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# BIBLIOMETRIC ANALYSIS OF QUALITY IN EDUCATION: GLOBAL TRENDS AND RESEARCH GAPS

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***Abstract***

*The aim of the bibliometric analysis of quality in education was to provide a clear and quantifiable overview of the evolution, trends and impact of research in this field, helping to identify authors, institutions and works with major influence. By analyzing metrics such as the number of publications, frequency of citations and international collaborations, research can contribute to highlighting centers of excellence and main research directions, as well as outlining emerging themes and gaps in the specialized literature. The integration of the bibliometric analysis in the current study enabled us to objectively evaluate the conceptual and methodological advancements in the field of education quality, making it easier to identify the most useful approaches and underlying theories. This gave us a strong foundation on which to guide future research and for the foundation of educational policies. The obtained results highlighted the main research directions, such as teaching evaluation and the impact of technology, also showing the evolution of interest in these topics. Influential authors and institutions, networks of scholarly collaboration, and seminal articles that formed the basis of the research were identified. It was also possible to identify gaps in the literature, insufficiently explored areas and future research directions, reflecting the impact of educational policies on academic priorities, which provided us with a complex picture necessary for the development of educational strategies and training programs.*

***Key words:*** *education, quality, bibliometric analysis, global trends, gaps*

## INTRODUCTION

Quality in education is a complex and dynamic concept, often defined and interpreted in various ways depending on the cultural, political and economic context [6]. According to academic research, the quality of education refers to the processes, the environment and the results within the educational system, aiming to ensure an optimal preparation for pupils and students so that they can contribute actively and effectively in society. Quality assurance in education depends on meeting the needs of the beneficiaries, compliance with established standards and continuous adaptation to the demands of modern society [1, 3, 14]. Thus, Cristea S. believes that education involves meeting the expectations of beneficiaries and complying with educational standards [4]. Taraza et al. emphasizes the fact that quality assessment must be based on social and community values [24]. Zorina Ghileț chi supports the need for a unified evaluation system, adapted to the needs of the beneficiaries [25]. Șerban Iosifescu shows that quality education must meet the expectations of "customers" through standards adapted to society's requirements. On an international level, Michael Fullan shows that a quality education involves continuous innovation and adaptation to changes in society and requires the support of the entire community [5, 11]. Harvey and Green distinguish between several forms of quality, such as quality as excellence, fit for purpose, transformation and added value, emphasizing the complexity of the concept in education [8]. J. P. Keeves and R. J. Watanabe show that quality assessment must

be contextualized and adapted to the cultural specificity of each region, highlighting the importance of a global frame of reference [9]. These papers outline the idea that ensuring educational quality depends on adapting to the needs of beneficiaries and integrating flexible and dynamic standards. Among the essential components of quality in education are: accessibility, content relevance, teaching effectiveness, and learning outcomes.

The quality of teaching activity directly influences students' learning outcomes and contributes to improving school performance. In essence, the quality of teaching is defined by the competences and abilities of teachers, by teaching methods and strategies, but also by their ability to create a stimulating and inclusive learning environment [13, 16, 22].

One of the main components of the quality of teaching activity is the professional training of teachers. Studies show that teachers who are well trained, both in their subject area and in pedagogy, have a greater ability to explain concepts clearly, answer students' questions, and motivate them in the learning process. Continuous training and constant updating of knowledge are essential for teachers to adapt to new requirements and educational technologies [2]. The quality of the teaching activity also depends on the teaching methods used. Research shows that interactive and student-centered methods, such as project-based learning, case studies, open and collaborative discussions, are more effective than traditional lecture-based teaching. These methods promote active learning and support the development of critical thinking, creativity and problem-solving skills.

Another important element is the teacher-student relationship, which influences the quality of the learning process. Studies show that teachers who build respectful and supportive relationships with their students create a more open and encouraging learning environment. This positive relationship can increase students' motivation and help them develop self-confidence, which helps improve their school performance.

Assessment is another significant factor in determining the quality of teaching. Formative assessments, which provide feedback throughout the learning process, are more effective in supporting student progress than summative assessments. They enable teachers to quickly identify areas where students are struggling and adapt teaching materials and methods to meet individual needs.

