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Learning Management System (LMS) Research using VOS viewer Application: A Scientometric Profile

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Abstract

This research aims to identify the trends and development and how technology supports education these days using the VOSviewer database. The purpose of the study is to appraise the research productivity on learning management systems (LMS) in India and to examine the various indicators like growth trajectory, annual growth rate, authorship trends, collaborative patterns, institutional collaboration, most prolific authors, top-ranked journals, top-ranked subjects, and top-ranked funding agencies. This study was conducted through scientometric analysis of Learning Management System (LMS) in the two decades from 2004 to 2023 retrieving the metadata in the Scopus database, VOSviewer mapping visualization application, and MS Excel spreadsheet for analysis. This study was expected to identify the research trends, collaborative patterns, novelty, and future education in LMS adaptability. The results show that Learning Management System Publication consists of 7 clusters with 3353 links and a total of 12025 Link Strengths through 178 items through the VOSviewer application. We examined how many articles have been published on the Learning Management System and connected with their problem areas using VOSviewer. This analysis can be aninitial point for further research related to LMS or mode of Distance Learning.

Keywords: Scopus, Research performance, Scientometrics, bibliometrics, learning management systems (LMS), e-learning, distance learning, international collaboration, India.

INTRODUCTION

One of the most recent innovations in distance education is course management or learning management systems. This LMS allows educators to develop and deliver instruction and learning opportunities in an organized and collaborative manner. E-learning can transform how students learn in the new world where knowledge is important and change is constant. E-learning is the continuous assimilation of knowledge and

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skills by learners, stimulated by synchronous and asynchronous learning events, which are authored, delivered, engaged with, supported, and administered using web technologies. Learning Management Systems (LMS) have been widely used in teaching and learning media. Technologyis an essential aspect of most school or university curriculum.[1-4] The adaptability of LMS in higher education or another level ofeducation has been a substantial concern for the implementation of the digital learningprocess.[5-6] LMS[7] is asoftware or application that assists teaching professionals in managing reporting, tracking, documentation,and delivering educational courses or training programs. LMS[8-9] supports the amalgamation of several objectsand services into the ecosystem, particularly in the education field, and sequent students'training experiences. LMS[10] provides several opportunities which include the ease of organizing and conductingonline courses, the ability to complete online assessments, accessibility and availabilityof learning materials, to save time and money for students and faculty, and communication and interactivity. On the other hand, LMS[11-14] challenges that students facea lot of shortcomings when adopting these technologies like lack of studentself-discipline and the discrepancy between LMS and specific academic programs. Nevertheless, as LMS[15] technology has widely been increased in different countries, environments,consumer styles, traditional or creative, and there are no boundaries in the LMS research trajectory.

Publication analysis and research productivity in the form of scholarly publications in a peer-reviewed journal are considered one of the main benchmarks for measuring research performance. Scientometric valuation evaluates scientific research productivity for research it is a science about science; it is a distinct, recognized, and well-established scholarly field with its own identity, history, theories, and methodologies. Scientometrics indicators apply to evaluate scientists, universities, and research institutes for systematic and scientific policy making.

Research publications on LMS education tend to increase every year. A simplemethod that can be undertaken is through the scientometric analysis by retrieving the metadata from the Scopus Elsevier database. The major objectives of this scholarly research are highlighted in the next paragraph.

OBJECTIVES OF THE STUDY

The major objectives of this study are:

- Toappraise the year-wise growth, document type, and countries that contributed to LMS research during 2004-2023;
- Toobserve the top affiliates and sponsorship funding of LMS research;
- To identify the top 10 most productive authors of the LMS research;
- To measure the most leading subject areas, and top source titles in LMS research and
- To recognize the results of research trend mapping visualization on LMS research.

