demands of the real economy. Among the general patterns of its development, we highlight the dominance of macro-level, conceptual, and methodological analysis of educational problems; the focus on overcoming disciplinary fragmentation of research; the search for ways to synthesise knowledge and overcome barriers between traditional academic disciplines and educational practices; and the integration of new technological and social contexts into the educational field. The pervasive and intensifying trends over the past five years are transdisciplinarity, the development of complex competencies, and the integration of technological and social innovations into the educational process.	Perminov E. A., Testov V. A. (2020); Zinchenko Yu. P. et al (2020) ;Lubkov A. V. (2020); Danilaev D. P., Malivanov N. N. (2020) ; Volosnikova L. M. et al (2021) ; Blinov V. V.,et al (2021); Salimova T. A. et al (2021); Fedorov V. A., et al (2022); Eroshenkova E. I. et al (2022); Mokronosov A. G., et al (2022); Sorokin P. S. , Vyatskaya Yu. A. (2022); Astashova N. A. et al (2023); Zeer E. F.,et al (2023);;Kantor V. Z et al (2023); Kicherova M. N., Trifonova I. S. (2023); Bordovskaia N. V. et al (2023); Nurieva L. M., Kiselev S. G. (2023); Gilmanov S. A. et al (2024); Demidova N.N et al (2024) ; Tretyakova V.S. (2024); Novopashina L.A.,et al (2024); Popova I.N., Satdykov A.I. (2024) Zapalatskaya V.S., (2025); Astashova N.A., (2025); Gnedykh D.S., (2025); Rafsanjani M.A., (2025); Bulkani B. (2025);
Psychological and Pedagogical Aspects of Learning and Well-Being of Subjects in the Educational Process An analysis of the publications featured in the journal over the past five years reveals several key research directions: a focus on the development of agency and new competencies among participants in the educational process, whereby the emphasis shifts from knowledge transmission to the formation of complex, integrative personality traits in both learners and educators; research into the effects of various types of coping behavior on psychological adaptation and quality of life; particular attention to issues of metacognition and digital	Belyakova E. G., Zakharova I. G. (2020): Alenezi A. M. (2020) ; Mendoza D. et al (2021);Kazakova E. I. (2021); Kislyakov P. A. (2021) ; Vyatkin B. F et al (2022); Nazarov V. L. et al (2022); Danaa H. M et al .(2022); Koltunov E. I.,et al (2022); Abu Hammad N. A. I. (2023); Pecherkina A. A.et al (2023) ; Zavodchikov D.P. et al (2024) ; Okonechnikova L.V. et al (2024) ; Morosanova V.I., (2025); Buzhinskaya N.V., (2025); Tretyakova V.S.,(2025); Shmeleva E.A., (2025);

stimuli; and a deepening of cross-cultural research. It is worth noting the growing interdisciplinarity of the scientific articles submitted for publication, the increasing influence of the digital environment and global challenges on the mental health of students and teachers, as well as the discipline's aspiration to offer not only explanatory models but also concrete diagnostic and corrective tools.	
Value-Semantic Aspects and Professional Development of the Individual in the Contemporary Educational Space. Among the actively developing research directions, the following should be highlighted: the analysis of socio-psychological consequences of accelerated digital transformation; the paradigm shift of agency in education from adaptation to transformative activity; a comparative analysis of Russian, Chinese, Southeast Asian, and Middle Eastern value systems in education, which indicates the ongoing integration of Russian academic discourse into the global context and the search for both universal and specific patterns of development in the educational sphere; and the increased attention to social inclusion, well-being, and specific risks faced by various groups of students and teachers amid the transformation of the educational system. The overarching pattern of development in this cluster can be characterized as a non-linear transition from studying the consequences of "shock digitalization" to a comprehensive, interdisciplinary analysis of the emerging socio-educational reality, at the center of which lies an active, self-reflective subject whose values, identity, and practices are being transformed under the influence of technology and global challenges.	Koch I. A., Orlov B. A. (2020) ; Shuklina E. A.et al (2020) ; Usova O.V.,et al (2020); Perić J. et al (2021); Zborovsky G. E., Ambarova P. A .(2021); Narkhov D. Yu. et al (2021); Tyurikov A.G.,et al (2022); Sakharchuk E. S..,et al (2023) ;Tikhonova I.V.et al (2023); Antonova N. L et al .(2023) ;Bany Yassien B.et al (2023) „;Rababa'h S.Y. et al (2024) ; Ali N., et al (2024); Melnik A.D.et al (2024);Chevtaeva N.G. et al (2024); Pevnaya M.V, 2025; Alorani O.I., (2025); Koltunov E.I., (2025); Tsenov M.Y., (2025);
Digital Transformation of Education: Pedagogical Strategies, Artificial Intelligence, and the Development of Agency Among the general developmental patterns of the cluster associated with the digital transformation and technologization of	Andryukhina L. M. (2020), Khenner E.K et al (2020); Derindag O. F., Cizmeci B. (2021); Zakharova I. G., et al (2022); Khenner E. K. (2021); Ainoutdinova I. N., et al (2021); Nazarov V. L. et al (2023) ; Zhamankarin M. M. ,et al (2023); Kharlanova E. M., et al (2024); ;Brega O. N., Kruglyakova G. V.(2024);Zakharov A.A et al

education, we highlight the following: a shift in focus from technological infrastructure to the anthropocentric and psychological-pedagogical aspects of digitalization; the integration of artificial intelligence as a key actor in the transformation of educational activities; the growing significance of network culture and digital ethics as factors shaping the educational environment; pathways for transitioning from mass to individually oriented education; and the study of the negative consequences of digitalization. Thus, the evolution of the cluster demonstrates a transition from describing technological innovations toward a comprehensive, interdisciplinary study of the digital educational ecosystem.	(2024) ;Avalueva N.B., Garkusha N.S.(2024) ; Chandafa M.J. (2025); Vavilova D.D., (2025); Apenko S.N., (2025);

