Electronic Module with Bibliometric Analysis: Design and Development of Android-Based Products for Assisting Scientific Writing Relating to Fluid in Higher Education

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ARTICLE INFO	ABSTRACT
           	Android-based products have been widely used in language field. However, some studies showed there is limited research revealed how to develop suitable android-based products and how it can improve scientific writing skill in higher education, especially in fluid topics. This research is intended to design and develop electronic module with bibliometric analysis to assist scientific writing in higher education. The method used was design-based research (DBR) to obtain comprehensive information related to design and develop electronic module with bibliometric analysis. University students, lecturers, and experts were taken as the participants in this research. The results showed that the electronic module with bibliometric analysis has been adapted to the university students' needs in scientific writing, especially in fluid topics. The contents empower students and lecturers with systematically scientific writing guidance. The electronic module with bibliometric analysis was user-friendly designed through Android-based technology. In line with expert validation, the electronic module with bibliometric analysis were systematically arranged for supporting self-instructional learning in higher education. Related to the language skill, the electronic module with bibliometric analysis can foster students' writing skill especially in scientific writing. These results give implications to improve scientific writing skill through electronic module with bibliometric analysis in higher education.

1. Introduction

Technological progress in the digital era indirectly influences all aspects of human life, including economy, culture, politics, education, and others [1]. Technology in education plays a role in learning, which facilitate the formation of collaborative interactions and building meaning in a context that can be understood meaningfully [2]. Moreover, educational technology is not only a science but also a source of information and learning resources that are appropriate to educational needs that can

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facilitate the learning process. Digital learning materials are one of products of educational technology that has been used in learning process.

In line with the technology and challenges in the 21st century, the printed learning materials currently available have not been able to accommodate the needs of students. As the impact, the electronic learning materials are needed to support the learning process. The need for types of electronic learning materials includes electronic textbooks, electronic modules, electronic student worksheets, electronic handouts and materials presented *via* power point. Electronic modules or e-module are non-printed digital-based learning material product that are independently designed to be learnt by students [3,4]. Electronic module facilitates students to learn effectively and efficiently in terms of the cost, time and affordability [3,5].

Writing is a language skill that is used to communicate indirectly, not face to face [6]. The ability of writing should be supported by knowledge, skills, and the ability to explain because writing is not only for oneself, but also for others [7]. Writing skills learned in college include writing scientific papers, proposals, reports and scientific articles. One type of scientific work that is used as learning in college is a scientific article. A scientific article is a type of academic text. An article as a scientific work is based on research, thinking results or literature reviews [8]. It means that writings originating from ideas and problems convey information to readers.

Writing is considered as a difficult language skill for students. The level of difficulty in writing is certainly a big challenge for students. Especially in higher education, writing is an important part of students' lecture assignments such as writing papers, scientific articles and others. The previous study showed that writing skill of students, especially for writing papers and scientific articles, are generally still in the low category [9-11]. Some of the difficulties faced by students in writing papers include not mastering writing techniques and difficulty finding references [12,11]. students are not being able to construct sentences properly, finding study topics and confuse how to start writing [13].

The problems of writing skill come from the learning process in higher education that has not maximized all components of learning, such as the lack of suitable learning materials [14]. In addition, the learning process is still teacher-centered learning. Based on the results of a study at 8 universities in Jakarta, it was found that some lecturers still use traditional teaching methods in learning Compulsory Curriculum Subjects of Indonesian language [15]. Learning is still centered on lecturers and there is a lack of interaction between students and lecturers. In addition, face-to-face hours for Compulsory Curriculum Subjects of Indonesian language are also considered lacking in universities so that this also becomes a problem in lectures [16].

The limitations of learning materials used in learning are one of the factors causing problems in achieving learning outcomes [17]. The previous study showed that there are still lecturers who not mastering the ability to compile learning materials [18]. It means that learning materials are not only limited but also difficult for lecturers to produce [19]. Learning materials used in universities have special characteristics that must be in line with the demands and achievements of student learning targets [20]. Learning materials in lectures not only act as learning materials, but can also be used to create student-centered learning situations so that learning can be more interactive [21,22].

