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A BIBLIOMETRIC ANALYSIS OF STUDENT ENGAGEMENT IN LEARNING MANAGEMENT SYSTEMS (LMS): TRENDS, INFLUENTIAL PUBLICATIONS, AND KEY THEMES (2005-2024)

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Abstract:

Student engagement in Learning Management Systems (LMS) is a crucial element in online and blended education, encompassing behavioral, emotional, and cognitive dimensions. While extensive research has examined LMS features and their impact on engagement, trends, key contributors, and research gaps in this field remain underexplored. This study addresses these gaps through a bibliometric analysis of 414 publications from the Scopus database (2005–2024), utilizing bibliometric, content analysis, and network approaches. Using tools like VOSViewer, MS Excel, and Harzing's Publish or Perish, the findings reveal a shift from basic system management to incorporating social learning and performance metrics. The analysis highlights the interplay between technical, social, and academic aspects of LMS engagement, showing how participation, sense of belonging, and self-regulated learning influence behavioral, emotional, and cognitive engagement. Interconnected clusters demonstrate that core LMS activities (communication, collaboration, assessment, and review) support learning behaviors and motivation, creating an integrated learning cycle. The study also identifies limitations and proposes directions for future research.

Keywords:

Bibliometric Analysis, Student Engagement, Learning Management System

Introduction

Student engagement is recognized as a critical factor influencing learning outcomes particularly in online and blended learning environments. Engagement is often broken down into three key domains: behavioral, emotional, and cognitive engagement (Fredricks et al.,

2016). Behavioral engagement refers to students' participation in academic tasks, including attendance, assignment submission, participating in activities, and discussions with peers and instructors. Emotional engagement involves students' feelings towards the learning process, including their sense of belonging, motivation, and satisfaction with the learning environment. Finally, cognitive engagement refers to students' investment in deep learning, such as critical thinking, self-regulation, and applying learned concepts to new contexts (Kahu, 2013). Research suggests that higher engagement levels lead to improved academic performance, increased satisfaction, and better knowledge retention in online learning environments (Redmond et al., 2018; Bedenlier et al., 2020). However, fostering engagement in online and blended learning environments remains a challenge due to issues such as reduced interaction, lower motivation, and feelings of isolation (Kahu, 2013; Martin & Bolliger, 2018).

Learning Management Systems (LMS) have become an essential tool to online and blended learning. As such, LMS provide tools that support engagement by enhancing communication, collaboration, and self-regulated learning. Features such as discussion forums, interactive quizzes, real-time feedback, learning analytics, and personalized learning paths help maintain student involvement and motivation (Al-Fraihat et al., 2020; Broadbent & Poon, 2015). One of the core advantages of LMS is their ability to provide personalized learning experiences, enabling students to track their progress and receive tailored feedback. This supports greater autonomy and can positively impact student engagement (Nasser et al., 2011; Blau & Hameiri, 2010).

In the context of LMS, each domain of engagement can be fostered by the features and tools that these platforms provide. Behavioral engagement in LMS is influenced by the availability of interactive components like quizzes, discussion forums, and real-time feedback, which encourage students to actively participate in the learning process (Henrie et al., 2017). Emotional engagement can be enhanced through the creation of supportive, collaborative environments, where students feel connected to their peers and instructors, even in virtual spaces (Martin & Bolliger, 2018). Additionally, cognitive engagement is facilitated by LMS features that promote self-regulated learning, such as progress tracking, personalized learning paths, and formative assessments (Broadbent & Poon, 2015).

While LMS platforms are designed to support these three forms of engagement, research on their effectiveness in fostering sustained engagement across all three domains remains inconsistent, scattered, or lacks of a unified perspective (Henrie et al., 2015). This gap in understanding is especially important as educational institutions increasingly rely on LMS for online and blended learning environments. By examining the current landscape of student engagement in LMS, this study aims to identify the trends, influential publications, and key themes for publication from 2005 to 2024.

To address this gap, bibliometric analysis provides a systematic, data-driven approach to understanding research trends, identifying influential publications, and mapping key themes in LMS-related engagement studies. Bibliometric methods, including co-citation analysis, keyword mapping, and network visualization, offer insights into how research in this field has evolved over time (Donthu et al., 2021). Previous bibliometric studies in nursing-related research (Zhu & Liu, 2020) and microbiology (Moral-Muñoz et al., 2020) have successfully identified dominant research themes, influential authors, and emerging trends, thus guiding future research directions. By applying a bibliometric approach, this study aims to

systematically examine the current state of research on student engagement with LMS, highlighting the most influential works in this domain and also uncover popular topics and research gaps. The research questions (RQs) that are addressed in the paper are as follows:

RQ1: What is the present state of publications regarding student engagement with LMS?
RQ2: Which are the most influential publications on student engagement in LMS?
RQ3: What are the most common publication topics on student engagement in LMS?

