

A bibliometric analysis of online universities from 1997 to 2021

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ABSTRACT: *Online universities have been overgrown since the 1980s due to technological development. When the COVID-19 pandemic broke out, traditional universities and colleges were forced to shift to online learning. In this study, we conducted a comprehensive bibliometric of online university research from 1997 to 2021 based on retrieval of the Scopus database. The bibliometric analysis revealed the number of publications, the most prominent countries, authors, journal sources, and critical articles based on citations and the most relevant research topics. Since the first paper was published in 1997, annual publications in online university research have increased rapidly to 1.5 - 2 times every five years. The United States, Spain, and Korea are the top three countries regarding the number of Online university studies. However, it is the authors from Korea who have the most publications. These findings could provide information to researchers and practitioners to better understand Online universities in the experiential and digital era.*

KEYWORDS: Online university, online learning, distance education, bibliometrics, Scopus, digital environment.

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1. Introduction

Online university (OU), also known as the virtual university (Jung, 2019b), was formed with the development of technology and the advance of online courses. It provided a new kind of online learning which became ubiquitous and increasingly affordable for learners (Jung, 2019b). The first fully online course was offered by the University of Toronto in 1984 (Sarkar, 2020). After that, the birth of the Electronic University Network in 1986, has attracted dozens of universities and colleges in the US. It was known as a mobile learning system and learning management system with many students participating in the online courses, up to 15,000 people scattered across several subjects in just two years (Etherington, 2018). The beginning of formation and development of the OU system was officially established with the opening of online higher education institutions in the USA, such as Virtual High School (1996) and Western Governors University (1997). Then, online higher education institutions were established in many countries, such as India, Malaysia, Pakistan,

and Korea. The creation of Massive Open Online Courses (MOOC) was driven by the fast development of information and communication technologies in the first decade of the twenty-first century, first introduced in 2008 (Jung, 2019b), allowed learners to participate in asynchronous online courses designed to each individual's capacity and circumstances (Thompson, 2021).

The issues of the OU topic attracted scholars, researchers, and practitioners in higher education after 12 years of the first fully online course offered in the world (Colyar, 1997). The starting point for these studies was to focus on issues related to online information systems for online teaching (Colyar, 1997; Cot, 2001). The topics were expanded and studied in more depth in teaching and learning processes. For example, the study of the OU model has changed the traditional way (Snchez-Gelabert, 2020); precisely, the issue of communication between lecturers - students, between students - students is done at a distance. On the other hand, the researcher is also concerned about the limitations in the interaction

between lecturers and students (Dennen, 2007), professional motivation (Badia, 2017), and the professional development of lecturers (Gregory, 2013). In psychological aspects, some other studies have pointed out the psychological problems of learners while taking online courses offered by universities (Heo & Han, 2018; Vayre, 2017) or personal psychology types suitable to OU learning (Harrington, 2010). OU became more popular, and easier to drop out of learners. Some studies tried to explain this problem by determining the relationship between disciplines and support needed to complete or drop out of school (Grau-Valldosera & Minguillón, 2014; Nistor, 2010). Additionally, several studies on learners' satisfaction were also carried out to enhance learners' interaction in the learning process and learning effectiveness (Kang & Shin, 2015; Shin & Kang, 2015). Besides, the assessment system has been mentioned to ensure accurate learning outcomes assessment (Joo et al., 2016; Rovai, 2004).

Although research on OU is hugely diverse, comprehensive studies in this field have not been done to visualise an overall picture. Therefore, the research team aimed to provide other researchers with a broader view of the studied directions and the network of colleagues that they can refer to when doing research related to OU by conducting a comprehensive scientific bibliometric analysis of the field in the period 1997 - 2021 based on retrieval of the Scopus database. This paper addressed several following research questions (RQs):

RQ1: What is the annual publication number of the OU field?

RQ2: Which country is leading the OU research field in the world?

RQ3: Who are the key authors of the OU field?

RQ4: Which journal sources are the most important in the OU sector?

RQ5: Which OU documents are the most cited?

RQ6: Which research topics in the OU are of most significant interest?

2. Data and methods

Bibliometrics is one of the methods of

measuring and evaluating science by measuring scientific publications. Bibliometrics is a field of research that started in the 1960s - 1970s in the US and some Western European countries when the volume of scientific information developed rapidly and significantly and posed the need to systematise information (Okubo et al., 1998). Bibliometrics was proposed by Alan Pritchard in the late 1960s, emphasising the physical element of doing research, such as counting the number of books, articles, publications, citations, and generally any well-known expression with statistical findings on recorded information, regardless of specialised boundaries (De Bellis, 2009).

The bibliometrics method was used to conduct this paper by analysing the collection of OU scientific articles kept in the Scopus database. Scopus is a bibliographic database of abstracts and citations for scientific articles, containing up to 57 million abstracts and over 22,000 categories from more than 5,000 publishers (Research Solution Reprints Desk, 2021). The selection of a collection source is based on its coverage. Given a large and frequently updated amount of data, Scopus fits the purpose of this study perfectly.

The research team explored the data by exploring the data by using the "The Preferred Reporting Items for Systematic reviews and Meta-Analyses" (PRISMA). PRISMA, published in 2009, was created to assist systematic reviewers in reporting why the review was conducted, what the authors did, and what they discovered transparently (Gümüş et al., 2020; Prisma, 2021; The BMJ, 2021). This study used the keywords "online university*", "online college*" and "online institution*" to explore OU literature from Scopus for the period 1997 - 2021. The keywords were searched in the information fields of the documents' title, summary, and keywords. Only English articles in the "original articles" category were included in the analysis of this dataset.

A total of 212 documents were retrieved from Scopus between 1997 and 2021, with average citations per document of 13.58 and average citations per year per document of 1,614. All published document types are articles. The

retrieved documents included 484 authors with 542 author appearances, 2.69 collaboration index, and 50 single-authored records.

Many of the statistics in this study were descriptive in nature. The distribution of the most productive countries/ territories, authors, journals, keywords, and total citations were among them. The database’s research trends and chosen publishing features were classified and analysed separately using the “Biblioshiny app” - (via R-studio cloud) (Nistor, 2010). These analytical methods were performed using Excel and R software.

