Global trends on open educational resources literature: A scientometric analysis

التوجّهات العالمية في الإنتاج العلمي عن الموارد التعليمية المفتوحة : تحليل سيانتومتري

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***Abstract**:*
As the open educational resources (OER) are becoming an extremely important role in the educational process, this scientometric analysis took place on literature on OER, the dataset analyzed was retrieved from SCOPUS database, defined by the time span of 2004-2022, and analyzed using the scientometric analysis tool Scientopy.
The study found that articles had the highest average growth rate (AGR) with 7.5, additionally, the United States came first as the most productive country regarding OER literature, with a 3.6 of AGR. The keyword "open educational resources" was the most trending keyword overall between 2004-2006. However, upon analyzing the time window 2019-2022, it has been found that there's a shift in trends on OER literature into "adapting" OER and its practices in higher education.
***Keywords:** Open educational resources, Scientometric analysis, Trend analysis, OER literature, Bibliometric measurement,*

ملخص:

نظرًا لتزايد الموارد التعليمية المفتوحة لتأخذ دورًا مهمًا للغاية في العملية التعليمية، تم إجراء هذا التحليل السيونتومتري عن توجهات الإنتاج العلمي عن الموارد التعليمية المفتوحة، حيث تم استرجاع البيانات التي تم تحليلها من قاعدة بيانات سكوبيس *SCOPUS*، والتي تم تحديده اطارها الزمني بين 2004–2022، وتحليلها باستخدام أداة التحليل السيونتومتري *Scientopy*. وجدت الدراسة أن المقالات لديها أعلى متوسط معدل نمو (*AGR*) قدر ب 7.5، بالإضافة إلى ذلك، جاءت الولايات المتحدة في المرتبة الأولى باعتبارها الدولة الأكثر إنتاجية فيما يتعلق بأدبيات الموارج التعليمية المفتوحة، ب متوسط معدل نمو 3.6. كما كانت الكلمة المفتاحية «*Open educational resources*» هي الكلمة الأكثر شيوعًا بشكل عام بين عامي 2004–2006 معبرة عن التوجه البحثي بذات الفترة. ولكن عند تحليل الفترة الزمنية 2019–2022، تبين أن هناك تحولًا في الاتجاهات في الإنتاج العلمي عن الموارد التعليمية المفتوحة إلى التمحور أكثر حول "تبني" الموارد التعليمية المفتوحة.

الكلمات المفتاحية: الموارد التعليمية المفتوحة، تحليل سيانتومتري، تحليل الاتجاهات، قياس الإنتاج العلمي، قياس بيبليومتري،

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1. INTRODUCTION.

Open Educational Resources (OER) have become increasingly important in the field of education, with a growing number of educational institutions and organizations using and promoting OER for teaching and learning purposes.

Open educational resources (OER), as defined by UNESCO in their recommendation adopted on November 2019، are learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others[2]. But even before, OER as a stream from the great flow of openness had and still have ongoing initiatives such as MIT open courseware, and an entire scientific production that had the purpose of studying the OER as they turned to be pillars, not only to the open science and open education, but even to the entire educational process, especially under radical circumstances such as the COVID19 pandemic, thus, we sought this study as it aims to focus on history and growth of scientific output on OER, as well as trying to measure global research trends on OER, in addition to identify the most productive authors, publishers and countries, furthermore, to identify the trending topics and how the pandemic affected the direction of OER scientific output and its trends.

Literature review:

There's absolutely no doubt that the research on OER is relatively new, since David Wiley coined the term "open content", after whence came the first OER project "open courseware" by MIT, to be followed later through the years by a series of projects and initiatives, and the research on OER is always accompanying the development of the latter.

Shettar, I. M., Hadagali, G. S., & Shokeen, A. (2021) conducted a scientometric analysis that demonstrated the growth of global literature on Open Educational Resources for the period 2004-2020, using dataset retrieved from SCOPUS, the results found a varying trend for the Annual Growth Rate and CAGR was recorded at 0.450971. The Relative Growth Rate was recorded between 0.16 and 1.70 for different years and observed a gradual increase in doubling time. The Degree of Collaboration (DC) noted was 1.32 and 3.11 Collaboration Index (CI)[3].

Tlili A. and others (2021) carried out a bibliometric mapping analysis of research papers on Open Educational Practices (OEP), using dataset retrieved from Web of Science and Scopus databases, and VOSviewer as a bibliometric analysis tool. The study found that research on OEP started in

[2] Recommendation on Open Educational Resources(OER), https://unesdoc.unesco.org/ark:/48223/pf0000373755/PDF/373755eng.pdf.multi.page=3 (consulted on 19/04/2023).