Writing learning for students requires analytical methods to find data and develop writing ideas. One of the widely used analytical methods is bibliometric analysis. Several studies have been conducted on bibliometric analysis in writing learning in higher education. Research on bibliometric analysis of technology-based foreign language learning during the COVID-19 pandemic: the direction of Indonesian language learning [23]. Research on bibliometric mapping with vosviewer on the development of research in the field of writing scientific papers [24]. In previous studies, bibliometric analysis was used to see research trends in Indonesian language learning, but there has been no research that uses bibliometric analysis as an analytical method in learning to write scientific articles

through e-modules. Table 1 shows the bibliometric analysis to provide insights into the current state of research.

Table 1
Previous studies on bibliometric

No.	Title	Author	Ref
1.	The REDCap consortium: building an international community of software platform partners	Harris *et al.,*	[25]
2.	bibliometrix: An R-tool for comprehensive science mapping analysis	Aria & Cuccurullo	[26]
3.	Green supply chain management: A review and bibliometric analysis	Fahimnia *et al.,*	[27]
4.	The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics	Ivanov *et al.,*	[28]
5.	A review of project-based learning in higher education: Student outcomes and measures	Guo *et al.,*	[29]
6.	Digital transformation in business and management research: An overview of the current status quo	Kraus *et al.,*	[30]
7.	Supply chain finance: A systematic literature review and bibliometric analysis	Xu *et al.,*	[31]
8.	Quantitative models for managing supply chain risks: A review	Fahimnia *et al.,*	[32]
9.	The determinants of students' perceived learning outcomes and satisfaction in university online education: An update	Eom & Ashill	[33]
10.	Can smartphone apps increase physical activity? Systematic review and meta-analysis	Romeo *et al.,*	[34]
11.	Additive manufacturing applications in industry 4.0: a review	Haleem & Javaid	[35]
12.	Reconfigurable supply chain: The X-network	Dolgui *et al.,*	[36]
13.	Bibliometric using Vosviewer with Publish or Perish (using google scholar data): From step-by-step processing for users to the practical examples in the analysis of …	Husaeni & Nandiyanto	[37]
14.	Canadian stroke best practice recommendations: rehabilitation, recovery, and community participation following stroke. Part one: rehabilitation and recovery	Teasell *et al.,*	[38]
15.	Development of student teachers' digital competence in teacher education-A literature review	Rokenes & Krumsvik	[39]
16.	From BIM to digital twins: A systematic review of the evolution of intelligent building representations in the AEC-FM industry.	Deng *et al.,*	[40]
17	A systematic review on trends in using Moodle for teaching and learning	Gamage *et al.*	[41]
18.	A systematic review of eHealth interventions to improve health literacy	Jacobs *et al.,*	[42]
19.	Industry 4.0 and Lean Manufacturing: A systematic literature review and future research directions	Pagliosa *et al.,*	[43]
20.	Opportunities and adoption challenges of AI in the construction industry: A PRISMA review	Regona *et al.,*	[44]
21.	From digital to sustainable: A scientometric review of smart city literature between 1990 and 2019	Zheng *et al.,*	[45]
22.	Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology	Bond *et al.,*	[46]
23.	How WEIRD are positive psychology interventions? A bibliometric analysis of randomized controlled trials on the science of well-being	Hendriks *et al.*	[47]
24.	Global evolution of research on green energy and environmental technologies: A bibliometric study	Tan *et al.,*	[48]
25.	Attributes of digital natives as predictors of information literacy in higher education	Šorgo *et al.,*	[49]

Technology have been widely used in language field, such as Android-based products. Several previous studies have been carried out regarding the development of Indonesian language modules in universities. Previous research has been conducted regarding the development of Indonesian

language learning materials for students in higher education [50–53]. Various research has also been carried out regarding the development of Indonesian language modules for students [54-56]. Research regarding the development of electronic modules (e-modules) for Indonesian language learning courses for students has also been carried out previously [57-60]. However, no previous research has been conducted that has developed learning materials in the form of electronic modules that utilize analytical methods to support students' learning to write scientific articles.