METHODOLOGY

The required metadata was collected from the Scopus database for data analysis and VOSviewer software for data mapping and visualization by applying the scientometric method. To extract metadata, choose search within the column that indicates article titles, abstract, and search documents was "Learning Management Systems" and "LMS" was in or add field and also chosen the country "India". A total of 1,58,166 scholarly literatures were found at the global level, and 10, 421 research publications were identified at the national level for two decades from 1st January 2004 to 31st December 2023. The VOSviewer software is applied to identify various metadata visualizations like network, overlay, and density visualization for sources, authors, countries, and keywords. It found that Learning Management System Publication consists of 7 clusters with 3353 links and a total of 12025 Link Strengths through 178 items through VOSviewer application.

Scope and Limitations

The scope of the present research is limited to scholarly research output of learning management systems (LMS) published two decades from 2004 to 2023 at the national level as listed in the Scopus Elsevier database based on the scientometric parameters.

RESULTS AND DISCUSSION

1. Year-wise Publication contribution

Chart 3.1 denotes the contribution of LMS scientific literature in year-wise for two decades from 2004 to 2023 at the national level. A total of 10421 publications and out of it, the maximum number of records was 3087 (29.62%) in the year 2023 and the lowest number of publications was 17 (0.16%) in 2004. The analysis reveals that the publication growth on LMS has gradually increased during the research.

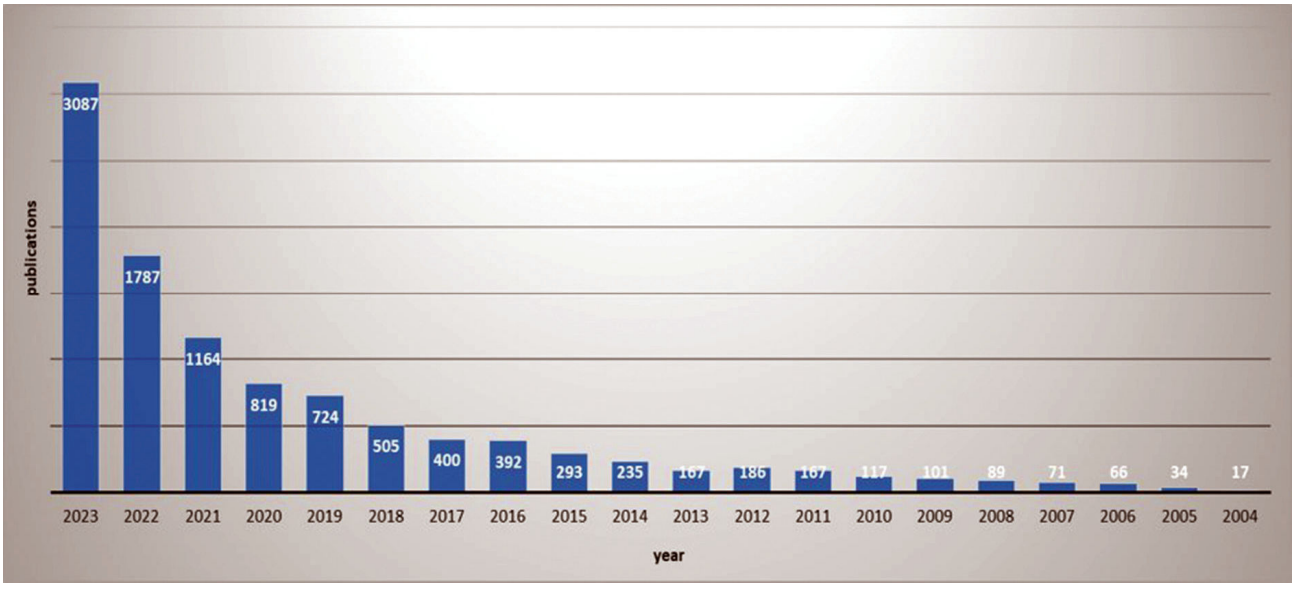

Chart 1: Chronology-wise publications

2. Types of Publications

Chart 2 shows different kinds of documents retrieved from the Scopus database. A total of 16 types of publications were found and only the top four categories were taken for analysis by the researcher. The results indicate that the majority of 51.56% of documents were conference papers followed by journal articles 38.76%. The third leading publications were book chapters with 6.57%.