[3] Shettar, I. M., Hadagali, G. S., & Shokeen, A. (2021), A Scientometric Analysis of Global Literature on Open Educational Resources, Libraries and Resource Management in the Knowledge Society (pp. 341–356). Shree Publishers & Distributors, New Delhi

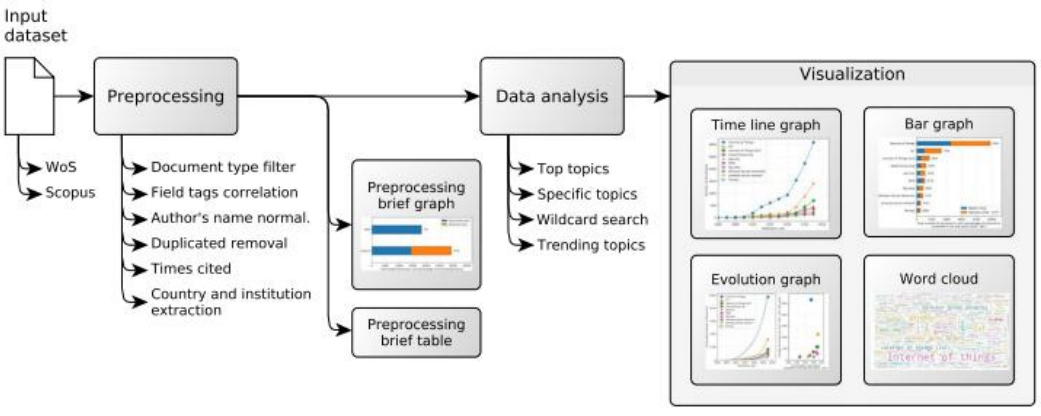
2007 and focused on higher education, including open and distance higher education. Most of the OEP studies were published in English as journal articles, in particular, many were published in Distance Education, International Review of Research in Open and Distributed Learning, and Open Praxis. The United Kingdom, Spain, and Australia were the top contributors to the OEP literature. The analysis of keywords and terms in the titles and abstracts revealed that current OEP trends covered only open pedagogy and open collaboration, suggesting a need for more research on other trends, such as open assessment, open data, and open science.[4]

Ratnaria Wahid, Aidi Ahmi, and A.S.A. Ferdous Alam (2020) conducted a bibliometric analysis regarding moocs literature, the study relied on dataset retrieved from SCOPUS database, with a total of 3.118 document, results found that starting from 2009, MOOCs caught the attention of researchers and the number of publications grew consistently over 10 years after that. There has been international collaboration, but there is a gap in MOOCs research originating from certain countries as compared to the rest of the world. The findings provide important input towards improving the inclusivity and global reach of MOOCs.[5]

2. Method and materials

A scientometric analysis is a quantitative study of science, communication in science, and science policy[6], hence, we used in our study the scientometric software tool **ScientoPy,** which is an open-source Python based scientometric analysis tool. It has variety of characteristics such as dataset filtration and processing, different visualization graphs: bar, bar trends, timeline, evolution, and word cloud, trending topics using the top average growth rate (AGR)[7]. the analysis overall follows the following flow chart:

Fig.1. Scientometric analysis using Scientopy



l). An Analysis of Peer-Reviewed Publications on Open Educational Practices (OEP) from 2007 to 2020: A Bibliometric Mapping Analysis. Sustainability, 13(19), 10798.

[5] Wahid, R., Ahmi, A., & Alam, A. F. (2020). Growth and collaboration in massive open online courses: A bibliometric analysis. International Review of Research in Open and Distributed Learning, 21(4), 292-322.

[6] Scientometrics, https://www.oecd.org/sti/inno/scientometrics.htm , (consulted on 18/04/2023)

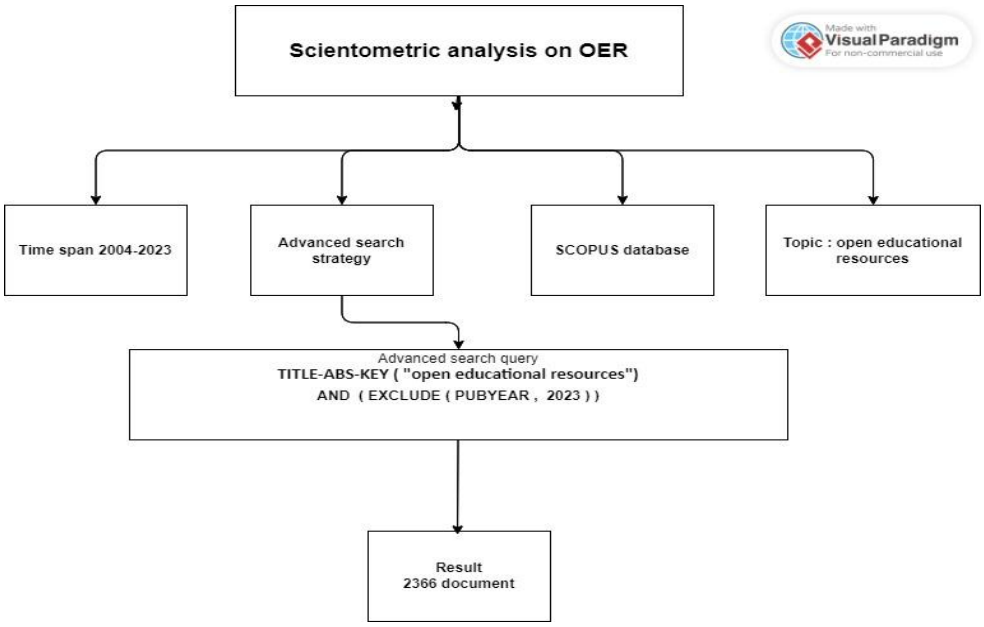
[7] Ruiz-Rosero, J., Ramirez-Gonzalez, G., & Viveros-Delgado, J. (2019) .
Software survey: ScientoPy, a scientometric tool for topics trend analysis in scientific publications. Scientometrics, 1-24.