3. Results

RQ1: What is the annual publication number of the OU field?

During 1997 - 2021, there were 212 studies in the field of OU published in Scopus journals, but the annual number of publications had irregular increases and decreases. The first article was published in 1997, but the following article was published four years later (2001). The average annual growth rate for the whole period was 29.0%, but there were years when the number of publications doubled from the previous year (e.g., 2002 - 2003, 2014 - 2015, 2018 - 2019) (Figure 1). If dividing the period 1997 - 2021 into short periods of 5 years, the figure shows that the number of published studies tends to increase gradually. In the period of 1997 - 2001,

the number of published studies was minimal; in 5 years, only two studies were published in journals. In 2002 - 2006, the number of studies overgrew, with the number of published articles being 21. In 2007 - 2011, the number of published studies was 28 articles, 1.3 times higher than the previous period. The period of 2012 - 2016 saw the fastest increase in the number of studies, with 67 articles published, 2.4 times higher than the last period. In 2017 - 2021, the number of published studies was 94 articles, 1.4 times higher than last.

The annual citation index of these studies did not trend in the same direction as the number of published studies. The data presented in Figure 1 for 2003 - 2008 has few articles but many citations. The period 2009 - 2012 was when the number of articles increased gradually, from 6 articles in 2009 to 12 articles in 2012. However, the number of citations saw a slight fall, respectively, from 342 to 212 in these two years. Research published in 2012 - 2016 has the highest number of citations and is the only period where the number of citations changes in sync with the number of publications. The period 2017 - 2021 has the highest number of publications in the whole considerable period from 1997 to 2021 but has a deficient number of citations.

RQ2: Which country is leading the OU research field in the world?