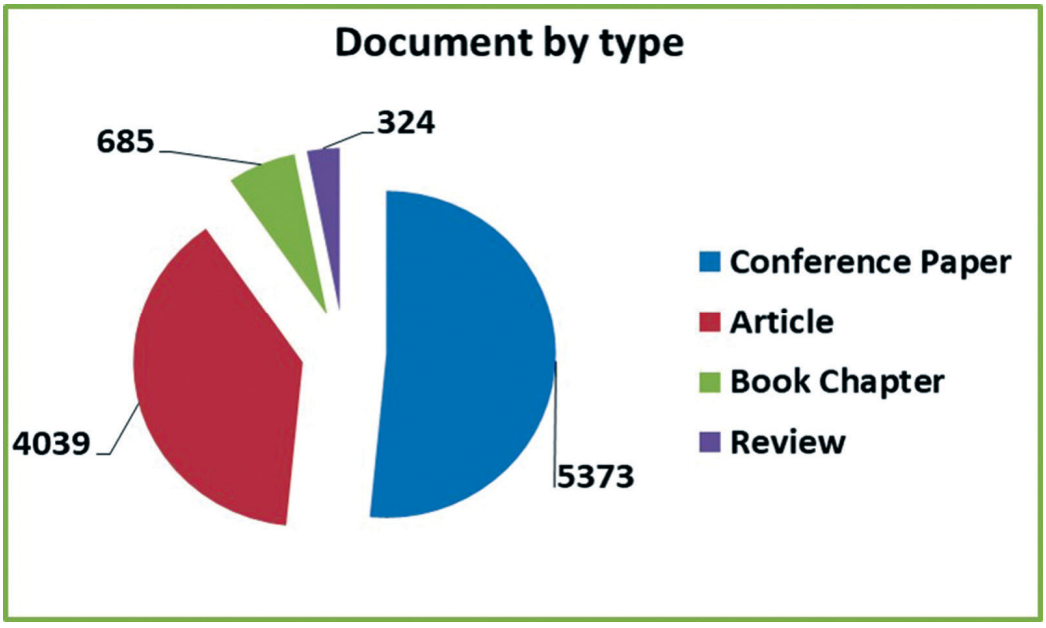

Chart 2: Document type

3. Collaborative Countries on LMS

Table 1 represents the international collaboration in LMS research and the results reveal that the Indian scientists produced scholarly publications on LMS and collaborated with foreign authors of 173 countries. But, the researcher has taken only the top 5 countries for analysis. The highest number of publications collaborated with the United States (490) with 13857 citations and a total of 3349 link strength, and got first rank, followed by the United Kingdom ranked second with 201 publications and citations 9547 and a total link strength was 1094, and Saudi Arabia published 236 research papers with citations were 4409 and the total link strength was 593 and got ranked third place among five countries.

Table 1: Top Five countries with papers and citations and Link strength

Country Name	Records	Citations	Total Link Strength
United States	490	13857	3349
United Kingdom	201	9547	1094
Saudi Arabia	236	4409	593
Australia	148	5381	535
China	144	5159	466