Technology is also playing an increasingly important role in teaching. Utilizing contemporary educational technologies, such tablets, interactive apps, and e-learning platforms, can improve students' educational experiences and assist teachers in modifying their instruction to accommodate different learning preferences. Research indicates that integrating technology into the classroom improves learning by making a variety of resources and current knowledge more accessible [2, 21].

Classroom atmosphere and climate also contribute to the quality of teaching. A safe learning environment that promotes collaboration and encourages the expression of ideas helps students to be more engaged and learn more effectively. A positive climate also reduces learning anxiety and fosters openness to new knowledge and skills.

Therefore, the quality of teaching depends on a number of factors that interact with each other, from teacher training and teaching methods to the use of technology and the creation of a positive learning environment. The quality of teaching not only influences academic results, but plays an essential role in the formation of individuals who are motivated, capable and ready to adapt to the demands of a constantly changing society [21]. In this context, the use of bibliometric analysis of quality in education has the role of providing an in-depth understanding of the evolution, trends and main research directions in this field, by quantifying and analyzing data related to scientific publications.

## MATERIALS AND METHODS

By using bibliometric analysis as our research approach, we were able to identify authors, institutions, and nations that made major contributions to the issue of quality in education and gather useful information about how this concept has changed over time.

Temporal trends, such as the frequency of publications published on the subject of educational quality, can be highlighted using bibliometric analysis, which identifies the times when this subject attracted more attention.

This reflected contextual changes such as educational reforms or international initiatives that influenced research and implementation of quality in education.

Another essential role is to identify the main areas and sub-areas of research related to the quality of education. Bibliometric analysis allows highlighting emerging themes and understanding topics that dominate current research, such as teacher quality assessment, curriculum effectiveness or the impact of educational technologies on teaching quality.

Through the bibliometric analysis, the collaboration network between authors and institutions can be identified, highlighting the centers of excellence in educational research. These allow the understanding of international collaboration dynamics and the recognition of higher education and research institutions that have a major impact in this field.

The study offers comprehensive data on the influence and citations of publications, highlighting the most significant works and writers in the area of educational quality. This makes it possible to emphasize basic theories and methods and to describe the theoretical and conceptual underpinnings upon which further study is based.

Another role of the bibliometric analysis is the evaluation of existing gaps in the literature, i.e. of insufficiently studied aspects. This information directs future research towards less addressed but essential topics for a complete and practical understanding of quality in education.

Additionally, bibliometric analysis makes it easier to create a cognitive map of the area, providing a nuanced understanding of the structure, connections, and development of the topic of educational quality. This approach allows highlighting not only the evolution, but also the connections and influences between the various theories, concepts and methodologies in the field.

The consulted databases were WOS and Scopus. The consultation took place between November 8-11, 2024, the keywords used being: "educational technology", "educational innovation", "quality in education" and "global trends". The search was made starting from the term "educational technology" resulting in a number of 118,967 articles. Next, the refinement was carried out according to the second keyword, resulting in a number of 10,559 articles. The third key word, "quality in education," was later searched for, yielding 1,501 articles that were evaluated using Voswiever software, which enabled us to both generate and analyze conceptual maps. After applying the fourth refinement, the term "global trend" is used, a number of 28 articles resulted that were analyzed with the aim of identifying the purpose, objectives and results obtained, as well as research gaps.

## RESULTS AND DISCUSSIONS

The bibliometric analysis followed several aspects related to scientific research. Thus, the relationship between co-occurrence and keywords highlights a complex research that explores the relationship between education, technology, as well as the impact on human development. Areas of interest include innovation in education, technological methods used in instruction, and the link between education and public health. The 3 interconnected clusters show that the themes of education, innovation, methodology and social impact are addressed together to explore the benefits and challenges of integrating technology into modern education.