Following this introduction, the paper presents a comprehensive literature review focusing on student engagement within LMS. The subsequent section details the literature review regarding the topic and methodologies employed in the investigation, accompanied by a presentation of the results obtained. The paper concludes with a discussion of the key findings and identified areas for future research.

Literature Review

Kahu (2013) identifies four key dimensions of student engagement in the literature: behavioral, psychological, socio-cultural, and holistic. The behavioral dimension considers how student actions and institutional practices affect engagement. The psychological dimension views engagement as a psycho-social process evolving over time with varying levels of intensity based on student experiences (Barua et al., 2018). The socio-cultural dimension focuses on student interactions within their social context, shaped by their cultural background. Lastly, the holistic dimension regards engagement as a dynamic combination of perceptions, expectations, experiences, locations, academics, staff, institutions, and resources in shaping a student (Barua et al., 2018)

However, student engagement is often interpreted in various ways. Reflecting this, Nkomo et al. (2021) found no universally accepted definition in their review of the literature. This variety of interpretations has prompted diverse discussions across different dimensions of student engagement. Scholars, however, point out that these dimensions are often used interchangeably. Burch et al. (2015), Christenson et al. (2012), and Fredricks et al. (2016) suggest that this interchangeable use results in inconsistencies when trying to measure student engagement accurately.

The dimensions of student engagement (behavioral, psychological, socio-cultural, and holistic) are often reflected in its definitions. For example, student engagement has been defined as the active involvement of students in matters related to their experiences (Robinson, 2012), in activities that produce high-quality learning outcomes (Coates, 2008), and in the amount of time and ambition devoted to academic activities (Shah & Cheng, 2019). Prior research frequently emphasizes learning behaviors and emotional belonging (Ahmadi et al., 2023). While many studies explore student engagement, few specifically concentrate on e-learning (Lee et al., 2019). In the context of Learning Management Systems (LMS), student engagement is enhanced when students use the LMS to monitor their progress (Al-Fraihat et al., 2020; Selwyn et al., 2011).

Despite a significant number of studies on Learning Management Systems (LMS), few bibliometric analyses have focused specifically on student engagement in recent years. For instance, Pham et al. (2022) used bibliometric methods to analyze LMS research in developing countries from 2005 to 2020, using the Scopus database, and found a rising trend in

publications, particularly between 2018 and 2020. Their analysis highlighted Covid-19, gamification, and perceived usefulness as common research topics. Phan et al. (2022) further clarified these findings with a bibliometric study of LMS in higher education, examining 1334 articles from 2000 to 2020, and also concluded that there has been an increasing trend in LMS research over the past decade. These trends suggest that LMS is an emerging field with the potential to impact policy and practice.

Methodology

This paper employs bibliometrics, a method first proposed by Alan Pritchard in 1969, to explore relevant scholarly publications. Bibliometrics is used to explore published scholarship relevant to a knowledge base. Scopus, Web of Science, and Google Scholar are popular databases used in academic research. While Google Scholar excels in retrieving literature, Scopus and Web of Science are better for citation analysis (Falagas et al., 2008). Scopus was chosen for this study due to its broader coverage compared to Web of Science (Hallinger & Nguyen, 2020; Singh et al., 2021).

The term "learning management", "learning management system" and "student engagement" were three main keywords in the search string. The initial query was inputted the advanced search form of Scopus at 14:30 Mei 30, 2024, was ((TITLE-ABS-KEY(" learning management" OR "learning management system") AND TITLE-ABS-KEY("student engagement"))). The search result yielded 414 documents. The data search process is shown in Figure 1.

The study used VOSViewer software to perform several analyses of the bibliometric meta-data. These analyses included: Co-authorship analysis which examines the relationships between authors based on their co-authorship of publications, bibliographic coupling that determines the relationships between publications, journals, and authors based on the number of shared references or resources, keyword co-occurrence analysis which identifies the frequency with which keywords appear together in publications, indicating common research topics and themes and also citation analysis which explores the relationships between publications based on how often they are cited by other works. The results of these analyses are then presented as tables and network visualization maps, providing a visual representation of the relationships and patterns within the data.

