Two decades of studies on learning management system in higher education: A bibliometric analysis with Scopus database 2000-2020

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Abstract

Over the past twenty years, using learning management systems in higher education has attracted increasing interest from researchers around the globe. In this context, the current study aimed to explore the volume, growth trajectory, and geographic distribution of learning management systems in higher education literature, along with identifying impactful authors, sources, and publications, and highlight emerging research issues. The authors conducted bibliometric analysis on 1334 documents, related to the use of learning management systems in the context of higher education, extracted from Scopus database. The findings show a rapidly growing knowledge base on learning management systems in higher education, especially intensely in the years 2015-2020 and primarily from research in developed societies. This flourishing is consistent with the development trend of international education and the strong development of technology. In addition, the core literature was identified based on the volume of publications and citations. The results also reveal the emerging intellectual structure of the field and provide points of reference for scholars studying the discipline. This paper offers a knowledge map for future research assessments of learning management systems in higher education.

Practitioner Notes

1. To promote internationalization in education and to cope with the Covid-19 pandemic, learning management systems are required in the higher education context.
2. This paper represents an example of conducting bibliometric analysis to provide an overview and development of research literature.
3. The intellectual structure in research on Learning management systems includes earning engagement and motivation, technology acceptance, educational data mining, web-supported course, and engineering education.
4. Research keywords in the topic received significant interest in the field are "learning analytic", "unified theory of acceptance and use of technology", "flipped classroom", and "gamification".
5. Learning management systems need to be researched and developed to meet the diverse needs of education, instructors and students, rather than being limited as a management tool.

Keywords

Higher education, Learning management system, LMS, Educational technology

Authors

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Introduction

The development of technology has changed the world in unprecedented ways. People from all professions must quickly adapt to this dramatic change, including higher education. Due to globalization and COVID-19, in-person classes are no longer optimal. Universities are compelled to adopt distance learning using various platforms. This poses new problems for the university administration, faculty staff, and students (Ellahi & Zaka, 2015; Mestan, 2019).

School boards have to consider incorporating technology in their management and teaching on the administrative level. Methods and challenges involved in this task have been discussed among universities (Aldiab et al., 2019, Huijser & Sankey, 2010; Ozkan, 2009). Implementing e-education can affect a university's business and organizational structure (Azarov & Mayboroda, 2020). Therefore, serious consideration and research must be carried out before implementing this new technology. In addition, this advancement introduces a new field to education – data mining. Research has shown that with appropriate data mining techniques, the administration board of higher education institutions can make better organizational decisions regarding their resource allocation and education quality (Job & Pandey, 2020); thus, improving institution-wide operating efficiency.

Moreover, datasets obtained from different learning management systems give detailed insight into students' academic performance (McGrath, 2010). As these studies suggest, data from these platforms can help instructors provide timely feedback and assistance for students struggling to improve their performance (Acheson & Ning, 2018; Dawson et al., 2008). Suppose this is done properly in the long run. In that case, it can even notify instructors of possible cases of drop-out, allowing prompt interventions and, as a result, reducing the drop-out rate among students (Cohen, 2017). These are helpful and necessary to the policy-making process in every university (Dawson et al., 2008).

This advancement does not come without any problems. The implementation of technology raises several issues for the faculty staff. One of the problems that arise is the lack of skills from teachers or instructors regarding the use of technology in teaching (Azlim et al., 2016). To address this problem, universities have designed courses to train their faculty staff basic digital skills to operate new teaching platforms (Krasnova & Shurygin, 2020). However, technical skills alone are not enough. Teachers are now obliged to implement new pedagogical strategies in an online environment (Ruefman & Scheg, 2016; Vandeyar, 2020). Suggestions have also been made to assist teachers in devising new pedagogical approaches (Marek et al., 2021; Saylor, 2018). Another fundamental element of a teacher's skill set is communication. Teaching on an online medium tends to hinder communication and interaction between instructors and learners and among fellow members in class (Musbahtiti & Muhammad, 2013). Due to the physical barrier between instructors and students, students are more hesitant to ask questions, and instructors are less informed on students' progress and concern (Bahar et al., 2020). Witnessing this phenomenon, researchers have examined several tools to encourage students' participation (Renee Staines & Lauchs, 2013; Woodley & Dorrington, 2015). After their implementation, these tools have proved to be effective in generating discussion and interaction between students and teachers and also among students.

On the other hand, web 2.0 technologies certainly make teachers' jobs easier. Online laboratories have been implemented in many universities and gained positive feedback from students and

instructors (Ruano et al., 2016). This change has made laboratories available for many more students, making their learning experience more comprehensive. Along with that is the new approach to examination – e-assessment (Draskovic et al., 2016). This type of assessment offers many useful functions, as implied in this study (Taşci et al., 2013). Teachers are now less burdened with designing exams and grading and instead can devote their time to giving feedback and answering questions from students.

With the introduction of technology come new modes of learning, the most widely used forms of distance learning are blended learning and e-learning (Rehatschek & Hruska, 2013). The benefits of these types of learning have been observed in a number of studies (Mestan, 2019; Hoic-Bozic et al., 2009), including increased student engagement and learning (Tena et al., 2016). These systems turn learning into a more active and interactive process, thus requiring more student effort and increasing knowledge retention and skills acquisition.

In addition, research has been done on new approaches to the learning which could be incorporated into these platforms (Huijser & Sankey, 2010; Tynan & Barnes, 2010). Another strategy many institutions have studied is personalized learning (Arsovic & Stefanovic, 2020). Understanding that each student has their own needs, universities have designed personalized learning management systems that cater to each student's learning needs and ability (Aeiad & Meziane, 2019). With this mode of learning, students can choose to study wherever and whenever they want, easing the stress of class attendance off of students and encouraging proactive learning (Amano, 2010). This approach also accommodates students with disabilities better by providing necessary assistance in studying, making education accessible to a more diverse population (Corredor & Gesa, 2012). Overall, these approaches seem to have revolutionized the traditional teaching-learning practice.