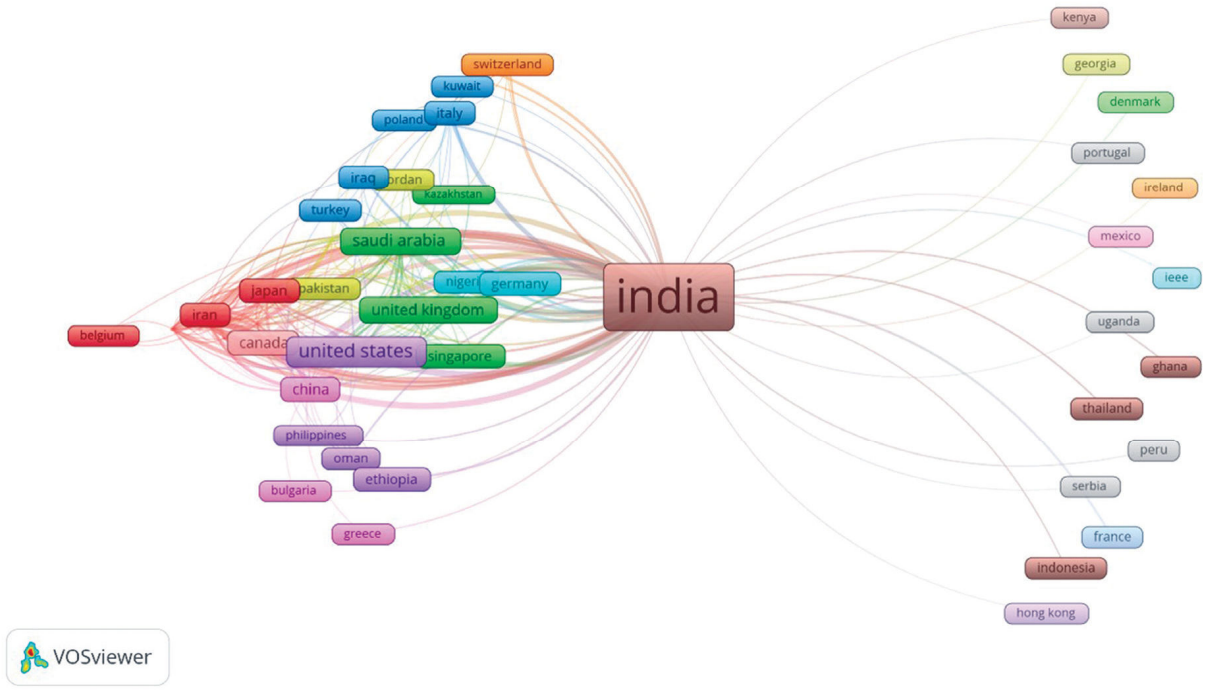

Fig. 1: Network visualisation of top-ranked countries with citations

4. Mapping visualization of keywords co-occurrence on all LMS research

The results of mapping using VOSviewer show the number of distribution items of keywords related to the Learning Management System, Each item found related to the LMS in data mapping was divided into 7 clusters, 178 items, 3353 links, and a total of 12025 link strength.The cluster indicates the relationship between each element. Labels are assigned to each term with colored circles. The size of the circle for each cluster varies depending on the frequency of occurrence of the cluster. The more often the term is encountered, the larger the label size. The mapping description analyzed in this study consists of 3 parts: Network Visualization (*see Figure* 3.2), Density Visualization (*see Fig.* 3), and Overlay Visualization (*see Fig.* 4).