Publication by Year

To address RQ1, the research trend based on the year of publication and total citation was monitored. Figure 2 shows the number of student engagement in LMS publications published each year between 2005 and 2024. The bar chart shows the growth pattern of total publications in the literature while the line graph shows the growth pattern of publications in the literature. The figure shows that the study on student engagement in LMS is significant and relatively stable, ranging from 2 publications (2005) to 63 publications (2023). In addition, a steady growth on total publications was visible for the year 2024 as there was 20 publications for the first quarter of 2024 which surpasses the total amount of publications for the years 2005, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, and 2017.
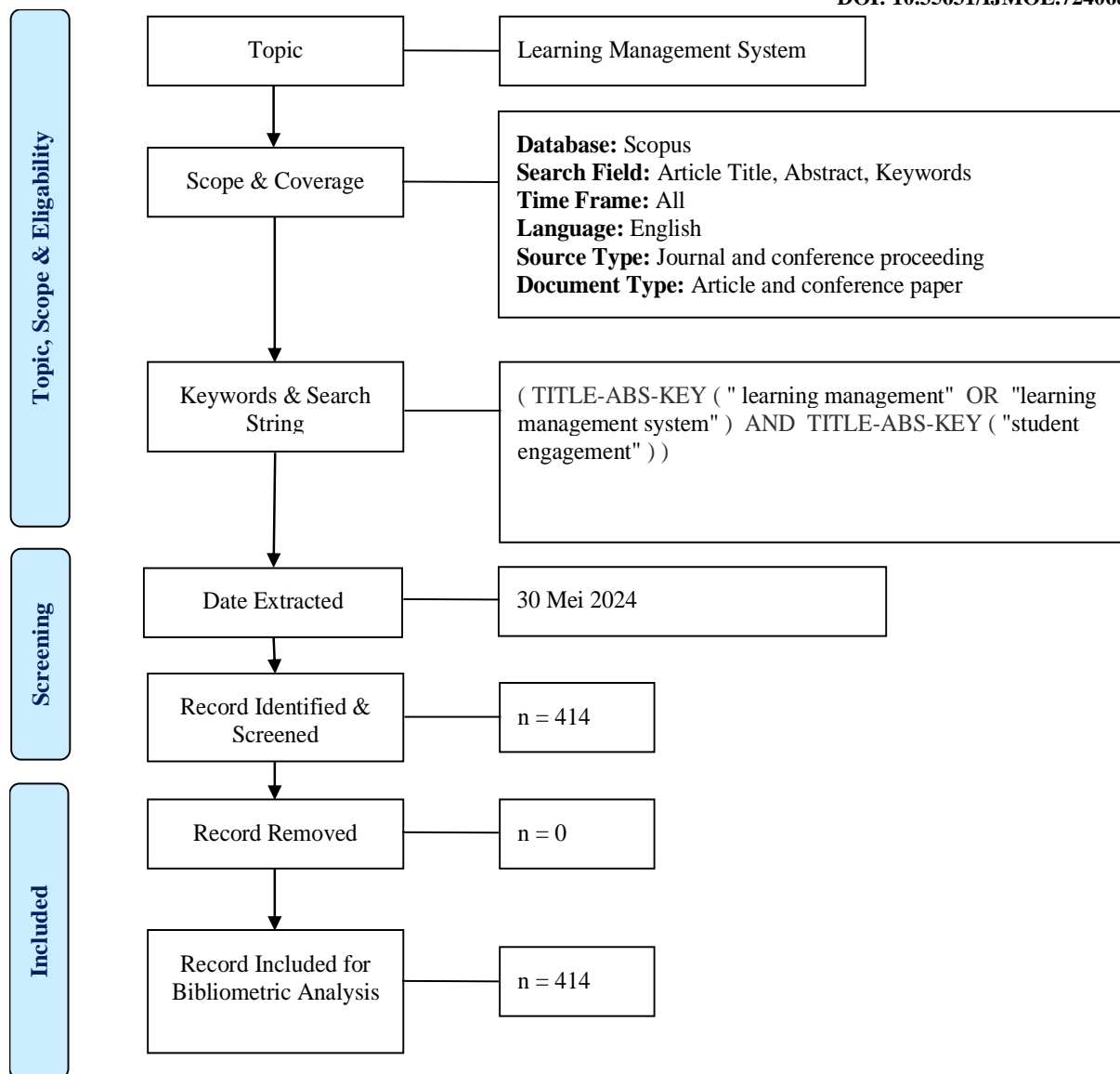
Figure 1: Flow Diagram of the Search Strategy

Source: Zakaria, R., Ahmi, A., Ahmad, A. H., & Othman, Z. (2020) Worldwide Melatonin Research: A Bibliometric Analysis of the Published Literature between 2015 and 2019, Chronobiology International. https://doi.org/10.1080/07420528.2020.1838534

In addition, analyses of co-authorship, bibliographic coupling, keyword co-occurrence, and citation were performed on bibliometric meta-data using VOSViewer software. For bibliographic coupling, the relationships of elements such as publications, journals and authors are determined according to the number of shared resources. The results of these analysis are presented in the form of a table or network visualization map.

