



Research trend of smart learning environment: Bibliometric analysis

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ABSTRACT

This study examines changes in teaching and learning methods by advancing the Smart Learning Environment (SLE). This study aims to examine the trend of Smart Learning Environment (SLE) Research using Bibliometric Analysis. Then, some interesting results were obtained. The number of annual Smart Learning Environment (SLE) articles has grown. The University of North Texas has made the greatest contribution to the Smart Learning Environment (SLE) community. In addition, "learning environment", "intelligent learning environment", and "learning process" were the most frequently used keywords. In addition, there are ten most cited Smart Learning Environment (SLE) articles based on the number of citations. This study presents the research status of intelligent learning environments to researchers and practitioners.

KEYWORDS

Smart Learning Environments (SLE); Bibliometric Analysis; Education Information Technology

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Introduction

Learning in the 21st century prepares generations to develop skills and abilities to master information and communication technology to face the challenges of globalization in the future (Zurweni et al., 2017). Smart Learning Environment (SLE) is one of them. Smart Learning Environment (SLE) is an environment that uses learning technology that integrates criteria and system functions. Learning services make it possible to be connected at a time and place, having a direct impact on self-management of learning by students, where they are the ones who set the schedule and time that best suits learning needs (Pebriantika et al., 2021). Learning materials can be in the form of videos, audio, or other digital files, which are delivered online for learning anytime and anywhere (Kardipah & Wibawa, 2020).

The Smart Learning Environment (SLE) must be able to effectively promote the development of personalized learning and adaptive learning (Peng et al., 2019). The most important components of the learning system are motivation and mentality. Mental preparation for an effective Smart Learning Environment (SLE) includes generating motivation. The most important condition for a Smart Learning Environment (SLE) is that students have the motivation to accept learning assignments seriously, so that learning outcomes are good. Specific learning outcomes are critical in designing effective blended learning (Anis Chaeruman et al., 2018). Recent research has shown that Smart Learning Environment (SLE) can affect learning outcomes (Thomas et al., 2018). Therefore, it is very important to know the development trend of Smart Learning Environment (SLE), in terms of publication output, distribution, sources, and citations; and earning, affiliates and social networks.

Interests in the Smart Learning Environment (SLE) for example students, instructors, and parents have a way to communicate in order to build a proper understanding of learning outcomes. The statement of expected learning outcomes refers to knowledge, skills, attitudes, and thinking skills. Learning outcomes must be generated through different interactions in the Smart Learning Environment (SLE) (Lawlor, 2012). This study examines the Smart Learning Environment (SLE) to provide an understanding of research activities from a multidisciplinary perspective, trends, and predictions of the future direction of the field using Bibliometric Analysis.

In the 21st century, technological developments have influenced and changed the world, trying to make work, learning and life efficient (Marinova et al., 2017). Aims to offer learning that is specifically for students in terms of broader learning. Educational developments today, and predicting future development trends can help to better guide educational practice and research. It is very important to conduct research describing the development and implementation of Smart Learning Environment (SLE).

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Literature review

The development of information and communication technology in all fields has an influence in improving the quality of Human Resources (HR) (Firdaus & Wibawa, 2019). Likewise with the development of the Smart Learning Environment (SLE). Smart Learning Environment (SLE) is an environment that uses learning technology that integrates the criteria and functions of a smart learning system. This environment allows students to learn using the latest technology and allows them to learn not limited by place or time through the technology offered in their Smart Learning Environment (Jang, 2017). The most important role of this technology is to support the Smart Learning Environment (SLE) which contains multiple sensors and connected devices providing services anywhere and anytime (Bdiwi et al., 2019).

Based on previous studies, many steps tried to define a Smart Learning Environment (SLE) and to identify the main characteristics that make up a Smart Learning Environment (SLE). Smart Learning Environment (SLE) as a physical environment enriched with digital devices, context aware and adaptive, to promote faster and better learning (Koper, 2014).

Smart Learning Environment (SLE) is defined as a technology-enabled learning environment that adapts and provides appropriate support in the right place and at the right time based on individual learner needs, which may be determined through analysis of learning behavior, performance and online and real-world contexts. (Hwang et al., 2009). The most important components of the learning system are motivation and mentality. Mental preparation for an effective Smart Learning Environment (SLE) includes generating motivation. The most important condition for a Smart Learning Environment (SLE) is that students have the motivation to accept learning assignments seriously, so that learning outcomes are good.

Methods

In this study, bibliometric information was obtained from Scopus, which is the most widely used database in research. Scopus is a database of abstracts and citations for peer-reviewed literature and is part of the SciVerse provided by Elsevier (Barneveld et al., 2012). In addition, this research is focused on mapping science literature from the Scopus database using a Bibliometric approach (Esfahani et al., 2019). Study results are evaluated based on journal growth. Keywords have been used to scan the article. The author concentrates on the title of the article, as it is a particular subject that is important for the study area and purpose of the report. The search was conducted in 2021 and the authors retrieved several tags from Scopus, such as author, title, abstract, country, citation, author affiliation, and references. Based on the author's search, 1080 documents have been obtained that match the keywords.