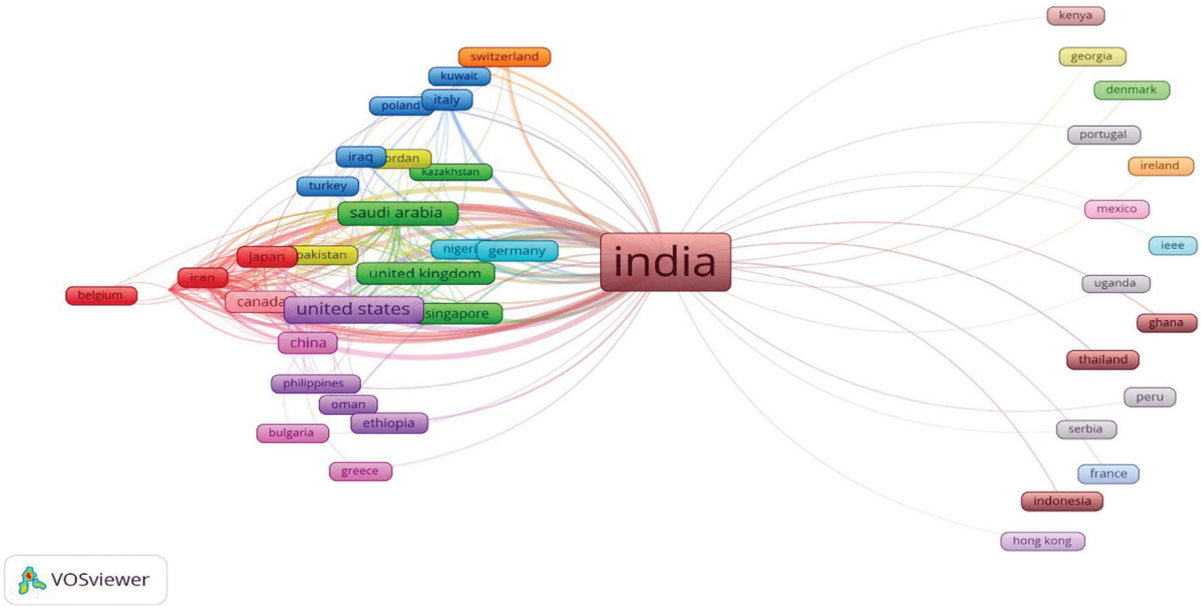

Fig. 2: Mapping visualization of keywords co-occurrence on all LMS research (2004-2023)

Fig. 2 shows visualizations of keyword co-occurrences in all LMS research over the past thirty years to find the novelty and inter-relationships between studies. The mapping visualization showed eight main clusters as the focus of LMS research. From the network visualization, the Learning Management System consists of 7 clusters with 3353 links and a total of 12025 Link Strengths.

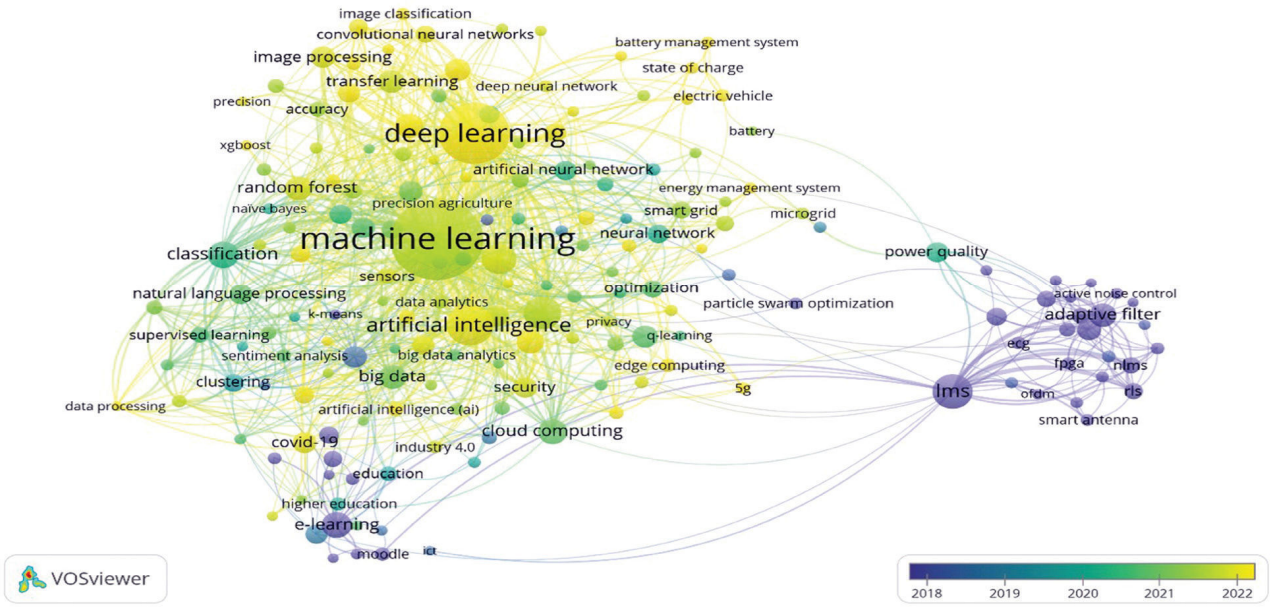

Fig. 3: Overlay visualization of the Learning Management System Publications.