Figure 2: Total Publications and Total Citations by Year

There were two peaks in terms of total citation of publications between 2005 and 2024. The first peak depicts 1067 citations in 2010. The second peak in terms of total citation of publications was in 2020, representing 1258 citations. Using Harzing's Publish or Perish software, it was found t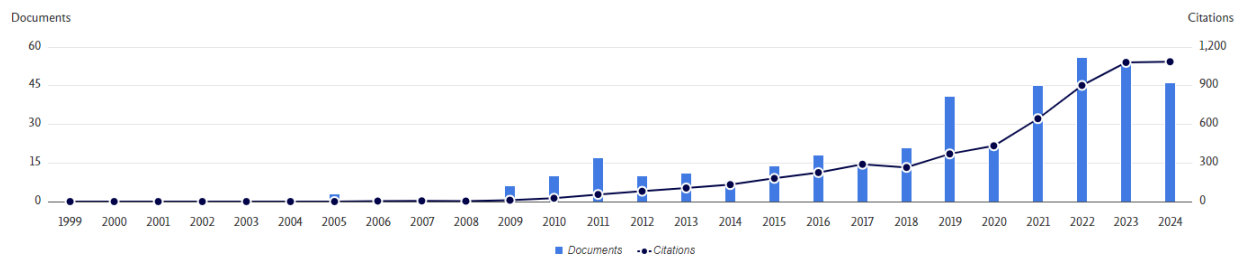hat the first student engagement in LMS related publication was published in 2005 (see Coates, James, & Baldwin, 2005). The publication was about the potential impact of LMS on teaching and learning in universities based on Australian experience. This would be the very start of studies on student engagement in LMS publications later.

The first peak of total citation of publications in 2010 was mainly attained from three publications. The first with 757 citations was about harnessing the predictive power of LMS data to develop reporting tools that identify at-risk students (see Macfadyen, & Dawson, 2010). The second publication (117 citations) was regarding the indicators of engagement where LMS's ability to record and track user behaviour was utilized to captured data relating to student engagement (see Beer, Clark, & Jones, 2010). The final publication obtained 103 citations elaborated on the functionalities present in LMS to maintain student engagement among super-sized online class (see Nagel & Kotzé, 2010).

The second peak in total citations, observed in 2020, was primarily driven by a combination of publications. Among these, two articles received the most citations. One study, by Bouilheres, Le, McDonald, Nkhoma, & Jandug-Montera (2020), with 81 citations, focused on the student learning experience in blended learning environments using LMS. The other, by Vytasek, Patzak, & Winne (2020), with 35 citations, examined the use of LMS learning analytics to describe student engagement and suggest more effective engagement strategies.

After the first publication, related publications appeared to decrease in 2008 with only one publication in 2008. However, the the growth pattern of total publications in the literature gradually increases (between 2009 and 2011). Thus, the period of 2009 – 2011 was the rapid rise stage in publications from 6 to 17. The following period of 2012 - 2019 was named the fluctuation stage. The number of publications significantly plummet from 44 publications to only 24 in 2020 due to the introduction of the Covid-19 pandemic. After that, the figure significantly increases from 50 publications in 2021, 60 publications in 2022 and 63 publications in 2023. The final period from 2021 to 2024 is the step-up stage, during which 46.62% (193) of student engagement in LMS related-publications was published. Overall, 414 eligible publications on student engagement in LMS were identified from Scopus indexed sources, comprising 201 journal articles (48.55%), 172 conference papers (41.55%), 27 book chapters (6.52%), 7 reviews (1.69%), 5 conference reviews (1.21%), and 2 book (0.48%) as shown in Table 1.

Table 1: Document Type

Document Type	Total Publications (TP)	Percentage (%)
Article	201	48.55
Conference Paper	172	41.55
Book Chapter	27	6.52
Review	7	1.69
Conference Review	5	1.21
Book	2	0.48
Total	**414**	**100.00**

Citation Network Analysis

This study expected to identify the most significant publication based on RQ2 (Which are the most influential publications on student engagement in LMS?). Thus, in order to answer the RQ, citation networks of 414 publications were examined.

To perform the centrality analysis of citations and construct a network visualisation map of the article's citations, the Harzing Publish or Perish and VOSViewer tools were used. Table 2 shows the citation metrics data for the publications. As for the 414 publications on student engagement in LMS, there were 5489 citations. The typical number of citations per year is 288.89, with each document receiving an average of 13.26 citations.

This study found papers that had received the most references by using information from the Scopus database. From the 414 publications analyzed, only 26 papers are cited more than 50 times. The top 20 most influential publications are presented in in Table 3. Macfadyen & Dawson wrote the most cited article entitled "Mining LMS data to develop an "early warning system" for educators: A proof of concept" which was published in 2010 and had 757 citations. The subsequent paper was entitled "A critical examination of the effects of learning management systems on university teaching and learning" by Coates, James, & Baldwin, with 314 citations.