Along with these changes to adapt, the Learning Management System (LMS) becomes a ubiquitous technology feature in higher education. A LMS is a software or a platform designed to administer teaching and learning processes, including creating and managing curricula, delivering and organizing training materials, assessment tools, interactive activities in the user community, and reports on learners' activities and learning progress (Srichanyachon, 2014). Online learning content is accessed through an LMS, allowing students to view and interact with learning tools through a web browser using any operating system, computer, or mobile device (Kasim & Khalid, 2016). As such, the LMS is an advanced and universally used tool to improve students' learning experience and build their understanding of specific topics.

LMS can be extended and used to support the entire range of university taught courses (Coates et al., 2005). Over the past decade, higher education institutions worldwide have made great strides in implementing and using LMS to coordinate learning and teaching online, with a variety of support offered to staff and students (Weaver et al., 2008). In the past, this use was finite as an assistant tool, while the current usage has more improvement and accepts multiple requests in a single system (Aldiab et al., 2019).

Currently, many universities around the world use LMS to organize online courses or blended courses in addition to their traditional classrooms with several LMS such as Moodle, Blackboard, Canvas, or D2L. These platforms are more than just a simple content manager, but also provide an array of tools to support the development of different pedagogy according to learning modes such as face-to-face courses, online courses, or hybrid courses (Cantabella et al., 2018). Therefore, LMS can be considered as a means to improve the quality of education and learning outcomes

(Cavus, 2015), at the same time, helping to reduce and save educational costs (Bates, 1997). Specifically, the application of LMS in the university training process has: simplified the learning process, made learning more flexible in terms of time and place; enabled monitoring and reporting for continuous performance improvement; assessed learners' capabilities instantly; helped upgrade content, information of courses quickly (Srichanyachon, 2014).

In fact, in any learning mode, the usefulness of LMS tools is directly related to their use (Cantabella et al., 2018). The effective use of LMS in education mainly depends on factors related to the behaviour and attitudes of lecturers and students, the support of the university, and the application of information technology (Webster & Hackley, 1997).

There has been lots of research on many different mediums to improve the quality and effectiveness of using LMS in the teaching process at universities. This bibliometric review of research is aimed to answer the following research questions (RQs):

Research Question 1. What is the status and growth pattern of research literature on LMS in higher education?

Research Question 2. Who are the most influential authors in terms of the volume of publications and citations in this field?

Research Question 3. Which are the most significant sources in terms of the volume of publications and citations in this field?

Research Question 4. Which documents evidenced the greatest impact in this field?

Research Question 5. What are the most relevant research topics on LMS in higher education?

Materials and methods

The method conducted in this paper was bibliometrics which was the first proposed by Alan Pritchard (1969). To date, this approach was used to explore the published scholar relevant in a knowledge base (Zupic & Čater, 2015) . In education, many of its aspects were researched, e.g. sustainable development (Hallinger & Nguyen, 2020), speech disorders of preschoolers (Anh et al., 2021), status of educational sciences (Vuong et al., 2020). A look closer in higher education, Pham et al. (2021) applied the bibliometric method to review the scholars of international student mobilities in Asia. Moreover, Hallinger and Chatpinyakoop (2019) were interested in sustainable development in HE.

Data collection

Scopus, Web of Sciences, and Google Scholar were the most popular sources in the academic community. Google Scholar, known as a database based on the web platform, had the strength in retrieving literature information. Meanwhile, Scopus, Web of Sciences, had an advantage in evaluating the performance citation analysis (Falagas et al., 2008). Besides, the journal coverage of Scopus was broader than the one of Web of Sciences (Hallinger & Nguyen, 2020; Pham et al., 2021; Singh et al., 2021). Therefore, Scopus was selected as a source to gather data.

The term "learning management system" and its abbreviation "LMS" were two main keywords in the search string. Focusing the topic study, the eligible documents had to be at the higher education level. The initial query was inputted the advanced search form of Scopus at 14:50 April 24, 2021, which was presented below:

TITLE-ABS-KEY (("learning management system*" OR lms) AND (universit* OR "higher education"))

The first search result yielded 4,339 documents. The PRISMA guidelines applied to the systematic review of research (Moher et al., 2009) were conducted to narrow the first search results. Figure 1 showed the steps of the PRISMA diagram. In the screening step, Scopus filters were used to exclude the irrelevant documents. The criteria were set following:

- *Document types:* article, conference paper, book, book chapter.
- *Subject area:* within social sciences, including Arts and Humanities, Business, Management, and Accounting, Decision Sciences, Economics, Econometrics, and Finance, Psychology, Social Sciences.
- *Language:* English
- *Published year:* exclude 2021