Figure three represents how publications on LMS are developing, the brighter the colour indicates that the topic is newer, and the darker the colour, the longer the publication period is. The popularity of research on Learning Management System in research has been around for a long time, and more and more topics related to Learning Management System over time with this visualization. The result indicates that we can do the latest research on LMS effortlessly.

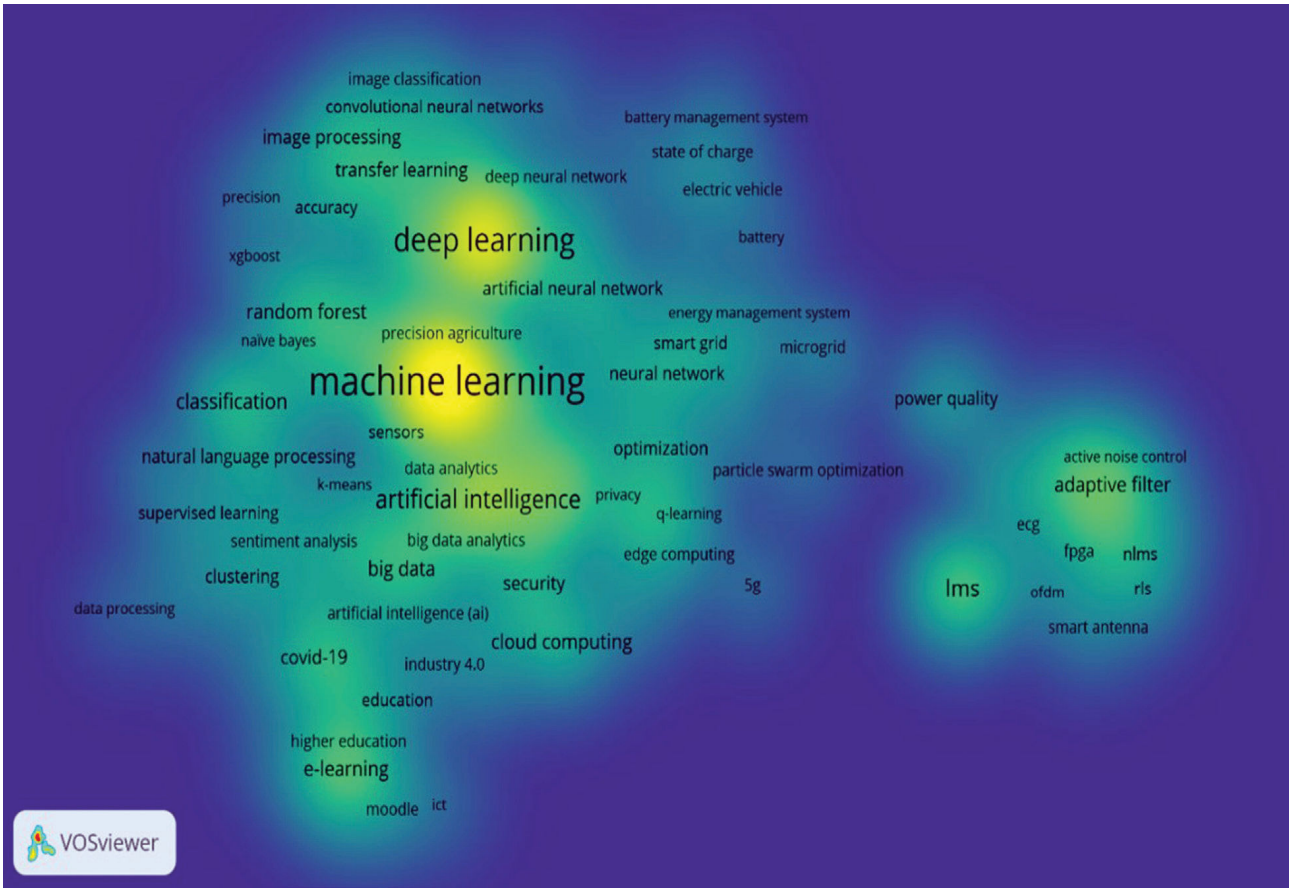

Fig. 4: illustrates the Density visualization of LMS

Fig. 4 shows the density curve of LMS which means that the brighter and larger the diameter of the big topic indicator, the more often that term appears in search results, which means more related terms have been researched. On the other hand, if the color of the term fades to near the background color, there is still little research on the term.[16]