Table 2: Citations Metrics

Metrics	Data
Papers	414
Number of Citations	5489
Years	19
Citations per Year	288.89
Citations per Paper	13.26
Cites_Author	2331.62
Papers_Author	186.42
Authors_Paper	2.95
h_index	36
g_index	66

Table 3: Top 20 Highly Cited Publications

No.	Authors	Title	Year	Cites	Cites per Year
1	L.P. Macfadyen, S. Dawson	Mining LMS data to develop an "early warning system" for educators: A proof of concept	2010	757	54.07
2	H. Coates, R. James, G. Baldwin	A critical examination of the effects of learning management systems on university teaching and learning	2005	314	16.53
3	L.P. Macfadyen, S. Dawson	Numbers are not enough. Why e-learning analytics failed to inform an institutional strategic plan	2012	228	19.00
4	J. Lee, H.D. Song, A.J. Hong	Exploring factors, and indicators for measuring students' sustainable engagement in e-learning	2019	175	35.00
5	S. Helal, J. Li, L. Liu, E. Ebrahimie, S. Dawson, D.J. Murray, Q. Long	Predicting academic performance by considering student heterogeneity	2018	138	23.00
6	C. Beer, K. Clark, D. Jones	Indicators of engagement	2010	117	8.36
7	L. Nagel, T.G. Kotzé	Supersizing e-learning: What a CoI survey reveals about teaching presence in a large online class	2010	103	7.36
8	A. Bakharia, S. Dawson	SNAPP: A bird's-eye view of temporal participant interaction	2011	95	7.31
9	N.D. Bowman, M. Akcaoglu	"I see smart people!": Using Facebook to supplement cognitive and affective learning in the university mass lecture	2014	92	9.20
10	F. Bouilheres, L.T.V.H. Le, S. McDonald, C. Nkhoma, L. Jandug-Montera	Defining student learning experience through blended learning	2020	81	20.25
11	C.R. Henrie, R. Bodily, K.C. Manwaring, C.R. Graham	Exploring intensive longitudinal measures of student engagement in blended learning	2015	79	79.00
12	J.E. Klobas, T.J. McGill	The role of involvement in learning management system success	2010	77	77.00
13	A. Dwivedi, P. Dwivedi, S. Bobek, S. Sternad Zabukovšek	Factors affecting students' engagement with online content in blended learning	2019	74	74.00

14	M. Murray, J. Pérez, D. Geist, A. Hedrick	Student interaction with online course content: Build it and they might come	2012	72	72.00
15	R.A. Green, L.Y. Whitburn, A. Zacharias, G. Byrne, D.L. Hughes	The relationship between student engagement with online content and achievement in a blended learning anatomy course	2018	72	72.00
16	R.S. Baragash, H. Al-Samarraie	Blended learning: Investigating the influence of engagement in multiple learning delivery modes on students' performance	2018	70	70.00
17	A.Y.Q. Huang, O.H.T. Lu, S.J.H. Yang	Effects of artificial Intelligence–Enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom	2023	70	70.00
18	V. Cardullo, C.H. Wang, M. Burton, J. Dong	K-12 teachers' remote teaching self-efficacy during the pandemic	2021	68	68.00
19	C. McGuinness, C. Fulton	Digital literacy in higher education: A case study of student engagement with e-tutorials using blended learning	2019	64	64.00
20	U. Alturki, A. Aldraiweesh	Application of learning management system (LMS) during the covid-19 pandemic: A sustainable acceptance model of the expansion technology approach	2021	63	63.00

The bibliographic coupling analysis (Figure 3) revealed nine distinct clusters, each contributing to the understanding of student engagement in Learning Management Systems (LMS) across behavioral, emotional, and cognitive dimensions. The largest cluster, Cluster 1 (red), focuses on indicators of learning engagement, with Lee et al. (2019) as a representative study exploring factors and metrics for measuring sustainable engagement in e-learning. This cluster emphasizes behavioral engagement, highlighting how LMS features like communication tools, task completion tracking, and interaction patterns foster active participation. Smaller clusters, such as Cluster 8 (brown) and Cluster 9 (light purple), contribute to emotional engagement, with Halawa (2016) examining the role of LMS in fostering a sense of belonging and Coates et al. (2005) emphasizing on student satisfaction and emotional investment in online learning. These studies point out how collaborative and interactive LMS features can create supportive and inclusive learning environments, enhancing emotional engagement.

Meanwhile, the most influential publication in the field, Macfadyen and Dawson (2010), bridges all three dimensions but particularly emphasizes cognitive engagement. Their work highlights how LMS analytics and performance metrics can track and enhance self-regulated learning and critical thinking, aligning with cognitive engagement as students process, reflect on, and internalize learning content through activities like assessments, feedback, and reviews.

