sustainability

MDPI

Review

Sustainable Development Goal 4 and Education Research: A Review of Polish Specifics Against the Background of Global Trends

Valery Okulich-Kazarin [1,2]

[1] Faculty of Social Sciences and Humanities, Humanitas University, ul. Kilińskiego 43, 41-200 Sosnowiec, Poland; okwalery@gmail.com
[2] Institute of Management and FiR, University of Business and Applied Sciences VARSOVIA, al. Jerozolimskie 133A, 02-304 Warsaw, Poland

Abstract: Analysis of publication intensity is an important tool for following research trends. Recent studies have recorded a decrease in the number of Polish publications on the topics of "economy" and "energy", while global trends showed an increase in the number of publications. The present study undertakes a review of research on the topic of "education" (Sustainable Development Goal 4, SDG 4) based on the number of scientific publications in the Scopus database from 2017 to 2024. The objective of the review was to examine whether a discernible decline in the number of publications by Polish researchers in the field of education research has indeed occurred since 2021. Eight research hypotheses were proposed and tested. The following methods were used: graphical interpretation of 1,116,101 search results from scientific sources, scientometric and correlation analyses, and an analysis of the top 10 most cited publications on this topic, both in Poland and globally. The scientific contribution of this study is in testing and evaluating the hypotheses: the first, the third, the fourth, the fifth, the sixth, and the eighth hypotheses were rejected; the second and the seventh hypotheses were accepted. For the first time, the data obtained confirmed a serious problem in Polish science: since 2021, Poland's position in the global scientific research market has been declining. The review showed the most popular branches of research in Poland and in the world. These are studies on the use of artificial intelligence, which corresponds to the sixth technological paradigm. The review also showed some differences in Polish specifics and global trends. The practical value lies in managerial recommendations for the Polish Government aimed at improving research on SDG 4. The knowledge gained advances modern knowledge about the management of education research in the context of SDG 4. This review is an important contribution to further research on the sustainability of education worldwide.

Keywords: Sustainable Development Goal 4 (SDG 4); sustainability; education; education research; trend line; Scopus; global scientific research market; artificial intelligence; sixth technological paradigm; Polish government; managerial recommendations

Academic Editor: Marc A. Rosen

Received: 10 December 2024
Revised: 11 March 2025
Accepted: 18 March 2025
Published: 19 March 2025

Citation: Okulich-Kazarin, V. Sustainable Development Goal 4 and Education Research: A Review of Polish Specifics Against the Background of Global Trends. *Sustainability* **2025**, *17*, 2747. https://doi.org/10.3390/su17062747

1. Introduction

To achieve sustainable development, it is necessary to combine the efforts of three sectors [1]: economic, socio-political, and environmental sectors in the broadest sense. The economic sector aims to promote sustainable economic growth, full and productive employment, and decent work for all. This sector also addresses the issues of creating a strong infrastructure, inclusive and sustainable industrialization, and the implementation

of innovations [2–6]. The socio-political sector of the Sustainable Development Goals (SDGs) includes the tasks of ensuring gender equality, quality education, empowering all women and girls, ensuring and rational use of water resources and sanitation for all, as well as reducing inequality within and between countries [5,7–12]. The environmental sector of the SDGs is aimed at ensuring rational consumption and production patterns, taking urgent measures to combat climate change and its consequences, conservation, and rational use of oceans, seas, and marine resources [5,12–14].

The full name of Sustainable Development Goal 4 (SDG 4) is "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" [15]. Achieving the SDGs in each of the sectors is impossible without quality education [1], as a source of qualified personnel. Thus, sustainability cannot be achieved without effective education. Education not only determines the main guidelines for the sustainable functioning of global and local communities, but also plays a key role in the formation of strategy and policy in various sectors of the economy and social life [16–18]. One of the main ways to measure the dynamics of the development of education is the analysis of scientific publications, which allows us to identify current trends and preferences of research communities [4,6,19–22].

Scientists consider patents and scientific publications as indicators of innovation [4,6,22–25]. Regular publications in scientific journals are the most important element of innovative development. They contribute to the creation and promotion of innovative ideas in the global scientific research market. The Scopus and Web of Science databases are the largest scientific electronic resources in the world. They contain abstracts and links to scientific publications in all fields of knowledge [26,27]. The authors of the work [25] showed that the Scopus and Web of Science databases differ only slightly in search relevance. Papers [4,28] showed a problem in the growth of the number of Polish publications in 2021. This result was obtained based on the analysis of the number of publications in the Scopus database. The Scopus database is used in the "Perspektywy" Polish University rating system [29]. This was the final argument in favour of choosing the Scopus database for detailed analysis.

The analysis of trend lines of publication intensity is an important tool for understanding how scientific interests are changing [4,6,19–22,28]. Modern challenges such as the digital economy [30,31], social inequality [1,11,12], globalization [32,33], the sixth technological paradigm [4,28] and the transformation of educational systems [6,21,33,34] require complex and interdisciplinary approaches, which, in turn, contributes to the growth of interest in these areas of knowledge. The impact of artificial intelligence (AI) on education is becoming increasingly evident [35–40]. The use of machine learning and big data analysis [6] allows us to more accurately predict the consequences of various human impacts on the education and develop the most effective strategies to minimize negative effects. Thus, the review of sources from one to 40 showed the important influence of education and SDG 4 on the economic, socio-political, and environmental aspects of our civilization. Researchers have shown the importance of education, starting from early childhood education [15,39] to the system of higher and postgraduate education [6,15,30,34]. Thus, in the Introduction Section, scientific sources and official documents confirming the importance of the scientific topic were studied.

The primary objective of this review was to examine whether a discernible decline in the number of publications by Polish researchers in the field of education research has indeed occurred since 2021. This topic is scientifically and practically important for identifying a hidden systemic issue and developing managerial recommendations for the Polish government to advance SDG 4. Additionally, it was crucial to contextualize these findings by comparing the publication dynamics in Poland with broader global trends in the global scientific research market.

The importance of the objective of this review is confirmed by two recent events in Poland. First, on 1 January 2025, Poland assumed the presidency of the Council of the European Union, which will last for the next six months (https://www.gov.pl/web/nauka/polska-prezydencja-w-ue-jakie-sa-priorytety-resortu-nauki, accessed on 3 February 2025). Poland's presidency of the Council is a unique opportunity to strengthen European cooperation in higher education, research, and innovation. One of the priorities is to accelerate the development of research in the field of artificial intelligence and its practical application in science. As the review showed, this priority has a problem against the background of global trends. Second, at the end of February, the Minister of Science and Higher Education, Marcin Kulasek, met with the rectors to discuss the future of higher education and science (https://www.gov.pl/web/nauka/minister-nauki-i-szkolnictwa-wyzszego-marcin-kulasek-rozmawia-z-rektorami-o-przyszlosci-szkolnictwa-wyzszego, accessed on 3 February 2025). The Minister stressed that science and higher education were recognized by the Prime Minister of Poland as one of the six areas of the program "Poland—Year of Breakthrough".

The author has tested eight research hypotheses for the above topic:

(1) Considering the importance of education for sustainable development, Polish scientists are increasing the number of publications in the field of education.
(2) Since 2021 Poland's position has been declining in the global scientific research market on education research.

This hypothesis 2 is formulated by analogy with the results published in papers [4,28]. The results of these papers showed that Poland's positions are declining in the global scientific research market in the fields of the economy [4] and energy [28] after 2021.

So, according to hypothesis 2, the trend lines show Poland's declining place in the global scientific research market on education research.

(3) Poland is in the top 10 countries by the number of publications on the topic of education in the Scopus database.
(4) Polish universities are in the list of the top 10 world universities that are leaders in the number of publications on the topic of education in the Scopus database.
(5) Polish scientists are in the list of the top 10 leading scholars by number of publications on the topic of education in the Scopus database.
(6) The shares of documents in education research on branches of knowledge in Poland and in the world are the same.

Hypotheses 3, 4, 5, and 6 help to analyse various aspects of education research. Hypotheses 3, 4, 5, and 6 were tested based on data from 2023. The year 2023 is the last completed year in the time frame of our review. Therefore, the year 2023 can be taken as a starting point for planning and making managerial decisions at the level of the Polish Government.

(7) There is no difference regarding the Sustainable Development Goals among the top 10 most cited Polish and world publications.
(8) There is no difference regarding artificial intelligence among the top 10 most cited Polish and world publications.

According to hypotheses 7 and 8, the top 10 most cited publications in Poland and in the world coincide with each other in the share of publications on SDGs and artificial intelligence. In this case, Poland strictly follows global trends in the field of education research.

The principal conclusions of the review are: the first, the third, the fourth, the fifth, the sixth, and the eighth hypotheses were rejected; the second and the seventh hypotheses were accepted.

While the number of publications on the selected topic is growing worldwide, there is growth in the number of publications in Poland before 2021 (the first research hypothesis). At the same time, there is a decline in Poland's position in the global scientific research market since 2021 (the second research hypothesis). Taken together, these facts may indicate the presence of a hidden systemic issue in education science in Poland. This hidden systemic issue is very important not only for Polish educational science, but also for the sustainable development of Poland. Papers [4,28] have proven the decline of Poland's position in the global scientific research market in the fields of the economy [4] and energy [28] since 2021. The analysis of education research complements the previously obtained data. As a result, this review helps to show the hidden systemic issue. This issue requires a solution at the level of the Polish Government.

The novelty of the review lies in testing eight research hypotheses. The review helped to identify a turning point (extreme point) in the graph of the growth of the number of Polish publications. This point is in 2021. Since 2021, Poland's position in the global scientific research market has been decreasing compared to 2020 in the field of education.