The blue cluster, focused on methodology and technology, underlines the growing importance of technology in education, this trend demonstrating that research in the field supports the development of computer-assisted teaching methods and digitized curriculum, facilitating a more accessible education adapted to modern needs . The link between the green and red clusters shows that education has a significant impact on human development, with research demonstrating that investment in education contributes to the overall well-being of communities and

improves quality of life. The red cluster highlights the role of innovative education and higher education in the formation of new generations, this because research on educational innovation is essential for adapting learning processes to contemporary challenges, including rapid technological changes.

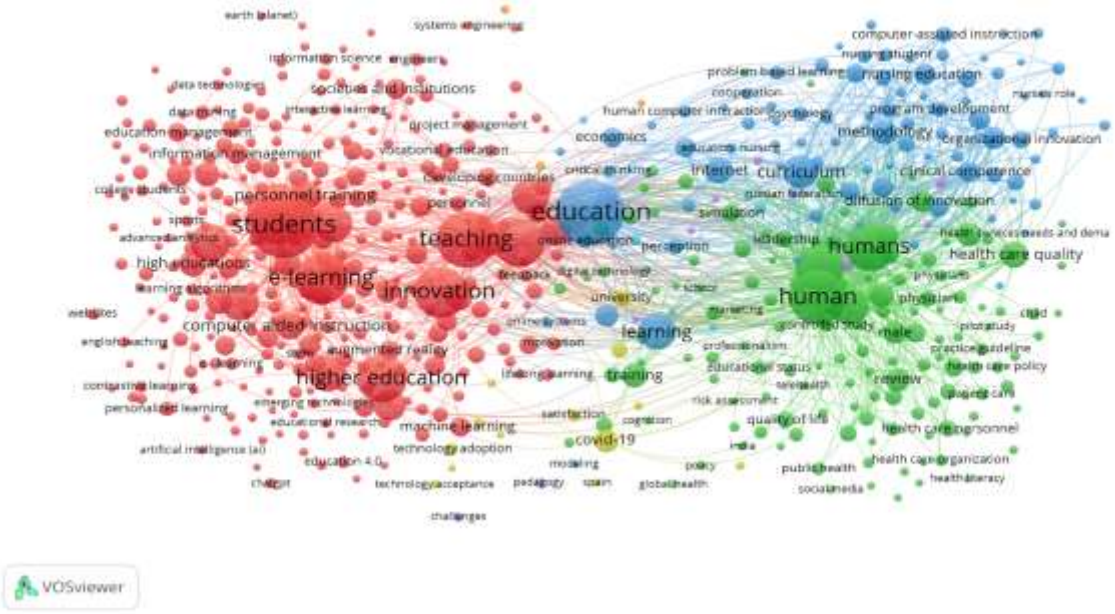


Fig. 1. The relationship between co-occurrence and keywords
Source: own processing Voswiever [25].

The interconnection between education, technology and health demonstrates that modern education can contribute to balancing social and economic differences.

Thus, research in this field supports educational policies that not only modernize education systems, but also contribute to a sustainable development of society.

Figure 2 shows the collaborative relationship between co-authors from various countries, highlighting international research networks. The analysis shows that the United States emerges as the main connecting node, having strong ties with multiple countries, which indicates its central role in the global scientific collaboration network.

Distinct regional clusters also appear, such as Russia and European countries, China and Asian countries, which demonstrate strong collaborations within geographic regions, and less inter-regional collaborations.

African and South American countries are relatively under-represented, due to unequal access to international collaborations, which limits scientific progress in the respective regions.

The relationship between co-citations and keywords is organized into several clusters that reflect the main areas of research interest. The minimum number of citations was 10. The blue and green cluster focuses on topics related to education, digital learning, curricula, and educational technology.

This cluster confirms an approach to new educational methods and their impact on students, with an emphasis on the integration of technology in education. The red cluster includes terms such as "humans", "health care delivery", "nursing education" and "health quality" because there is a field of study that focuses on health education and how it affects the caliber of medical services. This is because more people are using technology in the classroom, which has sparked interest in incorporating digital into the learning process.

As a result, subfields like e-learning and education have emerged. 4.0. The creation of strong research networks between subfields

such as e-learning, educational technology and health education shows research synergy and a multidisciplinary approach. There is a continuing need for interdisciplinary collaboration to improve learning and vocational training methods that can have a significant impact in various social fields.