Notes for the total number of publications derived from the source. Overall citations for the total number of citations obtained by the publication. Documents with citations to assess the number of citations obtained divided by the total number of publications. The bibliometric approach can determine the pattern of technology or research orientation using keywords, title keywords, and plus keywords (Sheikh & Sheikh, 2017). In combination with VOSviewer software, a bibliometric approach was used to analyze research from 2016.

Results and Discussion

Results and discussion of findings are presented in this section to reflect, growth and trends in Smart Learning Environment (SLE) research in terms of publication, distribution, sources, and citations; and earning, affiliates and social networks.

Research Growth and Trends

The author begins by presenting the annual scientific production of articles in the field of Smart Learning Environment (SLE). Smart Learning Environment (SLE) started in 2002 with the work of Sosteric and Hesemeier being the first article recorded in 2002. Analysis from bibliometrix R shows that the Smart Learning Environment (SLE) field has an annual scientific production growth rate of 33.63% from 2002 until mid-2020 (Rafi Hidayat, 2018). In 2017, 72 articles were recorded, showing the beginning of the impressive growth of publications in the field. This growth became drastic in 2018, where 138 articles were published. In 2019, 288 articles were published, making it the highest publication per year on record.

While the number of citations for Smart Learning Environment (SLE) publications, presents the average citations per year. These results indicate the magnitude of the influence of publications in the field per year. The results show that the first publication on a Smart Learning Environment (SLE) in 2002, which appears to be a start, received an average number of 3.1 citations. This means the authors are working well with impact in the area of Smart Learning Environment (SLE). Average citations per year increased to 10.2 in 2017, which is the highest citation recorded so far. And it rose sharply to be in 2018 and 2019.

Table 1. Smart Learning Environment (SLE) Growth and Research Trends Table

Year	No. of Scientific Journals
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Year	No. of Scientific Journals
2016	138
2017	136
2018	243
2019	288
2020	138

Related Documents & Sources

Results obtained from relevant journals focused on publishing articles on Smart Learning Environment (SLE). These results are based on data from Scopus retrieved in April 2021. It shows that records on educational technology remain a relevant resource. Other relevant sources include Computer Science, Intelligent Innovation Systems and Technology, and the Association for the International Computing Machinery (ACM) Conference Proceedings Series. Specific journals pointed to by the analysis include Computers and Education, Educational Technology and Society, and Smart Learning Environments (SLE). Among these top relevant source journals, in 2017 "Computers and Education" was the most cited source locally with 1,013 documents. Next, the most cited source locally is "Smart Learning Environment (SLE)", journal access started in 2018; published by Springer, and is dedicated to providing opportunities about the need for reform and the innovative use of emerging technologies and pedagogies to advance learning and teaching in the 21st century (Abdullah & Marican, 2016). The Smart Learning Environment (SLE) has a total of 622 documents based on the dataset.

Relevant documents are noted in the field of Smart Learning Environment (SLE), this study presents global and local citations from publications. Global citations measure the number of citations a document receives from the entire Scopus database. Global citations also measure the impact of a document, which in most cases can receive a larger number of citations than other disciplines. On the other hand, local citations measure the number of citations a document receives from the documents included in the analyzed data. The citation environment also measures the impact of the document in the analyzed collection (Aria & Cuccurullo, 2017). In other words, global citations consider citations from a global perspective in terms of disciplines, whereas local citations only focus on citations within the discipline under study. Research has shown that apart from scientific productivity, the number of citations for a publication also forms an index to ascertain its scientific significance and impact (Ahmed & Al-Reyae, 2019).

The analysis shows that the papers were cited the most globally between mid-2020 from articles published by Baker, D'Mello, Rodrigo, and Graesser with a global total of 400 citations. The author's work focuses on using three different computer-based learning environments to teach students and, after that, investigate the occurrence, persistence, and impact of cognitive states.

Scientific Publications by Country

This study also analyzes the number of publications and their contribution to the field of Smart Learning Environment (SLE) across countries. The results show that the United States has the highest amount of scientific production and remains the most relevant country in the field of Smart Learning Environment (SLE) (Agbo et al., 2021). Further analysis shows the first 20 countries with total and average citations. And the results show that the United States remains the top country, followed by China. In addition, Germany and Finland are also among the top countries whose contribution in the field has a significant influence. The results show that Arthur C. Graesser from the United States has produced a total of 12 documents and obtained the highest number of citations of 618. He also has the highest back index, indicating that Graesser remains the most influential writer in the Smart Learning Environment (SLE) field. Graesser's first article was published in 2017 with a total citation of 4.6.