The practical value lies in recognizing the existence of the hidden systemic issue in Polish education science (SDG 4). The review closed an important knowledge gap in Polish education research. The author made several managerial recommendations to the Polish Government with the aim of advancing SDG 4. These recommendations can lead to significant improvements in Polish research, including education research in the context of SDG 4.

The most popular research branches of knowledge in such important science as education were also identified. Comparison of the top 10 most cited publications for Poland and on a global scale for 2023 showed: an imbalance in the number of citations; a difference between Polish specifics and the global trends in the number of papers on AI; the possibility of linking all papers to SDG 4; and the practical absence of documents directly related to any other SDG.

2. Materials and Methods

The review was prepared in four steps.

Previously, in the Introduction, scientific sources and official documents confirming the importance of the scientific topic were studied. The analysis was based on the scientific publications in the Scopus database [4,23,27,28]. As the authors of [25] had shown, the Scopus and Web of Science databases differ only slightly in search relevance. The last argument in favour of choosing the Scopus database was the "Perspektywy" university rating system in Poland [29]. Six indicators of the "Perspektywy" out of 31 indicators [29] are related to the number of publications in the Scopus database. There are no indicators related to indexing in other databases. The study identified key changes in scientific intensity. It also showed the existence of a problem that requires further attention from researchers and practitioners. It is important to note that the analysis of publication trends allowed us to identify the current interests of the research community. This, in turn, can become the basis for developing recommendations for improving educational systems and sustainable development practices at all levels. If education research shows the same results as research in the economy [4] and energy [28], then we can talk about the hidden systemic issue in the management of Polish science in general, and education research in particular.

First, a scientometric analysis was performed using the keyword "education" in the Scopus database (https://www.scopus.com/search/form.uri?display=basic#basic, accessed on 28 November 2024) [23,25–29]. The author searched for the word "education" within paper titles, abstracts, and keywords. Scientometrics studies the evolution of science

through multiple measurements and statistical processing of scientific information, such as the number of scientific papers published in a given time period, citations, etc. The scientometric analysis was performed in two versions: for publications in Poland and for publications worldwide. The affiliation of publications to Poland was determined according to the rules of the Scopus database. The period from 2017 to 2024 was chosen for the analysis. A total of 1,116,101 search results were processed.

The beginning of the period was chosen for the following reason. Previously published papers [4,28] revealed a decline in Poland's position in the global scientific research market in the fields of the economy and energy since 2021. The author took data for analysis for the five years before this fact, i.e., data for 2017, 2018, 2019, 2020, 2021.

After that, 1,116,101 search results were interpreted graphically. Graphical interpretation of the data allowed to evaluate the correctness and accuracy of the data, and to comprehend the research results. Graphical methods also helped to identify patterns, exceptions, or anomalies that are difficult to quantify. Graphical interpretation also allowed correlation analysis [41] to be performed using standard Microsoft Office statistical tools. Examples of using correlation analysis to test hypotheses were previously described in sources [4,28].

Poland's position in the global scientific research market was determined for each year (2017–2024) using the methodology available in the Scopus database. The author entered the keyword "education" in the Scopus database (https://www.scopus.com/search/form.uri?display=basic#basic, accessed on 29 November 2024). Then, the author entered the years from 2017 to 2024 one by one. Next, the author opened the "Documents by Countries and Territories" window. All countries were listed in order of their position in the global scientific research market. The window automatically displayed the top 10 leading countries by the number of publications according to the keyword. Poland was recorded in the corresponding position below.

In the next step, the author assessed the top 10 countries, top 10 universities, top 10 authors, and top 10 branches of knowledge by the number of publications in the Scopus database. The top 10 countries, universities, authors, and branches were selected for analysis on the methodological basis of the Scopus database. Ten also is a number that allows drawing the most general picture. Moreover, being in the top 10 list declares a strong leading position. For example, the authors of the paper [23] processed articles only in the top 10 journals indexed in the Scopus database. Thus, the authors of the paper [23] did not waste readers' time studying the results published in mid- and low-level journals. The authors showed where scientific leaders are leading science [23]. This review also shows who the leaders are in education research and where they are leading educational science.

Finally, the author analysed the content of the top 10 publications by the number of citations in the topic of education. Such publications as books, reports, abstracts at scientific conferences, feedback were not taken into account. This is a limitation of this review. The author analysed the top 10 publications by the number of citations both for Poland and globally. Considering that ChatGPT 3.5 entered the global market at the end of 2022, the author compared the top 10 most cited publications (research hypotheses 7 and 8) for 2023. The year 2024 was not considered due to its incompleteness.

The citation rate (CR) has traditionally been used as an important indicator of the impact of papers [42]. Citations are a powerful evidence of knowledge accumulation and an interactive tool for academic communication [43]. Citations exist to give credit to earlier research, to acknowledge intellectual debt to other researchers, and to demonstrate one's familiarity with a field of knowledge [44]. The authors of [43] found that in the natural sciences, more recent citations are used than in the humanities and social sciences.

This is due to differences in the pattern of knowledge growth, publication speed, and discipline-specific expectations.

The number of citations of scientific publications reflects current trends and research directions in a particular field. Publications that receive a large number of citations are most often innovative, original, and relevant. They most likely reflect the interest of the scientific community in certain problems or areas of research. Publishing results as a review article or in journals with an impact factor does not contribute to an increase in the number of citations [45].

Citation counting is a mechanism for assessing scientific impact [46]. The number of citations also reflects the level of attention that a certain work arouses among other researchers in a certain field. The more citations a publication has, the higher its significance and influence on research directions. This allows us to evaluate both the contribution of the authors to the development of science and to identify current trends and research topics.

After completing the above four steps, the Section 4 was written.

3. Results

3.1. Testing of the First Research Hypothesis

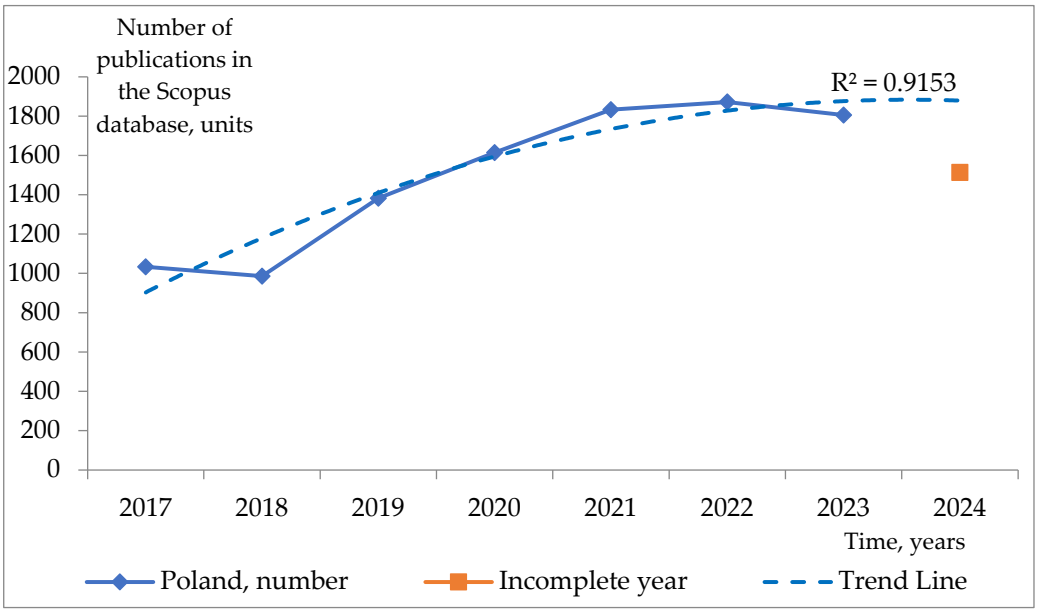
This review covers the processing of publication search results from around the world in the Scopus database for the keyword "education" in 2017–2024. Figure 1 shows the results of the scientometric analysis of this important topic both in Poland and globally.

For Poland, the trend line is directed from bottom in 2017 to top in 2023 (Figure 1a). However, starting from 2021, the growth rate of the number of publications slowed down, and from 2022, the number of publications began to decline. The year 2024 is an incomplete year on the date of analysis, so these data were not taken into account in the correlation analysis. The correlation coefficient $R^2 = 0.9153$ (Figure 1a) indicates a fairly high degree of polynomial dependence between the variables under consideration. A high value of R^2 means that about 91.53% of the variation in the number of publications is explained by changes in time within the framework of this model. This indicates that the model describes the observed data well and the identified relationship is significant. However, despite the high level of correlation, there remains about 8.47% of the variation that the model cannot explain. This may be due to the influence of factors not included in the analysis, as well as to the presence of random errors. So, Figure 1a does not allow us to accept the first research hypothesis.