Different from previous studies, our research gap is highlighted the need for innovative learning materials that combine technology with analytical approaches to address the challenges of teaching scientific writing, especially for fluid topics. This research is aimed to design and development electronic module with bibliometric analysis of to assist scientific writing in higher education using Android-based products, especially in fluid topics. The novelties in this research are (i) this study design the electronic module with bibliometric analysis (ii) this study implement the electronic module with bibliometric analysis for enhancing writing scientific article of students completed with literature review, bibliometric, and experiments for students and (iii) this study finds the next future research.

2. Literature Review
2.1 Android-Based Products

In the 21st century, technology plays a crucial role in education. Digital learning fosters creativity and gives students a sense of accomplishment, which in turn drives their motivation to explore new and innovative approaches beyond traditional methods. Mobile learning is a technology designed to aid both students and educators by utilizing the Internet through electronic devices [61]. Android is an application system developed by numerous individuals, enabling users to utilize it for solving problems in their work [62]. Android-based media is a learning style in the 21st century generation [63]. The creation of Android-based learning media is essential as it enables students to learn anytime and anywhere with greater flexibility and convenience using a smartphone [64].

2.2 Electronic Module with Bibliometric Analysis

Learning process must be supported and designed with an instructional concept and easy to practice [65]. The design of learning materials can support individual and independent learning so that the role of educators can be replaced by learning materials [66]. College students as adults need to be facilitated with learning that can train independence in learning [67]. There are various types of teaching materials that can be used in higher education, such as textbooks, modules, handouts, student worksheets, and so on. In the current digital era, teaching materials have also been widely developed in digital form.

For example, learning materials in the form of interactive e-books can be used for group or independent learning [68]. In line with the previous research that student independence can be increased through the use of e-books [69]. In addition, the use of digital textbooks can increase student motivation and achievement [70]. There are various benefits obtained through learning using modules, including 1) students can be responsible for their own learning activities, 2) learning with modules really respects individual differences, so that students can learn according to their ability level, so that learning is more effective and efficient [71].

An important role in writing scientific articles certainly has an analysis method that can be used in writing scientific articles. Bibliometric analysis is one of the analysis methods that utilizes bibliographic and statistical data to assess the quality, impact and trends of scientific publications. In

writing scientific articles, bibliometric analysis has a role, including (1) selection of research topics, authors can use Bibliometric analysis to identify gaps in research, estimate the novelty of existing literature, and find research topics that have impact and benefits, and (2) measuring Research Impact, authors can use Bibliometric analysis to measure the impact of their publications by looking at the number of citations, journal impact factors, and indicators such as the Hirsch index (h-index) or g-index.

The term Bibliometrics was first used by Pritchard in 1969. According to Pritchard, bibliometrics is the application of mathematical and statistical methods to books and other communication media. The scope of bibliometrics includes the relationship between the growth of the number of literature papers and the pattern of library database usage [72]. Bibliometrics is also a quantitative analysis of written documents that are often used to analyze scientific and scholarly publications [73].

In addition, bibliometrics is the study of the relationship between numbers and patterns in bibliographic data and their use, for example the number of papers, literature growth, and patterns of library and database usage [72]. Bibliometric analysis can be done based on a fairly large list of publications collected and published in print or electronically [74]. Bibliometric analysis is based on relevant information about scientific publications that can be taken from data sources.

Learning to write scientific articles assisted by bibliometric analysis is one of the effective and innovative approaches in developing scientific article writing skills. Utilizing bibliometric analysis, students can understand the latest research trends, identify relevant sources, and gain insight into the topics discussed. In addition, the literature search process becomes more efficient with the use of bibliometrics. In this way, the search for literature sources is directed at relevant and influential sources and saves researchers time in collecting the information needed.

