

# Research Trends on The Use of E-LKM in Education Research in Indonesia: Bibliometric Analysis

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**Abstract.** This research aims to analyze the main research trends, collaboration patterns, and dominant themes in research regarding the use of e-LKM in educational research in Indonesia in the last 5 years (2018–2023) using a bibliometric analysis approach. Data collection through searches based on titles, abstracts and article keywords from Google Scholar and ERIC databases in the last 5 years. The article selection process is carried out systematically using the PRISMA method to ensure data transparency and validity with the help of the VOSviewer application. The results show that the research trend on the use of e-LKM has experienced a significant increase in the number of publications since 2020, mainly driven by the need for distance learning during the COVID-19 pandemic. The pattern of collaboration between researchers shows that there is a strong synergy in several institutions and regions that contribute greatly to research productivity, such as Universitas Negeri Riau, Universitas Mataram and STKIP Bima as the main contributors. The mapping of the research theme uses a co-word network through VOSviewer to identify four main clusters, including: (1) examining the effectiveness and barriers in the practice of using e-LKM in the real classroom, both from the lecturer and student sides, (2) focusing on the design, development and impact of e-LKM on student learning outcomes, (3) the context of implementation and the use of e-LKM in education in Indonesia, and (4) media innovation and the role of educators in learning process. The findings of this research recommend the need for equitable distribution of research capacity, deepening pedagogical studies, as well as strengthening collaboration across institutions and regions, as well as sustainable innovation to support digital transformation in higher education to develop more inclusive and sustainable e-LKM in Indonesia.

**Keywords:** research trends; e-LKM, Indonesia; bibliometric analysis

## INTRODUCTION

The development of digital technology has had a significant impact on higher education practices in the 21st century, driving the transformation from conventional learning to digital-based models (Bates, 2019). In Indonesia, the use of technology in the education sector has accelerated significantly, especially after the COVID-19 pandemic with various online learning instruments developed to answer the challenges of distance learning (Rahayu & Wirza, 2020). The COVID-19 pandemic has affected the acceleration of distance learning changes, as educational institutions have adapted to provide educational services by bridging the digital divide to ensure health and safety, as well as increasing flexibility that encourages innovation in developing digital literacy skills for students (Mafara, Musa & Canon Haki, Adamu, 2023).

One of the innovations that can develop digital literacy skills for students by utilizing technology is the development of Electronic Student

Worksheets (e-LKM). The development of e-LKM not only serves as a substitution for conventional LKM, but also offers the advantages of interactivity, personalization and accessibility in supporting a better learning process (Putra et al., 2022). e-LKM not only replace the role of conventional LKM but also offer multimedia features, instant feedback, and ease of access that enhance the learning experience (Sari, D. K. & Wijaya, 2023). e-LKM is a development of conventional Student Worksheets that are digitized to increase efficiency, effectiveness, and student involvement in the learning process (Sari & Prasetyo, 2022).

The implementation of e-LKM in the learning process is becoming increasingly relevant in the context of 21st century learning that emphasizes active, collaborative, problem-solving-based, and technology use (Indarta et al., 2022). e-LKM not only provide materials and questions, but also allow the insertion of interactive content such as videos, animations, simulations, and automatic feedback. e-LKM allows for multimedia integration, interactivity, and more flexible access

for students, making e-LKM a learning medium that supports independent learning and strengthens digital skills for students (Rahmawati et al., 2023).

The use of e-LKM for students at universities in Indonesia has shown a consistent increase in the last five years. Data from the Ministry of Education noted that 68% of state universities have integrated e-LKM in their curriculum (June, 2020). This phenomenon is driven by research findings on e-LKM-based Problem solving can increase students' interest in learning and provide a more interesting and enjoyable learning experience. This can help increase student motivation and involvement in the learning process (Mukmin et al., 2024).

The focus of research on e-LKM as a research variable has increased, especially since the COVID-19 pandemic which forced a massive transition from face-to-face learning to distance learning. In these conditions, the need for learning media that is flexible, easily accessible, and supports distance learning is very important (Subroto et al., 2023). Distance education also involves the media in the delivery of knowledge (Knowledge) to students and demanding that students learn independently (Murnaka et al., 2021). Since the COVID-19 pandemic, various studies have begun to examine the development and effectiveness of e-LKM in various course contexts, learning approaches, and strengthening student competencies.