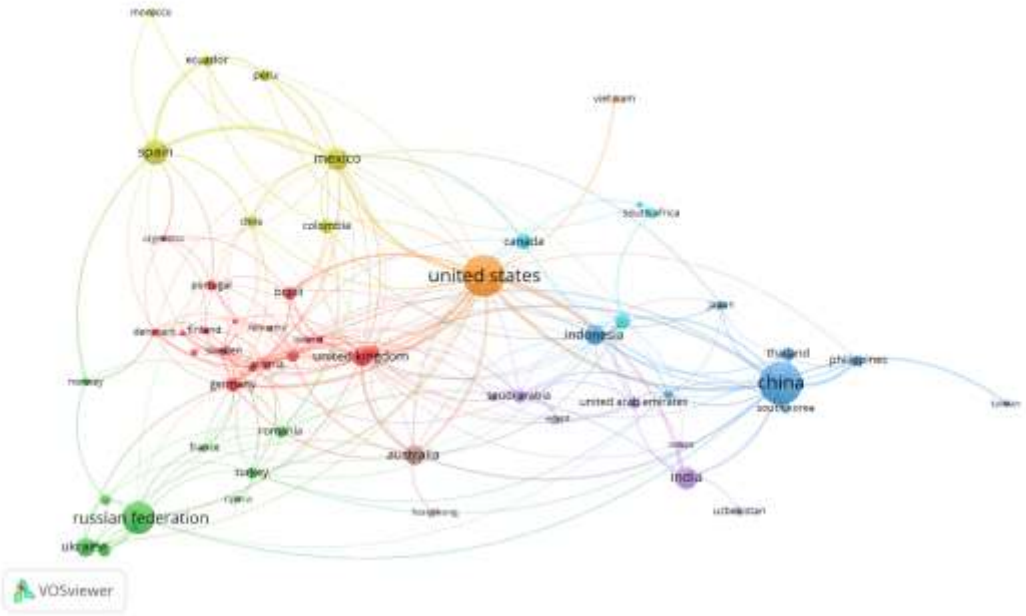


Fig. 2. The relationship between co-authors and countries
Source: own processing Voswiever [25].

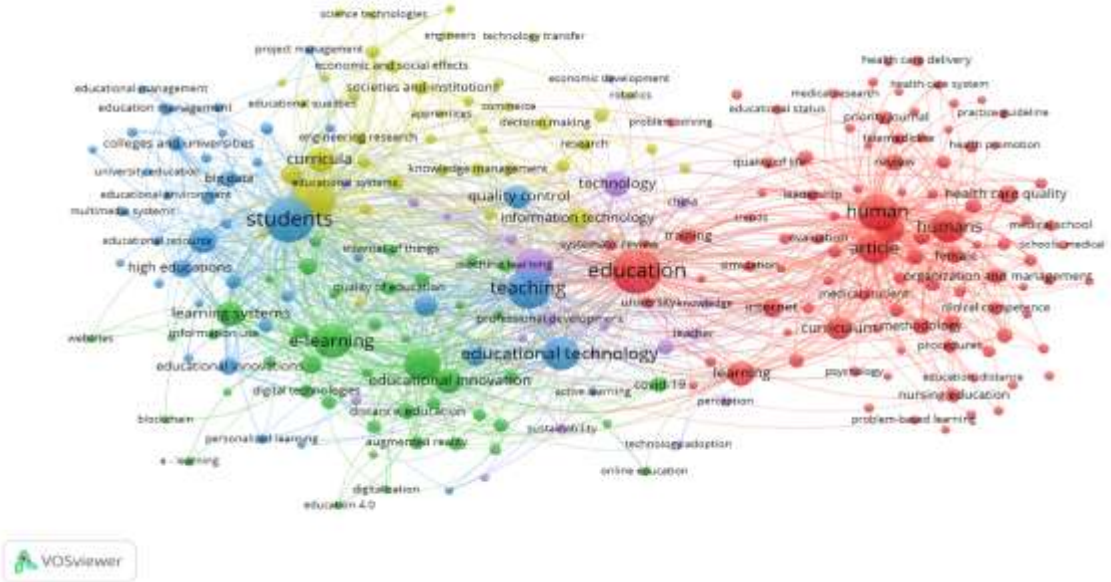


Fig. 3. The relationship between co-citations and all keywords
Source: own processing Voswiever [25].