Although the results show that Graesser has no publications in 2020, however, he has consistently published in this field between 2018. The second most prolific scholar in this field is Jose Aguilar from Colombia. Aguilar has an h-index of 6 and a total of 20 publications. Aguilar started publishing in 2018, during which he has six publications and consistently published 5, 6, 2, and 1 papers in 2017, 2018, 2019, and 2020.

Similarly, the results of the study showed Menno D.T. de Jong from the Netherlands, Hiroaki Ogata from Japan, and Kinshuk from the United States each had an h-index of 6.5, and based on our dataset; therefore, they greatly influence the field of Smart Learning Environment (SLE). China has more author affiliations, with 120 authors linked to the country. Although previously revealed that the United States is first in terms of scientific production and number of citations, they are second in affiliation. In that order, Japan has the next higher volume of authors, followed by Tunisia and Canada. Moreover, the aspect of analytic learning is more interesting as indicated by the result that 73 articles in learning analysis have emerged from authors such as Kinshuk, Hiroaki Ogata, and Kousuke Mouri, leading in that direction. In addition, writers in the field of Smart Learning Environment (SLE) also received interest and publications from Kinshuk and Ronghuai Huang as leading writers.

Table 2. Author with Highest H-Index

No	Researcher	Country of Origin	H Index
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No	Researcher	Country of Origin	H Index
1.	Arthur C. Gresser	United States of America	4.6
2.	Jose Aguilar	Colombia	6
3.	D.T. de Jong	Netherland	6
4.	Hiroaki Agata	Japan	5
5.	Khinsux	United States of America	5

Based on the results of the study, it shows that big names have been mentioned who are productive in their fields, such as Kinshuk, Graesser, have strong collaboration networks.

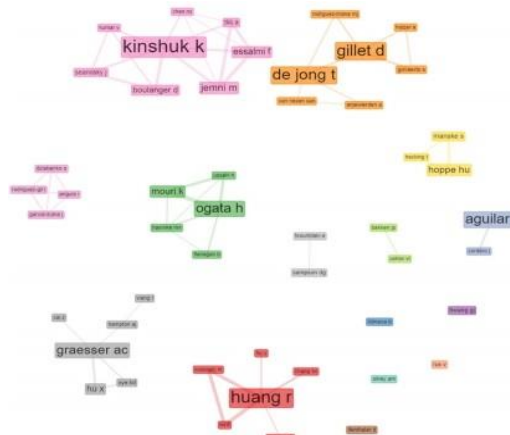


Figure 1. Authors' Collaborations

Likewise, Beijing Normal University in China and the University of Twente are considered to have created extensive collaboration networks with other universities. Although these institutions actively contribute to the field of Smart Learning Environment (SLE), they have not collaborated with other institutions in order to develop a wider social network.

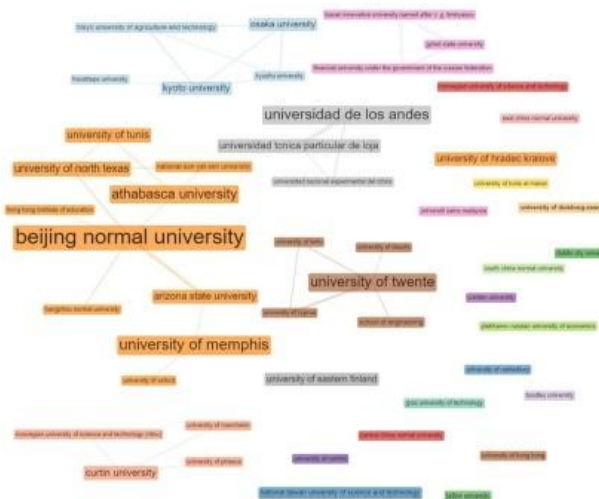


Figure 2. Institutional Collaboration

Conclusion

This study reveals that the first paper on Smart Learning Environment (SLE) was published in 2002. Mainly Among the publishing sources as revealed by this research is "Computers & Education". These results provide important guidance for experts regarding research paper publishing outlets.

Investigations into relevant articles published in the field reveal what Kinshuk's work stands out for. This author's work is primarily focused on transforming technology-enhanced learning into a Smart Learning Environment. Similarly, the authors' results show that the United States has the highest amount of scientific production in the field of Smart Learning Environment. This shows that the United States is the most relevant

country in the field of Smart Learning Environment. Regarding the contribution and relevance of the institution, Beijing Normal University tops the list.

Contribution to the field of Smart Learning Environment, Arthur C. Graesser from the United States occupies the position with an h-index 8. In addition, scholars such as Kinshuk, Graesser, Ogata, De Jong, and Aguilar have established various network collaborations. Further research informed that in mid-2020, “deep learning” became a trending topic. It found that between 2017 and 2020, new topics related to Artificial Intelligence (AI) such as learning analytics, and deep learning, have emerged and grown to become centers of Smart Learning Environment research. This finding informs that it is important to deepen to utilize Artificial Intelligence (AI) in the design of future Smart Learning Environment.

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