Source: ScientoPy v 2.0.1, User Manual

2.1. Dataset:

For the purpose of scientometric analysis, the SCOPUS database was chosen as it's one of the finest bibliographic databases with enriched data and linked scholarly peer-reviewed literature across a wide variety of disciplines. The time span chosen was 2004-2022, using the advanced search string : **TITLE-ABS-KEY ("open educational resources") AND (EXCLUDE (PUBYEAR , 2023))** .the search used the following dataset retrieval chart :

Fig.2. SCOPUS dataset retrieval chart



Source: Prepared by the authors

The search returned data as follows :

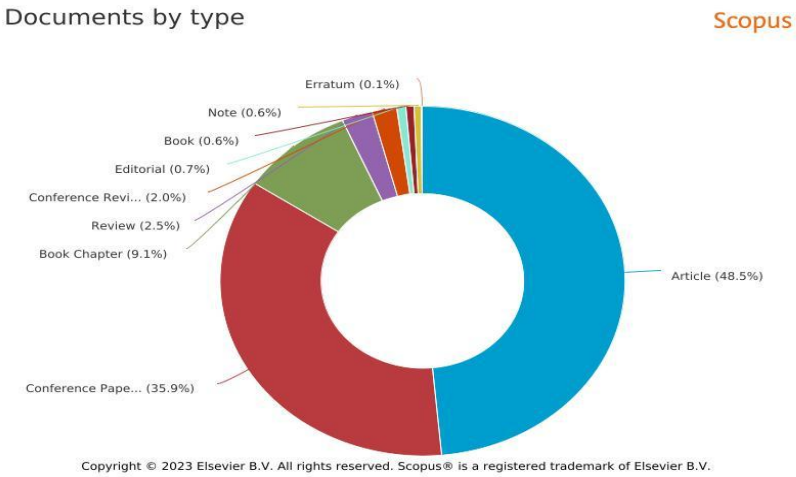
Table 1. Document distributed by type

Document type	Num. retrieved
Article	1148
Conference Paper	849
Book Chapter	216
Review	58
Conference Review	47
Editorial	17
Book	15
Note	14
Erratum	02

Source: Prepared by the authors using SCOPUS result analysis

The table above reveals the distribution of documents retrieved on many types, where articles and conference papers share the majority of documents retrieved with 1148 and 849 on row, leading by a huge gap above the rest of other scientific outcomes, as also demonstrated in the following chart

Fig.3. Document distributed by type



Source: SCOPUS

2.2. Pre-processing:

Upon its upload into ScientoPy, the dataset needs to be pre-processed in order to remove duplicates and have a more precise and reliable dataset[8]. The dataset pre-processing resulted the following report:

Table 2. Document loaded into Scientopy for pre-process

Loaded papers	2366	
Omitted papers by document type	311	13.10%
Total papers after omitted papers removed	2055	
Loaded papers from WoS	0	0.00%
Loaded papers from Scopus	2055	100.00%

Source: Prepared by the authors using ScientoPy preprocess

[8] Ruiz-Rosero, J., Ramirez-Gonzalez, G., & Viveros-Delgado, J. (2019) . software survey: ScientoPy, a scientometric tool for topics trend analysis in scientific publications. Scientometrics, 1-24.

Table 3. Preprocess brief results

Duplicated removal results:		
Duplicated papers found	14	0.70%
Removed duplicated papers from WoS	0	0.00%
Removed duplicated papers from Scopus	14	0.70%
Duplicated documents with different cited by	9	64.30%
Total papers after rem. dupl.	2041	
Papers from WoS	0	0.00%
Papers from Scopus	2041	100.00%

Source: Prepared by the authors using ScientoPy preprocess

The pre-process excluded documents such as books and book chapters, letters, notes, editorials, erratum, reports, retracted documents, meeting abstracts, corrections, software and hardware reviews, which were in this case 311 with a percentage of 13.10%, keeping only articles, conference papers, review, for a better precision and reliability measuring research indicator. At the end of the pre-process phase, the analysis resulted a final count of 2041.

3. Results and discussion:

the Average growth rate **(AGR)**, the top trending topics are based on the higher average growth rate (AGR) over the others, and by default, ScientoPy has the option of running analysis and visualizing the graphs depending on trend analysis which is based on **AGR,** thus, all analysis conducted on this study will use it by default. The AGR is calculated on two years periods, using the following Equation:

Fig.4. The AGV equation

$$AGR = \frac{\sum_{i=Y_s}^{Y_e} P_i - P_{i-1}}{(Y_e - Y_s) + 1},$$

where:

AGR = Average growth rate;
Y_s = Start year;
Y_e = End year;
P_i = Number of publications on year i.

Source: ScientoPy v 2.0.1, User Manual

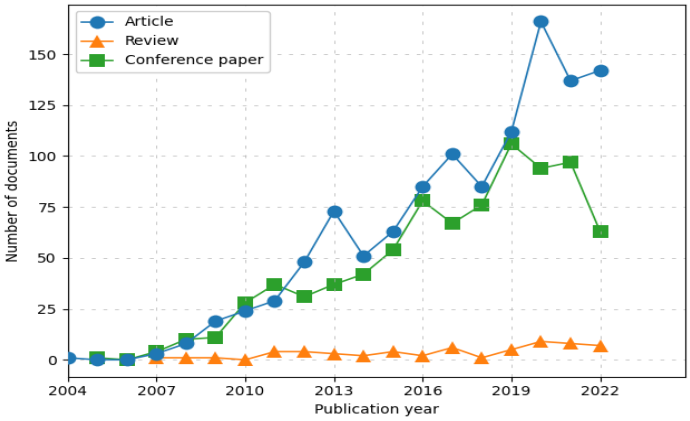
The second indicator used is average documents yearly **ADY**, which is the average number of

documents published in a time span for a topic.