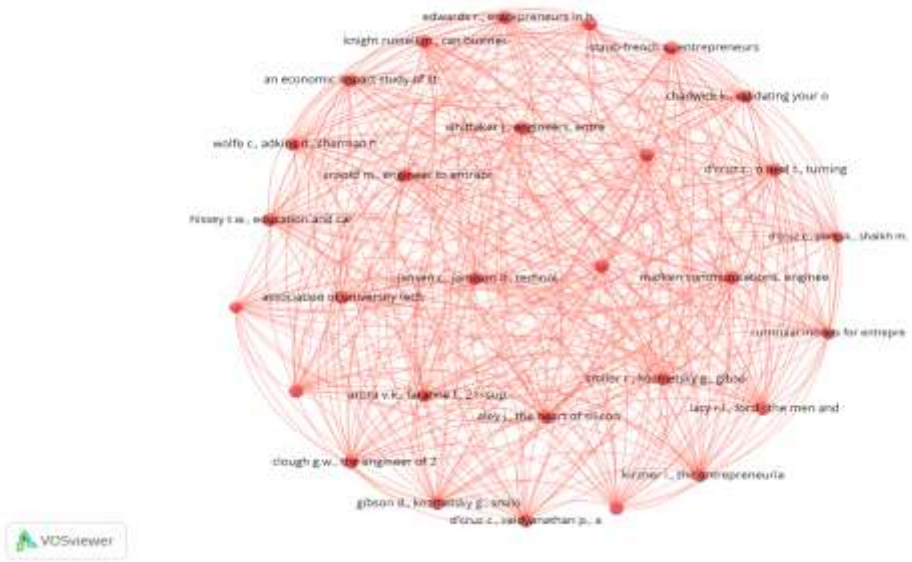

Fig. 4. The relationship between co-citations and cited references
Source: own processing Voswiever [25].

Figure 4 shows the relationship between co-citations and cited references, showing the interconnection between different papers through shared citations, illustrating a complex network of sources and authors contributing to a common research topic. The complexity and density of the network indicate a multidisciplinary approach or an interdependence of research themes. References are used repeatedly to support different aspects of the studies, thus showing that there is a common theoretical basis around which these works are built. The structure highlights the essential role of co-citation in forming a common knowledge base and in facilitating collaboration and integration of ideas between different research papers.

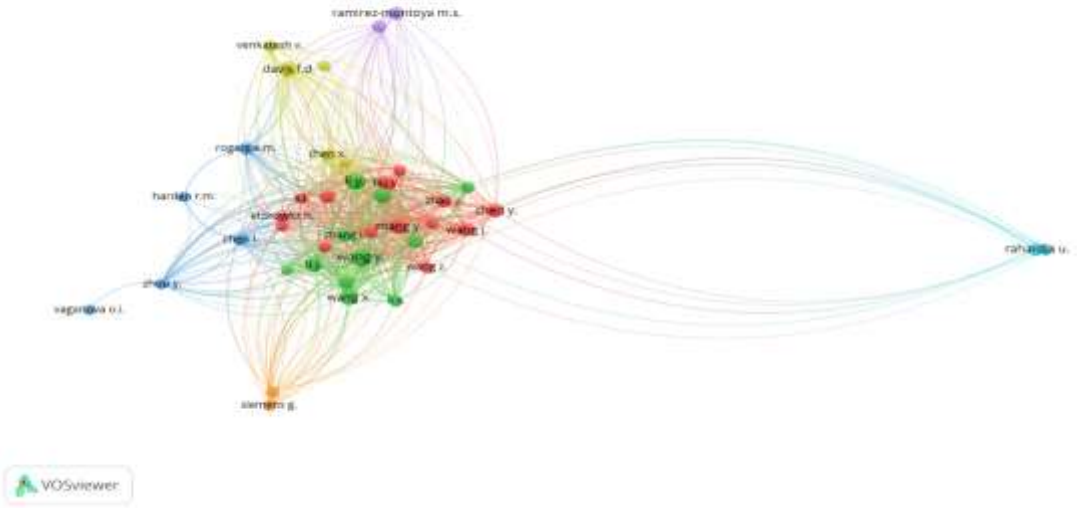

Fig. 5. Relationship between co-citations and authors
Source: own processing Voswiever [25].

