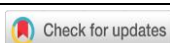# E-Module Research Trends in Learning Physics: Bibliometric Studies in 2017-2021 Range (Before and During the COVID-19 Pandemic)

Zainuddin Zainuddin[1], Surya Haryandi[1*], Misbah Misbah[1], Winda Febriani[1], Siti Aisyah[1], Nida Supiati[1], Mohd Ali Ibrahim[2]

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Sections Info	ABSTRACT
	The COVID-19 pandemic that has hit the world for the past two years has created a new trend in the world of education, one of which is through the use of e-modules. The purpose of this research is to identify and describe trends in e-module research in physics learning. The method used in this research is through bibliometric studies. The research was conducted by searching online through the Scopus database in July 2022 with the keyword "e-module" in the 2017-2021 range. The search results are then sorted and saved in CSV format which is then analyzed using VOSviewer software. Through this bibliometric approach, we can obtain an overview of research trends, patterns of interrelationships, and the potential to find novelty from these trends so as to assist further research in the future. The results of data analysis show that there are countries and the most productive authors who conduct research on e-modules. In addition, bibliometric visualization shows that research on e-modules continues to grow in various topics. So that research on e-modules in the future continues to develop according to needs.

INTRODUCTION

Supporting factors in the teaching and learning process include media and teaching materials. Teaching materials or often referred to as subject matter is the most important part in the learning process, subject matter is the core of learning activities. There are many forms of teaching materials used in the learning process, one of which is the module. Conventional module is a series of material about something written systematically with a certain grammar, equipped with pictures or illustrations and guided training to distinguish it from other written works (Sofyan et al., 2019). Print modules are commonly used in various fields such as education, courses, and industry. Thanks to advances in technology, information, and communication, the module is slowly but surely transforming into an electronic form called an electronic module or e-module (Febro et al., 2020; Komikesari et al., 2020). The e-module itself consists of various popular extension formats such as .docx, .pdf, .epub, .html. E-modules can contain content containing photos, videos, animations, and audio; some can be accessed offline, and some require an internet connection (McDonald et al., 2018; Nurjayadi et al., 2021; Sari et al., 2020).

The use of e-modules has become more in demand in recent years because it is easier to carry, do not take up space, are easily accessible, and are easy to distribute (Komikesari et al., 2020; Sari et al., 2020). The use has increased rapidly since the world experienced the COVID-19 pandemic, which began in 2020 (Hermawan, 2021). COVID-19 has forced the government to implement several policies to tackle and break

the chain of its spread (Adedoyin & Soykan, 2020; Batubara, 2021). Some of these government policies are regulated in health protocols and healthy hygiene behavior, such as getting used to washing hands, wearing masks, maintaining distance, studying from home, working from home, reducing mobility, and avoiding crowds. The consequences of implementing government policies and health protocols are the inability to carry out activities as usual and the trend of using video conferencing software, social media, video streaming services, learning management systems (LMS), etc (Adedoyin & Soykan, 2020; Batubara, 2021). One of the things that are also affected by this is the development of e-modules. The benefits of using e-modules are that they can be accessed independently by students outside of learning hours, minimize verbalism, and the ease of access is not limited to space and time (Kowitlawakul et al., 2017; Sari et al., 2020).

Prior to the COVID-19 pandemic, research on e-modules had been conducted and continued to increase over time. Especially during the COVID 19 pandemic. Developing research with the topic of e-modules attracted the attention of researchers to explore research trends regarding e-modules that were carried out before and during the COVID 19 pandemic (Erna & Anwar, 2020; Misbah et al., 2021; Sanjaya et al., 2021). Therefore, this study aims to investigate research on the development of e-modules viewed from the perspective of bibliometric distribution maps and their publication trends in the Scopus database using the Scopus sorting feature and VOSviewer software.

RESEARCH METHOD
General Background
The method used in this research is the bibliometric method, which analyzes the literature with a statistical approach to uncover indicators of either achievement or weakness (Liu et al., 2015; Pendlebury, 2010). Bibliometrics works by collecting and analyzing various metadata articles to draw a common thread from the existing findings (Muhaemin, 2019). The articles analyzed in this research were taken from the Scopus database, which is a database that provides quality scientific information and is one of the most popular in the world (Klapka & Slaby, 2018). Research is carried out online through the page search feature https://www.scopus.com/. Scopus was chosen because Scopus is a data base or data center that can be used as a search engine for scientific articles and scientific journals. This SCOPUS indexed journal already has a high reputation on an international scale. The study was conducted in July 2022 with the keyword 'e-module'. Search keywords are not year-specific. This is due to be able to take an inventory of all articles published on these keywords. in July 2022 with the keyword 'e-module'. Search keywords are not year-specific. That is due to taking an inventory of all articles published on these keywords.

