Two decades of research in e-learning: a deep bibliometric analysis

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Abstract: E-learning is the electronic version of distance learning: a planned teaching that presupposes a physical separation between the teacher and the student. The distance is either geographic or temporal, and communication can be asynchronous or synchronous, respectively. E-learning has been a target of high-quality research for the last two decades. The purpose of this paper is to analyze the scientific production on e-learning in journals indexed on Elsevier's Scopus. The sample was composed by 25330 articles from 2000 to 2019. The results obtained by bibliometric analysis showed that rates publication continue to increase. A report was made on the journals, languages, authors, keywords, organizations and countries that publish in the field. This analysis was done for all articles as well as for the most cited articles. The bibliometric analysis was done for a total of 20 years, as well as for four 5-year periods. This article provides information from the past, but mostly clues about research on e-learning in the future.

Keywords: Distance learning; e-learning; Bibliometrics; Data analysis

I. Introduction

Distance learning is planned teaching that presupposes a physical separation between the teacher and the student. The distance is either geographic - so that the two agents of the teaching-learning process are separated in space - or temporal, and communication can be asynchronous or synchronous, respectively. E-learning is the Internet version as a mean of communication, assuming computer supported collaborative learning (CSCL). E-learning appears at the end of the last century with the growth of the Internet. In 1989, the University of Phoenix became one of the first schools to offer courses on the Internet and introduced FlexNet, which combines online and classroom learning [1]. The concern was whether e-learning was going to replace classrooms [2] or how it would be accepted in in high-tech companies [3]. E-learning was defined as technology-based learning in which learning materials are delivered electronically to remote learners via a computer network [2], a system that includes instruction delivered via all electronic media including the Internet, intranets, extranets, satellite broadcasts, audio/video tape, interactive TV, and CD-ROM [4] or a web-based system that makes information or knowledge available to users or learners and disregards time restrictions or geographic proximity [5]. At the beginning of the century, there were problems with the adoption of distance learning mediated by the Internet, such as technical difficulties, lack of pedagogical models, pre-conceived ideas regarding the old distance learning or even the expectations generated around e-learning. Above all, there were fears: that the teacher's working time would be much longer and even questions related to the ownership of documents and the possibility of copying them. If e-learning is the electronic version of learning, b-learning is blended or mixed [6], m-learning is mobile [7], u-learning is ubiquitous [8], x-learning is the version that includes all the others [9].

Higher education institutions were the privileged places for adopting e-learning. The concern was to measure and test pedagogical and technical methods [10] [11] [12]. Quickly, e-learning started to be used in secondary schools and the concerns were similar [13] . There was great enthusiasm for the possibilities of distance learning in medical schools [14]. The e-learning platforms, or Learning Management System (LMS), are electronic tools that integrate a large number of interesting applications from the teaching-learning point of view by bringing this grouping quite advantages. Applications have two operating dimensions: asynchronous, not assuming a temporal simultaneity between them (for example, use of electronic mail and discussion forums) and synchronous, in which the activities of the participants take place at the same time and examples of which are online conversations, chats, and systems computer video conference. The discussion was much about technology and the use of learning management systems, like Blackboard [15], MOODLE [16], moving from Blackboard to MOODLE [17] or from MOODLE to Facebook [18].

Some literature reviews were made about some aspects of e-learning: Predictors of E-learning satisfaction in teaching and learning for school teachers [19], the nursing educator's role in e-learning [20] and about the factors influencing e-learning and blended learning in relation to learning outcome, student satisfaction and engagement [21]. Meta-analyzes on the comparison of e-learning with the classroom [22] and the media and pedagogy in undergraduate distance education [23] were also published. Bibliometric analyzes were carried out: 689 journal articles and proceedings retrieved from the Science Citation Index from 2000 to 2008 [24] and 324 articles on workplace e-learning published in academic journals and conference proceedings from 2000 to 2012 [25]. Two decades of quality research in e-learning are celebrated and a bibliometric analysis is necessary.