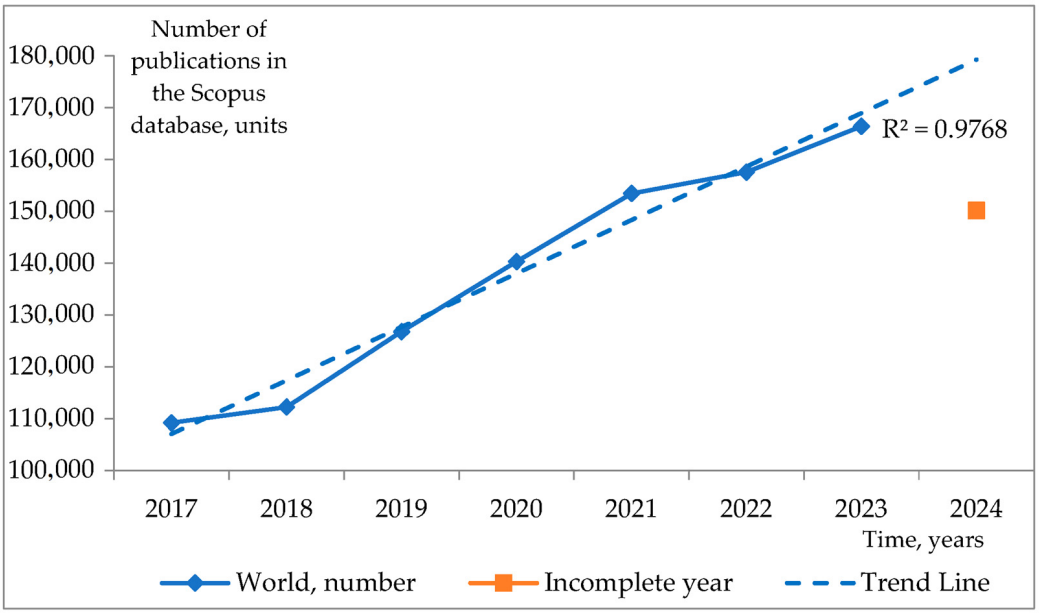
Figure 1b demonstrates a growth in the number of publications for the keyword "education" for the world in 2017–2023. The year 2024 is an incomplete year on the date of analysis, so these data were not taken into account in the correlation analysis. The correlation coefficient R^2, close to one (Figure 1b), indicates a strong degree of linear dependence between the analysed variables. This indicates that the variation of the number of publications is almost completely explained by the change in time. Checking other forms of graphical dependence (exponential, logarithmic, and polynomial) did not lead to an increase in the correlation coefficient R^2.

Thus, the result of the review confirms the presence of a significant relationship (Figure 1b). This means that scientists around the world are increasing the number of publications in the field of education from 2017 until 2023.

So, the first hypothesis is rejected. This means that Polish scientists are not increasing the number of publications in the field of education from 2017 until 2023.



(**a**) In Poland in 2017–2024.



(**b**) In the world in 2017–2024.

Figure 1. Number of publications and trend lines in Poland (**a**) and the world (**b**); keyword "education" in the Scopus database, 28 November 2024.

3.2. Testing of the Second and the Third Research Hypotheses

Figure 2 shows the results of scientometric analysis of the keyword "education" in the context of the position of Polish publications in the global scientific research market.

Figure 2 demonstrates the growth of Poland's position in the global scientific research market from 2017 to 2020. From 2020 to 2021, the growth of Poland's position stopped. Since 2021, Poland's position in the world market of scientific products began to dramatically decline.

As noted above, a violation of the stability of the growth in the number of publications was recorded in 2021 [4,28]. Therefore, from 2021 to 2024, a correlation analysis was performed and a trend line was built (Figure 2). Visually, Figure 2 shows a sharply downward trend line with $R^2 = 0.9602$. A high value of the correlation coefficient indicates a very high degree of exponential dependence between variables. An R^2 value of 0.9602 means that about 96.02% of the variation in the position in the global scientific research

market is explained by changes in time within the framework of this model. This indicates a significant and strong relationship between variables.

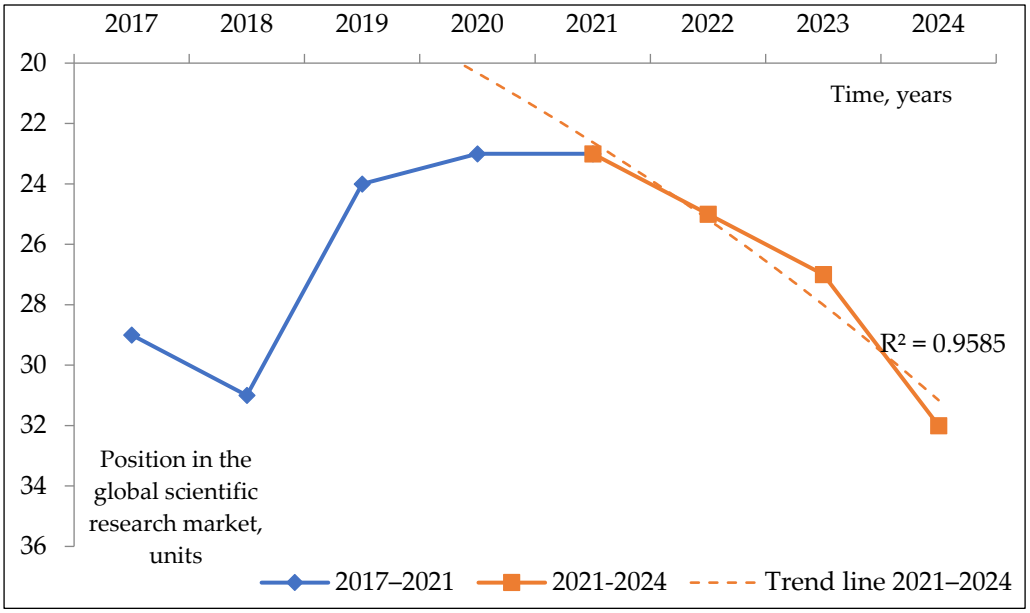


Figure 2. Position and trend line of Polish publications in the global scientific research market (the Scopus database): education, 28 November 2024.

The high correlation coefficient also indicates that the model is sufficiently stable and has high predictive power.

The sharply falling trend line, visualized in Figure 2, confirms the presence of a strong negative correlation on the topic of education. This means that an increase in the values of the independent variable is accompanied by a significant decrease in the values of the dependent variable. This result allows us to confidently accept the second research hypothesis. This means that Poland's position is declining in the global scientific research market in the field of education.

The review continues with an analysis of published documents by country (territory). Figure 3 shows the top 10 countries by the number of publications on the topic of education in the Scopus database for 2023.

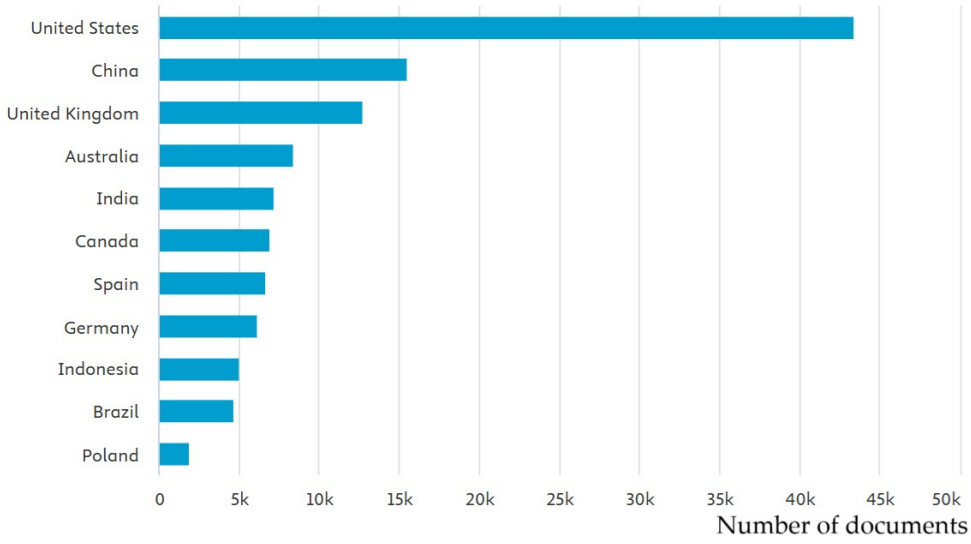


Figure 3. Modified screenshot: number of documents in education sciences by top 10 countries and Poland, 2023.

Figure 3 shows the clear leadership of scientists from the United States in the number of publications in the Scopus database. China and the United Kingdom have second and third positions with a significant gap. Then, there was a gradual decline in the position in the global scientific research market. Poland is in 27th position in the global scientific research market in 2023 (Figures 2 and 3). This result allows us to confidently reject the third research hypothesis.

Figure 3 also demonstrates the wide geographic diversity of the top 10 countries-leaders in the number of publications on the topic of education in the Scopus database for 2023.

3.3. Testing of the Fourth Research Hypothesis

Figure 4 shows the list of the top 10 world universities that are leaders in the number of publications on the topic of education in the Scopus database for 2023. A total of 166,225 document search results in the world were processed.

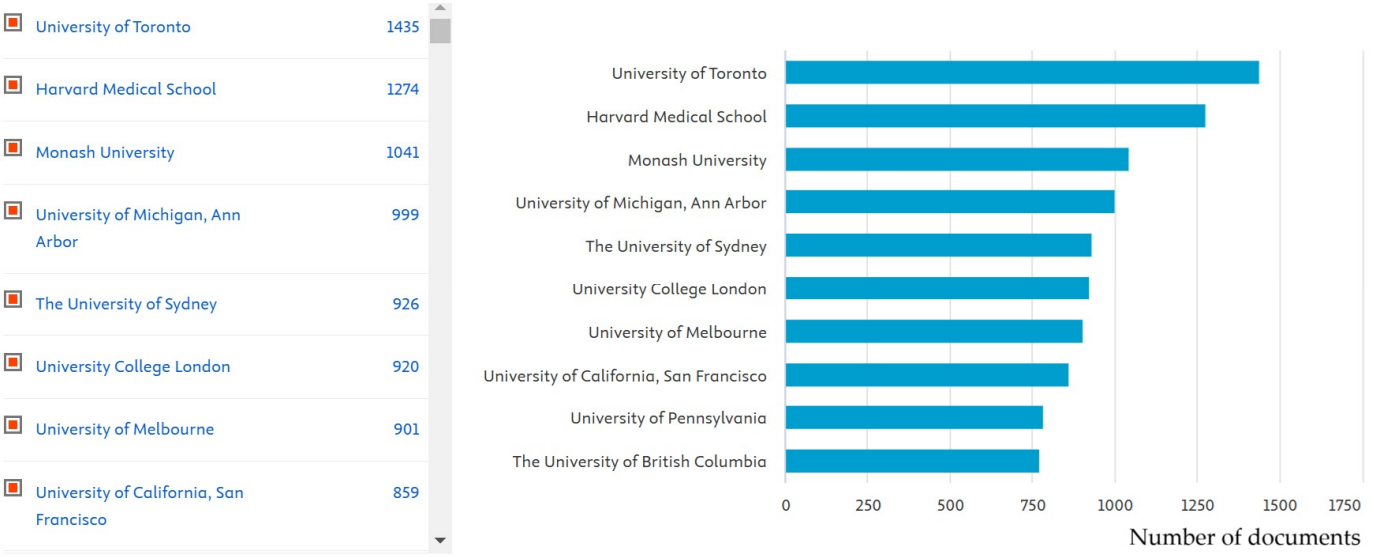


Figure 4. Modified screenshot: top 10 countries by the number of documents in education sciences in the Scopus database, 2023.