The development of e-modules for learning to write scientific articles assisted by bibliometric analysis integrates technology with learning to write scientific articles. The advantage of having e-modules is that they provide easy accessibility for students. Through e-modules, students can easily obtain materials, references, examples, and exercises in an integrated and directed manner. Other conveniences obtained by students include flexibility in accessing and time to obtain learning. In addition to the advantages obtained, e-modules utilize technology in visualizing bibliometric data interactively and easily understanding and analyzing information better. Students can understand learning to write scientific articles more interactively through these e-modules.

2.3 Fluids

Fluids are substances that can flow and provide little resistance to changes in shape when pressed. A fluid is a material capable of movement and undergoing continuous shape changes due to pressure and shear stress [75]. In the heat exchanger process, fluid serves as a medium for heat transfer, with temperature factors and the choice of heat transfer medium influencing the performance of the helical coil [76]. In Addition, fluids are substances that can change shape when subjected to shear forces through an in-depth discussion of the categories of liquids and gases [77]. The basic properties of fluids in the form of flowability, shear force characteristics, and the differences between liquids and gases [78]. Fluids are generally divided into two types, consisted of non-moving fluids (hydrostatic) and moving fluids (hydrodynamic).

One of the examples of implementation of fluids is hydraulic system. Hydraulic systems are fundamental to modern industrial applications, providing efficient power transmission and control mechanisms. A hydraulic system is a method of power transformation or transfer that utilizes liquid fluid as a medium to generate a higher output power than the initial input power [79]. The hydraulic system is composed of key components including hydraulic pumps, cylinders, control valves, and

accumulators, which operate in unison to drive machine parts [80]. The pressure of this delivery fluid is increased by the pump which is then passed on to the working cylinder through pipes and valves [81].

Pascal's principle states that the pressure applied to a liquid in a closed space is transmitted equally in all directions. A simple example of the application of Pascal's law is a hydraulic jack. Applications in daily life that use the principle of Pascal's law include hydraulic jacks, bicycle tire hydraulic pumps, car lifting hydraulic machines, hydraulic presses, and hydraulic disc rims. Figure 1 shows the implementation of Pascal's principle.
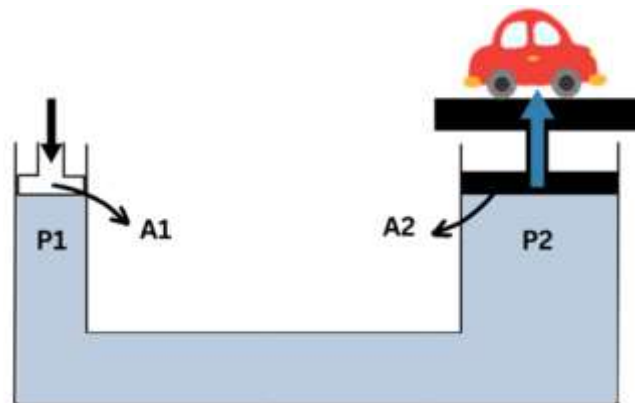

Fig. 1. Hydraulic system

Using Pascal's principle, the following mathematical relationship applies in Eqs. (1) and (2):