The interconnected nature of these clusters demonstrates that LMS engagement is multidimensional, with behavioral, emotional, and cognitive aspects often being overlapped. This integrated cycle underscores the importance of designing LMS features that address the equilibrium of all three dimensions, creating a comprehensive framework for understanding and enhancing student engagement in online and blended learning environments.
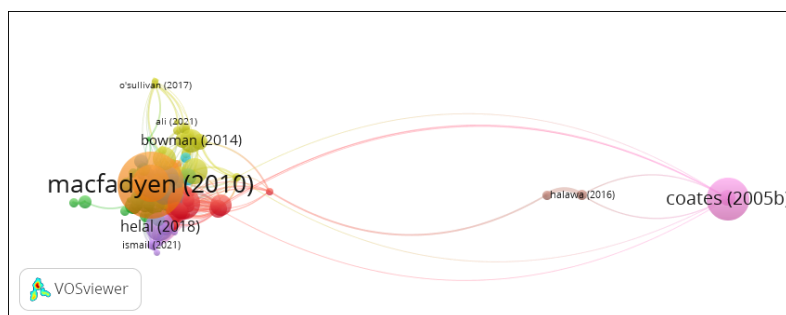

Figure 3: Bibliographic Coupling of Documents

Keywords and Co-occurrence Analysis

In response to RQ3 (What are the most common publication topics on student engagement in LMS?), this current study aimed to determine the most frequently used keywords by researchers investigating on student engagement in LMS. Data frequencies of keywords employed in the research topic were calculated using MS Excel and the results are displayed in Table 2. "students" is the most frequently used keyword in student engagement in LMS (188: 45.41%), followed by "learning management system" with 181 (43.72%) and "student engagement" with 179 (43.24%).

Table 2. Top Keywords

Author Keywords	Total Publications (TP)	Percentage (%)
students	188	45.41%
Learning Management System	181	43.72%
Student Engagement	179	43.24%
E-learning	122	29.47%
Learning Systems	85	20.53%
Teaching	75	18.12%
Computer Aided Instruction	54	13.04%
Online Learning	54	13.04%
Education	51	12.32%
Blended Learning	46	11.11%
Learning Analytics	46	11.11%
Curricula	43	10.39%
Engineering Education	42	10.14%
Information Management	41	9.90%
Higher Education	40	9.66%
Engagement	29	7.00%
Learning Management Systems	29	7.00%
Online Systems	29	7.00%
LMS	28	6.76%
Education Computing	26	6.28%

This study also ran the keyword co-occurrence analysis using the VOSViewer software to build a network visualization map. Fractional counting was used and the minimum number of occurrences was set at five per publication. 120 keywords met the criterion out of 2000. The co-occurrence keyword analysis, depicted in Figure 4, reveals five clusters that align with and also influence the behavioral, emotional, and cognitive dimensions of student engagement in Learning Management Systems (LMS). The red cluster, which focuses on the technical and administrative aspects of learning systems, underpins behavioral engagement by emphasizing the role of LMS infrastructure in facilitating participation, interaction, and task completion. For example, features like user-friendly interfaces, system reliability, and administrative tools enable students to engage actively with the platform, supporting behavioral engagement.

Figure 4. Network Visualisation Map For Co-occurrence Of Keywords

The green cluster, centered on pedagogical and engagement aspects, directly addresses emotional and cognitive engagement. Pedagogical strategies such as collaborative activities, personalized feedback, and interactive content foster a sense of belonging (emotional engagement) while encouraging critical thinking and self-regulated learning (cognitive engagement). The blue cluster, representing educational outcomes and research, highlights the impact of LMS on achieving measurable learning goals, which ties into cognitive engagement by emphasizing outcomes like acquiring knowledge, developing skills, and performing academically.

The yellow cluster, focusing on data-driven and technology-enhanced learning approaches, bridges the technical (red) and pedagogical (green) clusters, illustrating how learning analytics and adaptive technologies can enhance all three dimensions of engagement. Finally, the purple cluster, which emphasizes traditional teaching methods and disciplines like the humanities, complements emotional and cognitive engagement by highlighting the importance of human-centered approaches, such as fostering meaningful discussions and critical reflection, which are essential for deep learning.

The interconnectedness of these clusters demonstrates how technological infrastructure (red), pedagogical strategies (green), and educational outcomes (blue) work together to create a universal framework for student engagement. The integration of learning analytics (yellow) and traditional teaching methods (purple) further enriches this framework, ensuring that LMS environments support not only behavioral participation but also emotional connection and cognitive growth. This analysis underscores the importance of designing LMS systems that

balance technical, pedagogical, and human elements to foster comprehensive student engagement in online and blended learning contexts.

This study analysed the term co-occurrences of the title and abstract fields while reviewing the content of publications that focused on student engagement in LMS using the VOSViewer software. Binary counting was used and the requirement was that a term should appear at least ten times in the title and abstract of articles. As a result, 263 terms met the criterion out of 8809 total terms. By default, the software considered 60% of the criterion noteworthy, resulting in 158 terms being declared relevant. Using the titles and abstracts of the 414 Scopus papers as a basis, Figure 5 shows a network visualisation map of term co-occurrences. The term co-ccurrences of the title and abstract field is also visualised in Figure 6 as an overlay map.