5. Most productive top five authors with highly cited papers

Table 2 highlights the five top-ranked most prolific authors who produced papers on LMS during the study in India. The results reveal that the majority of papers published by "Singh, B" from the Indian Institute of Technology, Delhi with 76 prolific writings got ranked first. The next productive author is "Kukreja, V" from Chitkara University, Punjab with 42 research papers, and placed second and third prolific author is "Panda, G." from the Indian Institute of Technology, Bhubaneswar with 34 scholarly articles. The same work was pointed out in a previous study conducted by Velmurugan (2013).[17]

Table 2: Top five authors with highly cited papers

Author	Institution	No of Papers	Citations
Singh, B.	Indian Institute of Technology, Delhi	76	1458
Kukreja, V.	Chitkara University, Punjab	42	322
Panda, G.	Indian Institute of Technology, Bhubaneswar	34	634
Tanwar, S.	Nirma University, Gujarat	33	868
Kumar, N.	Deemed to Be University, Patiala	30	1290

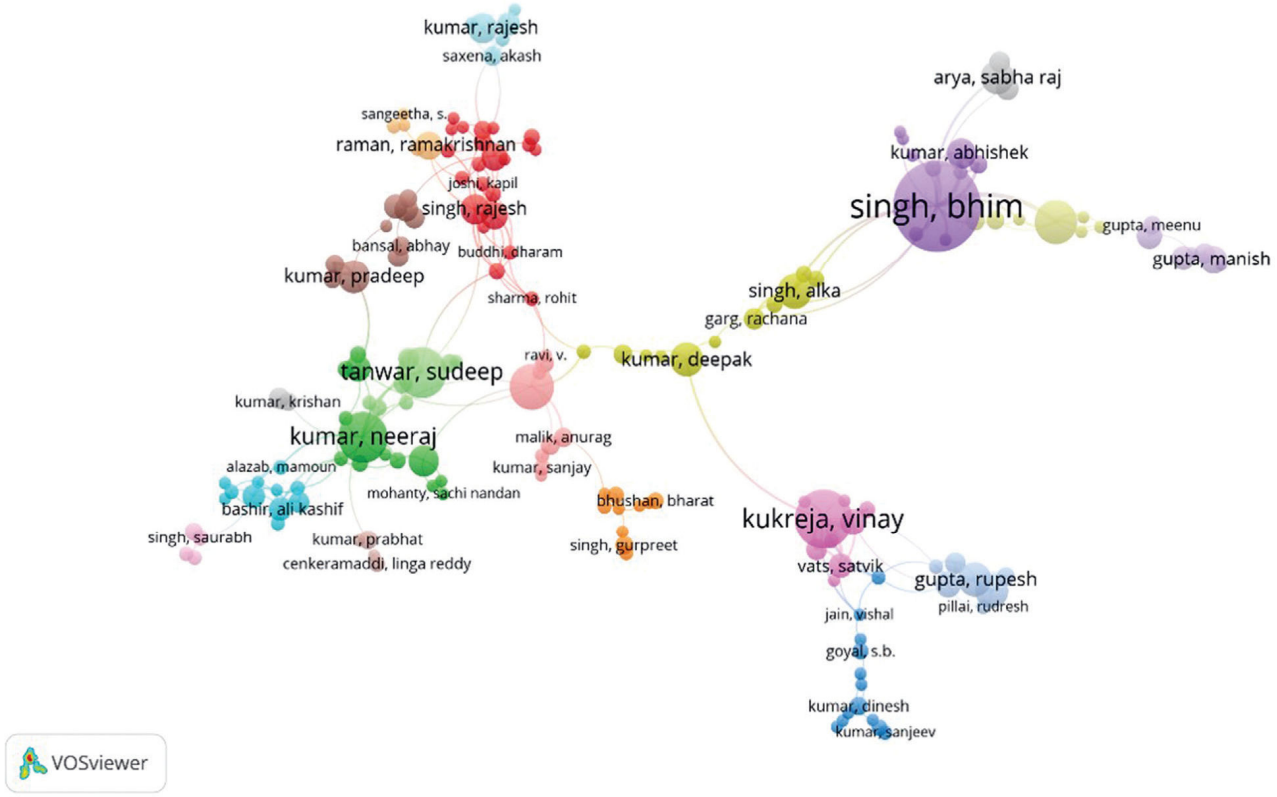

Fig. 5: Network visualisation of top-ranked authors on LMS

6. Identification of Source Impact on LMS

Table 4. The results represent that the source journals "Advances in Intelligent Systems and Computing" and "Lecture Notes in Electrical Engineering" are highly influential journals producing a maximum of 180 research papers,an h-index of 69, an impact factor of 7.4 and 180 papers, and an h-index of 45, impact factor is 0.37. The "Procedia Computer Science" journal is at the bottom of the list and has produced 55 papers and an h-index of 132. But, compared with the h-index among ten journals, "IEEE Access" ranked top with 68 papers.Cao *et al*. (2020)[18] carried out the same work.

Table 3: A list of the top ten journals on LMS by Indian authors was published

Source Title	No of papers	h-index	Impact Factor
Advances In Intelligent Systems and Computing	180	69	7.4
Lecture Notes in Electrical Engineering	180	45	0.37
Lecture Notes in Networks and Systems	172	36	0.54
Communications in Computer and Information Science	92	69	0.49
ACM International Conference Proceeding Series	91	151	0.50
Emerald Emerging Markets Case Studies	78	9	0.21
IEEE Access	68	242	3.9
AIP Conference Proceedings	67	83	0.7
Smart Innovation Systems and Technologies	58	31	0.53