The relationship between co-citations and authors, highlights close links between certain groups of researchers. The condition that was set when analyzing these relationships was the

minimum number of 30 citations/author. Center nodes, densely connected, represent authors frequently cited together, indicating common influence on the field. These core groups indicate the existence of specific research subfields or themes that have been developed through collaboration or common references. There are certain authors such as Siemens G., who is known for his contributions in the field of connectivist learning and educational technologies, Rogers E.M. who supports the theory of diffusion of innovation, with a direct influence in the adoption of new technologies, Venkatesh V. who analyzes the acceptance and use of technologies, including the UTAUT model or Davis F.D. known for the Technology Acceptance Model (TAM), frequently used in technology adoption studies. Certain authors, such as Rahimipoor U., are connected to the rest, but more peripherally, indicating a relatively independent specialization or influence, possibly with distinct contributions from the central group.

Next, we analyzed the first 11 of the 28 articles identified in the bibliometric analysis, starting from the addition of the last keyword "global trend" and taking into account the year of publication. Thus, the articles published in the period 2019-2024 were analyzed, taking into account the major changes in education that occurred after the outbreak of the Covid-19 pandemic and the progress recorded in this field.

Table 1. Findings from educational research, educational quality, and worldwide trends

| Author(s) | Title | Year of publication | Category Scopus | Main findings |
|---|---|---|---|---|
| Lopes, G. C. D., de Farias, W. S., Lopes, P. C. P., da Silva, R. T., Catapan, A | The importance of cross-border education in contexts of collaboration between countries according to the SDGS | 2024 | Journal of Lifestyle and SDG'S Review | To build an inclusive and sustainable global society, in accordance with the Sustainable Development Goals, effective policies and international collaboration are needed, but also investments in new technologies are essential to expand access and improve quality in cross-border education [10] |
| Muskhir, M., Luthfi, A., Watrianthos, R., Usmeldi, U., Fortuna, A., Samala, A. D. | Emerging Research on Virtual Reality Applications in Vocational Education: A Bibliometric Analysis | 2024 | Journal of Information Technology Education: Innovations in Practice | VR brings a significant transformation in vocational education, especially in training for technical skills. The study recommends that VR program designers align relevant technologies with trends in the literature to improve the quality of learning. For society, the increased interest and investment in VR in vocational education underlines the potential of this tool for global training. The study highlights the need for future research focused on the integration of VR into vocational curricula to address current gaps and support the development of interventions tailored to students' specific needs [17] |
| Zorrilla Noriega, A. M., Sánchez Arias, M., | Challenges for skills creation in legal education: an analysis of the Mexican context in line with global trends | 2023 | Higher Education, Skills and Work-Based Learning | The study aims to improve the training of law students, preparing them with the necessary skills to face the current challenges of the profession, connecting the learning process with the skills required in the labor market. The methodology includes two main components: an analysis of the norms governing the educational system and professional practice in Mexico, together with an extensive literature review on global trends in legal education [26]. |
| Melnychenko, S., Vedmid, N., Okhrimenko, A., Romanchuk, L. D. | Transformations of educational technologies | 2021 | IEEE International Conference on Modern Electrical and Energy Systems | The purpose of the article is to justify the directions for the formation of an innovative educational space according to the "Education 5.0" model, in order to guarantee the caliber of the curriculum, particularly for the instruction of electrical and energy system specialists. The results of the study include the generalization of |