Instrument and Procedures
In the first search, a total of 133 documents were obtained from all fields of science and various types of documents such as conference papers, scientific articles, review results, and short surveys. The second sorting was then carried out based on documents in the form of conference papers and scientific articles only so that a total of 123 documents were obtained. Sorting results are saved in CSV format to simplify the data analysis process. The procedures are showed at Figure 1.
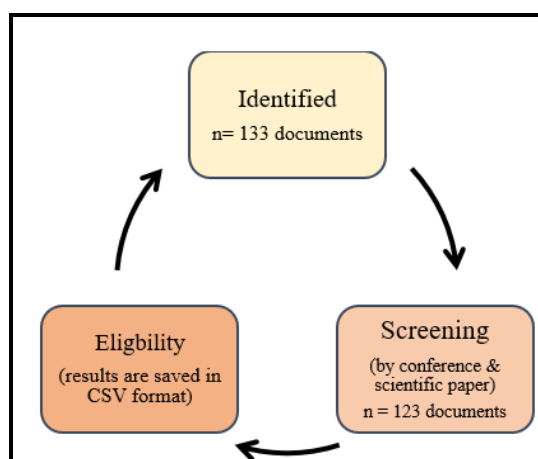
Figure 1. Procedures to collecting data

Data Analysis

Sorting data stored in CSV format is complete because it contains information such as the author's name, article title, year of publication, source, affiliation, abstract, keywords, etc. The CSV format data was then analyzed using VOSviewer software. VOSviewer is very useful in showing solid relationships between information that has been grouped into specific categories to display visualizations with attractive, informative, and efficient shapes and colors (van Eck & Waltman, 2010, 2017).

RESULTS AND DISCUSSION

Publications and Citation Structure

The data in CSV format that has been obtained is processed in such a way using Microsoft Excel software. Based on the results of data processing in CSV format, we can obtain several valuable findings, including the trend of e-module research every year in the 2017-2021 range, top 10 authors, top 10 author affiliations, top 10 countries, and the top 10 research subjects that publish the most articles on e-module. These findings will be described and analyzed comprehensively to find a common thread from the research results.

Of the 123 documents resulting from the second sorting, followed by a third sorting based on the range of years published in the last five years, namely 2017-2021. There were 65 third-sorted documents which can be seen in Figure 2.
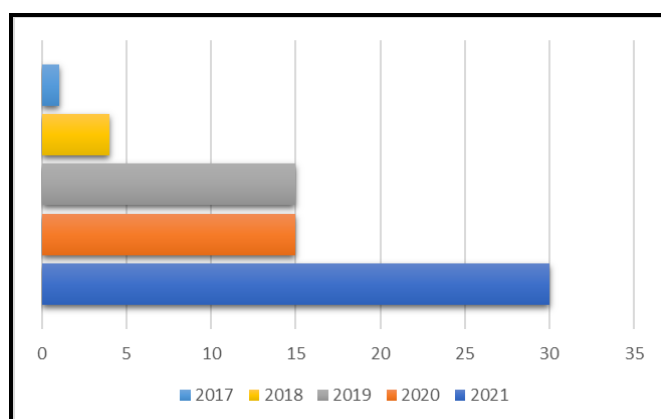

Figure 2. E-Modul Research Trend from 2017-2021.

Based on Figure 2, there is an increase in the trend of e-module research in this range, considering that entering 2019 has begun to enter the COVID-19 pandemic period where everyone is required to work from home and study from home (Purwasih et al., 2022; Wahyuni et al., 2022). Implementing this learning and working from the home system has reduced interaction with conventional print modules, thus creating opportunities for e-modules to emerge if sorted by the number of posts, the data obtained from the top 10 authors who published articles on e-modules, as shown in Figure 3.
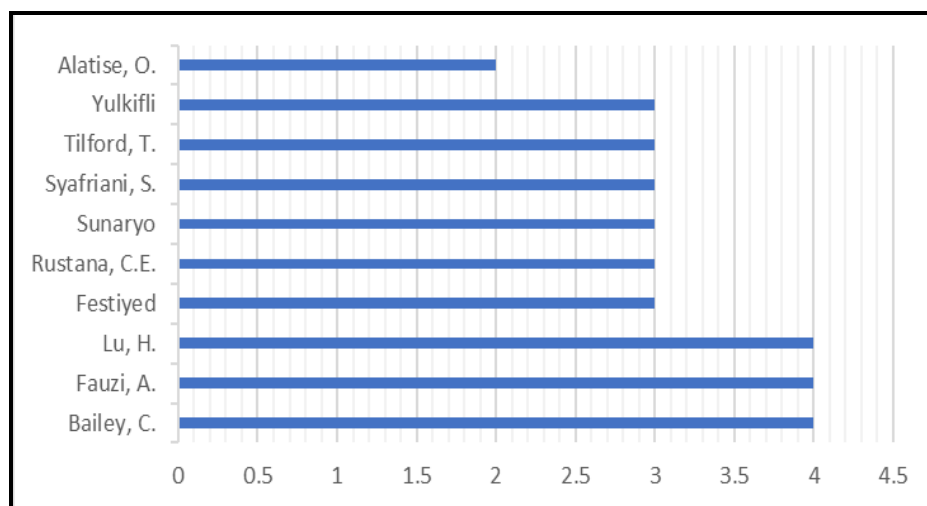