Bibliometric analysis [26] is the quantitative study of bibliographic material: it provides a general picture of a research field that can be classified by papers, authors and journals. Bibliometric methods employ a quantitative approach for the description, evaluation and monitoring of published research. These methods have the potential to introduce a systematic, transparent and reproducible review process and thus improve the quality of reviews [27]. Bibliometric analysis provides objective criteria that can assess the research development in a field and act as a valuable tool for measuring scholarship quality and productivity [28]. Bibliometric methods offer systematization and replication processes that can improve understanding of the dissemination of knowledge in a field

and can highlight gaps and opportunities that contribute to the advancement of the discipline [29].

The aim of this study is to conduct a literature review of the e-learning research using bibliometric methods. The next section presents the research questions. The methodology is defined in the third section. Then the results are presented and at the end they are discussed and a conclusion is made.

II. The research questions

The questions, along with the purpose of the review, the intended deliverables and the intended audience, determine how the data are identified, collected and presented [30]. There are several questions that we want to answer in this paper:

- How has the evolution of the publication of articles in quality journals related to e-learning been?
- What are the characteristics of journals where there is a greater number of publications related to the subject?
- What is the approach to e-learning?
- Who publishes on the subject? Where do researchers who are interested in e-learning work? What country do they work in? What are the languages in which most of these articles are published?
- What are the most cited articles?
- What is the purpose of the most cited articles? What is the perspective with which the articles approach the theme?
- Who writes the most cited articles? And where do they work?

It is intended that all these questions are answered for the total of 20 years, either for four groups of five years periods.

III. Methodology

The term bibliometrics was first used in 1969 by Alan Pritchard [31], hoping that the term would be explicitly used in all studies which seeked to quantify the processes of written communication and that it would quickly gain acceptance in the field of information science. Moed [32] mentioned the potential of this type of study that reveals the enormous potential of quantitative, bibliometric analyses of the scholarly literature for a deeper understanding of scholarly activity and performance, and highlighted their policy relevance. In scientific research, it is important to get a wider perspective of research already being conducted concerning a relevant subject matter [33] and a bibliometric analysis profile on the research trajectory and dynamics of the research activities across the globe [34]. This is a bibliometric study that systematically analyses the literature using articles indexed at Elsevier's Scopus (Scopus) database. This study conducts a bibliometric analysis of international journal papers that we expect provider a useful reference for future research.

The search strategy was:

TITLE-ABS-KEY ("distance learning" OR "e-Learning")
DocType: Article OR Review
PUBYEAR > 1999 AND PUBYEAR < 2020

III. Results

A set of 25330 published papers were collected from SCOPUS. There is a clear annual growth. This growth is even more visible if five-year periods are considered: there are 2377 articles in the period 2000-2004 (average 475.4), 4860 2005-2009 (972), 7437 2010-2014 (1487.4) and 10656 articles for 2015-2019 (2131.2) (Fig. 1. Annual evolution published papers and five-year period average.). 23793 are article type and 1537 are review type (94% and 6%, respectively) as shown in the table (Table 1. Articles by type and 5-year period.).

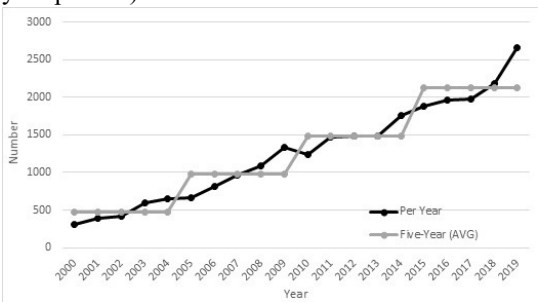


Fig. 1. Annual evolution published papers and five-year period average.

Table 1. Articles by type and 5-year period.