The field of OU has attracted the attention

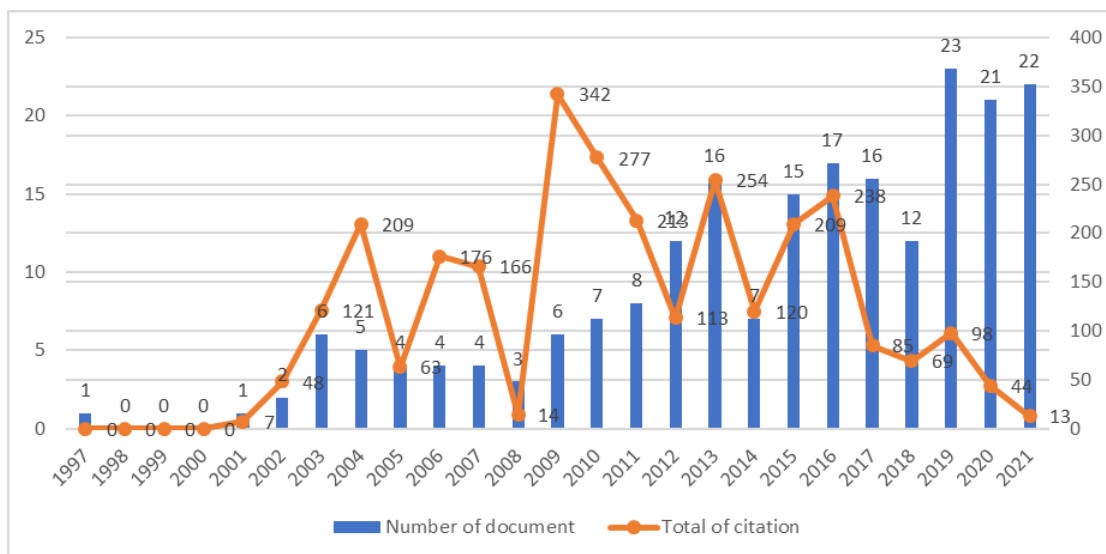


Figure 1. Number of publications and citations of OU studies from 1997 to 2021

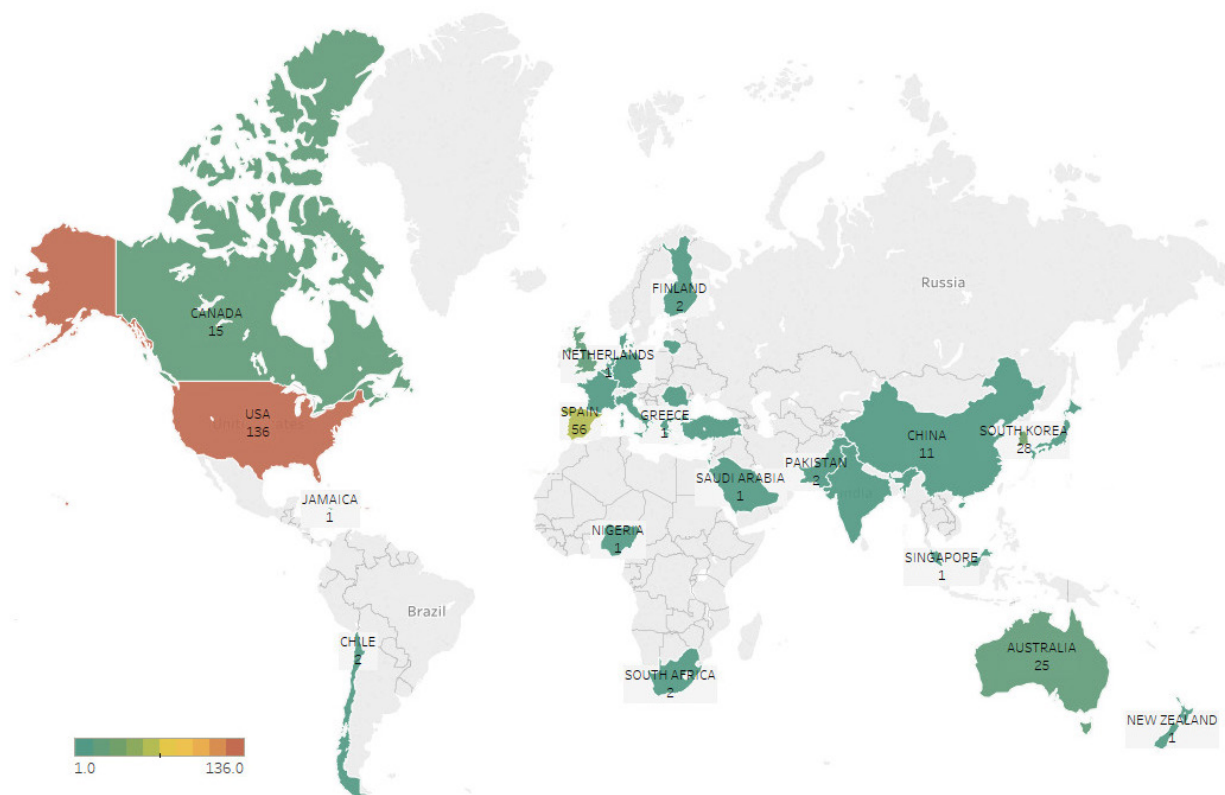


Figure 2. Distribution of OU studies by country

of researchers from many countries worldwide, mainly European and North American countries (see Figure 2). According to the data provided, 32 countries have published research on OU in Scopus journals since 1997. 43.56% are studies published in North American countries; 40.98% are published in the UK and Europe. OU publications from Asia and Africa account for only 14.43% and 1.03% of global OU publications.

Figure 2 shows the number of OU studies by country, whereby the US is the leading country with the highest number of articles (136 - 39%), followed by Spain (56 - 16%). The Republic of Korea, the United Kingdom, and Australia ranked third in the number of articles (28 - 25.7%). Canada, Italy, and China have about 4% of the articles, while the rest of the countries have contributed very little (less than 1%) to the total number of publications on OU since 1997.

Collaboration between countries in research is a big trend, but a single country in the OU field does most research. As shown in Figure 3, the SCP represents research done by a single country, and the MCP represents research done

by a collaboration of many nations. The amount of research done by a single country account for a considerable proportion. In the United States, the number of independently conducted studies is 12.75 times the amount of research conducted by American scientists in collaboration with other countries. Similarly, in Spain, the ratio is 9.5 times, and in Korea, it is 13 times. The US remains the leading country in the amount of research conducted independently and in collaboration with other countries, followed by Spain and South Korea. Among the countries with many articles, Australia is the country where OU studies are conducted entirely by domestic researchers.

RQ3: Who are the key authors of the OU field?

It is not the country and continent with the most publications on OU. However, Asian authors, specifically Korean, have the highest number of articles and citations. The results of the 20 most influential authors in OU research since 1997 are presented in Table 1 and Figure 4. In Table 1, the second column contains 20 authors with the number of articles. Moreover,

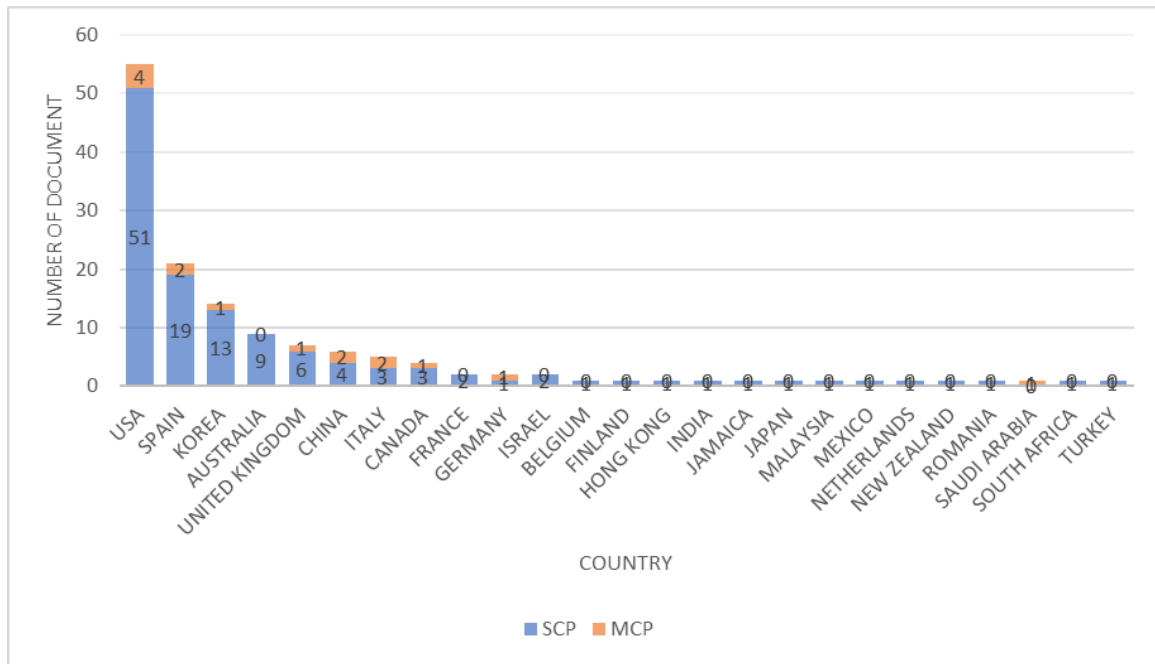


Figure 3. Cooperation of countries in conducting studies on OU

the fifth column is the 20 authors with the most citations. Accordingly, Joo Y. J. from Korea is author with the highest number of publications in OU (4 documents) and the person with the most citations (303 citations). Kang M., an author from Korea, has the highest number of publications (4 documents), but the number of citations is only seventh in the top 20 (163 citations). Followed by Lim K. Y. has the third-highest number of publications (3 documents) and the fifth-highest number of citations, with 250 times. Shin W. S. from the US is the fourth author with the number of publications (3 documents), and the number of citations ranked sixth with 171 times. Nistor N. (Germany) and Cacciamani S. (Italy) have the same number of publications (3 documents). However, Nistor N. has 90 citations, and Cacciamani S. has 53 citation, not in the top 20 authors with the highest number of citations.