Figure 3. Top 10 writer from 2017-2021

Based on what is shown in Figure 3, it can be traced the affiliations of writers who are prolific in writing about e-modules. The search results for the top 10 affiliate authors who publish articles on e-modules can be seen in Table 1.

Table 1. Top 10 affiliates in 2017-2021

Affiliates	Total Article
Universitas Negeri Padang	16
Universitas Lampung	8
Universitas Negeri Jakarta	8
University of Greenwich	5
University of Maryland, College Park	4
Universitas Lambung Mangkurat	4
Joint Institute for Nuclear Research, Dubna	3
University of Nottingham	3
European Organization for Nuclear Research	3
Universitas Riau	3

Table 1 provides sufficient information that most articles published on e-modules come from Indonesia with affiliations, namely Padang State University, Lampung University, Jakarta State University, Lambung Mangkurat University, and Riau University. The study have been done in many topic likes disaster, chemistry, physics or about learning model (Aulyana & Fauzi, 2019; Fauzi, 2019; Nisak & Yulkifli, 2020; Noer et al., 2021; Sari & Suyatna, 2021). If we identify which countries or regions are included in producing countries in producing articles about e-modules, it will be seen in the visualization in Figure 4.
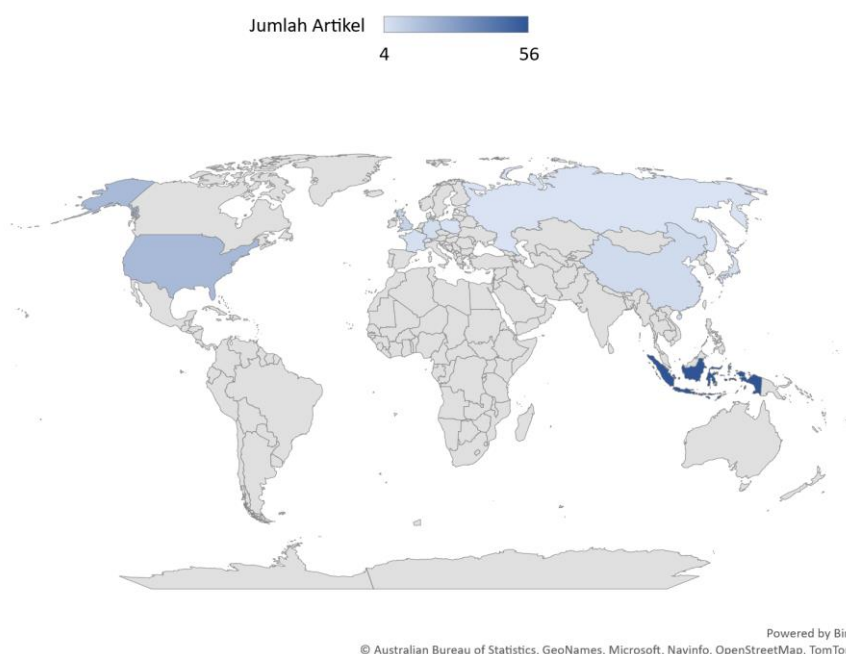
Figure 4. Productive countries or regions for authors of e-module
articles in 2017-2021

Figure 4 informs that the authors who write articles on e-modules are spread from the continents of Asia, Europe, and America. Most e-module articles are produced by the Asian continent, more specifically Southeast Asia, Indonesia, with 56 articles. One of the research that was conducted in Asia is about e-module as learning media helping student to learn even though study at home (Linda & Putra, 2021; Maielfi, 2021; Risma, 2021).