Type	2000-2004	2005-2009	2010-2014	2015-2019	Total
Article	2069	4358	7110	10256	23793
Review	308	502	327	400	1537

Papers were published in 413 international journals, 11 published of which two hundred or more articles (Table 2. Journals information's.). Four of those 11 journals were published in the United Kingdom (UK) and two in Germany. Computers in Human Behavior has the best SJR 2018 rank (SCImago Journal Rank measures weighted citations received by the serial [35]) and Lecture Notes In Computer Science the best h-index (324). The most common WoS subjects of those 11 journals are Social Sciences and Computer Science. The most common WoS categories of those 11 journals are Social Sciences (Education) and Social Sciences (E-Learning). Most of those journals are ranked in the first quartile in Journal Citation Reports. Computers And Education published 713 articles (0.28) and International Journal of Emerging Technologies in Learning published 468 (0.185).

Table 2. Journals information's.

Journal	Subject Area and Category	H	Q
Computers And Education	Computer Science (Computer Science (miscellaneous)); Social Sciences (Education; E-learning)	149	Q1
International Journal Of Emerging Technologies In Learning	Engineering (Engineering (miscellaneous)); Social Sciences (Education; E-learning)	15	Q2; Q2; Q3
Computers In Human Behavior	Arts and Humanities (Arts and Humanities (miscellaneous)); Computer Science (Human-Computer Interaction); Psychology (Psychology (miscellaneous))	137	Q1
Turkish Online Journal Of Distance Education	Social Sciences (Education)	17	Q3
British Journal Of Educational Technology	Social Sciences (Education; E-learning)	81	Q1

International Review Of Research In Open And Distance Learning	Social Sciences (Education; E-learning)	56	Q1
Distance Education	Social Sciences (Education; E-learning)	40	Q1
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	Computer Science (Computer Science (miscellaneous)); Mathematics (Theoretical Computer Science)	324	Q2; Q3
Educational Technology And Society	Engineering (Engineering (miscellaneous)); Social Sciences (Education; E-learning; Sociology and Political Science)	73	Q1
Journal Of E Learning And Knowledge Society	Computer Science (Computer Science Applications); Social Sciences (Education; E-learning)	12	Q3
Computer Applications In Engineering Education	Computer Science (Computer Science (miscellaneous)); Engineering (Engineering (miscellaneous)); Social Sciences (Education)	24	Q2; Q1; Q2

In the period 2000-2004 most articles were published in the Lecture Notes In Computer Science Including Subseries Lecture, which is not the case in the following 3 periods. On the contrary: the newspaper Computers In Human Behavior since 2005-2009 has doubled the publication on e-learning every 5 years (Table 3. Journal publication by 5-year period): P1: 2000-2004; P2: 2005-2009; P3: 2010-20 14; P4: 2015-2019.

TABLE 3. JOURNAL PUBLICATION BY 5-YEAR PERIOD.

Journal	P1	P2	P3	P4
Computers And Education	22	177	231	283
International Journal Of Emerging Technologies In Learning		36	119	313
Computers In Human Behavior		51	101	247
Turkish Online Journal Of Distance Education	3	106	149	89
British Journal Of Educational Technology	15	76	86	163
International Review Of Research In Open And Distance Learning	23	63	111	112
Distance Education	7	58	105	133
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	25 1	2	36	6
Educational Technology And Society	62	83	62	33
Journal Of E Learning And Knowledge Society		11	51	166
Computer Applications In Engineering Education	2	12	61	128

For all publications, the most common WoS subjects are social sciences and computer sciences (0.51 and 0.41), but there are publications in 27 subjects. In the following table (Table 4. Subjects, more than 500 articles, 5-year period.we list the subjects with more than 500 articles. There has been a huge increase in the area of medicine and the arts and humanities, in this case the event is especially visible in the last decade.

TABLE 4. SUBJECTS, MORE THAN 500 ARTICLES, 5-YEAR PERIOD.