The dataset was reduced to 2,049 publications. Then, the title, abstracts and full-text of documents were scanned to determine their eligibility. Seven hundred seventeen ineligibility documents were removed in this step. The final dataset consisted of 1,334 records for this study.
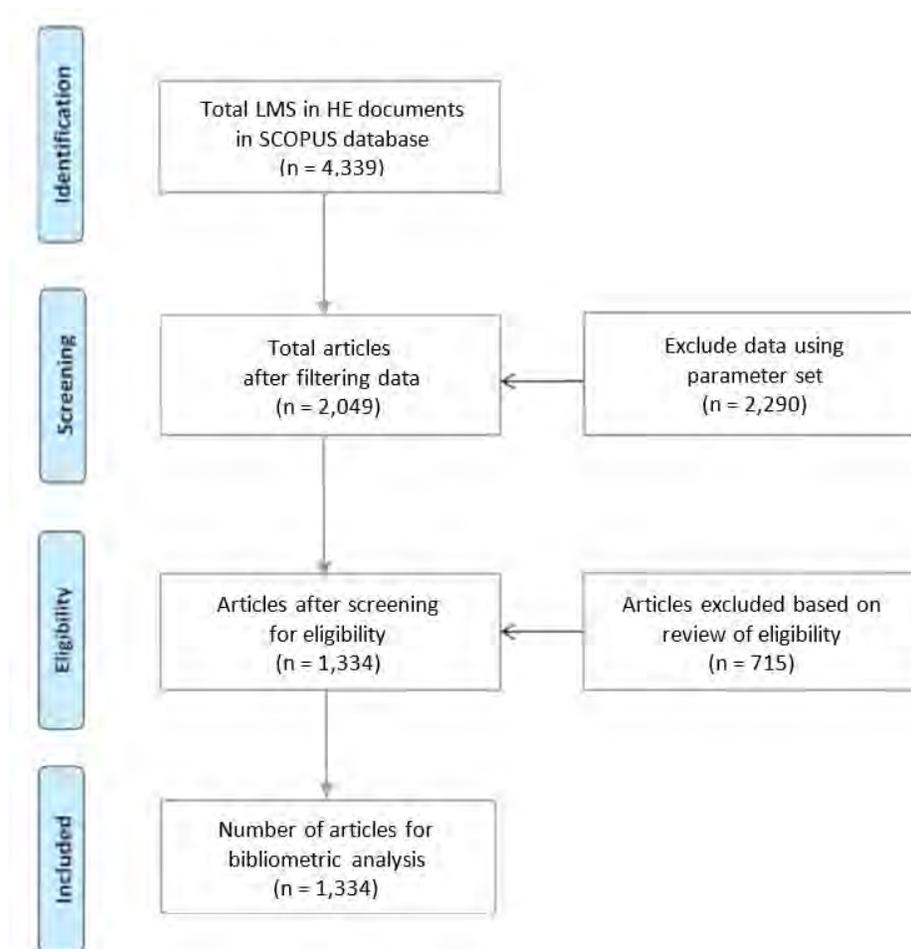
Figure 1:
The PRISMA diagram represents narrowing the analysis dataset of LMS in HE

Data analysis

The retrieved dataset was downloaded as a Microsoft Excel file. The file had 1,334 eligibility records in which referred author name(s), affiliation(s) of the author(s), document title, source type, document abstract, author keywords, number of citations of the document, published the year of the document, and document references. This information was used for bibliometric analysis, which answered RQs above. Each RQ was supported by two analysis approaches, description statistics and science mappings. First, description statistics listed the relevant authors, authors' countries, authors affiliations, sources, documents in LMS in HE field based on the statistics indices, e.g. number of publications, number of citations, Hirsch index (h-index). In this phase, three applications, R with Biblioshiny package, Microsoft Excel and Tableau (https://www.tableau.com/), were applied to the analysis and visualised analysed data. Second, science mappings represented relationships between relevant objects which related authors, countries, sources, affiliations, documents in LMS in HE subject. Their relationships were based on co-authorship analysis, co-citation sources analysis, coupling documents analysis, and co-

occurrence author keywords. VOSviewer version 1.6.14 (https://www.vosviewer.com/) was used to visualise all science mappings in this scholar.

Results

Growth of literature over years and across geographies

The results obtained from the longitudinal analysis of the dataset are shown in Figure 2. The line graph shows the growth pattern of different types of publications (article, conference paper, book, and book chapter) in the literature from 2000 - 2020. The first LMS in HE related document was published in 2000 (see Olivier et al., 2000). The publication was about the Instructional Management Systems (IMS) project, which aimed to improve how teaching and learning are delivered in the UK. The project analyzed and proposed a set of specifications and standards for learning technologies to provide integrated learning systems over the Internet and remove barriers in the way of globalization in higher education. This would be the very start of developing LMS serving HE later.
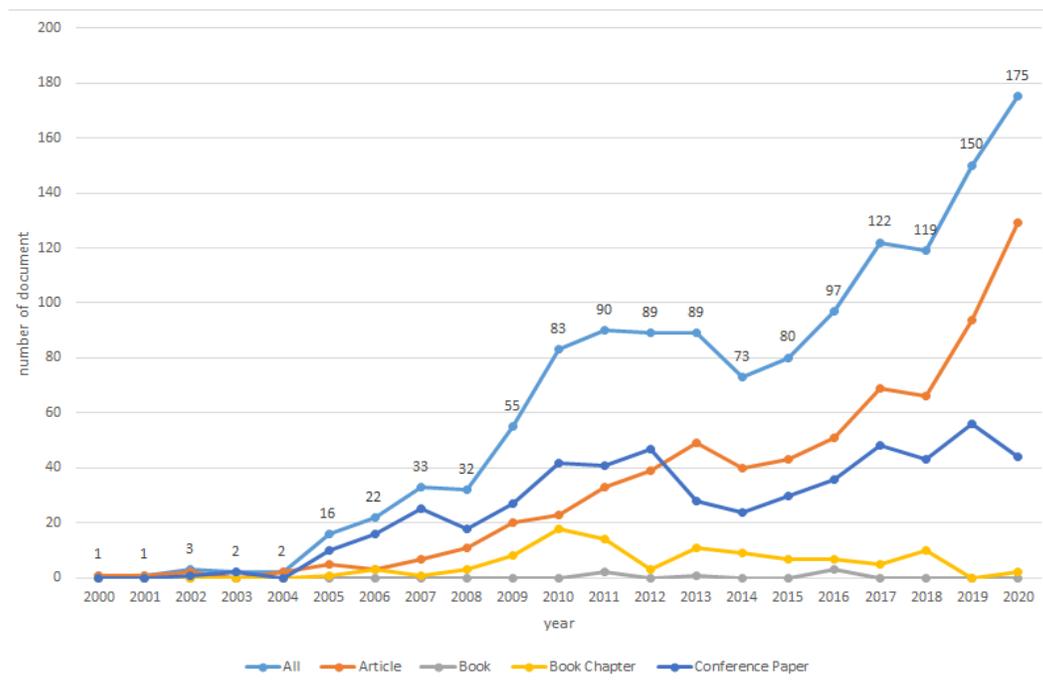
Figure 2
Volume and growth trajectory of the LMS in HE literature by years (n= 1,334)