One of the advantages of the information displayed in the Scopus search database is that we can find out the research subjects from published articles. Knowing the subject of this research can give us an idea of how widely e-modules can be applied in various fields. Table 2 shows that the fields of multidisciplinary and energy are not as many as those of physics, astronomy, and engineering in researching e-modules. E-modules that present several topics are developed in the form of a web or flipbook. This is intended to make it easier for students to learn independently (Cano et al., 2018; Nugraha et al., 2022; Sari et al., 2021; Wibawa et al., 2019)

Table 2. Top 10 research subjects in the 2017-2021 range.

Subject	Total
Physics and Astronomy	76
Engineering	37
Computer Science	10
Materials Science	10
Environmental Science	9
Earth and Planetary Sciences	8
Mathematics	6
Medicine	5
Energy	3
Multidisciplinary	3

After being analyzed using Microsoft Excel, the data in CSV format was analyzed using VOSviewer software. VOSviewer used here is version 1.6.18, released on January 24, 2022, and is the latest version of this article. VOSviewer can display three custom visualizations based on relationship patterns (Hamidah et al., 2020). Several visualizations of the analysis results from VOSviewer are network visualization in Figure 5, overlay visualization in Figure 6, and density visualization in Figure 7.
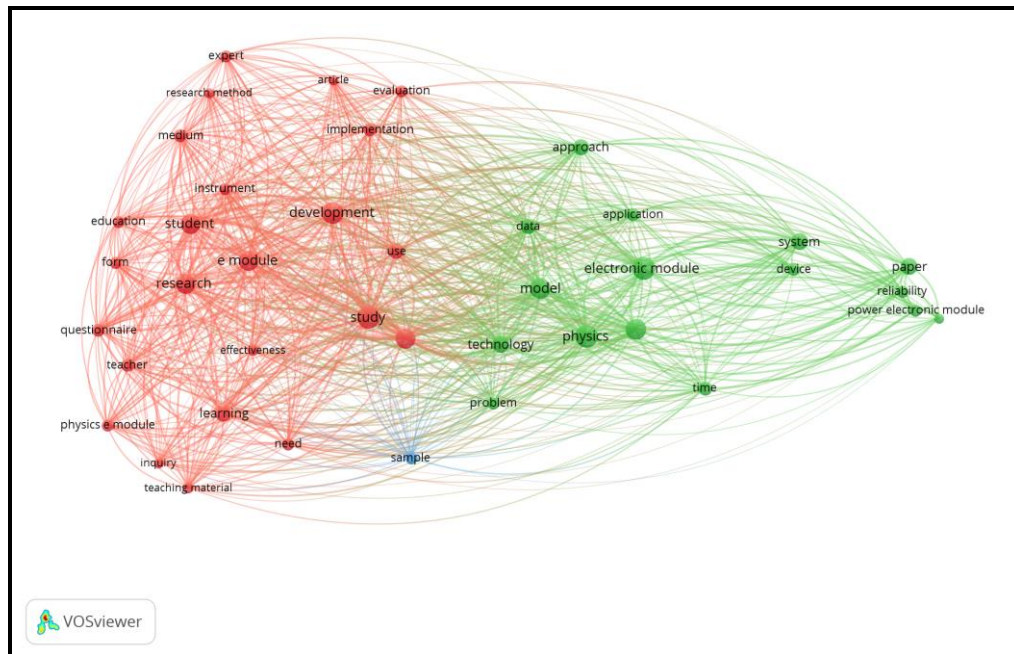

Figure 5. Network visualization on scopus database
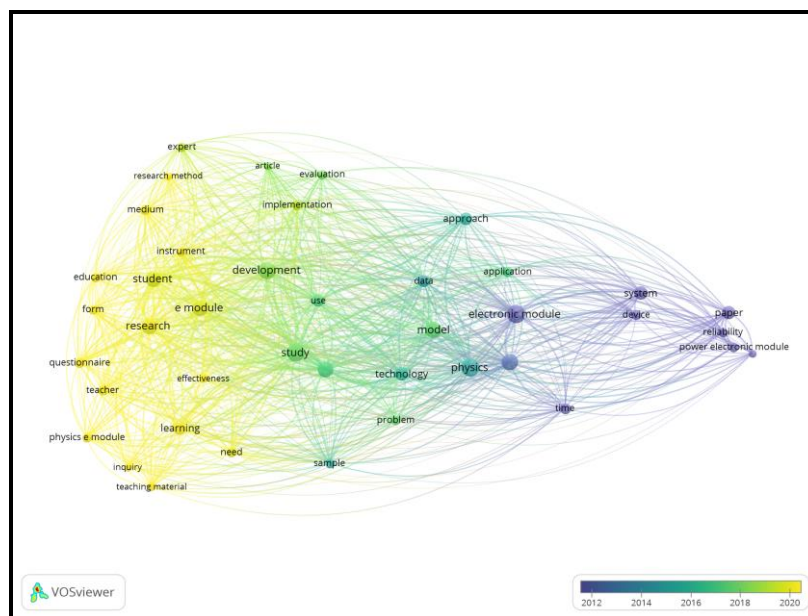