Figure 4 shows the clear leadership of the University of Toronto (1435 documents) and Harvard Medical School (1274 documents). Despite the fact that Canada is in sixth place in the ranking (Figure 3), the University of Toronto is the undisputed leader among universities (Figure 4). Polish universities are not in the list of the top 10 world universities that are leaders in the number of publications on the topic of education in the Scopus database for 2023.

In general, the leadership of universities (Figure 4) does not coincide with the ranking of leading countries (Figure 3).

Then there is a gradual decrease in the number of publications from university to university. In 100th place is Baylor College of Medicine with 363 publications. Polish universities are not in the list of the top 100 leading universities by the number of publications on the topic of education in the Scopus database.

This result allows us to confidently reject the fourth research hypothesis.

3.4. Testing of the Fifth Research Hypothesis

Figure 5 shows the list of the top 10 world scientists by the number of publications on the topic of education in the Scopus database for 2023. A total of 166,225 document search results were processed in the world.

Figure 5. Modified screenshot: top 10 authors by the number of documents in education sciences in the Scopus database, 2023.

Figure 5 shows the wide geographic diversity among the top-10 leading scholars by number of publications on the topic of education in the Scopus database for 2023. According to the ranking, these top 10 authors represent the following universities and countries: 1—National Taichung University of Education, Taichung, Taiwan; 2—Uniformed Services University of the Health Sciences, Bethesda, United States; 3—Imperial College London, London, United Kingdom; 4—Saveetha Institute of Medical and Technical Sciences, Chennai, India; 5—Nelson Mandela University, Gqeberha, South Africa; 6—Faculty of Health and Medical Sciences, Adelaide, Australia; 7—Tecnológico de Monterrey, Monterrey, Mexico; 8—Det Sundhedsvidenskabelige Fakultet, Copenhagen, Denmark; 9—Beijing Normal University, Beijing, China; 10—the University of Auckland, Auckland, New Zealand. In general, the leadership of academics does not coincide with the rankings of countries and universities (Figures 3 and 4).

Polish scientists are absent from the list of the top 100 leading scientists by the number of publications on the topic of education in the Scopus database. This result allows us to confidently reject the fifth research hypothesis.

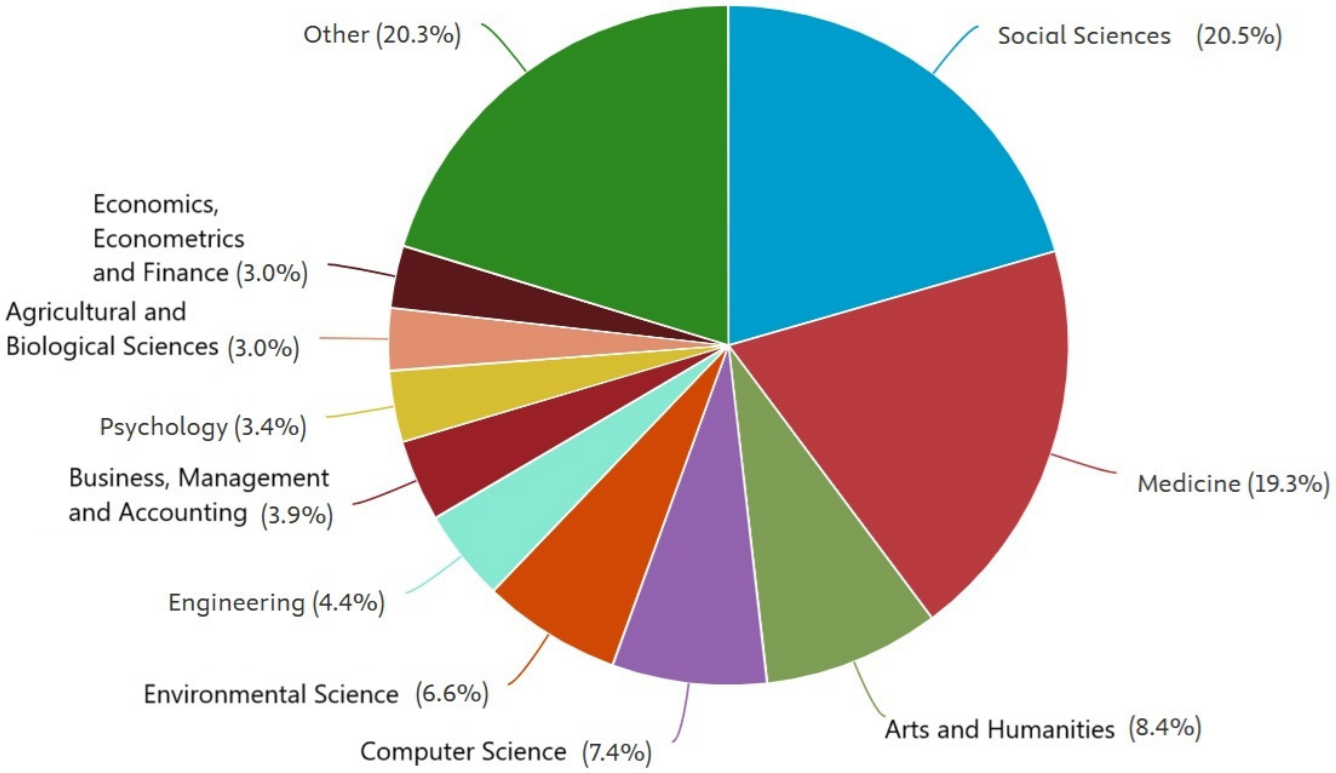
3.5. Testing of the Sixth Research Hypothesis

Figure 6 shows the top 10 branches of sciences related to education in Poland and globally in 2023. A total of 166,225 document search results were processed in the world.

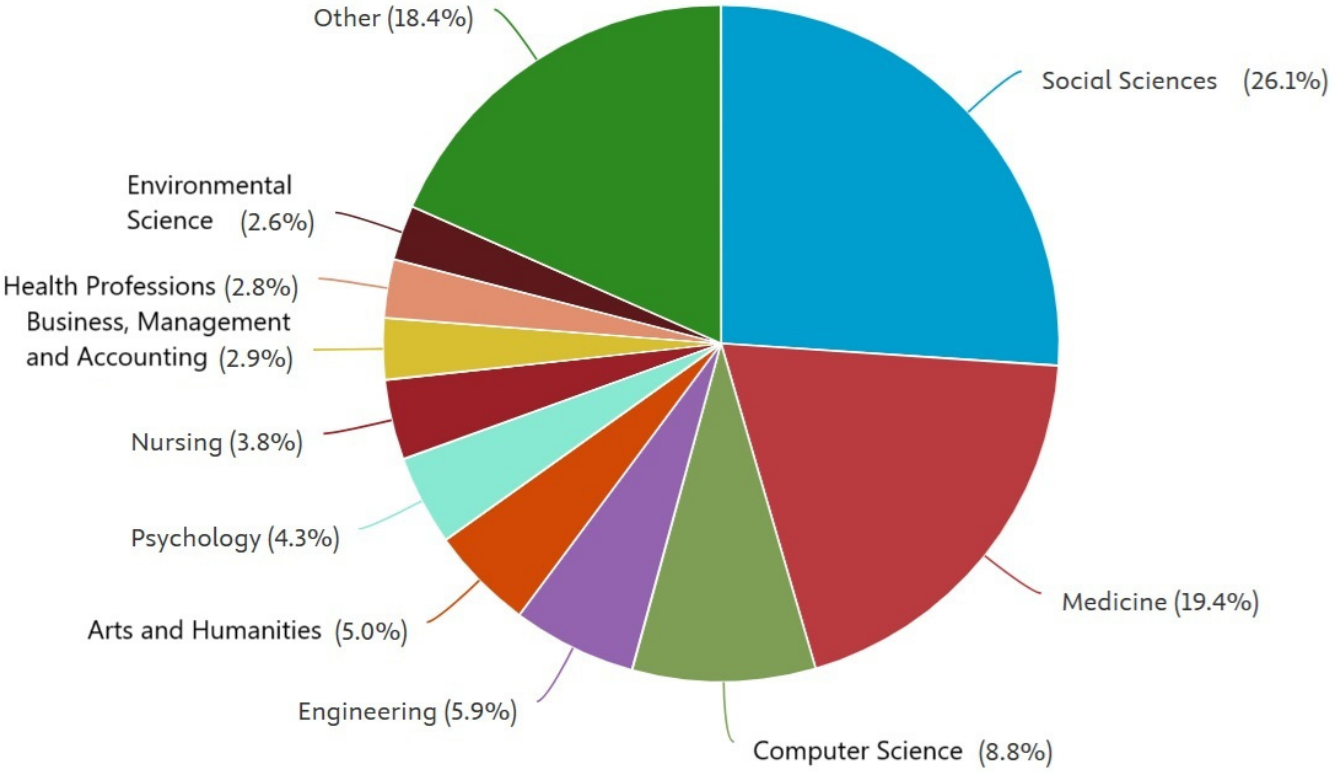
Figure 6a shows a share of documents in education sciences on branches of knowledge in Poland. These are the top 10 branches of sciences related to education. The maximum number of publications is in such branches as Social Sciences (20.5%) and Medicine (19.3%). The difference with the world result appears in the third position (Figure 6b). Here are the Arts and Humanities (8.4%). Computer Science makes up 7.4% and occupies the fourth position. Another difference is publications with undefined branches. They occupy a slightly larger share (20.3%). The unspecified branches include 17 branches. Among the Polish publications, there are no branches related to SDG 4 or other SDGs.