After the first publication, related studies appeared in succession (between 2001 and 2004) but only with the one-digit number per year. Thus, the period of 2000 – 2004 was the so-called *incipient stage.* The next period 2005 – 2007 was the *surge stage* after a rapid rise in publications between 2004 and 2005 from 2 to 16. The following period of 2008 - 2014 was the name *fluctuation stage.* The number of documents significantly increased between 2008 and 2010 to the peak of the stage with 90 papers in 2011. After that, the figure fell sharply to 73 in 2014. The final period from 2015 to 2020 is the *step-up stage*, during which 55,8% (743) of LMS in HE-related

works was published. Overall, 1,334 eligible publications on LMS in HE were identified from Scopus indexed sources, comprising 688 journal articles (51,57%), 538 conference papers (40.33%), 6 books (0.45%), and 102 book chapters (7.65%).

Figure 3 shows the contributions to the LMS in HE literature by countries; the map was built according to affiliation of the first author. It can be seen that scholars from nearly 40 countries have contributed research works on this issue. However, a large number of studies have been recorded in only certain countries. Notably, Australia and the US lead with a significantly higher number of publications than other countries, with the number of works being 159 (11.9%) and 154 (11.5%), respectively. Besides, some other countries are also active in this topic, which are South Africa (79 publications; 5.92%), Portugal (36; 2.69%), the UK (30; 2.2%), Canada (26; 1.94%), Russian (23; 1.72%), Hong Kong (18; 1.35%), China (16; 1.19%).

Figure 3
Geographical distribution of the LMS in HE literature (counted by 1st author)

The most influential authors

We calculated the number of publications and total citations, illustrated in Table 1. As ranked in Table 1 by the number of works, the most productive scholars are Manuel Castro (12 publications), Elio Sancristobal (7), Shane Dawson (6). However, evaluating by citation shows that the most highly cited authors are Shane Dawson, Leah P. Macfadyen, Refika Koseler, Sevgi Ozkan with the total citations being 830, 701, 350, 350, respectively. Combining two indicators (publications and total citations), we reveal that there are only three authors who appear in both leagues (top 10 according to the number of publications and citations). They are Shane Dawson, Steve Lonn, Stephanie Teasley.

Table 1:
The most important authors according to the number of publications and total citations

Ranked by NP	Author	Affiliation	NP	TC	Ranked by TC	Author	Affiliation	NP	TC
1	Castro M	Spanish University for Distance Education, Spain	12	97	1	Dawson S	University of Wollongong, Australia	6	830
2	Sancristobal E	Spanish University for Distance Education, Spain	7	72	2	Macfadyen LP	The University of British Columbia, Canada	2	701
3	Dawson S	University of Wollongong, Australia	6	830	3	Koseler R	Middle East Technical University, Turkey	3	350
4	Santoso H	Universitas Indonesia, Indonesia	6	73	4	Ozkan S	Middle East Technical University, Turkey	3	350
5	Babo R	ISCAP/Polytechnic Institute Of Porto, Portugal	6	17	5	Lonn S	University of Michigan, United States	5	298
6	Lonn S	University of Michigan, United States	5	298	6	Teasley SD	University of Michigan, United States	4	286
7	Nykvist S	Queensland University of Technology, Australia	5	41	7	Klobas JE	University of Western Australia, Australia	3	276
8	Smith S	Edinburgh Napier University, UK	5	30	8	Mcgill TJ	Murdoch University, Australia	2	276
9	Okamoto T	The University of Electro-Communications, Japan	5	16	9	Hoic-Bozic N	University of Rijeka, Croatia	2	263
10	Teasley S	University of Michigan, United States	4	286	10	Mornar V	Ministry of Science, Education and Sports of Republic Croatia, Croatia	2	263

NP = Number of Publications, TC = Total Citations

In addition, we set a threshold of 20 citations in VOSviewer to visualize connections among frequent co-cited authors (Figure 4). The map displays 205 authors divided into 5 clusters. Authors in the same cluster are believed to have a consensus in approaches, interests, and viewpoints about the research topic. Thus, each cluster represents a school of thought, which forms the intellectual base of the field (Hallinger & Chatpinyakoop, 2019; White & McCain, 1998).

The red cluster in the center illustrates the connections among researchers who focused on *students' learning engagement and motivation*. The cluster comprises 79 authors, led by Charles Graham (90 citations and 859 link strength), Hamish Coates (82 and 906), Steve Lonn (70 and 783). The green cluster with 52 scholars was directed to the *technology acceptance model* (TAM), especially on investigating how students, instructions, and institutions perceived LMS use. Critical scholars of this school of thought are Fred David (216 citations and 2,089 link strength), Viswanath Venkatesh (115 and 1,731), and Icek Ajzen (79 and 1,352).
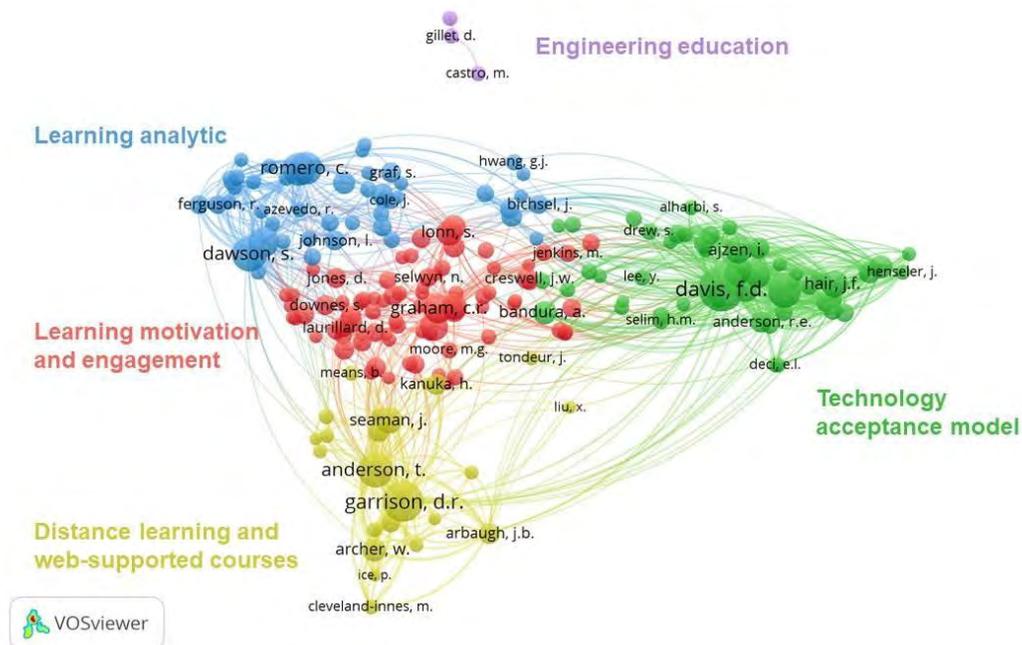