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| | | | | major challenges and directions for their implementation in the educational process; presentation of a quality assurance system model in a higher education institution, based on nine essential components; and substantiating the main directions of strategic changes in the design and implementation of educational programs, particularly for the education of experts in the fields of energy and electricity. The suggested strategy seeks to make educational programs more competitive as a foundational element for professional training in line with societal norms and demands [15]. |
| Shukshina, L. V., Gegel, L. A., Erofeeva, M. A., Levina, I. D., Chugaeva, U. Y., Nikitin, O. D. | STEM and STEAM education in Russian Education: Conceptual framework | 2021 | Eurasia Journal of Mathematic, Science and Technology Education | The quality of professional training in the digital domain may be enhanced by the real-world application of STEM and STEAM technologies. Digital literacy, computational thinking, creativity, and interpersonal skills are among the fundamental competences in STEM and STEAM professions. Through the development of abilities in exact sciences, linguistics, engineering, art, and other disciplines, STEAM education in Russian higher education seeks to change the way that scientific knowledge is perceived and create a process of innovative development [23]. |
| Guàrdia, L., Clougher, D., Anderson, T., Maina, M. | IDEAS for transforming higher education: an overview of ongoing trends and challenges | 2021 | International Review of Research in Open and Distributed Learning | Using a three-stage exploratory methodology, the study investigates organizational, educational, and technical trends and problems. A literature review in the first phase found 14 noteworthy trends, which were then discussed with higher education experts. The second stage inventoried 108 initiatives representing these trends, of which 30 were selected for detailed analysis in the third stage. Through the thematic analysis of the 30 cases, 12 innovative themes were identified that contributed to the development of the IDEAS framework, a guide for next-generation pedagogy in the transformation of higher education. The IDEAS framework is detailed in the discussion, with examples and methods of application in the context of higher education [7]. |
| Makhynia, N., Kichuk, Y., Ptashchenko, O., Kyrylenko, K., Horchynska, K., Riznyk, V. | Innovations in the educational process and pedagogical technologies under the influence of crisis phenomena and global digitalization | 2021 | Estudios de Economia Aplicada | Innovations in the educational process are essential because the future well-being of a country depends on the education level of the youth. Pedagogical technologies are improved to provide modern and quality education. In this study, the authors analyzed innovations in education, the impact of the crisis and global digitalization, as well as international trends, finding that the processes of knowledge acquisition and transfer are increasingly organized in networks and proposed an algorithm for the formation of a pedagogical cluster. The authors created a sophisticated system of indicators to determine this cluster's efficiency. The study's recommendations will assist academic institutions in comprehending the clustering process, appreciating its significance, and defining |

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| | | | | their part in this change in the educational process [11]. |
| Ovsienko, L. V., Zimina, I. V. | Model of university's career guidance activities within the context of lifelong learning, | 2020 | Higher Education in Russia | The authors believe that a reevaluation of the function of universities is necessary, beginning with the reality that the population's formal educational potential in Russia is not being properly utilized, which become engines of economic growth and regional centers of innovation. In addition to education and science, universities assume a third social mission, influencing regional processes through their intellectual potential. The authors believe that the unique mission of higher education is the continuous development of each child and the creation of conditions for self-development, career paths and supporting talents, ensuring continuity and identifying individual potential [18] |
| Romanenko, E. S., Khokhlova, E. V., Ivashova, V. A., Mironova, E. A., Chvalun, R. V. | Fermentation specialist competency profile: current trends | 2020 | IOP Conference Series: Earth and Environmental Science | The study presents the results of a survey conducted in southern Russia among fermentation specialists, who provided opinions on the competencies required in an educational program to ensure the competitiveness of graduates in this field. According to the survey, the less trained skills are: the use of information technologies to solve technological problems; applying the principles of the quality management system and the legal and organizational bases in the managerial and entrepreneurial activity; and the ability to search, store, process and analyze information from various sources, presenting it in the required format with the help of computer and network technologies [20]. |
| Makarigakis, A. K., Jimenez-Cisneros, B. E. | UNESCO's contribution to face global water challenges | 2019 | Water | Education is fundamental to addressing the challenges of water security and resource management in light of climate change and population expansion. Through the International Hydrological Program (IHP), UNESCO plays a crucial role in enhancing knowledge by promoting education and capacity building , innovation and the science-policy interface. This reflects an integrated educational approach that not only trains future hydrologists, but also sensitizes decision makers and the general public, promoting a deeper understanding of the importance of sustainable water management [12]. |
| Qamar, S. Z., Pervez, T., Al-Kindi, M. | Engineering education: Challenges, opportunities, and future trends | 2019 | Proceedings of the 16th IEOM Global Engineering Education: First GCC International Conference on Industrial Engineering and Operations Management | This article, based on the authors' experience as professional engineers and academics, examines the challenges, opportunities, and future trends in engineering education. The main challenges relate to the curriculum, teaching methods and educational environment. A balance is required between overall excellence and specific areas of performance. In pedagogy, the focus should be on improving problem-solving skills, continuous learning and developing social skills (leadership, teamwork, communication, understanding of economics, business, management and entrepreneurship). Support must be |

