

E-LEARNING COVID AND POST-COVID RESEARCH TRENDS: A BIBLIOMETRIC ANALYSIS APPROACH

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Abstract: *E-learning has reached its peak during the Covid-19 pandemic, when educational institutions started to implement online education and e-learning as a way of doing business. As a result of this implementation, teaching staff and students had to learn how to use different tactics, and digital tools for collaboration, so the effectiveness of lectures and courses improves or, at least, stays the same. Although the Covid-19 pandemic has ended, people continued to use digital solutions in education and learning, because of the benefits they have experienced. Accordingly, this paper has an aim to investigate Covid and Post-Covid research trends in the field of e-learning. The main results show the most productive authors, the most productive relevant journals, the main keywords, and the most productive countries in this field.*

Key words: *e-learning, higher education, Covid-19, bibliometric analysis;*

1. INTRODUCTION

The Covid-19 pandemic has caused a worldwide social isolation, which caused a need for adapting everyday life activities to new circumstances (Raza et al., 2021). As a part of everyday life, education was affected, and it needed to be made accessible to all students and teachers, through different solutions powered by technology (Rizun & Strzelecki, 2020; Scherer et al., 2021). Although roots of distance learning date back to the middle of the 19th century, e-learning started to attract attention at the end of 2019 (Bezhovski & Poorani, 2016; Coman et al., 2020). E-learning is a concept which combines electronic devices, digital solutions, and mediums which facilitate the learning process with an aim to share information and knowledge with large audiences (Sangra et al., 2011; Suresh Babu & Sridevi, 2018).

Research has shown that students which had a higher level of participation in online courses realised through collaborative digital platforms achieved better grades at the end of the course (Rakic et al., 2020). Also, students have shown interest and satisfaction with some of the platforms which were used (Almusharraf & Khahro, 2020). From the teachers' perspective, high implementation costs and needed financial support are the biggest deficiencies, but the benefits of e-learning justify the costs – students can develop technological skills, which are required in the modern world, and digital solutions provide more effective ways of learning which results in better memorisation (Lapitan et al., 2021; Maatuk et al., 2022). Even when the pandemic ended and lectures went from online platforms back to classrooms, some ways of e-learning, such as polling tools, and digital collaborative whiteboards kept their place in education as essential factors (Coman et al., 2020). As a result, numerous research groups attempted to execute and assess the impacts of e-learning during Covid-19 (Ivari et al., 2020; Lapitan et al., 2021). Additionally, prior Covid-19, researchers conducted bibliometric studies to synthesize information in the subject (Martin et al., 2020). This form of analysis, however, is not sufficiently investigated during the Covid-19. As a result, the authors chose to conduct bibliometric analysis to fill a gap in the literature and describe the new information gained via e-learning during the Covid-19. Scientific papers were used and are still being used as one of information sources. Accordingly, research questions suggested by the authors are:

RQ1: *Which authors have the biggest influence in the field of e-learning in higher education?*

RQ2: *Which articles are the most cited in the field of e-learning in higher education?*

RQ3: *Which journals have published the highest number of articles in the field of e-learning in higher education?*

RQ4: *Which countries have the biggest article production in the field of e-learning in higher education?*

The structure of this paper shows the methodology in Section 2, research results and discussion in Section 3, and main research conclusions in Section 4.

2. METHODOLOGY

With an aim to investigate research trends in e-learning, data collection is gathered from the Scopus database, as one of the most relevant databases for scientific papers. The obtained data was converted to a suitable format and loaded in the R studio “bibliometrics” tool. All chosen articles include “e-learning” and “higher education” in the title, abstract or keywords. Additionally, only articles from years 2020, 2021, 2022, and 2023 are included, since the research is about Covid and Post-Covid research trends. All articles are published in international journals and written in English language. The data collection has 1,954 articles which are analysed using the tool for quantitative research in bibliometrics – R studio. Segments which are analysed are production by authors, the most cited article, production by journals, and production by countries. The visual presentation of data is done using the VOSviewer software.

3. RESULTS AND DISCUSSION

To answer proposed research question, this section is divided into four segments: the most influential authors, the most cited articles, the most relevant journals, and the most productive countries.

3.1 The most influential authors

In this paper, author’s influence is measured by the number of published articles. Table 1 shows 10 most productive authors in the field of e-learning in higher education.

Table 1: The most influential authors in the field of e-learning in higher education

Number	Author	Number of published articles
1	Li X.	13
2	Li J.	8
3	Zhang L.	8
4	Liu J.	7
5	Wang X.	7
6	Elshaer I.	6
7	Wang L.	6
8	Yang L.	6
9	Zhang J.	6
10	Zhang X.	6

According to Table 1, the most influential author is Li X. with 13 published articles in the field of e-learning in higher education. Li J. and Zhang L. have 8 published articles each, and have taken the second and third places. Fourth and fifth places are taken by Liu J. and Wang X. with 7 published articles each. Places from sixth to tenth have 6 published articles each and are taken by Elshaer I., Wang L., Yang L., Zhang J. and Zhang X.