$$P1 = P2 \qquad (1)$$

$$\frac{F1}{A1} = \frac{F2}{A3} \qquad (2)$$

In details, P1 is pressure on cross section 1 and P2 is pressure on cross section 2. F1 represents force on cross section 1 and F2 represents cross section 2. A1 represents cross-sectional area 1 and A2 represents cross-sectional area 2. According to the picture of the hydraulic mechanism, since fluid cannot be added to or removed from a closed system, the volume of fluid pushed on the left will push the piston (solid cylinder) on the right upward. Another example is car Lifting Hydraulic Machine. Air with pressure high enters through the tap P1. This air is compressed in tube A Pressure this high air carried on by oil fluid to suction cup A2 on sucker A2. A lifting force is generated big enough to be able to lift the weight of the car. The other example is Hydraulic Jack. Principle working from a jack hydraulics use principles Pascal's law is simple. This jack has 2 tubes which differ in diameter. Each of these tubes filled with water and closed tightly the surface with give pressure on one surface then the pressure is incoming will be transferred to the tube the other so the jack can used for lifting heavy load. Figure 2 shows the other example of hydraulic systems.
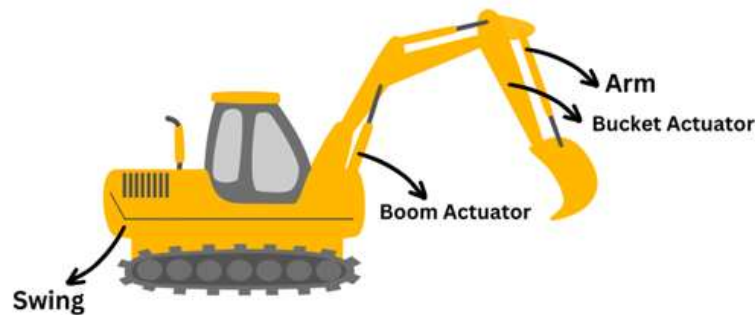
Fig. 2. Hydraulic system of excavator

Table 2 shows numerous studies related to fluid.

Table 2
Research fractions on education

No.	Title	Reference
1.	Temperature Condition Impact on The Onset of Rayleigh-Benard Convection in a Binary Fluid Saturated Anisotropic Porous Layer	[82]
2.	Tribological Characterisation of Biofluid Using Four Ball Experiment	[83]
3.	Characteristics of Void Fraction Using Image Processing of Two-Phase Flow of Air-Pure Water and Glycerin (40-70%) on A Transparent Mini Pipe With Slope of 45o to the Horizontal	[84]
4.	A Hybrid RANS/LES Model for Predicting the Aerodynamics of Small City Vehicles	[85]
5.	Solute Dispersion in Casson Blood Flow through a Stenosed Artery With the Effect of Temperature and Electric Field	[86]
6.	Development of Computational Benchmarking Model for Infusion Pumps	[87]
7.	Impacts of Nonlinear Thermal Radiation on A Stagnation Point of An Aligned MHD Casson Nanofluid Flow With Thompson and Troian Slip Boundary Condition	[88]
8.	Hull Water Resistance Calculation of a Seaplane Twin Float With Clearance Ratio Variation Configurations	[89]
9.	Evaluation of Streamline on Aerofoil With Suction Hole in Wind Tunnel	[90]
10.	Experimental Study on Flow Pattern and Void Fraction of Air-Water and 3 % Butanol Two-Phase Flow in 30o Inclined Mini Channel	[91]

2.4 Writing Scientific Article Related to Fluid Topics

Writing is one of the aspects of the four important language skills learned in college. Writing is a language skill in the form of expressing ideas or thoughts in writing that involves knowledge and skills in conveying ideas. Writing skills are needed in college to support the fulfillment of students' academic tasks. Writing is a language skill used in indirect communication [92]. Writing skills are not obtained naturally, but through the process of learning and practicing. This ability must be supported by knowledge, skills, and the ability to explain because writing is not only for oneself, but also for others [7].

Writing is a process of studying the thoughts and feelings of a particular person [93]. Writing is the ability to convey ideas through writing [17]. Through this process, ideas or concepts are produced. The process of writing in pouring ideas into writing is known as writing [94]. Writing can also be said to be a creative process that transforms ideas or thoughts into written symbols [95]. The process of expressing ideas and thoughts in writing [96].

One type of scientific work that is used as learning in higher education is a scientific article. A scientific article is a type of academic text. An article as a scientific work is based on research, thinking results or literature reviews [8]. Scientific writing demands dedication, knowledge and expertise across various scientific disciplines [97]. Scientific articles are articles that contain and examine a

particular problem using scientific principles [98]. Scientific articles must be written with good and correct writing methods [99]. An article as a scientific work based on research, results of thought or literature review [8]. Scientific writing and publication are essential to advancing knowledge and practice in public health, but prospective authors face substantial challenges [100].