Subject Area	P1	P2	P3	P4		
Social Sciences	1214	2688	4061	5008		
Computer Science	809	1762	3003	4842		
Engineering	404	870	1437	3187		
Medicine	268	531	767	1062		
Business, Management and Accounting			341	415	500	610
Mathematics			296	153	413	725
Arts and Humanities			58	172	413	650
Psychology			54	194	259	457
Nursing			81	152	225	218
Decision Sciences			36	169	180	230
Materials Science			21	79	72	375

E-learning, Education, Teaching, Human, Students, Article, Humans, Learning Systems, Distance Learning, Internet and Distance Education are the most common keywords (Fig. 2. Most common keywords.).



Fig. 2. Most common keywords.

If World Wide Web and Websites are in the 2000-2004 period top 20 keywords list, they cease to be in the following periods. Web Services, Educational Measurement and Blended Learning appear in 2005-2009; Surveys, Learning Algorithms and Machine Learning appear in 2010-2014. In 2015-2019, the keywords Human Experiment are new, as well as Forecasting and Major Clinical Study (Table 5. 20 most common keywords, 5-year period.)

TABLE 5. 20 MOST COMMON KEYWORDS, 5-YEAR PERIOD.

#	2000-2004	2005-2009	2010-2014	2015-2019
1	E-learning	E-learning	E-learning	E-learning
2	Distance Learning	Education	Teaching	Education
3	Internet	Internet	Education	Teaching
4	Distance Education	Teaching	Human	Human
5	Education	Learning Systems	Students	Students
6	Teaching	Distance Education	Article	Learning Systems
7	Article	Article	Humans	Learning
8	Human	Distance Learning	Distance Learning	Humans
9	Computer Aided Instruction	Human	Online Learning	Computer Aided Instruction
10	Humans	Humans	Distance Education	Article
11	Learning	Students	Learning Systems	Online Learning
12	Students	Learning	Internet	Female
13	Education, Distance	Medical Education	Learning	Distance Education
14	Learning Systems	Education, Distance	Computer Aided Instruction	Male
15	World Wide Web	Online Systems	Medical Education	Procedures
16	Medical Education	Computer Aided Instruction	Methodology	Learning Algorithms
17	Methodology	Methodology	Female	Distance Learning
18	Websites	Curricula	Male	Adult
19	Information Technology	Multimedia Systems	Curricula	Medical Education
20	Multimedia Systems	Computer-Assisted Instruction	Higher Education	Curricula

26% of the articles have only one author and 24% have two co-authors (Fig. 3. Number of authors.). We found 48545 authors. There are 16 authors with twenty or more articles, and four with over 30: Hwang, G.J. (36), Tsai, C.W. (35), Richardson, J.T.E. (32) and Shih, T.K. (32) (Table 6. Authors with 20 or more articles.). Taiwan is the country affiliation from seven of these 16 authors.

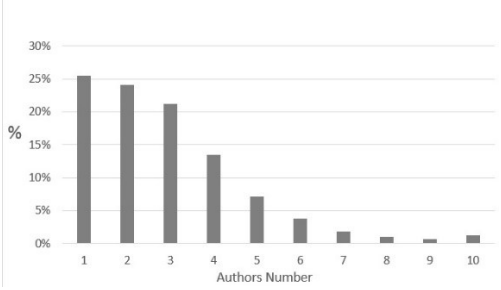


Fig. 3. Number of authors.

TABLE 6. AUTHORS WITH 20 OR MORE ARTICLES.

Author	P1	P2	P3	P4	Affiliation
Hwang, Gwojen	2	8	9	17	National Taiwan University of Science
Tsai, Chia Wen		4	20	11	Ming Chuan University, Taiwan
Shih, Timothy K.	9	11	9	3	Tamkang University, Taiwan
Richardson, John T,E,	5	11	9	7	Open University, Milton Keynes, Unite
Sandars, John Edward	1	12	14	1	Edge Hill University, Lancashire, Unite
Chen, Nian Shing		5	13	9	Griffith University, Brisbane, Australia
Huang, Ray Yueh Min	1	11	7	6	National Cheng Kung University, Taiw
Kinshuk		2	9	13	University of North Texas, Denton, Uni
Koper, Rob	1	19	2	2	Open University of the Netherlands, He
Wang, Minhong		1	15	6	The University of Hong Kong, Pokfular
Virvou, Maria K.	3	1	10	8	Panepistimion Pireos, Piraeus, Greece
Chen, Chihming		12	6	4	National Chengchi University, Taiwan
Shen, Peidi		5	11	5	Ming Chuan University, Taiwan
Kienties, Bart C.		2	5	14	Open University, Milton Keynes, Unite
Hoi, Steven C.H.			8	12	Singapore Management University, Sin
Tsai, Chin Chung		3	6	11	National Taiwan Normal University, Ta