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| | | | | provided through qualified technical staff and well-equipped facilities. Emerging trends include hands-on labs, industry-oriented curriculum, enhancing the active learning environment, and using interactive technologies such as adaptive software, e-learning, and distance learning [19]. |

Source: Own processing.

Although many of these studies focus on recent trends and innovations, such as STEM/STEAM education, interactive technologies, and hands-on methods, there is a lack of long-term evaluation of the impact of these innovations on graduate performance and adaptability. Therefore, we believe that longitudinal studies are needed to assess the lasting effects on skills and careers.

Although modern teaching methods such as hands-on laboratories and industry-oriented curriculum are discussed, few studies critically address the quality of their implementation. We therefore consider it necessary to put more emphasis on how differences in infrastructure, teacher training and resources affect the effectiveness of these methods.

Also, many educational trends emphasize the importance of social and cognitive skills (problem-solving skills, critical thinking, communication), but clearer and more objective methodologies are needed for their assessment. Future research could develop specific instruments to effectively measure these competencies.

At the same time, the use of modern technologies in education, although promising, can accentuate inequalities between students with limited access to technology and those who benefit from advanced resources. We believe that future research should look at how technological solutions can be implemented to support equity in education and reduce disparities.

On the other hand, given the rapid pace of technological and labor market changes, constant research into how education can become flexible enough to continuously adapt to new demands is essential. Thus, studies are needed on educational strategies that allow the rapid adaptation of curricula and teaching methods to new global challenges.

Exploring these aspects can contribute to a better understanding of how quality education can be ensured and improved in the long term to meet the complex and dynamic needs of contemporary society.

## CONCLUSIONS

The consolidation of knowledge in this area is greatly aided by bibliometric analysis of educational quality, which offers distinct and well-supported viewpoints for upcoming studies, educational initiatives, and governmental regulations.

By highlighting the crucial role of well-known writers who have made substantial contributions to our understanding of and integration of technology and innovation in educational processes, the analysis highlights the significance of quality in education. Their contributions, which are frequently co-cited and recognized as fundamental, support the development of models and theories that promote effective educational practices and the acceptance of technology in learning. The interdisciplinary collaboration and the diverse contribution of the authors in the network reflect a common concern for improving the quality of education, showing that a quality education requires the integration of validated theoretical approaches adapted to modern technological and pedagogical needs.

The study also highlights the central role of influential authors such as Siemens, Rogers, Venkatesh and Davis, whose seminal works are heavily co-cited and form the theoretical core of the field, while interdisciplinary collaborations and contributions by peripheral authors extend and diversifies understanding by emphasizing the importance of both central influences and niche contributions in the development of knowledge.

Global trends in education emphasize the importance of developing practical, technological and social skills that support both economic growth and social sustainability

and environmental protection. Education is no longer just a process of transmitting knowledge, but becomes an integrated platform that promotes critical thinking, international collaboration and the application of technology in the formation of innovative solutions to global challenges. This orientation towards skills-based education reflects an increasingly pressing need to prepare individuals capable of continuous learning, adaptability and active engagement in sustainable development, preparing them for an interconnected and rapidly changing world.

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