Finally, a time window of 19 years was chosen, in order to properly measure scientific output according to indicators during the entire span on 2004-2022.

3.1. Documents growth by year:

Fig.5. Document types growth by years



Source: Prepared by the authors using ScientoPy

The previous graph demonstrates a timeline of yearly published documents according to the document type criterion, it can be noted that the number of articles and conference papers published yearly is trending upward, this can be measured both by Average documents yearly **(ADY)**, alongside the **AGR.**

Table 4. Document type growth brief results

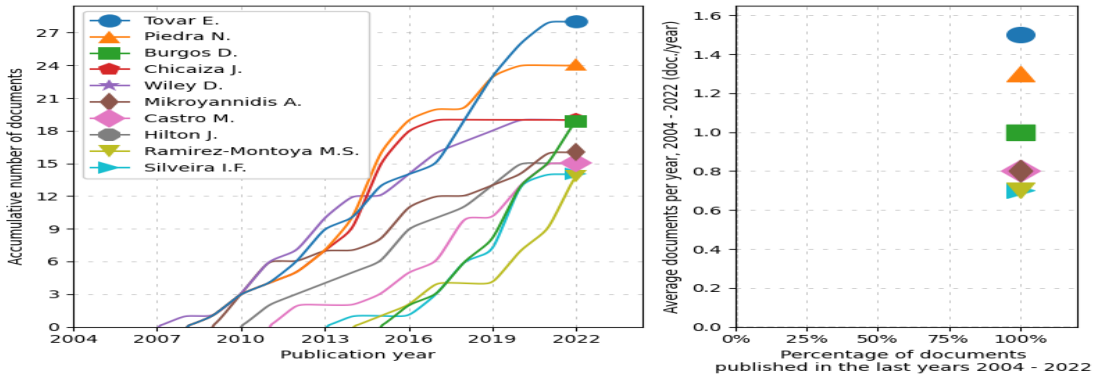
DocumentType	Total	AGR	ADY
Article	1147	7.5	60.4
Conference paper	836	3.3	44
Review	58	0.4	3.1

Source: Prepared by the authors using ScientoPy

As it appears on table 4, articles came first with 60.4 document published yearly, and an AGR of 7.5, followed by conference papers with 44 documents published yearly and AGR of 3.3, and finally, reviews with just as much as 3.1 documents published yearly and an AGR of 0.4.

3.2. Top productive authors:

Fig.6. Top 10 productive authors output growth



Source: Prepared by the authors using ScientoPy

Table 5. Top 10 productive authors output growth brief results

Author	Total	AGR	ADY
Tovar E.	28	0	1.5
Piedra N.	24	0	1.3
Burgos D.	19	0.2	1
Chicaiza J.	19	0	1
Wiley D.	19	0	1
Mikroyannidis A.	16	0	0.8
Castro M.	15	0	0.8
Hilton J.	15	0	0.8
Ramirez-Montoya M.S.	14	0.3	0.7
Silveira I.F.	14	0	0.7

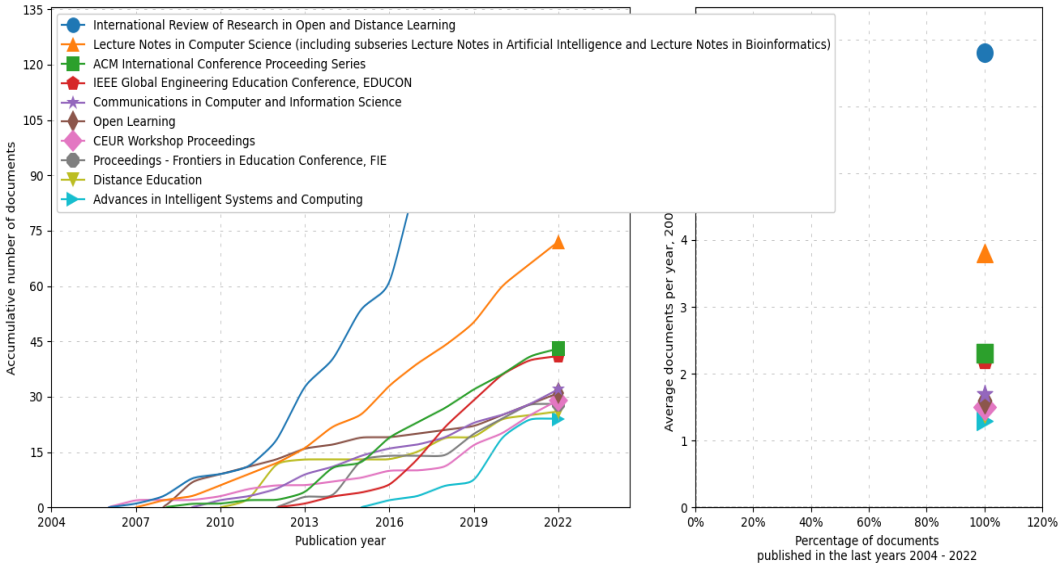
Source: Prepared by the authors using ScientoPy

Through both of Fig.6 and table 5. That show the top 10 authors for the OER literature, with an interval of 28 for the highest author output, and 14 for the lowest, noting that the AGR for most authors had the **AGR** of 0, excepting **Ramirez-Montoya M.S.** and **Burgos D.** with an AGR of 0.2 and 0.3 on row.