Figure 4

Author co-citation analysis map for LMS in HE (display 205 authors with at least 20 citations)

The blue cluster represents the group of researchers, which studied *learning analytic and educational data mining*. This school of thought includes 48 authors, and the most prominent authors are Shane Dawson (134 citations and 1,484 link strength), Cristobal Romero (116 and 1,160), Sebastián Ventura (114 and 1,156), and George Siemens (97 and 886). The yellow cluster is drawn by Terry Anderson (132 citations and 1,874 link strength), Randy Garrison (175 and 2,661), and Julia Seaman (77 and 706). Scholars belonging to this school of thought conducted studies about *e-learning, distance, blended learning, and web-supported courses in general*. The purple cluster is the most minor and isolated cluster with Manuel Castro (24 citations and 82 link strength), Denis Gillet (26 and 130), Sebastián Dormido (24 and 86). The school of thought

majored in *engineering education, intelligent and remote systems.* Their publications addressed educational technology and the development of virtual and remote labs for education.

The most significant sources

Resulting from source citation analysis, Table 2 lists the top sources for productivity and citations in the field. This provides us the viewpoint of distribution of LMS in HE literature across these journals and conference proceedings, along with their proportionate influence. In general, the sources presented mainly have aims and scopes in education and computer science.

As ranked by quantity, FIE (35 documents), IJETL (34) and ICEL (33) are the top three sources having the greatest number of publications. In terms of total citations, CE has the highest citations, which is 1994, followed by IHE, ETS, AJET, with the figure being significantly lower at 508, 331, 327, respectively. It is apparent that larger amounts of documents were published in conference proceedings, meanwhile, publications of journals were more cited and evidenced more influential. For instance, TEM is ranked 8th in the top citations list with only one document and 258 citations.

The most impactful documents

To explore the most remarkable documents in the field, we analyzed citations to compare the impact. We set VOSviewer to a threshold of at least ten citations to identify top highly cited publications. Twenty of the most highly-cited documents in the field of LMS in HE, including 19 journal articles and one conference paper, are listed in Table 3 with their indications of local citations (computed within the LMS in HE dataset) and global citations (referred to Scopus citations).

The earliest document in the list, authored by Coates et al. 2005, had the highest local citations. The paper overviewed the evolution and consequences of integrating LMS into teaching and learning in HE. Authors also discoursed on educational practices related to implement and develop LMS in university.

The article of Lonn and Teasley (2009) with 44 citations ranked 2nd in local citations. The study investigated how students and teachers perceived the usefulness of LMS. The research suggested that teachers and students tend to use it as a means of communication rather than a tool to improve learning experiences and pedagogical approaches.

In terms of Global citations, the publication authored by Macfadyen and Dawson (2010) evidenced the highest number with 538 citations. The paper was an exploratory research exam if tracking data of LMS could predict students' achievement. They indicated that a few LMS variables, subordinated to courses' site design and objectives, effectively predicted students' academic outcomes.

Ozkan and Koseler (2009) surveyed to validate the construct of the conceptual e-learning assessment model, an approach to evaluate LMS via six features: (1) system quality, (2) service quality, (3) content quality, (4) learner perspective, (5) instructor attitudes, and (6) supportive issues. The result showed that the six dimensions were significant in both assessing the effectiveness of LMS and evaluating students' satisfaction. The document was recorded with 305 global citations and was the second-highest global citations in the data.

Table 2:

The most significant sources according to number of publications and total citations

Most prolific sources						Most highly-cited sources					
Source	ST	Scopes	NP	TC	SQ	Source	ST	Scopes	TC	NP	SQ
Frontiers in Education Conference (FIE)	CP	Engineering and computing education	35	223	Q3	Computers And Education (CE)	JN	Technology in education	1994	18	Q1
International Journal of Emerging Technologies in Learning (IJETL)	JN	Learning technology	34	246	Q2	Internet And Higher Education (IHE)	JN	Online teaching, learning, management, and administration in higher education	508	12	Q1
Proceedings Of The International Conference On E-Learning (ICEL)	CP	E-learning	33	32	-	Educational Technology And Society (ETS)	JN	Technology in education	331	8	Q1
Proceedings Of The European Conference On E-Learning (ECEL)	CP	E-learning	28	27	-	Australasian Journal Of Educational Technology (AJET)	JN	Technology in tertiary education	327	19	Q1
Australasian Journal Of Educational Technology (AJET)	JN	Technology in tertiary education	19	327	Q1	IEEE Transactions On Education (TOE)	CP	Engineering education	316	4	Q1
Education And Information Technologies (EIT)	JN	ICT in education	19	134	Q1	Computers In Human Behavior (CHB)	JN	Cyberpsychology	314	5	Q1
Turkish Online Journal Of Distance Education (TOJDE)	JN	Distance education	19	75	Q2	Ieee Transactions On Learning Technologies (TLT)	CP	Learning technology	260	6	Q1
Computers & Education (CE)	JN	Technology in education	18	1994	Q1	Tertiary Education And Management (TEM)	JN	Higher education	258	1	Q2
International Review Of Research In Open And Distance Learning (IRRODL)	JN	Distance education	16	204	Q1	International Journal Of Emerging Technologies In Learning (IJETL)	JN	Learning technology	246	34	Q2
IEEE Global Engineering Education Conference, Educon (GEEC)	CP	Engineering education	10	47	-	Frontiers In Education Conference (FIE)	CP	Engineering and computing education	223	35	Q3