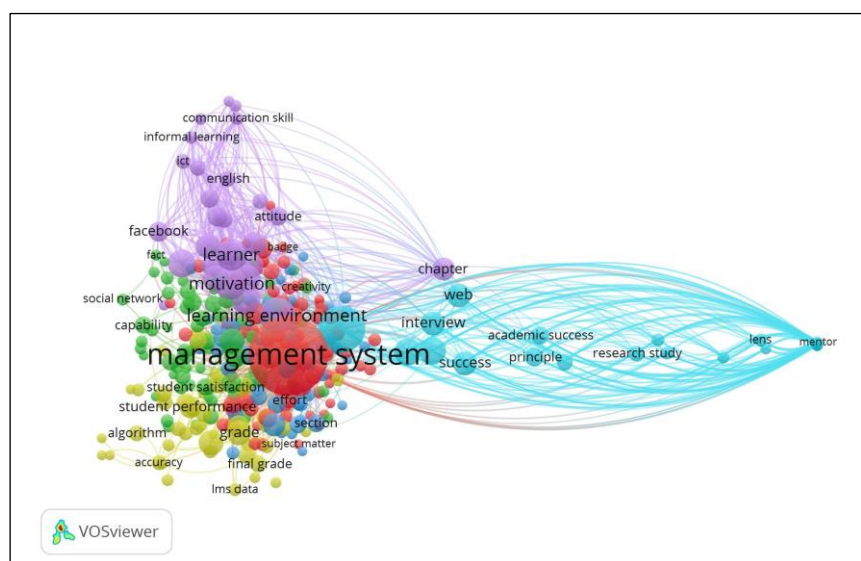**Figure 5: Network Visualisation Map Of Term Co-occurrence Of Title & Abstract Field**

Figure 5 shows the network visualisation map with 5 clusters. The red theme (Cluster 1) represents how students engage with communication tools within the LMS (forums, messaging, group work). The purple theme (Cluster 2) appears to be related to review and reflection activities. The blue theme (Cluster 3) describes the main engagement points where students interact with the system, while the yellow theme (Cluster 4) maps how students engage with assessment activities in the LMS. The green theme (Cluster 5) highlighted how students approach and engage with the LMS content. Therefore, the green theme also indicates the psychological and behavioral aspects of online learning.

The analysis of the map reveals interconnected behavioral patterns across different aspects of online and blended learning. Student engagement in the LMS demonstrates interconnected patterns where core system activities (blue theme) directly support learning behaviors and motivation (green theme), while facilitating communication and collaboration (red theme). These activities are closely tied to assessment processes (yellow theme) and review behaviors (purple theme), creating an integrated cycle of learning. This interconnectedness underscores the importance of designing LMS environments that balance system functionality, content delivery, and interactive features to promote comprehensive student engagement in online and blended learning contexts.
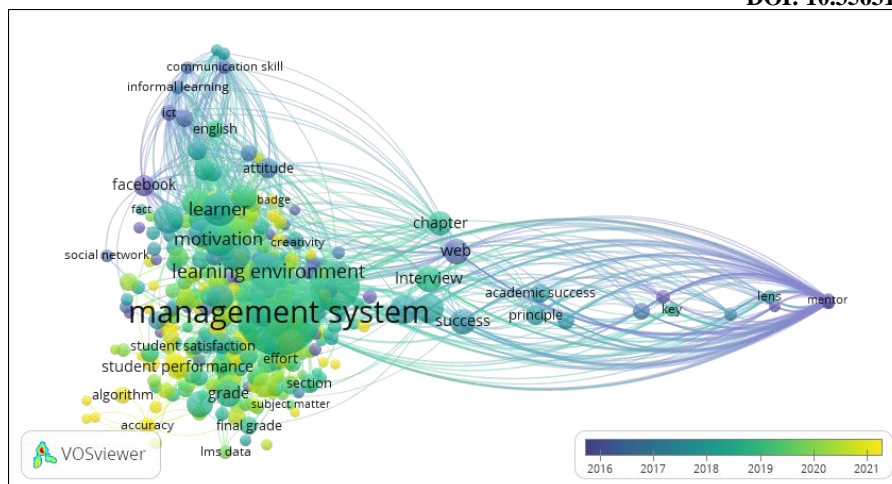
Figure 6: Overlay Visualisation Map Of Term Co-occurrence Of Title & Abstract Field

The overlay map from the keyword co-occurrence analysis reveals evolving research trends in student engagement within Learning Management Systems (LMS), reflecting shifts in focus that align with the behavioral, emotional, and cognitive dimensions of engagement. The slight color variation in Figure 6 between 2017 and 2019 shows that the research topics remained relatively consistent, emphasizing foundational aspects of LMS, such as system management and basic engagement metrics. However, a notable shift occurred between 2019 and 2021, with increased attention to advanced topics like educational data mining, predictive models, algorithms, and data analysis. These emerging themes highlight a growing emphasis on leveraging technology to enhance behavioral engagement through tools like badges, which incentivize participation and task completion, and predictive models, which analyze patterns in student interactions to identify at-risk learners and improve intervention strategies.