Figure 6b shows the share of documents in education sciences on branches of knowledge in the world. These are the top 10 branches of sciences related to education. The maximum number of publications on the topic of education are in such branches as Social Sciences (26.1%) and Medicine (19.4%). In third place is Computer Science (8.8%). A large

number of publications are in unspecified branches (18.4%). There are 17 unspecified branches. There are also no branches related to SDG 4 or other SDGs.



(**a**) In Poland.



(**b**) In the world.

Figure 6. Modified screenshot: the share of documents in education sciences by branches of knowledge in Poland (**a**) and in the world (**b**), the Scopus database, 2023.

This result allows us to confidently reject the sixth research hypothesis.

3.6. Testing of the Seventh and Eighth Research Hypotheses: Analysis of the Top 10 Publications in the World and in Poland by the Number of Citations

The author had started by analysing the contents of the top 10 publications by the number of citations on the topic of education in the world. The author then analysed the top 10 publications of Polish scientists. The analysis of 166,196 documents was performed for the last full year (2023).

Paper [47] took the first place in citations. The paper scored 1703 citations in the Scopus database. The authors found that large language models (AI) "can potentially help in medical education and possibly in making clinical decisions".

Paper [48] took the next place in citations. The paper scored 1631 citations in the Scopus database. The authors identify issues requiring further research on AI in three topic areas: knowledge, transparency, and ethics; digital transformation of organizations and societies; teaching, learning, and research.

The authors of paper [49] evaluated the performance of ChatGPT on the US Medical Licensing Examination (USMLE). The authors found that ChatGPT performed at or near the 60% accuracy threshold. Impressively, ChatGPT was able to achieve this result without any formal training from academics. The paper scored 1607 citations in the Scopus database.

Paper [50] scored 1189 citations in the Scopus database. The author has studied the usefulness of AI in education, scientific research, and healthcare practice. The author also identified the potential limitations of AI.

The next place in citation was taken by paper [51]. The paper scored 1018 citations in the Scopus database. The author writes that artificial intelligence (AI) is transforming the landscape of scientific research. The author offers valuable insights for researchers, developers, and stakeholders interested in the ever-changing landscape of AI-driven conversational agents. This study examines the various ways in which ChatGPT is revolutionizing scientific research, spanning data processing and hypothesis generation, collaboration, and public outreach.

The authors of study [52] aimed to evaluate the performance of ChatGPT in answering questions included in the United States Medical Licensing Examination (USMLE). The paper scored 929 citations in the Scopus database. The authors showed that ChatGPT marks a significant improvement over natural language processing models in medical question answering tasks. Performing at a threshold of over 60% on the NBME-Free-Step-1 dataset, the model achieved the equivalent of a passing grade for a third-year medical student.

In an editorial paper (762 citations), H. Holden Thorp (Editor-in-Chief, *Science* journal) expressed concern about how ChatGPT could change education and scientific writing [53].

The authors of paper [54] explored new AI chatbot technology, specifically GPT-4, to assess the opportunities—and risks—in health care delivery and medical research. The paper scored 732 citations in the Scopus database.

A follow-up paper [55] received 711 citations. The authors reviewed the literature on ChatGPT and its implications for higher education. The authors discussed the future of learning, teaching, and assessment in higher education in the context of ChatGPT.

Finally, paper [56] received 699 citations. The authors' results showed that ChatGPT is a powerful tool in education. However, it should be used with more caution. This study [56] identified several research directions and issues that should be explored for better and safer use of chatbots, including ChatGPT.

Thus, 10 publications out of 10 are related to the use of AI in education. One of them mentions large language models [47]. This was the most cited paper (1703 citations).

Two papers evaluated the performance of ChatGPT on the US Medical Licensing Examination (USMLE) [49,52]. The number of citations is 1607 and 929.

The authors write about the use of AI for research [48,50,51,53,54]. The number of citations ranges from 732 to 1631.

Papers [55,56] do not go beyond the educational topic. The numbers of citations are 711 and 699.

Thus, all the papers cover various areas of education research. They can be linked to SDG 4. However, there are no papers directly related to any SDG.

Polish scientists are absent from both the top 10 and top 100 leading authors by the number of citations in the Scopus database.

Recall that on the topic of education, all 10 world publications are associated with AI. The number of citations of all 10 papers on the use of Artificial Intelligence lies in the range from 699 [56] to 1703 [47]. This result corresponds to the sixth technological paradigm [57,58]. The sixth technological paradigm requires new scientific knowledge that can be found in scientific publications [4,28,57,58].

So, this was the analysis of the top 10 education research in the world.

Below, the author conducted an analysis of the top 10 publications in Poland by the number of citations. This was based on 1815 publication search results in the Scopus database in 2023. The most cited paper [59] scored 249 citations. The authors examined the potential benefits and threats of ChatGPT in academic writing and research publications. The authors also examined a number of ethical considerations associated with the use of these tools and considered their possible impact on the authenticity and credibility of academic work. The authors analysed the content of research articles published in peer-reviewed journals indexed in Scopus as quartile 1 [59].

The next most cited paper has 177 citations [60]. Its authors studied the problems and opportunities associated with the use of generative artificial intelligence in business. This study also collected the negative aspects of AI development (ChatGPT) in management and economics.

In third place is the paper [61], which has 68 citations. To achieve the SDGs, the authors recommend that the Ukrainian government focus on ensuring adequate access to education, creating new jobs, and stimulating intellectual migration to the country.

The authors of the following paper identified educational and communication barriers as the main obstacles to developing a sustainable financial market in Poland [62]. This paper is related to sustainability (SDG 9), although it is not written directly in the text. The paper received 62 citations.

Paper [63] received 56 citations. The authors describe the potential benefits of using ChatGPT to improve medicine and public health, ranging from health literacy, medical training, and education.

In paper [64], the authors wrote that health literacy plays an important role in secondary prevention of cardiovascular diseases. This paper received 55 citations.

The authors of paper [65] studied the labour market and education. These are two factors that largely determine the success of the integration process of foreigners into the host society. The paper has collected 45 citations.

The next paper is devoted to the prevention and treatment of cardiovascular diseases [66]. This paper includes a section "Education and training" in which the authors discuss the training of operators of percutaneous coronary interventions. The paper has been cited 44 times.

The main goal of paper [67] is to indicate the key areas of required knowledge and skills of employees necessary for the implementation of the Industry 4.0 concept. According to the authors, the results of this study are important for adapting the employee training system and the student learning process. The paper has been cited 44 times.

The paper that concludes the list of the top 10 publications received 43 citations. The authors aimed to evaluate the performance of two large language models (LLMs): ChatGPT based on GPT-3.5 and GPT-4 [68]. The obtained results indicate the growing potential of using LLM in terms of medical education.

Thus, four publications out of 10 are related to the use of AI in education [59,60,63,68]. In the first publication, the authors write about the use of AI for research [59]. In the next paper [60], the authors write about the use of generative AI in business. The third paper [63] is related to the use of AI to improve medical literacy, medical training, and education. The last of them mentions large language models [68]. This was the least cited paper out of the top 10 publications of Polish scientists (43 citations).

The remaining six publications describe various aspects of education research without touching upon the topic of Artificial Intelligence. Two of them relate to cardiology education and training. The rest cover various areas of education research.

Thus, the top 10 papers by the number of citations cover various areas of education research. They can be associated with SDG 4. Papers [61,62] are the only papers directly associated with SDGs.

Recall that in the field of education, only four publications are associated with AI. The number of citations of four papers on the use of Artificial Intelligence ranges from 43 [68] to 249 [59]. The remaining papers received from 44 [67] to 68 [61] citations. That is, Polish publications on AI received more citations than papers on other topics. It seems that this result corresponds to the sixth technological paradigm [57,58]. Overall, the number of citations of Polish publications corresponds to Poland's position in the global scientific research market (Figures 2 and 3).

So, this was an analysis of the top 10 educational research in Poland.

Thus, the results allow us to confidently accept the seventh research hypothesis and reject the eighth research hypothesis.

4. Discussion

The main results of the review are as follows:

4.1. The First Research Hypothesis Was Rejected

The review showed no stable growth in the number of publications on the topic of education in Poland from 2017 to 2023 (Figure 1a). The correlation coefficient $R^2 = 0.9153$ (Figure 1a) indicates a fairly high degree of polynomial dependence between the variables under consideration. The review helped to identify a turning point (extreme point) in the graph of the growth of the number of Polish publications on this topic. This point is in 2021. After 2022, the number of Polish publications on this topic decreased (Figure 1a). This means that despite the importance of education for sustainable development, Polish scientists are not increasing the number of publications in the field of education since 2021. Thus, a hidden systemic issue was identified in the publication of research results by Polish scientists starting in 2021 (Figure 1a).