Considering country affiliation, the papers are from 168 countries. There are 14 countries that are responsible for at least 500 papers. These 14 countries represent 75% of the total papers (Fig. 4. Countries with at least 500 papers.).

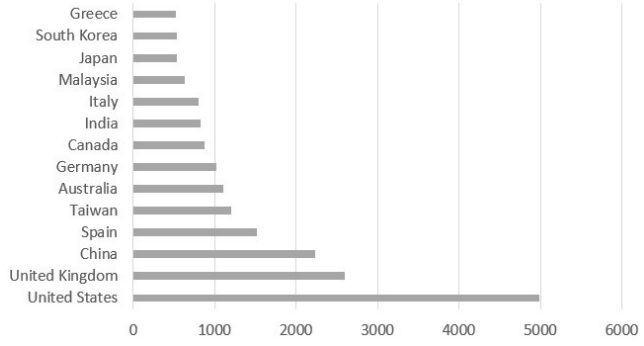


Fig. 4. Countries with at least 500 papers.

United States has always been first in terms of the number of articles on these last 20 years. But there are cases like Spain: from 2000-2004 was on the 11th position but that in the other 15 years it was the country where more articles were published. The case of India should also be taken into account: 29th position in 2000-2004, but 5th in 2015-2019 (

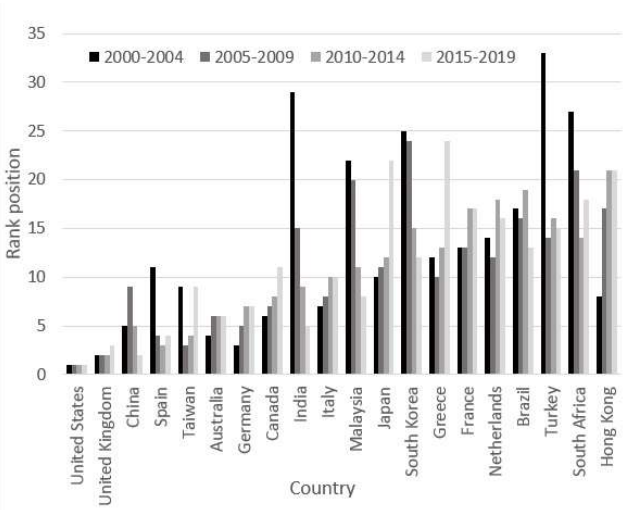


Fig. 5. Country rank, 5-year period.).

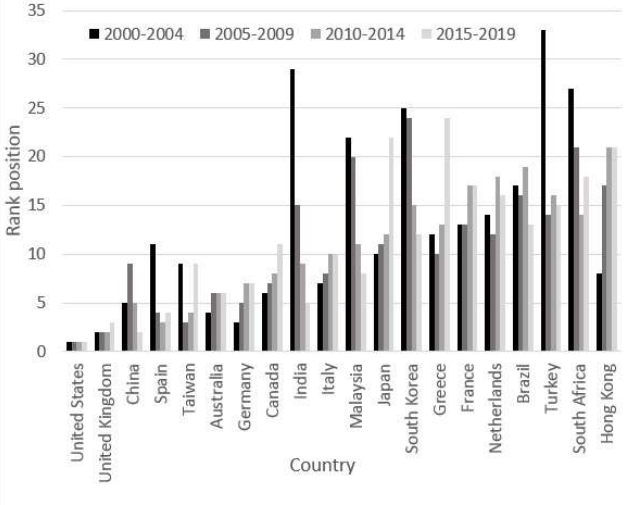


Fig. 5. Country rank, 5-year period.