As for **ADY**, it varies between 1.5 and 0.7 for the top 10 productive authors.

3.3. Top productive publishers:

Fig.7. Top 10 productive publishers' growth



Source: Prepared by the authors using ScientoPy

Table 6. Top 10 productive publishers' growth brief results

SourceTitle	Total	AGR	ADY
International Review of Research in Open and Distance Learning	129	0.3	6.8
Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	72	0.3	3.8
ACM International Conference Proceeding Series	43	0.1	2.3
IEEE Global Engineering Education Conference, EDUCON	41	0.1	2.2
Communications in Computer and Information Science	32	0.2	1.7
Open Learning	31	0.2	1.6
CEUR Workshop Proceedings	29	0.2	1.5
Proceedings - Frontiers in Education Conference, FIE	28	0	1.5
Distance Education	26	0.1	1.4
Advances in Intelligent Systems and Computing	24	0	1.3

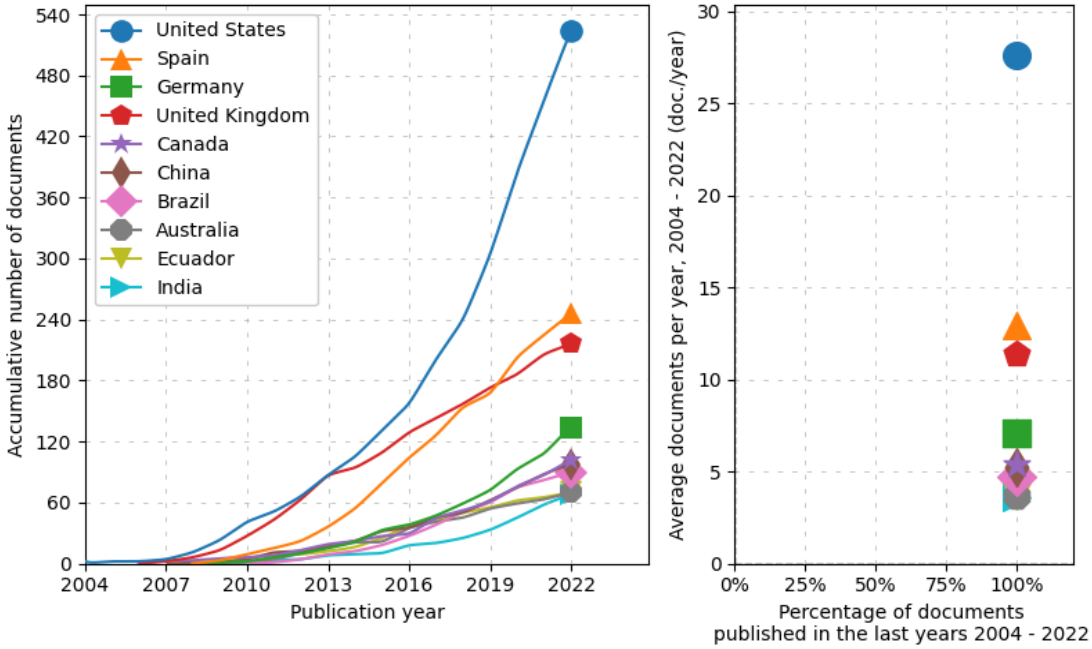
Source: Prepared by the authors using ScientoPy the authors

As for most productive publishers, the analyzed data shows that International Review of Research in Open and Distance Learning was the most productive publisher with a total of 129 publication, an AGR of 0.3, and the highest ADY with 6.8.

Furthermore, it can be noticed from both Fig.7 and table 6 the gap between the most productive publisher and the second one, who is Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), the latter has a total of 72 publications during the time span studied, with an AGR of 0.3, and an ADY of 3.8.

3.4. Top productive countries:

Fig.8. Top 10 productive country growth



Source: Prepared by the authors using ScientoPy the authors

Table 7. Top 10 productive country growth brief results

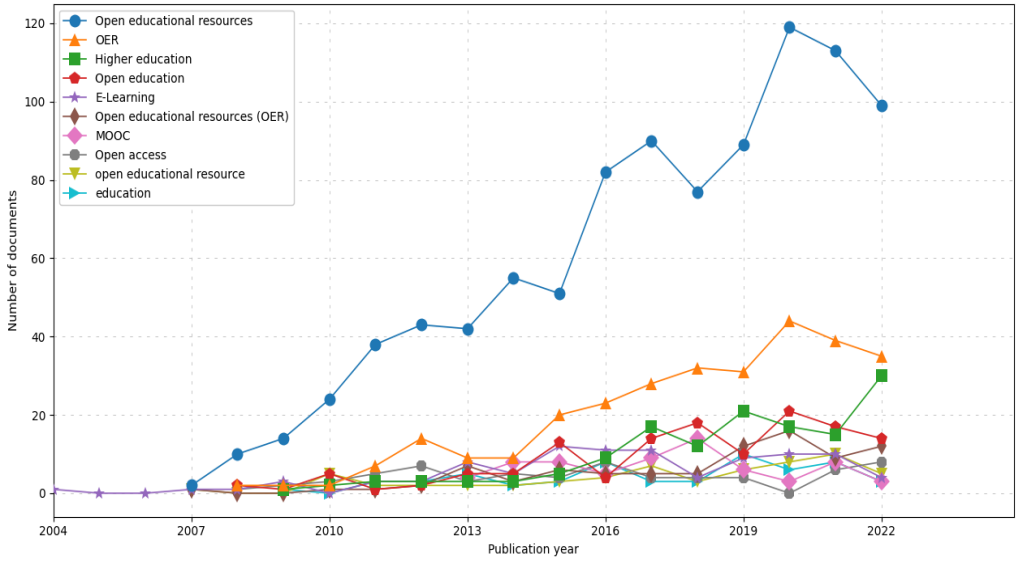
Pos.	Country	Total	AGR	ADY
1	**United States**	525	3.6	27.6
2	**Spain**	246	1.1	12.9
3	**United Kingdom**	216	0.5	11.4
4	**Germany**	135	1.4	7.1
5	**Canada**	102	0.8	5.4
6	**China**	98	0.5	5.2
7	**Brazil**	90	0.4	4.7
8	**Australia**	70	0.4	3.7
9	**Ecuador**	70	0.3	3.7
10	**India**	68	0.5	3.6