DISCUSSION OF THE RESULTS

Structurally, the journal's ecosystem currently comprises the following key components: the journal platform itself, serving as an organizational mechanism and mediator, which constitutes the core of the ecosystem, enabling direct interaction among all parties and generating a network effect; the community of autonomous stakeholders consisting of internal participants (editorial boarc publisher), key partners (authors, reviewers), valu consumers (readers), and external service providers and digital and traditional services that address th needs of the interacting parties (from peer review t indexing). Important factors contributing to th sustainability of the developing journal ecosyster include the principles of openness (open access transparency, adaptability (manifested in a rapi response to emerging trends), and networ interaction through informational partnerships wit other journals, including participation in th activities of the Association of Scientific Publisher and Editors of the Russian Federation (ANRI Thus, the journal's ecosystem represents a self regulating environment in which the balance c stakeholder interests and process flexibility ensur the long-term development of the periodical itse as well as the dissemination of scientific ideas withi the global information space. This finding i consistent with the results of recent studies (Izotova & Gavrilyuk, 2022; Vetchinova, 2022; Rong et al., 2018; Li et al., 2022).

Based on empirical data and a synthesis of the theoretical sources analyzed, we identify four generalized sustainability factors for the ecosystem of scientific knowledge dissemination through the capabilities of scholarly journals:

1. **Structural-organizational factor** (transparency of peer review, a formalized code of ethics, the presence of an openness policy). The journal *Education and Science* demonstrates a high level of compliance with this factor, which correlates with the absence of retracted articles during the period under study.
2. **Communication-network factor** (stakeholder interaction, partnerships with other journals, participation in the work of the Association of Scientific Publishers and Editors). Bibliometrically, this is expressed in a growing share of articles co-authored by researchers from different institutions and a decreasing Herfindahl index by organization.
3. **Adaptation-digital factor** (use of the OJS platform, DOI, ORCID; rapid response to emerging topics). Identified clusters 1 and 4 confirm that the journal does not confine itself to traditional pedagogy but addresses sociological issues of educational development, philosophical and

cultural aspects of the educational sphere, the digital agenda, and problems of complexity methodology.

4. **Reputation-metric factor** (impact factor, Hirsch index, Matthew effect). The increase in the ten-year Hirsch index from 36 to 54 over four years indicates accumulated reputational capital, which serves as a "protective mechanism" against external shocks.

It should be noted that none of these factors is dominant. Sustainability is ensured by the synergy of all four groups. For instance, high adaptability (digital factor) without network interaction leads to growing isolation; transparency without reputation fails to attract authors. This aligns with the principles of system dynamics [24] concerning the nonlinear interaction of elements.

Comparison with other studies: Our findings corroborate the conclusions of Mabe (2010) that a sustainable journal is not merely an archive of articles but requires systematic efforts to develop feedback loops within the scientific community. Moreover, advancing this agenda, we demonstrate that diversification and adaptability are important sustainability factors.

CONCLUSION

From the perspective of a systems approach, the ecosystem of a contemporary peer-reviewed scientific journal can be conceptualized as an integrated, dynamic, and resilient network of stakeholders, with the journal itself serving as the integrative core—functioning as a platform for the discussion and dissemination of scientific research results. The application of bibliometric analysis methods has enabled the extraction of several research clusters from the information array of articles published in the journal, thereby facilitating the systematization and structuring of the overall information flow of scholarly works into sets and subsets. Based on a cluster analysis of the journal's publication activity over a five-year period, stable thematic clusters have been identified. The most representative among these include: the enhancement of methodology and analytical tools for research on educational development under conditions of uncertainty; psychological and pedagogical aspects of learning and ensuring the well-being of participants in the educational process; value-oriented and meaning-related frameworks alongside professional identity formation in the contemporary educational landscape; and the digital transformation of education, encompassing pedagogical strategies and the development of digital agency.

The conducted systematic investigation allows for the following conclusions regarding the resilience of the scientific knowledge dissemination ecosystem:

1. The ecosystem for disseminating scientific knowledge in the form of a peer-reviewed scientific journal constitutes a complex adaptive system, the resilience of which is determined by a combination of internal and external factors. The key factors are: openness of communications, transparency of editorial processes, networked distribution of stakeholders, diversification of citation sources, cumulative advantage, and digital adaptability.

2. The proposed four-factor model (comprising structural-organizational, communication-network, adaptation-digital, and reputation-metric factors) can serve as a diagnostic tool for assessing the resilience of scientific journals across any discipline.

3. Using the journal *Education and Science* as an empirical example, it is demonstrated that the synergy of these factors ensures a self-sustaining and self-improving mode of editorial operation: an increase in publication quality → a rise in citation rates → enhanced attractiveness to authors → an expanded pool of reviewers → improved peer review quality.

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