The focus on keywords such as creativity and logistic regression further highlights the integration of cognitive engagement into LMS research. Predictive analytics and data-driven approaches enable educators to design personalized learning experiences that challenge students to think critically and creatively, fostering deeper cognitive engagement. Additionally, the addition of performance metrics and social learning tools reflects an increased awareness of emotional engagement, as these features help build a sense of achievement, belonging, and motivation among learners.

The interconnected clusters in the map demonstrate the complex relationships between the technical, social, and academic aspects of LMS engagement. Academic outcomes through improved accuracy in performance predictions can reinforce cognitive engagement by enabling students to track their progress and reflect on their learning. This progression from basic system management to incorporating social learning and performance metrics illustrates how LMS research has evolved to address the multi-layered nature of student engagement, integrating behavioral, emotional, and cognitive dimensions into a cohesive framework for online and blended learning.

Findings and Future Areas of Research

This section presents a summary of the study's findings and proposes potential research directions. The study also pinpoints challenges encountered by researchers in this field. The study began with a quantitative analysis of metadata to examine publication outputs, including

annual trends, publication types, and citation counts. The findings reveal a generally steady growth in publications on student engagement with LMS from 2005 to 2024, punctuated by three distinct stages: a rapid rise (2009–2011), a fluctuation phase (2012–2019), and an accelerated growth period (2021–2024). A sharp decline in publications occurred in 2020, likely due to the disruptions caused by the Covid-19 pandemic. Despite this decline, publications from 2020 achieved a remarkably high citation count (1,258 citations), surpassing even the first peak in 2010 (1,067 citations). This suggests that research on student engagement during the pandemic gained significant attention, as evidenced by two highly cited studies from 2021 (Cardullo et al., 2021; Alturki & Aldraiweesh, 2021), which explored the impact of Covid-19 on LMS engagement. As such, these studies highlighted how the pandemic influenced all three dimensions of engagement; behavioral (changes in participation patterns), emotional(increased stress and isolation), and cognitive (changes in self-regulated learning and motivation).

The co-occurrence analysis highlights the importance of student engagement with LMS as a research topic. Despite 414 publications over 19 years, the persistent prominence of keywords like "learning management system" and "student engagement" highlights the ongoing challenges in this field. These challenges may be due to the rapid technological advancements of the Fourth Industrial Revolution (IR 4.0), which have significantly impacted education. However, the analysis reveals a surprising gap in research addressing these advancements. As a result, technology-related keywords such as "educational data mining," "artificial intelligence," "random forest," and "learning analytics" each appeared only once in the dataset, indicating limited exploration of how emerging technologies can enhance LMS engagement. This gap is particularly significant because these technologies have the potential to address all three dimensions of engagement; behavioral (through predictive analytics to track participation), emotional (through the use of AI-driven personalized feedback to foster motivation), and cognitive (by leveraging learning analytics to support critical thinking and self-regulated learning).

This study has several limitations. First, the data were sourced exclusively from the Scopus database, excluding publications indexed in other databases like Web of Science. Second, recent 2024 publications accepted but not yet indexed in Scopus were not included. Additionally, the search terms were limited to "student engagement" and "learning management system," which, while sufficient to capture major aspects of the topic, could have been expanded with synonymous terms like "Moodle" or "online learning" to potentially broaden the dataset. Despite these limitations, the results provide a comprehensive and acceptable dataset to address the research questions.

The findings highlight a notable gap in research on technological advancements related to student engagement with LMS in e-learning. This raises critical questions about whether these advancements are being overlooked or underutilized in LMS design and implementation. Could integrating technologies like artificial intelligence, learning analytics, and predictive modeling improve student engagement? To address this gap, future research should focus on conducting a systematic literature review or an overview of technological advancements that could enhance LMS engagement. Such efforts would provide valuable insights into how emerging technologies can be leveraged to support the behavioral, emotional, and cognitive dimensions of student engagement in online and blended learning environments.

The significance of this research lies in its comprehensive analysis of student engagement with LMS, highlighting both the progress made and the gaps that remain. By identifying the limited exploration of technological advancements and their potential to enhance engagement, this study calls for a renewed focus on integrating innovative tools into LMS to address the multifaceted nature of student engagement. Such advancements could transform online and blended learning, creating more inclusive, motivating, and effective educational experiences for students.

Acknowledgement

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