At the same time, the review showed the global growth in the number of publications on the topic of education (Figure 1b). A straight trend line has the correlation coefficient $R^2 = 0.9768$. In other words, scientists around the world are increasing the number of publications on the topic of education taking into account the importance of education for sustainable development. So, Polish publication results are not constantly growing against the background of the growing global trend.

4.2. The Second Research Hypothesis Was Accepted

Poland's position in the global scientific research market began to decline in 2021 (Figure 2). A high value of the correlation coefficient (R^2 = 0.9602) indicates a very high degree of exponential dependence between variables. This means Poland's position is declining in the global scientific research market on education research.

The result obtained in this review is adequate to the conclusions published in the papers [4,28]. Thus, it was proved the hidden systemic issue in the publication of research results by Polish scientists starting in 2021 (Figure 2). In order to increase Poland's position in the global scientific research market, the author gives the Polish Government managerial recommendations to adopt the best practices of the top 10 leading countries (Figure 3) and implement the recommendations published in papers [4,28]. These recommendations include: changing the national system for assessing the weight of scientific journals [4]; eliminating frequent changes in the weight of scientific journals within the existing national system; eliminating the differentiation of weight for scientific papers written independently and in collaboration; allowing the use of all publications (not one per year) when assessing the results of scientific work; and others [28]. The author performed an analysis of a very important government document [69] using artificial intelligence. Unfortunately, the analysis data showed that the Polish Government used the experience of weak countries (ranked 30–42 in the global scientific research market) to regulate Polish science both in education research and in other fields of sciences [70].

4.3. The Third Research Hypothesis Was Rejected

Figure 3 shows the wide geographic diversity of the top 10 leading countries by the number of publications on the topic of education in the Scopus database for 2023. Figure 3 also shows the leadership of scientists from the USA, China, and the United Kingdom in the global scientific research market. Poland is in 27th position in this market. That is, Poland is not among the top 10 leading countries that shape global trends in education research.

So, to improve the situation shown in Figure 2, the author recommends that the Polish government adopts the best practices of the top 10 leading countries. The experience of these countries, starting with the United States and ending with Brazil, is useful for improving Poland's place in the global scientific research market. We are talking about education research of SDG 4.

4.4. The Fourth and Fifth Research Hypotheses Were Rejected

Polish universities and Polish scientists are absent from the lists of both the top 10 and the top 100 leaders by the number of publications in education research (Figures 4 and 5). These are the differences between Polish specifics and the global trends.

The leaders among universities are the University of Toronto and Harvard Medical School (Figure 4), despite the fact that Canada is in 6th place in the global scientific research market (Figure 3). This example of Canada suggests a chance for at least one Polish university or at least one Polish scientist to be included in the list of the top 10. However, neither Polish universities nor Polish scientists are among the top 10 most influential leaders in educational research.

The author recommends that the Polish Government not only change the general system of stimulating research in the country, but also organize the selection and support of talented scientists.

4.5. The Sixth Research Hypothesis Was Rejected

Among the top 10 branches of sciences related to education research (Figure 6b), the leadership globally belongs to such branches as Social Sciences (26.1%) and Medicine (19.4%), Computer Science (8.8%).

In Poland, among the top 10 branches of sciences related to education research (Figure 6a), the leadership belongs to such branches as Social Sciences (20.6%), Medicine (19.3%), and Arts and Humanities (8.4%). In contrast to the global distribution of branches (Figure 6a), Computer Science occupies the fourth position (7.4%).

Table 1 compares the share of documents in education sciences by branches of knowledge in Poland and in the world (Figure 6).

Table 1. Top 10 branches of education research in the world and Poland, Scopus database, 2023.

No	Branches, the World	Share, %	Branches, Poland	Share, %
1	Social Sciences	26.1	Social Sciences	20.6
2	Medicine	19.4	Medicine	19.3
3	Computer Science	8.8	Computer Science	7.4
4	Engineering	5.9	Engineering	4.3
5	Arts and Humanities	5.0	Arts and Humanities	8.4
6	Psychology	4.3	Psychology	3.4
7	Nursing	3.8	-	-
8	Business, Management, and Accounting	2.9	Business, Management, and Accounting	3.9
9	Health Professions	2.8	-	-
10	Environmental Science	2.6	Environmental Science	6.6
-	-	-	Economics, Econometrics, and Finance	3.0
-	-	-	Agricultural and Biological Sciences	3.0
11	Other	18.4	Other	20.3

Table 1 shows the difference in the distribution of publications by top 10 branches in 2023. Let us consider only those branches where the differences are more than 1.0%.

Table 1 shows that Poland was lagging behind in such branches as Social Sciences by 5.5%, Computer Science by 1.4%, and Engineering by 1.6%. Branches such as Nursing and Health Professions did not make it into the top 10 branches in Poland.

The imbalance in favour of Poland is in such branches as Arts and Humanities (the difference was 3.4%), Environmental Science (the difference was 4.0%), and Business, Management, and Accounting (the difference was 1.0%). There were two branches (Agricultural and Biological Sciences; Economics, Econometrics, and Finance), which were not in the top 10 branches in the world (Table 1).

Thus, Figure 6 and Table 1 show the imbalance in the number of publications in various branches of education research. This is the next difference between Polish specifics and the global trends.

In the world there are no branches related to SDG 4 or other SDGs. There are no branches related to SDG 4 or other SDGs in Poland.

To eliminate the imbalance in the branches of knowledge, the Polish Government needs to adopt the best practices of the top 10 leading countries (Figure 3).

4.6. The Seventh Research Hypothesis Was Accepted and the Eighth Research Hypothesis Was Rejected

The number of citations of the top 10 papers ranges from 699 [56] to 1703 [47] globally. In Poland, the number of citations of the top 10 papers ranges from 43 [68] to 249 [59]. In general, the number of citations of Polish publications corresponds to Poland's position in the global scientific research market (Figures 2 and 3). This is one more difference between Polish specifics and the global trends.

The top 10 papers cover various areas of education research both globally and in Poland. All of these papers can be linked to SDG 4. However, there are papers [61,62] directly linked to other SDGs. Here, Poland appears as a country that is slightly more focused on sustainable development.

As noted in point 4.5, there are no branches related to SDG 4 or other SDGs in either Polish studies or global trends in 2023 (Figure 6, Table 1).

Globally, all top 10 publications are associated with AI. The number of citations of all 10 papers on the use of Artificial Intelligence ranges from 699 [56] to 1703 [47]. This result corresponds to the sixth technological paradigm [57,58].

In Poland, only four publications from the top 10 are associated with AI. The number of citations of four papers on the use of Artificial Intelligence ranges from 43 [68] to 249 [59]. According to the number of papers on AI and the number of their citations, the topics of Polish publications are less consistent with the sixth technological paradigm. This is the last difference between Polish specifics and the global trends.

To eliminate the differences, the Polish Government needs to adopt the best practices of the top 10 leading countries (Figure 3).

4.7. This Study Has Several Limitations

The first limitation was the use of only the top 10 countries, universities, authors, branches of knowledge, and papers with the maximum number of citations. Analysing a larger number of countries does not make sense, because Poland was in the 27th position in 2023. The experience of countries that are lower in the global scientific research market is unlikely to be useful for the Polish Government. The experience of the leading countries will be most useful. A detailed study of the experience of the first 10 countries will be sufficient to obtain a positive result in the near future. An analysis of the top 100 universities and top 100 scientists showed that there are no Polish universities or scientists among them. A detailed analysis of a large number of branches of knowledge is also not of interest, since each branch after the 11th accounts for, on average, about 1% of publications. A detailed analysis of more of the most cited publications may be the next goal for research.

The second limitation of the review was the exclusion of publications such as books, abstracts at scientific conferences, reports, and feedback from the analysis.

The third limitation of the study was the use of the Scopus database without the Web of Science database. The review also does not mention studies published in journals that are not indexed.

5. Directions for Future Research

1. Given the importance of education research for sustainable development, it is necessary to conduct research directly related to sustainability on a global and Polish scale, including SDG 4.

An analysis of the top 10 branches of knowledge and the top 10 publications by number of citations showed that there are neither branches nor papers directly related to SDG 4 among them. One Polish paper was related to SDG 9. Despite the fact that research

on the topic of sustainability is poorly reflected in the top 10 papers by number of citations, this direction is important;

2. Based on the importance of the sixth technological paradigm, it is necessary to conduct research directly related to the use of artificial intelligence in education on a global and Polish scale.

Analysis of the global top 10 publications by the number of citations showed that all 10 publications are related to the use of AI. Analysis of the Polish top 10 publications by the number of citations showed that four of them are related to the use of AI;

3. The verification of two new hypotheses is the direction of subsequent research on the Polish scale.

The sharp decline in Poland's position in the global scientific research market on the topic leads to the first new hypothesis about problems in the public management of science in Poland. The sharp lag in education research in the global scientific research market should lead to a sharp lag in Poland in other fields of science. This is the second new hypothesis. It is possible that in the medium term, this sharp lag in education research will lead to the degradation of the economy based on knowledge and innovations;

4. One of the next directions of the study may be a detailed analysis of a larger number of the most cited publications;
5. Research directions such as sustainability, education, artificial intelligence, and public management may be interesting for future research on a national scale in each country. It would be interesting to know the opinions of scientists on what interconnections and interdependencies help Poland and other countries to strengthen or lose its influence on the global scientific research market.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: All data are available in the Scopus database at https://www.scopus.com.

Acknowledgments: The study was supported by the International Science Program "Advantages and threats of the use of Artificial Intelligence on the Eastern European higher education services market". The author is very grateful to reviewers for their appropriate and constructive suggestions to improve this paper.