Figure 6. Overlay visualization on Scopus database

Figure 5 shows the relationship patterns of various research subjects. The red color shows the pattern of the most substantial relationship between subjects which can be seen in several keywords such as e-module, development, student, teacher, and learning. It indirectly explains that the research trend of prospective teacher students,

teachers, and lecturers has tended to be dominant in developing e-modules in the last few months. This can happen because educational actors are given the opportunity to work and develop teaching materials creatively and innovatively. The goal is to increase learning motivation for the students themselves. In addition, this can encourage the competence of teachers or prospective teachers in the field of technology (Azmi, 2019; Maskar & Dewi, 2021; Rivalina, 2014). The green color shows a reasonably strong pattern of relationships between subjects which can be seen in several keywords such as physics, approach, model, technology, and problem. From this green net, we can draw the meaning that the articles written are dominant in the field of physics by using a specific approach based on technology such as information technology. Figure 6 shows the trend pattern of e-module research from 2012 to 2020. Initially, there was e-module research in 2012, but there was still tiny. As the time approaches 2020, it is observed that research related to e-modules is increasing significantly, which is indicated by the color pattern moving towards yellow.
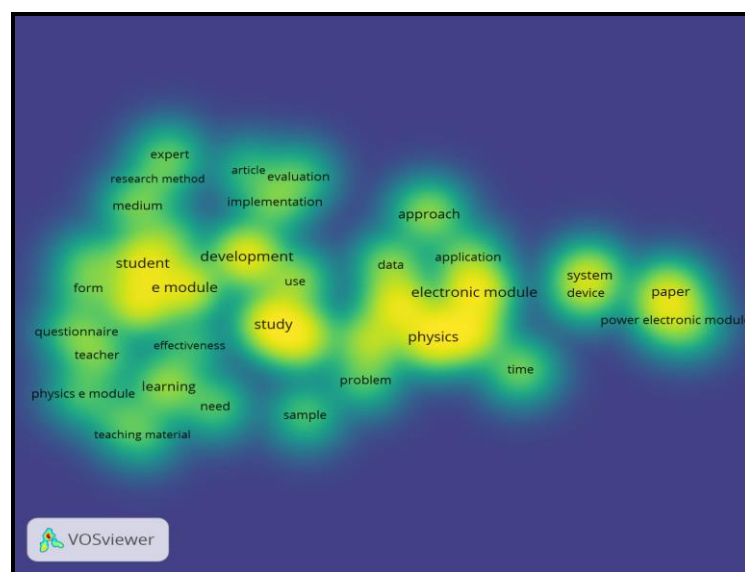

Figure 7. Visualization density on Scopus database.

Figure 7 shows us the density pattern of the research results, marked in yellow with a broad pattern to form islands. The larger the pattern formed, the meaning the topics there are closely related to e-module research. Topics such as physics, electronic module, data, and application form a pattern that indicates the research is related to the development of physics e-module with the help of specific applications and data. Moving on from Figures 4-6, we can catch some topics or keywords that often appear, including e-module, study, physics, approach, technology, and learning (Astalini et al., 2019; Darmaji et al., 2019; Resita & Ertikanto, 2018; Sari et al., 2019; Sujanem et al., 2020). The topics or keywords shown in Figures 4-6 also provide information on research topics that other researchers are currently studying. Based on this data, we can find novelty in e-module research.

The findings obtained are that future research can be carried out by examining topics regarding the effectiveness of using e-modules that can be related to 21st century competencies such as digital literacy, critical thinking, creative thinking, collaboration, and communication (Astalini et al., 2019; Darmaji et al., 2019; Resita & Ertikanto, 2018; Sari et al., 2019; Sujanem et al., 2020). In addition, this finding becomes a consideration for the government to continue to develop teaching materials that are not only print-based but

in electronic form so that they can be used in synchronous or asynchronous system learning.

CONCLUSIONS

Overall, the results of this study indicate that research trends regarding e-modules before and during the pandemic continue to grow. This is supported by the times that have entered the industrial revolution 4.0 guiding our steps to slowly but surely use technology by utilizing e-modules as teaching materials. Research on e-modules has been widely carried out in various research subjects in various countries around the world. Through this bibliometric approach, it can be seen that research on e-modules continues to develop according to the needs in the world of education, one of which is by continuing to develop the topics outlined in e-modules specially in physics learning.

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