Source: Prepared by the authors using ScientoPy the authors

The visualization represents the top 10 productive countries on OER literature, where the United States leads with a total of 525 publication, with the highest AGR of 3.6, and ADY rate of 27.6. Additionally, the countries appearing in the visualization above represent the core of scientific research on OER, and they vary between east and west of the world.

3.5. Author Keywords Analysis:

Fig.9. Top 10 author keywords trend growth timeline

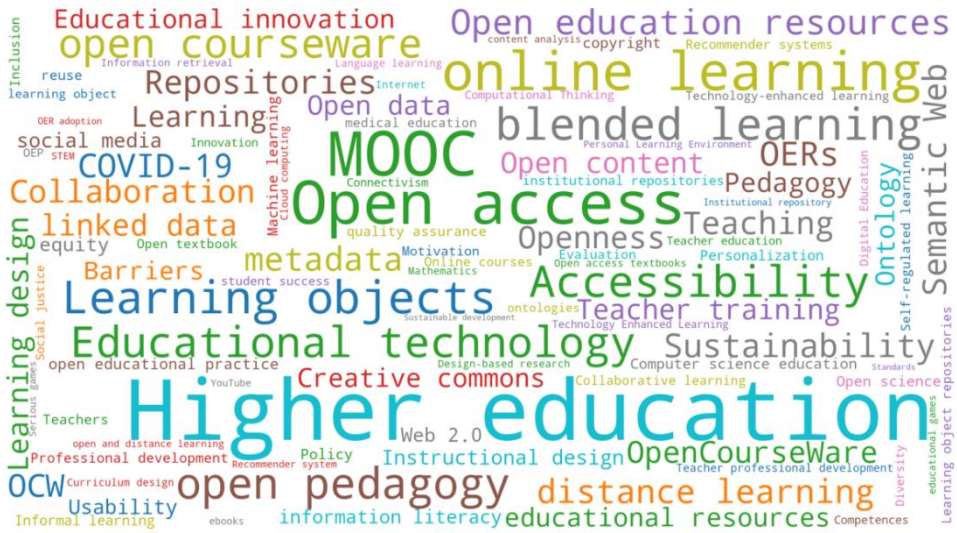


Source: Source: Prepared by the authors using ScientoPy

After visualizing the author keywords criterion results, we can notice the top 10 trending keywords in scientific output on OER, with the keyword "Open educational resources" leading the list, alongside contextually related keywords such as "Higher education", "Open education". Additionally, there were no publication regarding the trending keywords above except for the keyword "E-Learning" before 2007, after whence starting the growth of scientific output on the trending author keywords on OER, and it's worth mentioning that this progress went with an important development on OER, which a meeting in September 2007 in Cape Town that led to the Cape Town Open Education Declaration release on 22 January 2008[9]. it also appears that the number of documents on trending author keywords witnessed a decrease after late 2019, which is the time that the pandemic broke out.

[9] CAPE TOWN OPEN EDUCATION DECLARATION: UNLOCKING THE PROMISE OF OPEN EDUCATIONAL RESOURCES, https://www.capetowndeclaration.org/read/ , (consulted on 18/04/2023)

Fig.10. Top 100 author keyword cloud



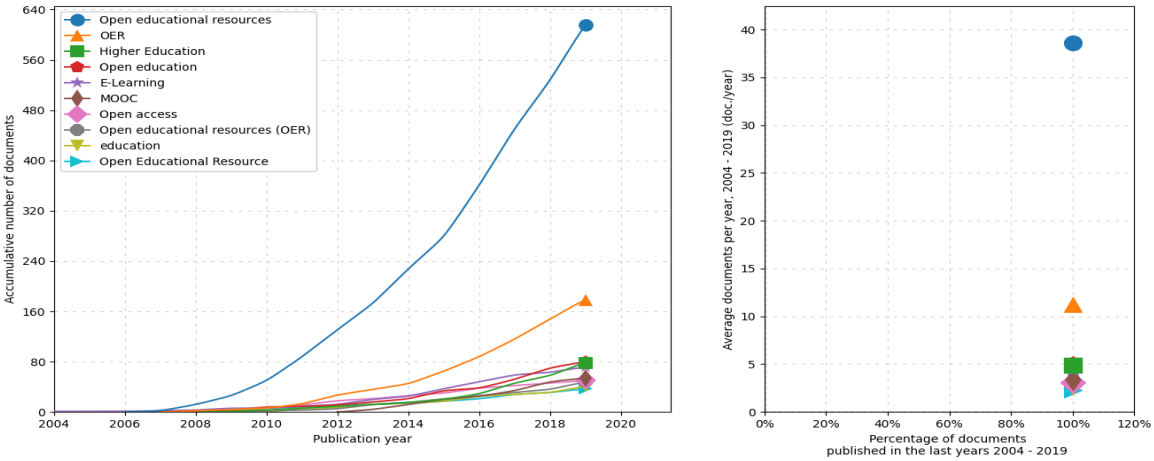
Source: Prepared by the authors using ScientoPy

The word cloud above represents the top 100 trending keywords analyzed, where word size indicated the frequency in which these keywords appeared during the overall span from 2004 to 2022.