In contrast, scholars from China, Shen L., Shen R., and Wang M., each author has only one publication, but the number of citations together ranks second among 20 authors with citations. The highest number of citations is 278. Other authors in the top 20 in the OU field and their citation counts are presented in Table 1.

Note: The line represents an author’s timeline. The bubbles’ size equals how many documents an author produces each year. The number of

Table 1. Top 20 authors’ productivity over the years

ID	Author	Number of publications	Author	Total citation
1	JOO YJ	4	JOO YJ	303
2	KANG M	4	SHEN L	278
3	LIM KY	3	SHEN R	278
4	SHIN WS	3	WANG M	278
5	NISTOR N	3	LIM KY	250
6	CACCIAMANI S	3	SHIN WS	171
7	EDWARDS M	3	KANG M	163
8	CESARENI D	2	KIM EK	160
9	BETTINGER E	2	ROVAI AP	155
10	LOEB S	2	MACDONALD CJ	136
11	VAYRE E	2	STODEL EJ	136
12	VONTHRON AM	2	THOMPSON TL	136
13	YICK AG	2	DARABI AA	117
14	BARAK M	2	DENNEN VP	117
15	USHER M	2	SMITH LJ	117
16	BADIA A	2	BROWN-WELTY S	93
17	GARCIA C	2	TRACZ S	93
18	MENESES J	2	VUONG M	93
19	HETTIARACHCHI E	2	NISTOR N	90
20	HUERTAS MA	2	HAN I	79

citations per year is proportional to the colour intensity of the bubble. The first bubble on the line denotes the start of the author’s work in the field. The larger the bubble, the more articles an author publishes per year; the bubbles with a darker colour intensity indicate more citations (Friday et al., 2021).

Korean and American authors lead in research performance and contributions at OU. Author Joo Y. J. (Korea) has regularly published four studies on OU within six years, published the first study in 2011 and the most recent study in 2016 (see Figure 4). However, the first study published in 2011 is more valuable than the other documents. Kang M. (Korea) published more papers in 2015 than in the remaining years (from 2011 to 2016), and at the same time, the research he published in 2015 also has more than ten total citations annually. Shin W. S. (USA) has two studies published in 2015 and one published in 2016. These studies have the highest citations (shown in bold bubble colour). A Canadian scholar - Edward M., is also the person with the highest research performance, with two publications published in 2011 and one published in 2012. However, his contribution is not much, reflected in the number of citations. His studies are few (with pale bubbles).

RQ4: Which journal sources are the most important in the OU sector?

Journals in the North American and European

regions are the most important sources of journals in OU, as measured by the volume of publications. These journals all share the same goal of focusing on the pedagogical uses of digital technology rather than the technical aspects (hardware, software) of technology (Elsevier, 2021; Scimago, 2021; Taylor & Francis Online, 2021).

Athabasca (Canada) ranks first among 20 important journals in the field of OU. In North America, according to aggregated data from Scopus, the International Review of Research in Open and Distance Learning, later renamed International Review of Research in Open and Distributed Learning, belongs to the university’s publishing house. The International Review of Research in Open and Distributed Learning is a refereed, open-access e-journal. The journal targets researchers and practitioners of open and distance education systems (Scimago, 2021a). Between 2005 and 2020, there were 16 OU studies published in this Journal (accounting for 7% of the number of articles in the 20 most critical peer-reviewed sources).

In the same region, The American Journal of Distance Education (AJDE) is the third most important Journal, with six publications on OU research between 2013 and 2020, representing 2.8% of the total publications in the 20 most important journals. The AJDE is the journal of the Taylor & Francis (USA) publishing house. The Journal is internationally recognised as the