ST = Source Type, JN = Journal, CP = Conference Paper, TC = Total Citations, NP = Number of Publications, SQ = Scopus Quartile.

Table 3:

Top 20 highly-cited documents

Rank	1st Author, PY	Title	DT	LC	GC	LC/GC Ratio
1	Coates H, 2005	A critical examination of the effects of learning management systems on university teaching and learning	JA	57	258	22.09
2	Lonn S, 2009	Saving time or innovating practice: Investigating perceptions and uses of learning management systems	JA	44	224	19.64
3	Macfadyen LP, 2010	Mining LMS data to develop an "early warning system" for educators: A proof of concept	JA	24	538	4.46
4	Naveh G, 2010	Student lms use and satisfaction in academic institutions: The organizational perspective	JA	20	92	21.74
5	Weaver D, 2008	Academic and student use of a learning management system: Implications for quality	JA	15	92	16.30
6	Cerezo R, 2016	Students' LMS interaction patterns and their relationship with achievement: A case study in higher education	JA	14	118	11.86
7	Heirdsfield A, 2011	Blackboard as an online learning environment: What do teacher education students and staff think?	JA	13	50	26.00
8	Carvalho A, 2011	Students perceptions of Blackboard and Moodle in a Portuguese university	JA	12	65	18.46
9	Ozkan S, 2009	Multi-dimensional students' evaluation of e-learning systems in the higher education context: An empirical investigation	JA	11	305	3.61
10	Machado M, 2007	Blackboard vs. Moodle: Comparing user experience of learning management systems	CP	11	77	14.29
11	Gautreau C, 2011	Motivational factors affecting the integration of a learning management system by faculty	JA	11	52	21.15
12	Islam AKMN, 2013	The moderation effect of user-type (educators vs. students) in learning management system continuance	JA	9	108	8.33
13	Klobas Je, 2010	The role of involvement in learning management system success	JA	9	37	24.32
14	Emelyanova N, 2014	Introducing a learning management system at a russian university: Students' and teachers' perceptions	JA	8	34	23.53
15	Mcgill TJ, 2009	A task-technology fit view of learning management system impact	JA	7	239	2.93
16	Macfadyen LP, 2012	Numbers are not enough. Why e-learning analytics failed to inform an institutional strategic plan	JA	7	163	4.29
17	Venter P, 2012	Drivers of learning management system use in a south african open and distance learning institution	JA	7	34	20.59
18	Findik Cokunay D, 2013	A model for instructors' adoption of learning management systems: Empirical validation in higher education context	JA	7	33	21.21
19	Raman A, 2013	Preservice teachers' acceptance of learning management software: An application of the UTAUT2 model	JA	6	114	5.26
20	Stantchev V, 2014	Learning management systems and cloud file hosting services: A study on students' acceptance	JA	6	107	5.61

PY= Published year, DT = Document type, JA = Journal article, CP = Conference paper, LC = Local citations, GC = Global citations.

Bibliography coupling analysis was conducted with a threshold of at least 20 citations to identify subject-relatedness among publications in the dataset (figure 5). Nodes visualized documents with captions including names of first author and publishing years; when both documents cite the third document, they are linked together and clustered into groups. The bibliography coupling maps revealed five clusters colored differently.
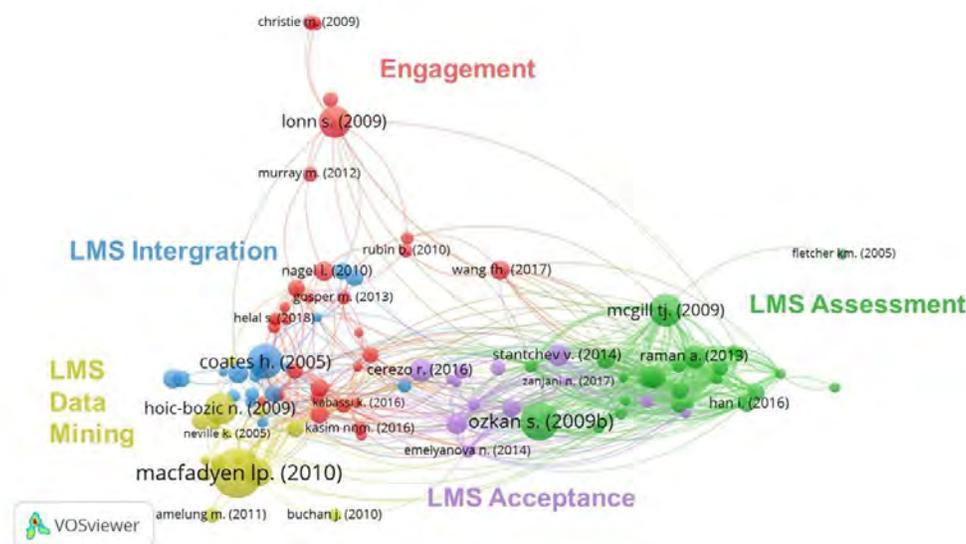

Figure 5:
Bibliography coupling map of LMS in HE (20 times, 106 publications)

The largest cluster in red, named *Engagement*, comprises 33 documents, led by Lonn (2009) (15 link strength and 224 citations); Wang (2017) (14 and 81); and Nagel (2010). Publications in this cluster focused on engagements, collaborators, and interactions of/among students and instructors with/on LMS and usage of LMS as a means to innovate pedagogical practices.