Procedia Computer Science	55	132	3.0

7. Top five funding sponsors and affiliations on LMS

Table 4 shows the top 5 funding sponsors and top affiliations in LMS research within two decades. Among the top 5 funding sponsors, the most sponsorship funding was the Ministry of Science and Technology from India with 148 research literature, followed by the Science and Engineering Research Board with 84 research documents, the Ministry of Electronics and Information Technology with 46 documents, Council of Scientific and Industrial Research with 34 and University Grants Commission with 34 research outputs.

Table 4: The top 5 funding sponsors and affiliations with LMS research during 2004-2023

Top Funding sponsors	Total Records	Top affiliations	Total Records
Ministry of Science and Technology, India	148	Vellore Institute of Technology	255
Science and Engineering Research Board	84	Indian Institute of Technology Delhi	211
Ministry of Electronics and Information Technology	46	SRM Institute of Science and Technology	205
Council of Scientific and Industrial Research, India	34	K L Deemed to be University	191
University Grants Commission	31	Anna University	161

As the institutional ranking is an essential indicator of higher education in any discipline, researchers analyzed the top five productive affiliations out of 160 institutions. The results reveal that among the top ten, "The Vellore Institute of Technology" ranked first with 255 research papers followed by "The Indian Institute of Technology Delhi" which occupied the second position with 211 articles. SRM Institute of Science and Technology has ranked third productive institution with 205 research publications.

CONCLUSION AND RECOMMENDATION

This study examines the scientometric assessment of literature on learning management systems concerning the evolution of computer technology and education over 20 years. The information for research mapping with VOSviewer, utilizing an MS Excel document and data sources from the Scopus database. The study's conclusions demonstrate the rising growth patterns on LMS that occur yearly. The findings of this study can be utilized to locate more recent LMS research that has wide-ranging effects on the creation of educational models, institutions, and LMSs themselves.

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