The development of technology-based learning that is increasingly advanced requires educators to always innovate in the creation of digital-based learning media for students, one of which is e-LKM. e-LKM is useful for facilitating lectures with a learning model Think Pair Share to improve critical thinking skills (Sumargiyani & Azty Acbarrihfa Nour, 2023). Use of Electronic Student Worksheets (e-LKM) with assistance Live Worksheet Distance learning can increase the effectiveness of student learning outcomes (Murtalib et al., 2022). The results of the research explain that students urgently need teaching materials in the form of LKM to support the understanding of lecture materials in a real and factual manner and improve student learning outcomes or in other words, this research is the basis for further research on the development of e-LKM (Natalia & Wicaksana, 2023).

However, until now there have not been many studies that systematically map the development of research trends regarding e-LKM in Indonesia. Most studies are still descriptive, contextual and

focused on technical implementation aspects. To obtain a complete picture of the dynamics and direction of e-LKM research development, a quantitative approach is needed that can identify publication patterns, collaboration between researchers, popular keywords, and research spaces that are still open. This research gap is exacerbated by the lack of a research that analyzes the collaborative network of e-LKM researchers in Indonesia. There is research that proves that the strength of research networks is the main indicator in the sustainability of educational innovation (Nguyen et al., 2020).

The bibliometric analysis approach is a relevant method to answer the needs in the research gap. Through a bibliometric approach, researchers can analyze metadata from scientific publications to uncover trends, individual and institutional contributions, and the direction of scientific development in a particular topic (Donthu et al., 2021). The bibliometric analysis approach has proven effective in mapping the development of the field of science, as shown in a research on online learning in Malaysia (Tan, K. H., Abdullah, S. M., & Lee, 2022). Thus, a bibliometric analysis approach to publications on e-LKM in Indonesia is important to fill the gap in scientific mapping studies in the field of e-LKM.

Based on the gap analysis, this research is designed to: (1) identify the main trends in e-LKM research in Indonesia over the past five years (2018–2023) using a bibliometric analysis approach, (2) analyze patterns of collaboration and productivity among researchers, (3) map the dominant themes that develop regarding e-LKM in Indonesia. These findings are expected to be the basis for policy-making and strategic direction in designing the development and implementation of more strategic e-LKM in Indonesia.

## METHOD

The research method used is a qualitative approach with a literature research method to analyze the research trends of e-LKM in Indonesia over the past five years (2018–2023). This method was chosen because it is able to integrate findings from various literature sources to produce a comprehensive synthesis of knowledge (Snyder, 2019). The data collection process follows the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) which consists of four main stages, including identification, screening, eligibility, and inclusion (Page et al., 2021).

**Table 1.** Research Inclusion and Exclusion Criteria

No	Criteria	Inclusion	Exclusion
1	Year	2018-2023	< 2018
2	Design	Empirical Studies (quantitative/qualitative)	Conceptual paper
3	Language	English/Indonesian	Other languages without relevant translations
4	Access	Full-text available	Only abstracts are available
5	Relevance	Focus on e-LKM in higher education	non-educational e-LKM

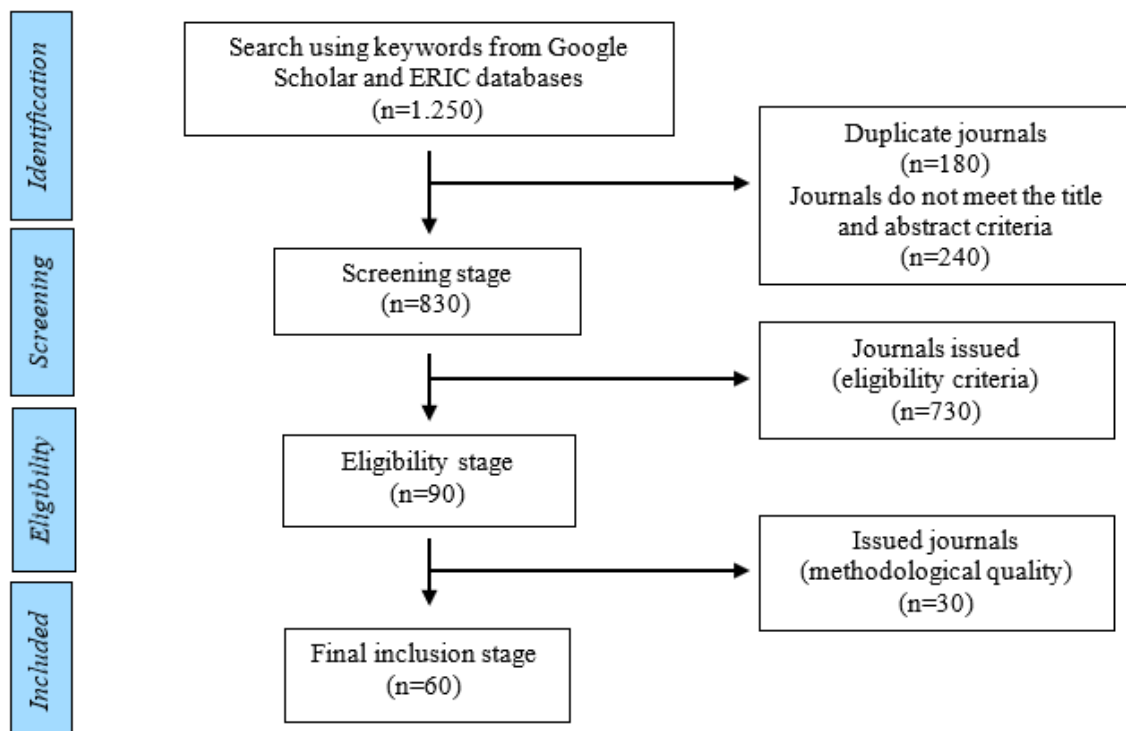
The identification stage was carried out by searching literature from the Google Scholar database and Education Resources Information Center (ERIC) using a combination of the keywords e-LKM, Student Worksheet, Electronic and Indonesian Student Worksheets. The search was limited to publications within the last five years, namely 2018–2023 to ensure the relevance of the findings. From the initial search, 1,250 articles were obtained which were then filtered based on the inclusion and exclusion criteria of the research, as table 1.