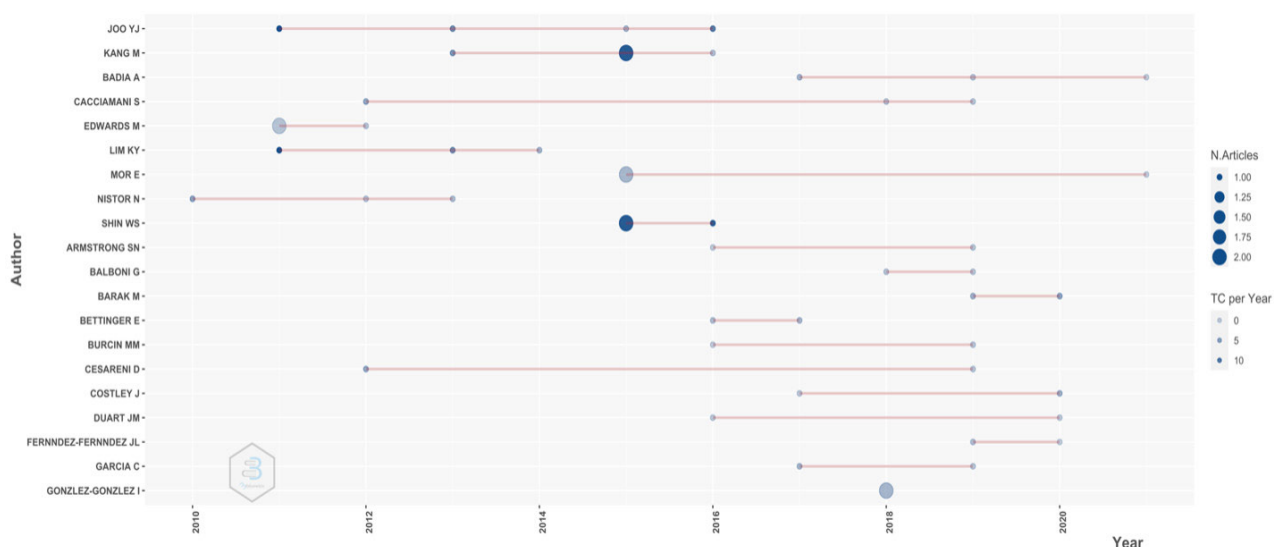


Figure 4. Top 20 authors’ productivity over the years

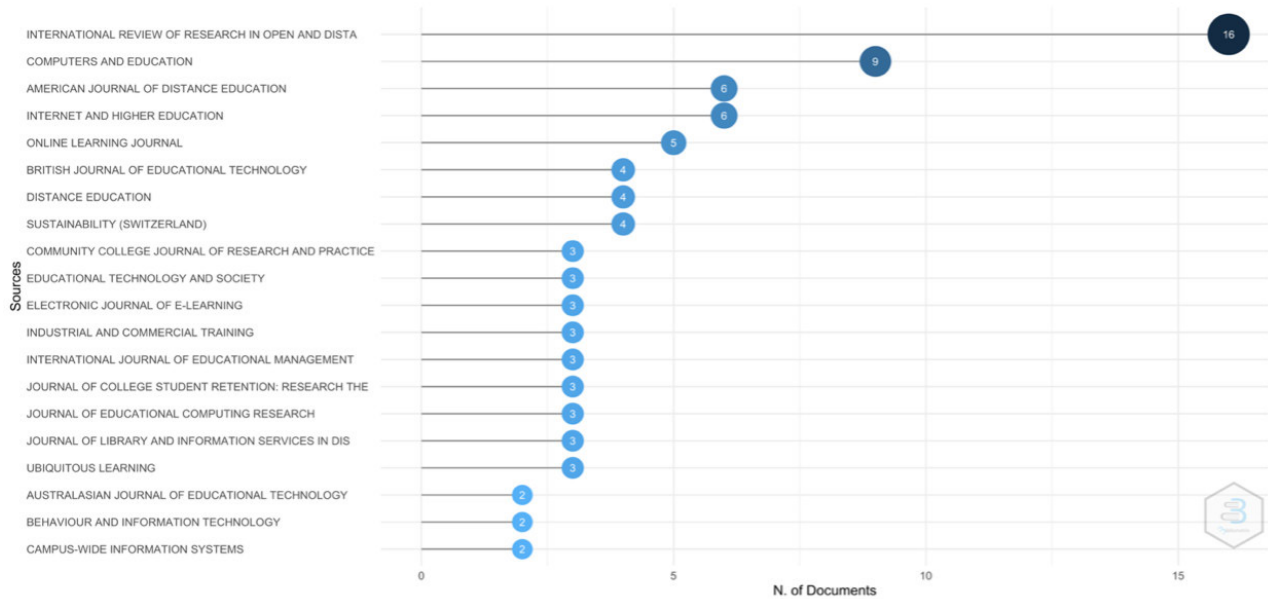


Figure 5. Distribution of articles by relevant sources from 1997 to 2021

Journal of record of research and scholarship in American distance education. The Journal aims to promote research on distance education in the Americas and disseminate information about it. AJDE investigates all aspects of teaching-learning relationships in which the actors are geographically separated, and technology mediates communication (Taylor & Francis Online, 2021). The Online Learning Journal is also a journal in North America, and the Journal has the fourth-highest number of articles (5) published among the 20 journals most relevant to OU research. The Online Learning Journal is a magazine of the Online Learning Consortium (USA). This Journal aims to foster the development and dissemination of new knowledge at the intersection of pedagogy, emerging technologies, policy, and practice in the online environment (Scimago, 2021b). Articles were published in this Journal between 2015 and 2020.

In Europe, Elsevier has become an important publisher, with two journals publishing many research publications on OU. The Computers and Education, an open-access journal of Elsevier publishing house (Netherlands), is the second most important Journal with nine publications of OU research, accounting for 4% of publications in the past 20 years. The OU studies were published

in this Journal from 2012 to 2020. Computers and Education seek to increase knowledge and understanding of how digital technology can improve education. They welcome research papers on the context of use, the user/system interface, usability difficulties, evaluations of the user experience, and the consequences and, notably, the implications for learning and teaching (Elsevier, 2021). Next in this region, the Internet and Higher Education, a journal of Elsevier BV (UK), is as essential as the AJDE, which publishes six publications of OU research from 2003 to 2021. This journal addresses current and future development issues related to online learning, teaching, and governance for post-secondary education (Scimago, 2021b).

Figure 5 above shows relevant journal sources. In addition to the journals listed above, other journal sources published less than five OU studies during this period.

RQ5: Which OU documents are the most cited?

The team explored the most cited OU literature in the global citation (GC) and local citation (LC) indexes. The number of citations a document has from the entire database, in this case, the Scopus database, is known as a global citation. The global citation also assesses the impact of a document, which may obtain more citations from

Table 2. List of 20 documents with at least one local citation

ID	1 st author, published year	Title	Source	Keywords	LC	GC	LC/GC Ratio
1	Joo YJ, 2011	Online university students' satisfaction and persistence: Examining perceived level of presence, usefulness and ease of use as predictors in a structural model	Computers and Education	distance education and telelearning; learning communities; post-secondary education	3	160	1.88
2	Grau-Valldosera J, 2014	Rethinking dropout in online higher education: The case of the Universitat Oberta de Catalunya	International Review of Research in Open and Distance Learning	distance education; dropout; early dropout; higher education; learning analytics; online university	3	24	12.5
3	Rovai AP, 2004	A constructivist approach to online college learning	Internet and Higher Education	constructivism; course design; distance education; higher education; learning; pedagogy	2	155	1.29
4	Dennen VP, 2007	Instructor-learner interaction in online courses: The relative perceived importance of particular instructor actions on performance and satisfaction	Distance Education		1	117	0.85
5	Shin WS, 2015	The use of a mobile learning management system at an online university and its effect on learning satisfaction and achievement	International Review of Research in Open and Distance Learning	ISS; mobile learning; mobile LMS; TAM	1	73	1.37
6	Nistor N, 2010	From participation to dropout: Quantitative participation patterns in online university courses	Computers and Education	distance education and telelearning; media in education; pedagogical issues; post-secondary education	1	61	1.64
7	Joo YJ, 2016	Factors predicting online university students use of a mobile learning management system (M-Lms)	Educational Technology Research and Development	actual usage; expectation-confirmation model; M-Lms; mobile learning; mobile learning management system; technology acceptance model	1	58	1.72
8	Harrington R, 2010	MBTI personality type and other factors that relate to preference for online versus face-to-face instruction	Internet and Higher Education	extraversion; face-to-face instruction; introversion; Mbt; online instruction; personality type	1	47	2.13
9	Cacciamani S, 2012	Influence of participation, facilitator styles, and metacognitive reflection on knowledge building in online university courses	Computers and Education	computer-mediated communication; cooperative/ collaborative learning; pedagogical issues; post-secondary education; teaching/ learning strategies	1	45	2.22