Author Keywords Analysis before 2019 (Pre-pandemic)

There is no doubt that covid pandemic affected the world in every way possible, which was already referred to previously, and it would be no wonder if even research trends on OER might have changed according to the circumstances, hence, an analysis on the time spans 2004-2019 was conducted, and a time window of 16 years was chosen on ScientoPy, in order to precisely identify trends on oer before the pandemic.

Fig.11. Top 10 trending author keywords before 2019



Source: Prepared by the authors using ScientoPy

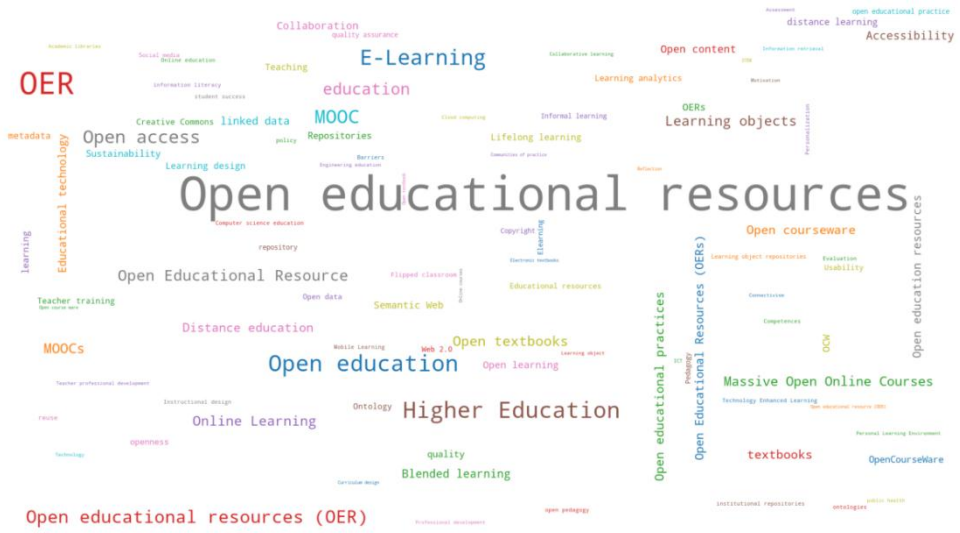
Table 8. Top 10 trending author keywords before 2019 brief results

Pos.	AuthorKeywords	Total	AGR	ADY
1	**Open educational resources**	617	5.6	38.6
2	**OER**	179	1.9	11.2
3	**Open education**	80	0.6	5
4	**Higher Education**	79	1.3	4.9
5	**E-Learning**	72	0.6	4.5
6	**MOOC**	54	0.4	3.4
7	**Open access**	50	0.2	3.1
8	**Open educational resources (OER)**	48	0.8	3
9	**education**	41	0.6	2.6
10	**Open Educational Resource**	37	0.4	2.3

Source: Prepared by the authors using ScientoPy

Depending on visualization in Fig.10 and table 8, it appears that the trending author keywords until 2019 focus much on keywords “open educational resources”, “OER”, “Open educational resources (OER)”;” Open Educational Resource”, indicating an emphasis on the research on OER themselves, which appears as well in the world cloud visualization below.

Fig.12. Top 100 author keyword cloud before 2019

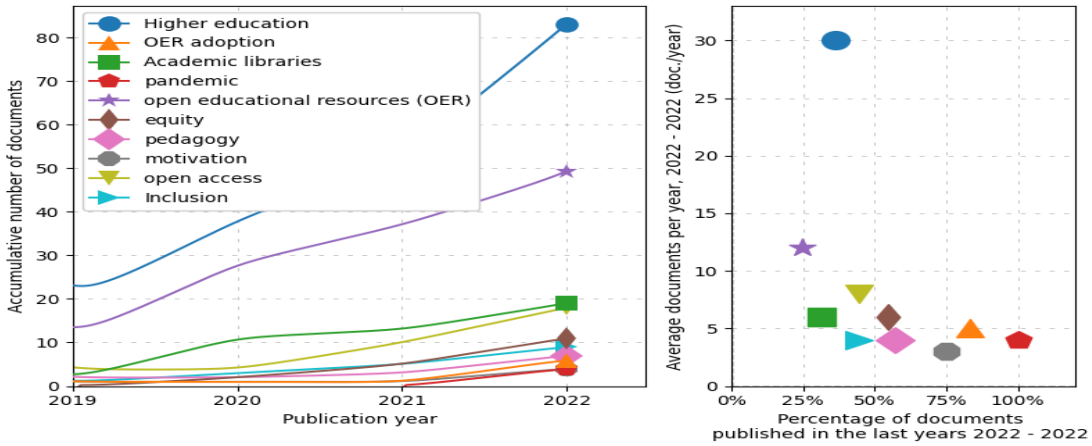


Source: Prepared by the authors using ScientoPy

Author Keywords Analysis after 2019 (Post-pandemic)

As mentioned above, the pandemic breakthrough might have affected not only the number of documents published, but even trend of outcomes of scientific output on OER, thus, an analysis on the time spans 2019-2022 was conducted, and a time window of 4 years was chosen on ScientoPy, in order to precisely identify trends on OER after the pandemic.