3.2 The most cited articles

Significance of an article is measured by the number of times it was cited. The most cited articles in the field of e-learning in higher education globally are shown in Table 2.

Table 2: The most cited articles in the field of e-learning in higher education

Number	Authors	Article title	Number of citations
1	Radianti J., Majchrzak T. A., Fromm J., Wohlgenannt I.	A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda	762
2	Iivari N., Sharma S., Venta-Olkkonen L.	Digital transformation of everyday life – How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care?	394
3	Coman C., Tiru L. G., Mesesan-Schmitz L., Stanciu C., Bularca M. C.	Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective	375
4	Sundarasan S., Chinna K., Kamaludin K., Nurunnabi M., Baloch G. M., Khoshaim H. B., Hossain S. F. A., Sukayt A.	Psychological Impact of COVID-19 and Lockdown among University Students in Malaysia: Implications and Policy Recommendations	289
5	Al-Balas M., Al-Balas H. I., Jaber H. M., Obeidat K., Al-Balas H., Aborajoo E. A., Al-TaHER R., Al-Balas B.	Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives	270
6	Waheed H., Hassan S., Aljohani N. R., Hardman J., Alelyani S., Nawaz R.	Predicting academic performance of students from VLE big data using deep learning models	191
7	Scherer R., Howard S. K., Tondeur J., Siddiq F.	Profiling teachers' readiness for online teaching and learning in higher education: Who's ready?	177
8	Martin F., Sun T., Westine C. D.	A systematic review of research on online teaching and learning from 2009 to 2018	175
9	Tang Y. M., Chen P. C., Law K. M. Y., Wu C. H., Lau Y., Guan J., He D., Ho G. T. S.	Comparative analysis of Student's live online learning readiness during the coronavirus (COVID-19) pandemic in the higher education sector	167
10	Raza S. A., Qazi W., Khan K. A., Salam J.	Social Isolation and Acceptance of the Learning Management System (LMS) in the time of COVID-19 Pandemic: An Expansion of the UTAUT Model	161

The most cited article is "A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda" written by Radianti et al, and it has 762 citations. Second place is taken by "Digital transformation of everyday life – How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care?" from Iivari et al, with 394 citations. Article "Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective" written by Coman et al is in the third place, with 375 citations. With 289 citations, in the fourth place is "Psychological Impact of COVID-19 and Lockdown among University Students in Malaysia: Implications and Policy Recommendations" written by Sundarasan et al. Next, in the fifth place is "Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives" written by Al-Balas et al, with 270 citations. In the sixth place is "Predicting academic performance of students from VLE big data using deep learning models" by Waheed et al, with 191 citations. "Profiling teachers' readiness for online teaching and learning in higher education: Who's ready?" by Scherer et al is in the seventh place, with 177 articles. Eight place is taken by "A systematic review of research on online teaching and learning from 2009 to 2018" from Martin et al, with 175 citations. "Comparative analysis of Student's live online learning readiness during the coronavirus (COVID-19) pandemic in the higher education sector" written by Tang et al is in the ninth place with 167 citations. Tenth place is taken by "Social Isolation and Acceptance of the Learning Management System (LMS) in the time of COVID-19 Pandemic: An Expansion of the UTAUT Model" written by Raza et al, with 161 citations.

3.3 The most productive journals

The most productive journals are ones which have the highest number of published articles in the field of e-learning in higher education. Ten most productive journals are shown in Table 3.

Table 3: The most productive journals in the field of e-learning in higher education

Number	Journal	Number of published articles
1	International Journal of Emerging Technologies in Learning	116
2	Computers and Education	81
3	International Journal of Environmental Research and Public Health	69
4	Sustainability (Switzerland)	59
5	British Journal of Educational Technology	36
6	International Journal of Advanced Computer Science and Applications	33
7	Education and Information Technologies	32
8	IEEE Access	30
9	Plos One	29
10	Technology, Knowledge and Learning	28

According to Table 3, the most productive journal is International Journal of Emerging Technologies in Learning with 116 published articles in the field of e-learning in higher education. In second place is Computers and Education with 81 published articles. Third place is taken by International Journal of Environmental Research and Public Health with 69 published articles. Sustainability (Switzerland) is in the fourth place, with 59 published articles in this field. Fifth place is taken by British Journal of Educational Technology with 36 published articles. Next, in the sixth place is International Journal of Advanced Computer Science and Applications with 33 published articles, followed by Education and Information Technologies with 1 published article less. Eight place is taken by IEEE Access with 30 published articles. Plos One is in the ninth place with 29 published articles, and Technology, Knowledge and Learning is in the tenth place with 28 published articles.