The green cluster, termed *LMS Assessment*, consists of 26 publications, drawn by documents of Ozkan (57 link strength and 305 citations); Mcgill (105 and 239); and Islam (94 and 108). The major research problem of the cluster is to propose or adopt a framework to assess the efficiency of LMS in HE.

The blue cluster was formed from 18 documents. Key documents were authored by Coates (5 link strength and 258 citations), Despotovi-zraki (12 and 86), and Machado (1 linkstrength, 77 citations). These documents focused on integrating LMS on a blended program and LMS assistance to the face-to-face classroom. Thus, the cluster is so-called *LMS Integration*. The yellow cluster with 18 nodes is the *LMS Data Mining* cluster. The two most prominent nodes represent publications of Macfadyen (34 link strength and 538 citations) and Hoic-bozic (11 and 223). The research front draws attention to using features and implementing data from LMS in courses design and exploring student learning behavior patterns. Finally, the smallest cluster is the purple one with 13 documents. The most cited publications in this group are Cerezo (2016) (13 link strength and 118 citations), Stantchev (2014) (31 and 107), Naveh (2010) (52 and 92). The common topic in this group is *LMS acceptance* of students, lecturers, and academic institutions.

The global trending research topics

Figure 6 illustrates the result obtained from author keyword analysis with a threshold of 5 occurrences, displaying 129 keywords/noun phrases. The frequency of keywords was illuminated by the size of nodes, while the width of links presented the times of co-occurrences of two keywords. After the keywords in the search query ("LMS," "Learning system management*"; "universit*," "higher education") was excluded, the most frequent topics are "E-learning" (276 occurrences and 572 link strength), "Moodle" (137 and 298), "Blended learning" (106 and 201), "Online learning" (59 and 129), "Learning analytic" (52 and 95), "TAM" (42 and 93), "distance learning" (40 and 103).
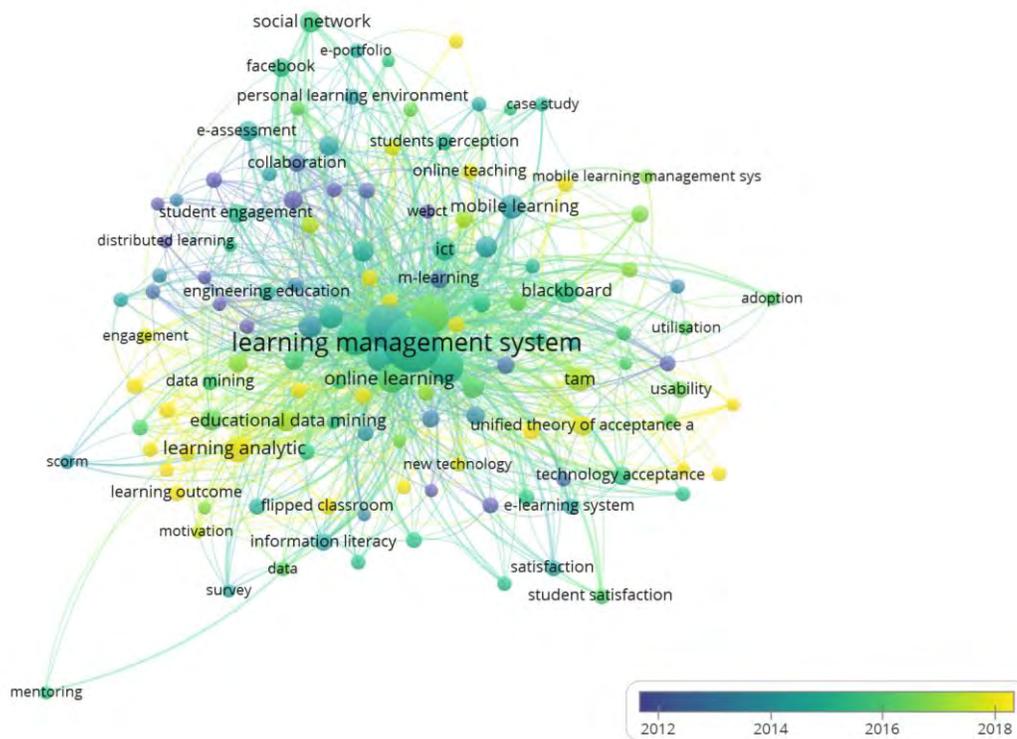
Figure 6:

Overlay visualization map of co-occurrence author keyword in LMS in HE (129 word, 5 times)

Besides, the temporal prevalence of keywords was reflected by the color ranging from purple (most popular around 2012) to yellow (recent). As shown in the figure, the most trending keywords are "learning analytic" (52 occurrences and 95 link strength), "unified theory of acceptance and use of technology" (19 and 50), "Pls-sem" (15 and 34), "flipped classroom" (9 and 22), "gamification" (9 and 20), "gender" (9 and 21), "covid-19" (8 and 16).

Discussion and conclusion

Through the bibliometric analysis of 1,334 Scopus-indexed documents published between 2000 and 2020, this systematic review mapped knowledge on the LMS in HE.

Research results show that, in the past two decades, research on LMS has grown rapidly, especially intensely in the years 2015-2020. The research is mainly articles and conference papers. The number of works quickly increased and intensely in 2015 - 2020. This growth process of LMS research is consistent with the development trend of international education and the strong development of technology. The development of international collaboration in education and science lead to the widespread use a unified of digital learning system in higher institutions to promote cooperation (Kerimbayev et al., 2017).