Open University from United Kingdom is the organization with the most references (306). There are 22 organizations with more than 80 articles (Table 7. Organizations with more than 80 references.).

TABLE 7. ORGANIZATIONS WITH MORE THAN 80 REFERENCES.

Organization	P1	P2	P3	P4
Open University	61	83	74	88
University of South Africa	3	9	56	89
Universitat Oberta de Catalunya	4	17	64	70
Nanyang Technological University	11	26	44	51
Universidad Nacional de Educacion a Distancia	3	10	38	65
The University of Hong Kong	10	15	31	51
Chinese Academy of Sciences	0	10	23	68
National Taiwan Normal University	1	12	39	46
Universiti Kebangsaan Malaysia	1	9	45	41
National Cheng Kung University	3	32	37	24
Universidad Politécnica de Madrid	4	16	32	44
Athabasca University	4	25	39	24
The University of Sydney	4	19	30	38
Tamkang University	19	31	31	10
University of Malaya	0	3	32	55
University of Manchester	7	27	24	31
Universidade de Sao Paulo - USP	6	6	28	47
National Taiwan University of Science and Technology	0	18	27	41
City University of Hong Kong	21	14	20	30
Tsinghua University	21	13	17	34
Deakin University	16	17	24	24
Hong Kong Polytechnic University	11	18	21	30

Since we had not used the language exclusion criterion, we can now see that English is used in 93% of the articles (Fig. 6. Language articles.). There are other 37 languages, like are Spanish 1.6%, German and Chinese 1%. Portuguese and French is used in 0.67% of the articles

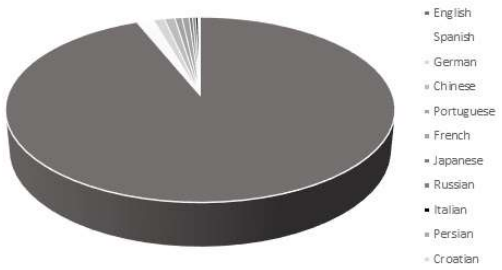


Fig. 6. Language articles.

In the following table (

Table 8. Most cited papers.) we list articles with over 500 citations.

IN THE KEYWORDS OF THE MOST CITED ARTICLES WE FIND 4 CLUSTERS: C1: ASYNCHRONOUS LEARNING, COMPUTER MEDIATED COMMUNICATIONS, COMPUTER MEDIATED LEANING, DISTANCE LEARNING, FACULTY SATISFACTION, INTERACTION, LEARNING EFFECTIVENESS, PERCEIVED LEARNING, SOCIAL PRESENCE AND STUDENT SATISFACTION. C2: DATA MINING, DISTANCE EDUCATION AND TELELEARNING, E-LEARNING, E-LEARNING MANAGEMENT, EVOLUTION OF CAL SYSTEM, LEARNER SATISFACTION AND WEB MINING. C3: COMPUTER GAME, ENGAGEMENT, GAME MECHANIC, GAMES-BASED LEARNING, GAMIFICATION AND MOTIVATION. C4: ELM FEATURE SPACE, ELM KERNEL, ENSEMBLE EXTREME LEARNING MACHINE, INCREMENTAL LEARNING, ONLINE SEQUENTIAL LEARNING AND SUPPORT VECTOR MACHINE. IN THE OTHER TABLE (

) we list articles with over 50 citations per year. Kent State University, Purdue University, University of California, University of Plymouth and VA Medical Center are the organization with two of the most cited paper (

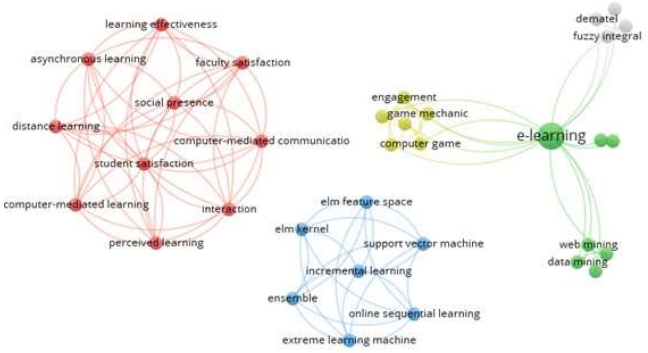


Fig. 7. Network visualization, keywords, more cited articles.