Fig.13. Top 10 author keywords trend growth timeline after 2019



Source: Prepared by the authors using ScientoPy

Table 9. Top 10 trending author keywords after 2019 brief results

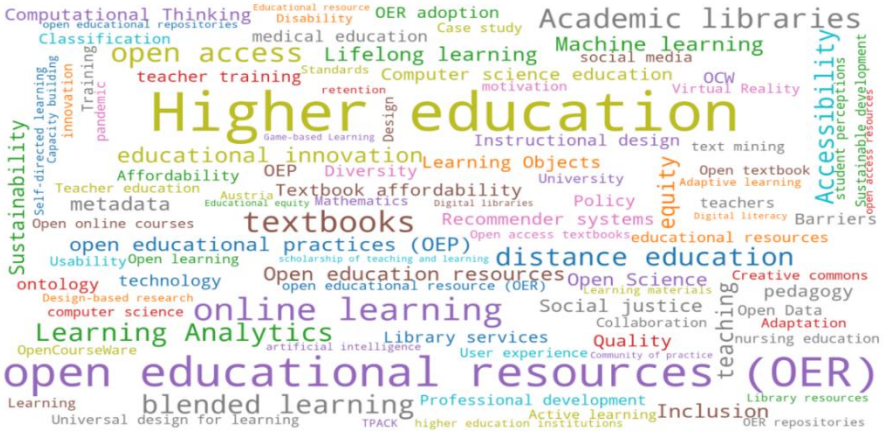
Pos.	AuthorKeywords	Total	AGR	ADY
1	**Higher education**	83	15	30
2	**Open educational resources (OER)**	49	3	12
3	**Academic libraries**	19	4	6
4	**Open access**	18	2	8
5	**equity**	11	3	6
6	**Inclusion**	9	2	4
7	**pedagogy**	7	3	4
8	**OER adoption**	6	5	5
9	**pandemic**	4	4	4
10	**Motivation**	4	3	3

Source: Prepared by the authors using ScientoPy

According to Fig.12 and table 9, the outcome of author keyword trend analysis appears to have shifted, as the top trending keywords after 2019 became “Higher education”, in addition to other trending keywords such as “Academic libraries”, “pedagogy”, “OER adoption”, which indicate a shift in research trends on OER as it appears in world cloud visualization in Fig.13 below, also it is also worth mentioning that 2019 was the year that UNESCO adopted an OER recommendation. Furthermore, the AGR post pandemic are much higher compared to the

trending keywords AGR before, especially with the first positions, as the keyword “Open educational resources” had the AGR of 5.6 prior to 2019, while the keyword “Higher education” had the AGR of 15 after 2019.

Fig.14. Top 100 author keywords trend cloud after 2019



Source: Prepared by the authors using ScientoPy

4. CONCLUSION

As the scientific research on OER thrives and develops , driven by projects and initiatives or under circumstances such as the pandemic ,it is important to understand where the current of OER research is heading , as well as the trends that the global scientific communities base their scientific outputs upon , thus , it was important that our current scientometric analysis was carried out using scientometric software tool ScientoPy , as it relied on a dataset retrieved from SCOPUS database , defined by the time span of 2004-2022 .

As per documents growth by year, it was found that articles had the highest AGR with 7.5, with 60.4 document published yearly.

Additionally, the most productive author was Tovar E., with a total of 28 top publications to his name, also, the top publisher was International Review of Research in Open and Distance Learning, with 129 total publications, and 0.3 AGR. Additionally, the United States came first as the most productive country regarding OER literature, with a total of 525 document published, and as high as 3.6 of AGR.

As per the author keyword analysis, the first analysis over the time span from 2004-2022 shows the top 10 trending keywords, on the top of which came the keyword “open educational resources”, as it’s the corner stone of these publications. However , upon analyzing the trending author keywords on 2 time spans separated by an important event which is the pandemic breakthrough , the first analysis which was defined by a time window 2004-2019 , it shows an emphasis on keywords such as “open educational resources” , “OER”, “Open educational resources (OER)”;” Open Educational Resource” , which indicate that the scientific output was on the phase on introducing and conceptualizing the OERs .However , upon analyzing the second time window 2019-2022 , it has been found that there’s a shift in trends on OER literature , with keywords such as

"higher education" , Academic libraries" , "pedagogy", "OER adoption" , taking the first positions , which indicates that the trend on OER literature is turning to the next phase of "adapting" OER and its practices in higher education , driven by both the pandemic and the UNESCO initiative under its recommendation .

It's also important to refer that the global literature responds fast in accordance with initiatives and projects and circumstances that lead to effect the OER practices and education themselves.

Additionally, the research on OER seems relatively new, especially as new trends appeared among the already produced scientific output, as well as it need further analyzing and monitoring, so as to reach better outcomes that support developing and thriving OER as efficient element in the educational process.

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