3.4 The most productive countries

Country's production is measured by the number of published articles. Figure 1 presents a world map which shows countries that have the highest number of published articles in the field of e-learning in higher education. Countries which are coloured in deep blue are the most productive – China, and United States of America.

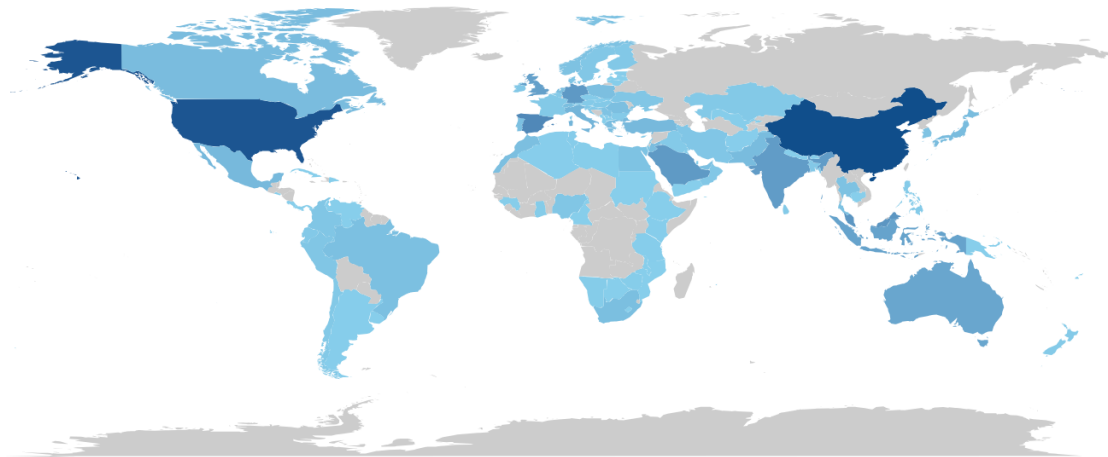


Figure 1: The most productive countries in the field of e-learning in higher education

While Figure 1 visually presents data, Table 4 shows tabular view of 10 countries which have the highest number of published articles in the field of e-learning in higher education.

Table 4: The most productive countries in the field of e-learning in higher education

Number	Country	Number of published articles
1	China	805
2	United States of America	756
3	Spain	425
4	Malaysia	336
5	Germany	316
6	Saudi Arabia	309
7	India	296
8	United Kingdom	272
9	Indonesia	258
10	Australia	237

As shown in Table 4, China took the first place with 805 published articles in this field, and is followed by United States of America with 756 published articles. Spain has 425 published articles, and is in the third place. Fourth place is taken by Malaysia with 336 published articles. With 20 published articles less comes Germany in the fifth place. Germany is followed by Saudi Arabia with 309 published articles. India took the seventh place with 296 published articles, and is followed by United Kingdom with 272 published articles. Indonesia is in the ninth place with 258 published articles, and Australia is in the tenth place with 237 published articles.

4. CONCLUSION

E-learning in higher education has rapidly drawn attention during the Covid-19 pandemic (Becker et al., 2020). The use has risen and reached its peak during the pandemic, and it has also transformed the course realisation process at Universities worldwide and affected curriculums (Iivari et al., 2020). With an aim to discover Covid and Post-Covid research trends in e-learning, this paper answered four research questions regarding the most productive authors, articles, journals, and countries in this field according to data of 1,954 articles from the Scopus database. When it comes to authors, Li X. has the highest impact with 13 published articles in the field of e-learning in higher education, which is 5 articles more than the next most influential author. The most cited article is "A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda" written by Radianti et al. This article is cited 762 times, almost two times more than the second most cited article, and gives information about different ways of implementing virtual reality into education, as well as scenarios which have shown benefits and gained success in learning based on virtual reality. The highest number of articles in the field of e-learning in higher education – 116 published articles – are published in the International Journal of Emerging Technologies in Learning, while the most productive country is China, with 805 published articles in this field of research. As a result, the key findings suggest that China and the United States, as leading global countries, have the most impact in the e-learning community. Furthermore, the top ten most productive journals are published by eight different publishing houses, demonstrating high diversity in this discipline. The most cited article is written by Norwegian, German, and Liechtenstein authors. These findings suggest that e-learning is the most researched issue among developed countries. Although this paper answers proposed research questions, its limitation is that the used data is gathered only from the Scopus database. Future research should include data from the Web of Science database. With the information from the WoS and Scopus database authors could propose future research perspectives in the field of e-learning.

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