Conflicts of Interest: Not applicable.

References

1. Summers, J.K.; Smith, L.M. The Role of Social and Intergenerational Equity in Making Changes in Human Well-Being Sustainable. *AMBIO* **2014**, *43*, 718–728. [CrossRef] [PubMed]
2. United Nations. Resolution Adopted by the General Assembly on 25 September 2015, Transforming Our World: The 2030 Agenda for Sustainable Development (A/RES/70/1). 2015. Available online: https://upload.wikimedia.org/wikipedia/commons/d/d5/N1529189.pdf (accessed on 21 June 2024).
3. Bangani, S. Leveraging Community Engagement to Contribute to Sustainable Development Goals 8 and 11. *IFLA J.* **2024**, *50*, 451–462. [CrossRef]
4. Okulich-Kazarin, V.; Artyukhov, A.; Skowron, Ł.; Wołowiec, T.; Bokhonkova, Y. Science and Innovation Management: Sustainable Development Goals 8 and 9 as Challenges for Poland. *Sustainability* **2024**, *16*, 9668. [CrossRef]
5. Anwar, A.; Malik, S.; Ahmad, P. Cogitating the Role of Technological Innovation and Institutional Quality in Formulating the Sustainable Development Goal Policies for E7 Countries: Evidence from Quantile Regression. *Glob. Bus. Rev.* **2022**. [CrossRef]
6. Okulich-Kazarin, V. Statistics Using Neural Networks in the Context of SDG 9.5. *Sustainability* **2024**, *16*, 8395. [CrossRef]

7. Vara-Horna, A.A.; Giraldo-Mejia, W.; Guzman-Melgar, C.; Quintana-Otiniano, M.; Navarro-Viacava, M.; Delgado-Zegarra, J. SDGs Managers' Assessment Bias and Their Implications for Preventing Violence Against Women in Companies. *Violence Against Women* **2024**, *31*, 933–959. [CrossRef]
8. Pandit, J.M.; Paul, B. Gender Diversity, Sustainable Development Goals and Human Resource Management Practices in Higher Education. *Indian J. Hum. Dev.* **2023**, *17*, 111–130. [CrossRef]
9. Kassa, G.M.; Abajobir, A.A. Prevalence of Violence Against Women in Ethiopia: A Meta-Analysis. *Trauma Violence Abus.* **2020**, *21*, 624–637. [CrossRef]
10. Okulich-Kazarin, V. Are Students of East European Universities Subjects of Educational Services? *Univers. J. Educ. Res.* **2020**, *8*, 3148–3154. [CrossRef]
11. Stanberry, J.; Bragan Balda, J. A Conceptual Review of Sustainable Development Goal 17: Picturing Politics, Proximity and Progress. *J. Trop. Futures* **2024**, *1*, 110–139. [CrossRef]
12. Cling, J.-P.; Eghbal-Teherani, S.; Orzoni, M.; Plateau, C. The Interlinkages Between the SDG Indicators and the Differentiation Between EU Countries: It Is (Mainly) the Economy! *Stat. J. IAOS* **2020**, *36*, 455–470. [CrossRef]
13. Campbell, J.; Neuner, J.; See, L.; Fritz, S.; Fraisl, D.; Espey, J.; Kim, A. The Role of Combining National Official Statistics with Global Monitoring to Close the Data Gaps in the Environmental SDGs. *Stat. J. IAOS* **2020**, *36*, 443–453. [CrossRef]
14. Kaczan, D.J.; Patil, P.G. Potential Development Contribution of Fisheries Reform: Evidence from Pakistan. *J. Environ. Dev.* **2020**, *29*, 275–305. [CrossRef]
15. United Nations. Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for All. Available online: https://sdgs.un.org/goals/goal4 (accessed on 12 November 2024).
16. Roshid, M.M.; Le Ha, P. Higher Education as Public Good, Sustainable Development Goals, and Crisis Response in Neoliberal Political Economy. *Res. Comp. Int. Educ.* **2023**, *18*, 317–347. [CrossRef]
17. Roy, R.; Al-Absy, M.S.M. Impact of Critical Factors on the Effectiveness of Online Learning. *Sustainability* **2022**, *14*, 14073. [CrossRef]
18. Moratis, L.; Melissen, F. Bolstering Responsible Management Education Through the Sustainable Development Goals: Three Perspectives. *Manag. Learn.* **2022**, *53*, 212–222. [CrossRef]
19. Bux, C.; Amicarelli, V. Circular Economy and Sustainable Strategies in the Hospitality Industry: Current Trends and Empirical Implications. *Tour. Hosp. Res.* **2023**, *23*, 624–636. [CrossRef]
20. Deroncele-Acosta, A.; Bellido-Valdiviezo, O.; Sánchez-Trujillo, M.d.L.Á.; Palacios-Núñez, M.L.; Rueda-Garcés, H.; Brito-Garcías, J.G. Ten Essential Pillars in Artificial Intelligence for University Science Education: A Scoping Review. *Sage Open* **2024**, *14*, 3. [CrossRef]
21. Sahito, Z.; Wassan, S.H. Literature Review on STEM Education and Its Awareness Among Teachers: An Exploration of Issues and Problems with Their Solutions. *Sage Open* **2024**, *14*, 1. [CrossRef]
22. Lu, H.; Feng, Z.; Wang, S. The Impact of Economic Openness and Institutional Environment on Technological Innovation: Evidence from China's Provincial Patent Application Data. *Sage Open* **2024**, *14*, 2. [CrossRef]
23. Pandey, S.; Mahesh, J. Emerging Trends in People-Centric Human Resource Management: A Systematic Literature Review. *Vision* **2023**. [CrossRef]
24. Rodgers, S.; Zhang, W. Evaluating Reliability of Google Scholar, Scopus, and Web of Science: A Study of Faculty in U.S. Advertising and Public Relations Programs. *J. Mass. Commun. Educ.* **2022**, *77*, 292–307. [CrossRef]
25. Singh, P.; Singh, V.K.; Piryani, R. Scholarly Article Retrieval from Web of Science, Scopus and Dimensions: A Comparative Analysis of Retrieval Quality. *J. Inf. Sci.* **2023**. [CrossRef]
26. Ochoa Jiménez, S.; García García, A.R.; Valdez del Río, S.; Jacobo Hernández, C.A. Entrepreneurship in Tourism Studies in the 21st Century: A Bibliometric Study of WoS and Scopus. *Sage Open* **2022**, *12*, 2. [CrossRef]
27. Liu, W.; Wang, P.; Wang, H. A matter of time: Publication dates in Scopus. *J. Inf. Sci.* **2024**. [CrossRef]
28. Okulich-Kazarin, V.; Artyukhov, A.; Skowron, Ł.; Wołowiec, T. The Crossroads of the Knowledge Economy and Renewable Energy: Recommendations for Poland. *Energies* **2024**, *17*, 6116. [CrossRef]
29. Metodologia Rankingu Uczelni Akademickich 2024. Available online: https://2024.ranking.perspektywy.pl/article/metodologia-rankingu-uczelni-akademickich-2024 (accessed on 3 November 2024).
30. Zhang, Y.; Wang, Q. Higher Education, Digital Economy, and Common Prosperity. *ECNU Rev. Educ.* **2024**. [CrossRef]
31. Desai, B.H. The 2023 New York SDG Summit Outcome: Rescue Plan for 2030 Agenda as a Wake-up Call for the Decision-makers. *Environ. Policy Law* **2023**, *53*, 221–231. [CrossRef]
32. Rickard, S.J. The Electoral Consequences of Compensation for Globalization. *Eur. Union. Polit.* **2023**, *24*, 427–446. [CrossRef]
33. Sarpong, J.; Adelekan, T. Globalisation and Education Equity: The Impact of Neoliberalism on Universities' Mission. *Policy Futures Educ.* **2024**, *22*, 1114–1129. [CrossRef]
34. Okulich-Kazarin, V.; Zhurba, M.; Shorobura, I.; Bokhonkova, Y.; Serbin, Y. Three Characteristic Features of the East European Educational Services Market. *Univ. J. Educ. Res.* **2020**, *8*, 1549–1556. [CrossRef]