At the screening stage, as many as 420 articles were removed because they did not meet the criteria such as duplicates of 180 articles and did not meet the inclusion criteria based on the assessment of titles and abstracts as many as 240

articles. The feasibility stage involves a full-text assessment of the remaining 830 articles, resulting in 90 articles being considered for further analysis. The final inclusion process considered the quality of the methodology and the depth of the research results, so that 60 articles were selected to be used as research samples. This selection process is visualized in the PRISMA Diagram which includes the screening flow and the reason for exclusion (Moher et al., 2009), as Figure 1.

## RESULTS AND DISCUSSION

Based on bibliometric analysis, 60 selected articles were used as research samples using databases from Google Scholar and ERIC in the last five years (2018–2023) by utilizing metadata,


**Figure 1.** Data Collection Stage Using the PRISMA Method

namely titles, abstracts, and keywords to ensure the relevance of the findings. The results of this research will reveal three main findings.

### Key Research Trends on e-LKM

The trend of research publications on e-LKM in Indonesia in the last 5 years has continued to increase significantly. The increase in the number of publications aims to understand the trend of scientific publications globally and institutionally, considering Google Scholar and ERIC is one of the largest national and international indexed databases that includes high-reputable journals (Baas et al., 2020). The number of publications in 2018 was 5 articles, increasing in 2023 by 25 articles, as shown in the following table 2.

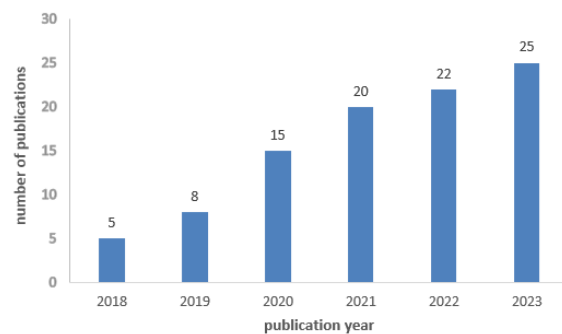
**Table 2.** Publication Trends in the Last 5 Years

Year	Number of Publications
2018	5 articles
2019	8 articles
2020	15 articles
2021	20 articles
2022	22 articles
2023	25 articles
Total	95 articles

Based on table 2 above it can be seen that the highest increase in the number of publications occurred from 2022 to 2023, which was 22 and 25 articles respectively. The increase was due to the government's policy on adapting distance learning during the COVID-19 pandemic (Online Learning Guide During the COVID-19 Pandemic, 2021). This trend is in line with global findings on adoption Digital Worksheet (Zawacki-Richter et al., 2019), but with unique characteristics of the dominance of product development topics (65%) based on STEM and models Problem Based Learning (Putra et al., 2022), as well as the lack of research on pedagogical aspects is only 18%, such as learning theory or curriculum adaptation (Nahar et al., 2022).

The purpose of the analysis of publication trends on e-LKM in Indonesia in the last 5 years includes measuring research productivity (Thelwall & Sud, 2022), identification of trends in the field of science that are developing, evaluation of academic performance in higher education (Mongeon & Paul-Hus, 2016), comparison of

achievements between institutions (Verma & Gustafsson, 2020), as well as the basis of policies to encourage an increase in the quantity and quality of scientific publications (Hicks et al., 2015). The number of articles published in the last 5 years can be described or visualized as Figure 2.