ID	1 st author, published year	Title	Source	Keywords	LC	GC	LC/GC Ratio
10	Russo TC, 2004	Perceptions of mediated presence in an asynchronous online course: Interplay of communication behaviors and medium	Distance Education		1	36	2.78
11	Gregory J, 2013	Professional development for online university teaching	Distance Education	capacity building; contextualization; E-moderating; mentoring; online teaching; professional development	1	30	3.33
12	Heo JC, 2018	Effects of motivation, academic stress and age in predicting self-directed learning readiness (Sdlr): Focused on online college students	Education and Information Technologies	academic stress; motivation; online education; self-directed learning readiness (Sdlr)	1	19	5.26
13	Kang M, 2015	An empirical investigation of student acceptance of synchronous E-learning in an online university	Journal of Educational Computing Research	distance education; media in education; multimedia/hypermedia systems; post-secondary education	1	19	5.26
14	Vayre E, 2017	Psychological engagement of students in distance and online learning: Effects of self-efficacy and psychosocial processes	Journal of Educational Computing Research	college/ university; engagement; online courses; online learning; self-efficacy; sense of community; social support	1	18	5.56
15	Yick AG, 2005	Navigating distance and traditional higher education: Online faculty experiences	International Review of Research in Open and Distance Learning	academia; distance education; online education; online faculty experiences; tenure	1	17	5.88
16	Badia A, 2017	Approaches to teaching online: Exploring factors influencing teachers in a fully online university	British Journal of Educational Technology		1	14	7.14
17	Janzen KJ, 2011	Becoming real: Using the artistic pedagogical technology of photovoice as a medium to becoming real to one another in the online educative environment	International Journal of Nursing Education Scholarship	artistic pedagogical technologies; authenticity; becoming real; interaction; photovoice; social presence	1	8	12.5
18	Castao-Muoz J, 2016	Estimating the economic payoff to virtual university education: A case study of the Open University of Catalonia	Higher Education	adult learners; E-learning; economic payoffs; online universities	1	4	25
19	Blum D, 2017	Nine potential solutions to abate grade inflation at regionally accredited online U.S. universities: An intrinsic case study	Qualitative Report	academic policies; best practices; grade inflation solutions; intrinsic case study; revising student evaluations	1	2	50
20	Armstrong SN, 2016	Digital health education for the fully online college student: An exploratory study	American Journal of Health Education		1	2	50

different disciplines in most circumstances. On the other hand, local citation counts the number of citations a document has received from other documents in the study (Friday et al., 2021).

Regarding LC, a study on dropouts in online higher education by Grau-Valldosera J. (Grau-Valldosera, 2014) and a document on OU student satisfaction by Joo Y. J. (Joo, 2011) topped the number of internal citations (3). Next is Rovai A. P.'s methodological document on approaching college-level online teaching (2004), which ranked second in internal citations (2). The remaining documents in the list had a minimum number of LC citations (1) (see Table 2).

Regarding GC, the study of Joo Y. J. (2011) also ranked first in the number of citations (160), followed by the study of Rovai A. P. (2004) with 155 citations. The study by Dennen V. P. (2007) ranked 3rd with a number of citations 117. The study by Shin W. S. (2015) ranked 3rd on GC (73). The GC ranked fourth is the study of Nistor N. (2010), with 61 citations. Joo Y. J. et al. also conducted a study on OU in 2016 (Joo, 2016), but GC citations only ranked 5th with 58. The remaining studies had GC less than 50.

RQ6: Which research topics in the OU are of most significant interest?

The thematic analysis derives themes from clusters of authors' keywords and their interconnections. These themes are distinguished by specific characteristics (density and centrality). The vertical axis represents density, while the horizontal axis represents centrality. The degree of correlation between different topics is measured by centrality, and the density of the nodes is measured by density (Esfahani et al., 2019).

These two characteristics measure whether specific subjects are well-developed and important. The more relationships a node has with others within the thematic network, the more central and important the position is. Likewise, coherence between a node that reflects a research field's density delineates its ability to develop and maintain itself (Friday et al., 2021).

Figure 6 provides the thematic map of the field of OU, which is divided into four quadrants (Q1 to Q4). Data modelling reveals

essential research topics that guide other studies related to the human experience in the OU environment: psychology and mental health of the participants of the OU courses, participants' choices and satisfaction (Armstrong & Burcin, 2016; Han & Shin, 2016); interaction in OU teaching and learning, community response to OU (Cacciamani et al., 2018); local and regional human development related to the selection of OU courses (Bignoux & Sund, 2018; Guillén-Gámez & Mayorga-Fernández, 2020). The research topic is in-depth studies of the behaviour of OU students who prefer OU courses to face-to-face university courses (Harrington & Loffredo, 2010; Lan et al., 2003). Research topics that have not had a lasting impact in the OU research area are those in education and online education. In these studies, OU is a research context rather than the subject, for example, the influence of digitisation in higher education (Bettinger et al., 2017; Toader et al., 2021), the need for training university teachers (Gormaz-Lobos et al., 2021), theoretical expectations about dialogue in online interaction (Arvaja & Hmlinen, 2021), or predicting the attitude of teachers and students towards ICT in higher education (Guilln-Gmez & Mayorga-Fernndez, 2020). The primary research topic in the OU field is the study of students and their online learning. The terms "students", "online learning", and "teaching" appear in a wide range of studies, from research on assessment systems to enhance interoperability (Marqus et al., 2021) to predicting dropout and course completion in OU (Figuroa-Canas & Sancho-Vinuesa,

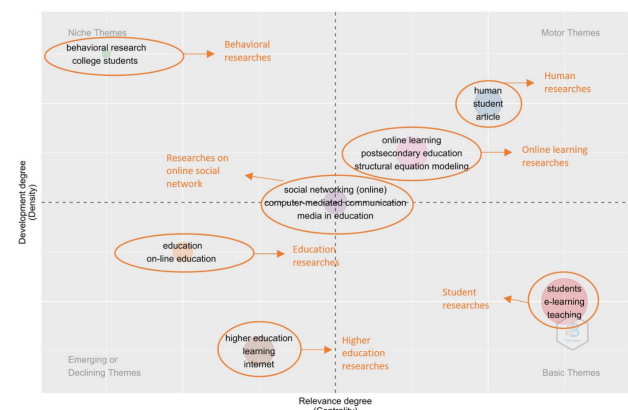


Figure 6. Thematic map

2020), from research on promoting interactive skills in OU (Martnez-Cerd et al., 2018) to an online assessment of knowledge and skills (Hettiarachchi et al., 2019).