35. Tlili, A.; Saqer, K.; Salha, S.; Huang, R. Investigating the Effect of Artificial Intelligence in Education (AIEd) on Learning Achievement: A Meta-Analysis and Research Synthesis. *Inf. Dev.* **2025**. [CrossRef]
36. Filgueiras, F. Artificial Intelligence and Education Governance. *Educ. Citizsh. Soc. Justice* **2024**, *19*, 349–361. [CrossRef]
37. Lu, H.; Alhaskawi, A.; Dong, Y.; Zou, X.; Zhou, H.; Ezzi, S.H.A.; Kota, V.G.; Abdulla, M.H.A.H.; Abdalbary, S.A. Patient Autonomy in Medical Education: Navigating Ethical Challenges in the Age of Artificial Intelligence. *INQUIRY J. Health Care Organ. Provis. Financ.* **2024**, *61*. [CrossRef]
38. Shaikh, F.; Afshan, G.; Anwar, R.S.; Abbas, Z.; Chana, K.A. Analyzing the Impact of Artificial Intelligence on Employee Productivity: The Mediating Effect of Knowledge Sharing and Well-Being. *Asia Pac. J. Hum. Resour.* **2023**, *61*, 794–820. [CrossRef]
39. Latorre-Medina, M.J.; Abdelmaula-Mesaud, S. Artificial Intelligence Applied to Early Childhood Education: A Focus for Educational Research? *Contemp. Issues Early Child.* **2024**, *26*, 140–153. [CrossRef]
40. Okulich-Kazarin, V.; Artyukhov, A.; Skowron, Ł.; Artyukhova, N.; Wołowiec, T. Will AI Become a Threat to Higher Education Sustainability? A Study of Students' Views. *Sustainability* **2024**, *16*, 4596. [CrossRef]
41. von Eye, A.; Wiedermann, W. *The General Linear Model. A Primer. Chapter 3—Correlation and Regression Analysis*; Cambridge University Press: Cambridge, UK, 2023. [CrossRef]
42. Butler, J.S.; Sebastian, A.S.; Kaye, I.D.; Wagner, S.C.; Morrissey, P.B.; Schroeder, G.D.; Vaccaro, A.R. Understanding Traditional Research Impact Metrics. *Clin. Spine Surg.* **2017**, *30*, 164–166. [CrossRef]
43. Wang, G.; Hu, G. Citations and the Nature of Cited Sources: A Cross-Disciplinary and Cross-Linguistic Study. *Sage Open* **2022**, *12*. [CrossRef]
44. Pecorari, D. Visible and Occluded Citation Features in Postgraduate Second-Language Writing. *Engl. Specif. Purp.* **2006**, *25*, 4–29. [CrossRef]
45. Agyei-Henaku, K.A.A.; Badu-Prah, C.; Srofenyoh, F.; Gidiglo, F.K.; Agyeiwaa-Afrane, A.; Djokoto, J.G. Citations of Publications on Foreign Direct Investments into Agribusiness: Nature, Variability and Drivers. *Sage Open* **2024**, *14*. [CrossRef]
46. Ullah, A.; Hayat, S.; Ameen, K. Impact of Research Characteristics and Methodologies Used in LIS Articles on Citation Count. *J. Librariansh. Inf. Sci.* **2024**. [CrossRef]
47. Kasneci, E.; Sessler, K.; Küchemann, S.; Bannert, M.; Dementieva, D.; Fischer, F.; Gasser, U.; Groh, G.; Günnemann, S.; Hüllermeier, E.; et al. ChatGPT for Good? On Opportunities and Challenges of Large Language Models for Education. *Learn. Individ. Differ.* **2023**, *103*, 102274. [CrossRef]
48. Dwivedi, Y.K.; Kshetri, N.; Hughes, L.; Slade, E.L.; Jeyaraj, A.; Kar, A.K.; Baabdullah, A.M.; Koohang, A.; Raghavan, V.; Ahuja, M.; et al. Opinion Paper: "So What If ChatGPT Wrote It?" Multidisciplinary Perspectives on Opportunities, Challenges and Implications of Generative Conversational AI for Research, Practice and Policy. *Int. J. Inf. Manag.* **2023**, *71*, 102642. [CrossRef]
49. Kung, T.H.; Cheatham, M.; Medenilla, A.; Sillos, C.; De Leon, L.; Elepaño, C.; Madriaga, M.; Aggabao, R.; Diaz-Candido, G.; Maningo, J.; et al. Performance of ChatGPT on USMLE: Potential for AI-Assisted Medical Education Using Large Language Models. *PLoS Digit. Health* **2023**, *2*, e0000198. [CrossRef]
50. Sallam, M. ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns. *Healthcare* **2023**, *11*, 887. [CrossRef]
51. Ray, P.P. ChatGPT: A Comprehensive Review on Background, Applications, Key Challenges, Bias, Ethics, Limitations and Future Scope. *Internet Things Cyber-Phys. Syst.* **2023**, *3*, 121–154. [CrossRef]
52. Gilson, A.; Safranek, C.W.; Huang, T.; Socrates, V.; Chi, L.; Taylor, R.A.; Chartash, D. How Does ChatGPT Perform on the United States Medical Licensing Examination (USMLE)? The Implications of Large Language Models for Medical Education and Knowledge Assessment. *JMIR Med. Educ.* **2023**, *9*, e45312. [CrossRef]
53. Thorp, H.H. ChatGPT is Fun, but Not an Author. *Science* **2023**, *379*, 313. [CrossRef]
54. Lee, P.; Bubeck, S.; Petro, J. Benefits, Limits, and Risks of GPT-4 as an AI Chatbot for Medicine. *N. Engl. J. Med.* **2023**, *388*, 1233–1239. [CrossRef]
55. Rudolph, J.; Tan, S.; Tan, S. ChatGPT: Bullshit Spewer or the End of Traditional Assessments in Higher Education? *J. Appl. Learn. Teach.* **2023**, *6*, 342–363. [CrossRef]
56. Tlili, A.; Shehata, B.; Adarkwah, M.A.; Bozkurt, A.; Hickey, D.T.; Huang, R.; Agyemang, B. What if the Devil is My Guardian Angel: ChatGPT as a Case Study of Using Chatbots in Education. *Smart Learn. Environ.* **2023**, *10*, 15. [CrossRef]
57. Knell, M. Nanotechnology and the Sixth Technological Revolution. In *Technological Innovations, Multinational Corporations and the New International Competitiveness*; Springer: Dordrecht, The Netherlands, 2011; pp. 175–194. [CrossRef]
58. Grishnova, O.; Berezhna, I.; Mikhurinskaia, E.; Berezhnoy, A. The Economic Crisis of 2020 and the Sixth Technological Order: Interconnection and Patterns. *Bull. Taras Shevchenko Natl. Univ. Kyiv Econ.* **2021**, *3*, 25–34. [CrossRef]
59. Dergaa, I.; Chamari, K.; Zmijewski, P.; Ben Saad, H. From Human Writing to Artificial Intelligence Generated Text: Examining the Prospects and Potential Threats of ChatGPT in Academic Writing. *Biol. Sport* **2023**, *40*, 615–622. [CrossRef]

60. Wach, K.; Duong, C.D.; Ejdys, J.; Kazlauskaitė, R.; Korzynski, P.; Mazurek, G.; Paliszkiewicz, J.; Ziemba, E. The Dark Side of Generative Artificial Intelligence: A Critical Analysis of Controversies and Risks of ChatGPT. *Entrep. Bus. Econ. Rev.* **2023**, *11*, 7–30. [CrossRef]
61. Pudryk, D.; Kwilinski, A.; Lyulyov, O.; Pimonenko, T. Towards Achieving Sustainable Development: Interactions between Migration and Education. *Forum Sci. Oeconomia* **2023**, *11*, 113–132. [CrossRef]
62. Dmuchowski, P.; Dmuchowski, W.; Baczewska-Dąbrowska, A.H.; Gworek, B. Environmental, Social, and Governance (ESG) Model; Impacts and Sustainable Investment—Global Trends and Poland's Perspective. *J. Environ. Manag.* **2023**, *329*, 117023. [CrossRef]
63. Wang, X.; Sanders, H.M.; Liu, Y.; Seang, K.; Tran, B.X.; Atanasov, A.G.; Qiu, Y.; Tang, S.; Car, J.; Wang, Y.X.; et al. ChatGPT: Promise and Challenges for Deployment in Low- and Middle-Income Countries. *Lancet Reg. Health West. Pac.* **2023**, *41*, 100905. [CrossRef]
64. Pedretti, R.F.E.; Hansen, D.; Ambrosetti, M.; Back, M.; Berger, T.; Cordeiro Ferreira, M.; Cornelissen, V.; Davos, C.H.; Doehner, W.; de Pablo y Zarzosa, C.; et al. How to Optimize the Adherence to a Guideline-Directed Medical Therapy in the Secondary Prevention of Cardiovascular Diseases: A Clinical Consensus Statement from the European Association of Preventive Cardiology. *Eur. J. Prev. Cardiol.* **2023**, *30*, 149–166. [CrossRef]
65. Duszczyk, M.; Górny, A.; Kaczmarczyk, P.; Kubisiak, A. War Refugees from Ukraine in Poland—One Year after the Russian Aggression. Socioeconomic Consequences and Challenges. *Reg. Sci. Policy Pract.* **2023**, *15*, 181–200. [CrossRef]
66. Barbato, E.; Gallinoro, E.; Abdel-Wahab, M.; Andreini, D.; Carrié, D.; Di Mario, C.; Dudek, D.; Escaned, J.; Fajadet, J.; Guagliumi, G.; et al. Management Strategies for Heavily Calcified Coronary Stenoses: An EAPCI Clinical Consensus Statement in Collaboration with the EURO4C-PCR Group. *Eur. Heart J.* **2023**, *44*, 4340–4356. [CrossRef] [PubMed]
67. Saniuk, S.; Caganova, D.; Saniuk, A. Knowledge and Skills of Industrial Employees and Managerial Staff for the Industry 4.0 Implementation. *Mob. Netw. Appl.* **2023**, *28*, 220–230. [CrossRef]
68. Rosoł, M.; Gąsior, J.S.; Łaba, J.; Korzeniewski, K.; Młyńczak, M. Evaluation of the Performance of GPT-3.5 and GPT-4 on the Polish Medical Final Examination. *Sci. Rep.* **2023**, *13*, 20512. [CrossRef] [PubMed]
69. Rozporządzenie Ministra Nauki w Sprawie Sporządzania Wykazów Wydawnictw Monografii Naukowych Oraz Czasopism Naukowych i Recenzowanych Materiałów z Konferencji Międzynarodowych, 31 October 2024. Available online: https://legislacja.rcl.gov.pl/docs//580/12391400/13093608/13093609/dokument691645.pdf (accessed on 2 November 2024).
70. Okulicz-Kozaryn, W. Two Vectors of Poland's Movement in the World Market of Scientific Products. In *Globalization Processes: Challenges and Solutions, Proceedings of the IX International Scientific and Practical Conference, Odessa, Ukraine, 12 November 2024*; pp. 49–52.