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TABLE 8. MOST CITED PAPERS.

Authors	Year	Title	Journal	Cited	Keyword
J. Duchi, E. Hazan and Y. Singer	2011	Adaptive subgradient methods for online learning and stochastic optimization	Journal of Machine Learning Research	2523	Adaptivity; Online learning; Stochastic convex optimization; Subgradient methods
B. Babenko, M. H. Yang and S. Belongie	2011	Robust object tracking with online multiple instance learning	IEEE Transactions on Pattern Analysis and Machine Intelligence	1619	multiple instance learning; online boosting; Visual Tracking
G. B. Huang, D. H. Wang and Y. Lan	2011	Extreme learning machines: A survey	International Journal of Machine Learning and Cybernetics	1195	ELM feature space; ELM kernel; Ensemble; Extreme learning machine; Incremental learning; Online sequential learning; Support vector machine
P. C. Sun, R. J. Tsai, G. Finger, Y. Y. Chen and D. Yeh	2008	What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction	Computers and Education	969	E-Learning; E-Learning management; Learner satisfaction
J. G. Ruiz, M. J. Mintzer and R. M. Leipzig	2006	The impact of e-learning in medical education	Academic Medicine	881	
J. C. Richardson and K. Swan	2003	Examining social presence in online courses in relation to students' perceived learning and satisfaction	Journal of Asynchronous Learning Networ	699	Asynchronous learning; Computer-mediated communications; Computer-mediated learning; Distance learning; Faculty satisfaction; Interaction; Learning effectiveness; Perceived learning; Social presence; Student satisfaction
M. N. Kamel Boulos, I. Maramba and S. Wheeler	2006	Wikis, blogs and podcasts: A new generation of Web-based tools for virtual collaborative clinical practice and education	BMC Medical Education	668	J.
C. Roca, C. M. Chiu and F. J. Martínez	2006	Understanding e-learning continuance intention: An extension of the Technology Acceptance Model	International Journal of Human Computer Studies.	637	Expectancy disconfirmation theory; Satisfaction; Technology acceptance model
G. H. Tzeng, C. H. Chiang and C. W. Li	2007	Evaluating intertwined effects in e-learning programs: A novel hybrid MCDM model based on factor analysis and DEMATEL	Expert Systems with Applications	615	DEMATEL; E-learning; Factor analysis; Fuzzy integral; Multiple criteria decision making (MCDM)
A. Domínguez, J. Saenz-De-Navarrete, L. De-Marcos, L. Fernández-Sanz, C. Pagés and J. J. Martínez-Herráiz	2013	Gamifying learning experiences: Practical implications and outcomes	Computers and Education	591	Computer game; e-learning; Engagement; Game mechanic; Games-based learning; Gamification; Motivation
C. Romero, S. Ventura and E. García	2008	Data mining in course management systems: Moodle case study and tutorial	Computers and Education	541	Data mining; Distance education and telelearning; E-learning; Evaluation of CAL systems; Web mining

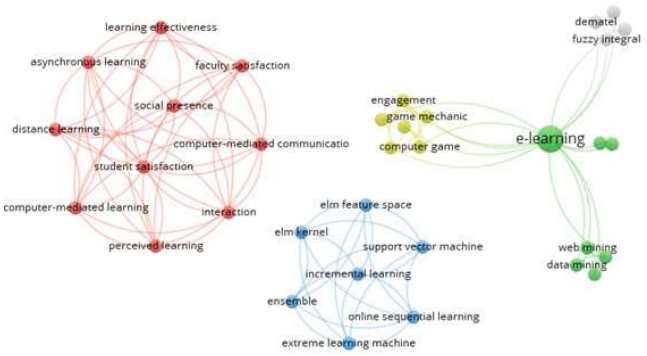


Fig. 7. Network visualization, keywords, more cited articles.