The upper right quadrant (Q1) represents driving themes, including the “internet”, “human”, and “learning” in addition, there are themes such as “collaborative learning”, “human experiment”, and “computer-supported collaboration”. The upper left quadrant (Q2) is the very specialised themes, including “higher education”, “behavioural research”, and “college students and digitisation”. The lower left quadrant (Q3) is emerging, or disappearing themes, including “education” and “online education. The lower right quadrant (Q4) is underlying themes, including “students”, “e-learning”, and “teaching”. The themes of “online learning”, “post-secondary education” and “education computing” relates to some concepts in Q1 and Q3.

4. Discussion

OU is a model of higher education born in the late 1980s and expanded in the 1990s with the rapid emergence and widespread Internet use (Jung, 2019a). In the 21st century, online education is entering the mainstream and becoming a growing market as it continues to expand the accessibility of learning to more people (Gallagher & La-Brie, 2012). The development of OU and its related issues has attracted researchers from all aspects linked to this type of university during the past 30 years. Only the English-language studies published in Scopus until 6/2021 have 212 articles with the participation of 484 authors. This study performed a bibliometric review of articles in the OU field from 1997 to 2021 to provide a comprehensive picture of OU-related research. By using the PRISMA process, a dataset was completed with a total of 212 articles selected. The research results have also shown this topic’s development status and important research trends by determining the number of publications, the most prominent countries, authors, journal sources, the critical articles based on citation index, and research topics of most interest. The findings of the study will be discussed in detail below.

Research publication trends of OU

Regarding the number of published studies in the journals of the Web of Science system, the results of data analysis have shown that it is not a linear increase due to irregular increase-decrease fluctuations. A delineation by 5-year sub-periods could even see an increasing trend over time. Based on the foundation of distance education in terms of flexibility, accessibility and affordability suitable for a wide range of learners, online learning methods have been becoming popular with ideally providing higher education opportunities for socially disadvantaged people (Lee, 2020), especially for those who are unable to study because of geographical distances, schedule conflict, and insufficient payment for in-person learning (Amanda & Kathleen, 2013; Sun & Chen, 2016). This is the core foundation for creating and sustaining the growth of higher education institutions that deliver online learning, a new form of learning service delivery by networking technology becoming more and more available and cheaper (Jung, 2019b). Therefore, the increase in articles from the 2000s until now is suitable for solving problems arising and existing in the teaching and learning process and operating the online education system. Based on statistical data, the period from 2012 to now displays an explosion of research related to OU topics.

This is the period when the rapid development and continuous improvement of important technologies supporting distance learning based on online methods such as VCTs, smart mobile devices, wifi, LMS (Latchem & Jung, 2009).

Along with that, the relentless and rapid expansion of online courses, including conventional online courses and MOOCs (Escuenta et al., 2017), the trend of developing systems of open learning resources (OERs) and using Web 2.0, Web 3.0, and now Web 4.0 also strongly promotes the development of learning by online approach to an open and distance education system (Bozkurt et al., 2015).

Looking in more detail, in the last three years, the number of OU studies had increased the most, especially when the COVID-19 pandemic broke out in early 2020, causing most universities in

the world to switch to forms of online learning or stop providing training courses (Hodges et al., 2020; Nguyen et al., 2021).

Although the number of publications in the field of OU in the period 1997 - 2021 has generally increased, the number of citations has not always followed the same trend as the number of publications. This can be disconcerting as 2009 was not the year most OU studies were published, but the studies conducted this year had the highest total citations. This may be due to the data limitation of the new study, which is limited to publications on the Web of Sciences database. Therefore, this will also be an expanded research direction in the future to review the research system on OU more comprehensively.

Countries leading the field of OU research

As mentioned above, the US and Korea have the highest number of OU studies and two countries with strong growth in information technologies and OU courses. The studies in 2011, 2013 and 2016 have high citations, which is the only year where there is a consensus between the number of studies and the level of citation of these studies.

The obtained data shows that the US is the leading country in the field of OU research, followed by Spain. Notably, there is a significant gap in the number of studies between these two leading countries and the following countries, Korea, the UK, and Australia. One point can be seen from the results of the leading countries in OU research, most of which are pioneers in the establishment and development of Open Universities, a type of university associated with the increasing people's demand for access to higher education (Jung, 2019a). These universities offer a wide range of online programs and courses for a wide variety of learners that embrace the philosophy of distance and open education.

The number of studies on OU in the US is twice as much as that of Spain and five times as much as ones conducted by Korea, the UK and Australia individually. The US is a leading country in designing technology platforms for online teaching, such as online learning programs. Universities in the US are also leaders in providing

online learning courses (Amanda & Kathleen, 2013; Sun & Chen, 2016; Thompson, 2021). As of 2013, more than a third of American students had taken an online course during their undergraduate studies (Bettinger et al., 2012), and more than 11% were enrolled in completely online academic programs (Deming et al., 2015). Therefore, it is not difficult to understand that they pay great attention and take the lead in OU research.

The second in this ranking is Spain. It is also one of the first countries to establish an open higher education institution since 1972, the National Distance Education University, only after the UK - the country opened the first open university in the world in 1969 (Jung, 2019a).