**Figure 2.** Number of Publications in the Last 5 Years (2018-2023)

The 90 articles that passed the feasibility stage, the assessment was conducted based on full-text. Only 60 articles met the criteria through a thorough assessment using Mixed Methods Appraisal Tool (MMAT) 2018 version (Hong, Q. N. et al., 2018). The quality assessment process by identifying 30 other articles that had to be issued, due to various methodological limitations, especially in terms of: (1) inadequate research design ( $n=12$ ), (2) lack of clarification on the method Sampling ( $n=9$ ), and (3) no discussion of the limitations of the research ( $n=9$ ). These findings are in line with previous research that showed that an average of 30-40% of articles in systematic reviews often do not meet minimum quality standards after a critical assessment (Page et al., 2021). Therefore, a rigorous screening process is essential to ensure that only valid and reliable research findings are included in the final analysis (Aromataris, E., & Munn, 2020).

It can be concluded that this researcher aims to identify the main trends in e-LKM research in Indonesia over the last five years (2018–2023) using a bibliometric analysis approach can be said to be answered because the number of publications in the last 5 years continues to increase significantly, starting in 2018 the number of publications is 5 articles, in 2019 the number of publications increases by 8 articles, In 2020 the number of publications increased by 15 articles, in 2021 the number of publications increased by 20

**Table 3.** Patterns of Collaboration and Researcher Productivity

No	Researchers	Institution	Area	Year						Number of Articles
				2018	2019	2020	2021	2022	2023	
1	Murtalib	STKIP Bima	NTB	2	1	3	4	3	2	15
2	Gunawan	Universitas Mataram	NTB	1	2	2	3	3	2	13
3	Aldresti	Universitas Riau	Riau	0	1	3	4	2	2	12
4	Syarifuddin	Universitas Mataram	NTB	1	1	2	2	3	2	11
5	Erviyenni	Universitas Riau	Riau	1	1	2	3	2	1	10
6	Simbolon	Universitas Negeri Medan	North Sumatra	1	1	2	3	2	1	10
7	Hartono	Universitas Tanjungpura	West Kalimantan	0	1	2	3	2	1	9
8	Haryati	Universitas Riau	Riau	0	1	1	3	2	1	8
9	Putra	Universitas Tanjungpura	West Kalimantan	0	0	2	2	2	1	7
10	Nurjanah	Universitas Negeri Medan	North Sumatra	0	1	1	2	1	1	6
<b>Total</b>				<b>6</b>	<b>10</b>	<b>20</b>	<b>29</b>	<b>22</b>	<b>14</b>	<b>101</b>

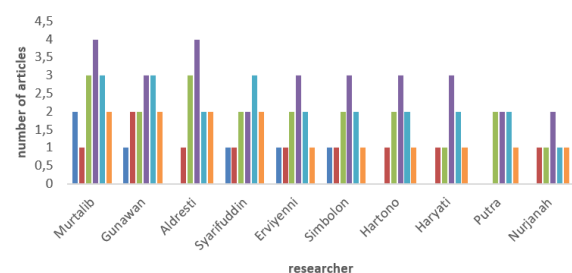
articles, in 2022 the number of publications increased by 22 articles, and in 2023 which is the largest increase in the number of publications, which is 25 articles.

### Patterns of Collaboration and Researcher Productivity

The relationship between productivity among researchers in Indonesia is carried out with the intention of identifying the relationship between article authors, institutions, regions in Indonesia and the number of documents from relevant journals from the Google Scholar and ERIC databases can be seen from the following table 3.

From table 3 above, it shows the 10 best order of collaboration and productivity patterns of researchers, institutions, regions in Indonesia and the number of documents sourced from Google Scholar and ERIC databases. The researcher with the highest number of articles and every year always publishes articles is Murtalib from STKIP Bima, West Nusa Tenggara with 15 articles and for the second place is Gunawan from the Universitas Mataram, West Nusa Tenggara with 13 articles. Researcher productivity is not only an indicator of individual contribution, but also reflects the strengthening of research networks in several regions of Indonesia that are increasingly

focused on the development of e-LKM, especially in areas with digitalization needs in Higher Education. To make it easier to interpret the above data, it can be described, as Figure 3.