Kent State University, Purdue University, University of California, University of Plymouth and VA Medical Center, are the affiliation of two papers each. Using Vosviewer we made an analysis of the keywords of the most cited articles on each 5- year period, the authors who published the most each 5-year period and the countries which published the most each period- No significant clusters were find.

IV. DISCUSSION AND CONCLUSIONS

The purpose of this paper is to analyze the scientific production on e-learning in journals indexed in Elsevier's Scopus:

- How has the evolution of the publication of articles in quality journals related to e-learning been?

There is a clear annual growth. This growth is even more visible if five-year periods are considered: there are 2377 articles in the period 2000-2004, 4860 2005-2009, 7437 2010-2014 and 10656 articles for 2015-2019. In other words, there has been a huge growth.

- What are the characteristics of journals where there is a greater number of publications related to the subject?

Papers were published in 413 international journals, 11 of which published two hundred or more articles, the four of those 11 journals were published in the United Kingdom (UK) and two in Germany. The most common WoS subjects of those 11 journals are Social Sciences and Computer Science. The most common WoS categories of those 11 journals are Social Sciences (Education) and Social Sciences (E-Learning). Most of those journals are ranked in the first quartile in Journal Citation Reports. Computers And Education published 713 articles (0.28) and International Journal of Emerging Technologies in Learning published 468 (0.185).

- What is the approach to e-learning?

World Wide Web and Websites were two of the 2000-2004 top 20 keywords; Web Services, Educational Measurement and Blended Learning appears in 2005-2009; Surveys, Learning Algorithms and Machine Learning in 2010-2014; and Human Experiment, Forecasting and Major Clinical Study in 2015-2019.

- Who publishes on the subject? Where do researchers who are interested in e-learning work in? What country do they work? What are the languages in which most of these articles are published?

We found 48545 authors. There are 16 authors with twenty or more articles, and four with over 30: Hwang, G.J. (36), Tsai, C.W. (35), Richardson, J.T.E. (32) and Shih, T.K. (32). Taiwan is the country affiliation from seven of these 16 authors. Considering country affiliation, the papers are from 168 countries. There are 13 countries responsible for at least 500 papers. The United States has always been first in terms of the number of articles on these last 20 years. Spain was on the 11th position from 2000 to 2004, but from 2005 to 2019 was a country where most articles were published. India was 29th position in 2000-2004, but 5th in 2015. English is used in 93% of the articles.

- What are the most cited articles?

J. Duchi, E. Hazan and Y. Singer; 2011; Adaptive subgradient methods for online learning and stochastic optimization; Journal of Machine Learning Research was cited 2523 times.

- What is the purpose of the most cited articles? What is the perspective with which the articles approach the theme?

In the keywords of the most cited articles we find 4 clusters: C1: Asynchronous learning, computer mediated communications, computer mediated leaning, distance learning, faculty satisfaction, interaction, learning effectiveness, perceived learning, social presence and student satisfaction. C2: data mining, distance education and telelearning, e-learning, e-learning management, evolution of cal system, learner satisfaction and web mining. C3: computer game, engagement, game mechanic, games-based learning, gamification and motivation. C4: elm feature space, elm kernel, ensemble extreme learning machine, incremental learning, online sequential learning and support vector machine.

- Who writes the most cited articles? And where do they work? J. Duchi, E. Hazan and Y. Singer wrote the most cited paper and B. Babenko, M. H. Yang and S. Belongie wrote the second one. Kent State University, Purdue University, University of California, University of Plymouth and VA Medical Center are the organizations with two of the most cited papers.

From the findings, we can see that e-learning continues to be an object of research with a lot of potential and that the best journals still have an interest on the field.

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