An interesting case on the chart is the appearance of Korea, a country in Asia, in the third place of countries with the number of OU studies according to analytical data from the Web of Sciences. That shows the country's great interest in online education. Korea was one of the first countries to establish an open university in 1972 (the Korean Air and Correspondence College, later renamed Korea National Open University in 1991) (Huh, 2007). From 2001 until now, Korea has established more than 20 virtual or OU (Jung, 2019a). It is the result of the Korean Government's Virtual University Trial Project, which was started in February 1998 (Jung & Rha, 2001), and earlier, the Cyber Teacher Training Center project in the summer of 1997 (Jung, 2001).

The data also show that, in these studies, most countries performed independently. In other words, there is little linkage between two countries (or more) in conducting and publishing OU studies. In particular, the data shows that Australia is the country where the research on OU is conducted entirely by domestic researchers among the countries with many articles. Researchers believe that the degree and form of development of OU vary widely across countries (Sun & Chen, 2016), while studies on OU are closely tied to the OU context of each country. Maybe that is why researchers are stopping at a limited extent of working together.

The analysed data indicates that the most important fakes were from Korea (Joo Y. J., Kang

M.), the USA (Shin W. S.) and Canada (Edward M.). This is also consistent with these countries having the largest number of OU studies with total citations.

The most critical journal sources in the OU field

Data shows that the International Review of Research in Open and Distance Learning - IRRODL (Canada) and the Computers and Education (Netherlands) are the two most relevant sources for OU studies. IRRODL is the journal of the University of Athabasca in Canada. This is a journal of Scopus Q1 and SSCI of Web of Science. Looking for in the field of e-learning in Scimago, this is the ninth ranking. This journal specialises in distance and open education, online learning, e-learning, and technology application in education, especially distance education and online education, closely related to OU. This journal has leading researchers in this field like some authors mentioned above) on the editorial board. This journal is also free. In addition, Athabasca University is also a university with leading scholars and a long history in distance education. The Computers & Education is the Scopus Q1 and SSCI of Elsevier and is very strong in research areas of technology in education with high IF.

The research topics in the OU are of the most interest.

Learner's experience in the online learning environment

The analysis results show that the learners' experience in the online learning environment shows that Q1 is entirely developed and capable of structuring the research field. In other words, they remain the leading theme within the field. OU is developed based on learning methods with an online aspect, so learners' experience in an online learning environment is a motor topic. The change to a traditional learning environment that has been familiar since high school for both students and adult learners is a new and possibly a first-time experience. These experiences can affect learners' learning activities or learning outcomes (Fawaz & Samaha, 2021). Understanding how learners experience an online learning environment is core to how

OU can develop online programs and courses appropriate for a certain group of learners or gradually progress to absolute personalisation of the learning process. Consequently, topics such as online social networking, computer-mediated communication, and media in education are research topics with connection and orientation for the research group on online teaching and learning in higher education in Q4.

Studying student behaviours in the online learning environment

This research topic presented in Q2 has been linked in terms of research topic and content but still makes a small contribution to developing the OU research field. The analysed results show that the research topic is student behaviours in the online learning environment, the impact of online learning on student behaviours, or factors affecting learning. Learner behaviours have always been an essential topic in educational research. Studies on human behaviour in the learning process have also shown that understanding the behaviours of those people is an essential factor for practical solutions to develop and improve the quality of the learning process. The learner's learning corresponds to the teaching activity of the teacher. With a new method of teaching and learning, such as online education, organisations need to study the behaviour of learners to understand their "customers", thereby offering the best and most appropriate educational services for specific groups and individuals. For example, recent empirical research on MOOCs has mainly focused on whether a range of behavioural interventions can improve MOOCs completion rates and extend coverage to disadvantaged groups (Escuenta et al., 2017). Student online internships are potential and necessary topics to connect with OU research.

Online education in relation to educational development

Although research topics on online education concerning educational development appear to be emerging, it crosses Q4, showing that some of its components are fundamental for the development of the field of OU. The thematic analysis suggests that more efforts are needed to

develop themes such as “online education” and its associated components, such as education more ties with OU. This is necessary because OU, an established field, can significantly effort contribute to the OU’s structure.

Online teaching and learning in higher education.

In Q4, online teaching and learning in higher education are fundamental research studies and are quite crucial in developing OU research. Online learning or computer-based education is also emerging as a guiding topic in OU research. OU’s foundation is a distance education philosophy and an online teaching and learning environment supported by information technologies. Therefore, the research trend in this field focuses more and more on the core activities of the pedagogical or training process, which are teaching and learning activities.

5. Conclusions

The bibliometric analysis summarised the research findings on OU and recorded a sizable publication volume from 1997 to 2021. This study provides a quantitative analysis of leading journals, most cited articles, and most relevant authors in OU publications from 1997. This bibliographic study also provides information on the author’s research topic, duration and frequency, and relevant countries of the respective authors. This will enable evidence-based reports, assessments, and reviews of research outcomes on OU. Furthermore, there is little or no cooperation between authors from different countries. In the context of globalisation and the internationalisation of higher education, it is necessary to promote the coordinated participation of these countries with other

countries in research activities. Collaboration or partnership between developing and developed countries with high-quality research facilities can help some of these low publishing/ collaboration-ratio countries increase their publication volume/ collaboration.

This is the first bibliometric study in the OU field. In this way, researchers interested in the OU field have a compass to guide future research. In addition, the most recurring themes have been identified and mapped to show how the theme is evolving. Research on OU is increasing, and the development speed is fast, but the topics are quite fragmented and not connected to aim at the general development of the research field.

This study also has some limitations. First, a bibliographic survey of newly published high-quality articles is incomplete. This is due to the method stopping at citation analysis. The value or impact of a study in a field cannot be measured solely by the number of citations. Furthermore, since only using keywords in English, this analysis only applies to articles published in English-language journals. In addition, a country’s low publication/ collaboration ratio should not indicate the low quality of scientific research.

The limitations are good suggestions for future research directions. The upcoming study will examine the global collaborative network and map, the contributions of the lead authors and their collaborative networks, and the most productive research institutions at OU. In addition, an attempt should be made to explore the subject matter of research across time and country to identify differences and further appreciate these themes’ contributions to the overall development of the OU field.

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