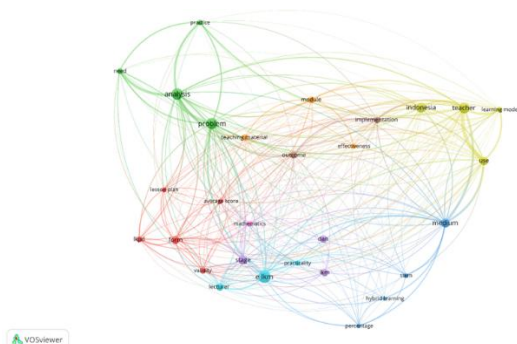
**Figure 3.** Patterns of Collaboration and Researcher Productivity

In addition to these two researchers, figure 3 above shows the top 10 rankings of researchers from institutions, such as Universitas Negeri Riau, Universitas Tanjungpura and Universitas Negeri Medan spread across several strategic areas in Indonesia. This collaboration between institutions shows a strong synergy in enriching content and innovation in e-LKM research, both locally and nationally. This indicates the existence of a network of cooperation related to continuous research and supports the development of

technology-based learning. The high number of article publications on e-LKM in Indonesia can raise challenges related to the quality and impact of the research, so it needs to be balanced with an increase in publications in high-reputable journals to strengthen scientific contributions in the global arena (Muhammedov & Kirievskii, 2023).

### **Dominant themes regarding e-LKM in Indonesia**

One expert argues that collaboration between authors in international journals, such as ERIC and Scopus can increase the impact of citations by up to 2.3 times (Prastowo, A., 2022). Although the number of publications in Indonesia has increased significantly, other analyses show that the citation rate in Indonesia is still lagging behind other ASEAN countries, emphasizing the need for improved research quality and more effective dissemination strategies (Suryadi, A., 2023). To reveal the results of the analysis Co-Word Network through the app VOSviewer from Database Google Scholar and ERIC in the last five years (2018–2023) can be seen in Figure 4.



**Figure 4.** Results of Co-Word Network Analysis

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Based on figure 4 above it can be seen that the analysis of the co-word network using the

VOSviewer application can identify 4 research clusters on e-LKM in Indonesia, including: (1) Cluster 1 which is green is centered on the keywords "analysis", "problem" and "practice" to examine the effectiveness and obstacles in the practice of using e-LKM in real classrooms, both from the lecturer and student sides.; (2) Cluster 2 which is red is centered on the keywords "LKPD", "form or worksheet" and "outcome or results" which focus on the design, development and impact of e-LKM on student learning outcomes; (3) Cluster 3 which is yellow centered on the keywords "teacher", "Indonesia", "use" which indicates the context of implementation and the use of e-LKM in education in Indonesia; (4) Cluster 4 in blue is centered on the keywords "e-LKM", "medium or media" and "lecturer or educator" which show media innovation and the role of educators in the learning process.

It can be concluded that the results of the research show that the trend of e-LKM research in Indonesia over the last five years (2018–2023) has increased significantly with a primary focus on the development and effectiveness of e-LKM in various learning contexts. The analysis of the collaboration pattern explains that there is a close cooperation network between researchers and institutions, especially in several regions in Indonesia, such as Riau, NTB and North Sumatra, which contributes greatly to the productivity of scientific publications. Through co-word network analysis using VOSviewer, four dominant theme clusters in e-LKM research were identified, namely: analysis and practice of e-LKM, design and results of digital worksheets, perception and use by teachers and lecturers in Indonesia, and the role of e-LKM as a digital learning medium. These findings illustrate the dynamics of comprehensive e-LKM research development and show the potential for collaboration and innovation that can encourage the wider use of e-LKM in higher education in Indonesia. These findings indicate the need for equitable distribution of research opportunities, strengthening collaboration networks, and a more holistic approach in the development of e-LKM in the future.

### **CONCLUSION**

This research aims to analyze the main research trends, collaboration patterns, and dominant themes in research regarding the use of e-LKM in educational research in Indonesia in the last 5 years (2018–2023) using a bibliometric analysis approach. The results of research showed



that the number of publications in 2018 was 5 articles and there was the highest increase in the number of publications in 2023, which was 25 articles. The pattern of collaboration between researchers shows that there is a strong synergy in several institutions and regions that contribute greatly to research productivity, such as Universitas Negeri Riau, Universitas Mataram and STKIP Bima as the main contributors. The mapping of the research theme uses a co-word network through VOSviewer to identify four main clusters, including: (1) examining the effectiveness and barriers in the practice of using e-LKM in the real classroom, both from the lecturer and student sides, (2) focusing on the design, development and impact of e-LKM on student learning outcomes, (3) the context of implementation and the use of e-LKM in education in Indonesia, and (4) media innovation and the role of educators in learning process. The findings of this study recommend the need for continuous innovation to support digital transformation in higher education to develop more inclusive and interactive e-LKM.

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