After a long period of widely applying information technology and media to education, the relationship between the use of technology and educational effectiveness has received considerable critical attention. Technology in education has encouraged creativity and problem-solving ability and empowered learners to promote equality (Aristovnik, 2014). The impact of technology also leads to the use of many LMS to provide courses, combined and online programs (Mune et al., 2015), to develop e-learning and support frequent activities of students outside classrooms (Gomes et al., 2015). Technology has played an essential role in solving problems related to teaching and learning in university (Stoddart, 2015). Therefore, recent years' rise of research works on LMS in HE is understandable.

Regarding geographical perspective, Australia and the US are leading countries with a significantly higher number of publications than other countries. In the US, nearly 99% of higher education institutes use LMS (Awad et al., 2019). As it is an indispensable part of universities, there is a considerable number of studies related to LMS. Similarly, Australia is a country that has used LMS in almost all educational institutes, and the systems have been utilized to support learning in many fields, various levels of learning and learning situations (Turnbull et al., 2021). Australia and the USA are leading countries in implementing and developing university online courses, especially in international training cooperation. Thus, these two countries are conducting several studies to assess the ability to apply and the influence of LMS.

The number of publications on LMS in developed countries is superior to that of developing countries. Although this result may be skewed as this study focused on English-language publications, the findings suggest that the capacity to investigate LMS in HE is poorly distributed globally, with relatively little research from developing societies. This is understandable because there are always differences between developed and developing countries in e-learning implementation. In developed countries, e-learning grows not only in quantity but also in quality. There are few challenges in developed countries when implementing e-learning because they have the appropriate infrastructure and knowledge of the technology (Reddy & Naresh, 2015). Meanwhile, utilizing LMS in developing countries is considered incomplete and rated below satisfactory (Alshammari et al., 2016).

The above fact shows that formal research funding programs should be prioritized to encourage research on LMS in HE in developing countries. Over the past decade, there has also been a growth pattern in LMS research conducted by academics in developing societies (such as South Africa). Therefore, we could expect active international efforts to stimulate further interest, build competence, and support empirical studies among LMS scholars in HE in developing societies to make use of LMS in online courses or blended learning more effective.

This study brings a list of relevant authors and documents that shaped LMS discourse in HE. For example, top influential academics and papers identified in this review provide a 'point of entry' for LMS researchers in the new HE, reducing its time to catch up on key topics, concepts, and

experimental discoveries. Defining the emerging intellectual structure of the LMS in HE highlights several key areas that may be ripe for further consideration using narrative synthesis methods, thematic and traditional criticism.

Our analysis concludes that research on LMS in HE is being published in a group of high-qualified journals and conferences. However, most journals that are highly-cited on LMS in HE are not the most publications on this subject. Three of the top five productivity sources published on LMS in HE are from technical and computer education conferences and e-learning. This shows that the LMS in HE is a "hot topic", attracting much attention from researchers and practitioners.

The global research topics on LMS in HE are pretty common and familiar topics, which have been noticed in education (distance education, technology in education, e-learning) and technology, not much participation from other industries. In which, focus on "e-learning " and teaching models associated with LMS using such as "blended learning ", "online learning", "analytical learning ", "distance training ". The result also shows that Moodle is the most popular and researched LMS system. This could rely on Moodle being open-source, free of charge. In recent years, along with using LMS, educational institutions have become more interested in how students obtain learning outcomes and what could be improved by upgrading and monitoring LMS systems' learning activities. At the same time, they have also focused on evaluating the use and acceptance of users. Therefore, the studies on "learning analytic", "unified theory of acceptance and use of technology" are becoming more popular.

In the past two years, new studies on LMS use have been created in a new context with the keyword "Covid-19". As the disruption of the covid pandemic, online learning has become a compulsory form of teaching for many countries worldwide. Universities have had to shut down on-campus teaching for a long time completely. Therefore, LMS systems are increasingly used as an online learning environment (Dias et al., 2020). Research currently focused on issues, such as the ability to track and flexibly manage the learning process; organize the examination and assessment of learning results; difficulties in learning online; and increased use of features associated with LMS because many schools are not prepared to respond to a complete transformation of teaching formats (Ilieva & Yankova, 2020; Khraisat et al., 2020).

This review article does not replace the need to delve into the results of studies in the knowledge base. In addition, the analysis did not involve all documents related to the LMS in HE. Although a large number of documents have been identified, the use of Scopus index cannot determine the extent to which the dataset represents the entire document. Other sources, e.g. Web of Sciences, Google Scholar, Dimensions, could be referred to in further research. However, according to Hallinger & Chatpinyakoop (2019), this limitation was slightly lessened by using co-citation analysis, which enabled the identification of the "co-cited" documents, which were located in the larger database excluded from Scopus.

Despite the limitations, this study offers some promising implications. This paper analyzes and indicates noteworthy topics and keywords, impactful authors and documents in each topic, which is supposed to assist the searching strategy of both researchers and practitioners when they learn about LMS in HE. Especially for researchers, the findings act as a map, where they can find the core documents, spot recent topics and ignored topics, and identify potential research issues. Furthermore, the sources rankings also help future researchers determine where to and submit their manuscripts. In the same vein, higher education policy makers and university's leaders and

managers may also use this study as a knowledge base to utilize as inputs for their policy and decision making practices.

On the methodological level, this study represents a sample of how to implement bibliometrics analysis, an increasingly demanding method by the community, political and funding agencies to evaluate research productivity and relevance, and the effectiveness of research activities and research cooperation activities at regional and national levels.

In conclusion, this review reinforces the growing recognition that LMS play an essential role in the global effort to implement digital transformation in education. Therefore, attracting more attention from various fields of education and interdisciplinarily drawing knowledge by involving two or more academic disciplines (such as administration, policy, and culture) is necessary to make the use in HE more effective, potent, and valid. These trends combine to create a picture of an emerging sector that can impact policy and practices in the coming up years.

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