Writing scientific articles certainly has a purpose. The purpose of writing scientific articles is to generate ideas [101]. The writing indicators to measure the level of student ability in learning to write is with assessment criteria based on the following aspects, including trying to do (write), determining the title according to the content written, using EYD spelling, using word choice (diction) correctly, harmony in content and topic, writing effective sentences, student creativity (for example, the results of writing are given simple pictures or illustrations) and telling events coherently and clearly [102].

Related to fluids topics, Table 3 shows numerous studies about writing scientific article related to fluid.

Table 3
Research of writing scientific article related to fluid

No.	Title	Reference
1.	Experimental and Numerical Study on the Effect of Teardrop Dimple/Protrusion Spacing on Flow Structure and Heat Transfer Characteristics	[103]
2.	Mxene and Strontium Titanate Hybrid Casson Nanofluid with CMC Base via the Caputo-Fabrizio Fractional Derivative over a Vertical Riga Plate	[104]
3.	Porosity and Slip Velocity Effects on MHD Pulsatile Casson Fluid in a Cylinder	[105]
4.	Interaction Analysis of Micro Bubbles in the Flat Plate to Reduce Drag Using Computational Fluid Dynamic	[106]
5.	Utilization of Nanofluids in Minichannel for Heat Transfer and Fluid Flow Augmentation: A Concise Research Design	[107]
6.	Numerical Prediction of Laminar Nanofluid Flow in Rectangular Microchannel	[108]
7.	Computational Fluid Dynamic Simulations of Wind-Induced Ventilation in Idealized Step-Up Street Canyons	[109]
8.	Investigation of the Fluid Motion with Various Clearances in Biodiesel Reactor by Using CFD	[110]
9.	Double Population MRT LBM in an Enclosure using Nanofluid	[111]
10.	A GUI for Computing Hybrid Nanofluid Boundary Layer Flow using bvp4c Solver in MATLAB: Educational Purposes for University Students	[112]

2.4 Research Trends of Electronic Module and Writing Scientific Article

The research trends of electronic module and writing scientific article were identified using publication data from Google Scholar. This data was gathered through the Publish or Perish application, which utilizes Google Scholar's database as its data source. The analysis revealed a total of 999 articles relevant to the research criteria. The publication data were analysis to analyze the research trends showed in Figure 3.

Fig. 3. Electronic module and writing scientific article research trends

Figure 1 shows the research trends of electronic module and writing scientific article through article publications from 2014 to 2024. From 2014 to 2024, the research trends research trends were fluctuated. In 2014, the number of publications as many as 121 articles. However, from 2014 to 2015 there were a decrease of number of publications from 121 to 115. In 2016, the number of publications same as in 2015 which is 121 publications. In 2017, the number of publications increase to 119. From 2018 to 2019, the number of publications decrease as many as 113 and 87 publications. In 2020 – 2024, the number of publications were fluctuated, sequentially 142, 98, 55, 14, and 20.

Figure 4 shows that research about writing scientific article and electronic module was carried out from 2014 to 2024.

Fig. 4. Electronic module and writing scientific article research trends by vosviewer

According to Figure 3, the term of module, electronic modul, and writing have a connection. It means that from 2014 to 2024 research about electronic module have been conducted. Moreover, Figure 5 shows a network of other terms, such as electronic module and writing scientific article terms.

Fig. 5. The Connection of writing and module by vosviewer

3. Methodology

This research was conducted using the Design Based Research (DBR) approach. This research has developed steps consisting of four steps, including 1) identify and analyze the problem, (2) design the electronic module with bibliometric analysis, (3) develop the electronic module with bibliometric analysis, and (4) reflect the electronic module with bibliometric analysis. The research procedure can be described in Figure 6.

Fig. 6. Research procedure

The research subjects consisted of 45 university students from a private university in Bekasi City, Indonesia. Table 4 provides details of the research subjects.

Table 4
Research subjects

Characteristics	Categories	Frequency	Percent (%)
Gender	Male	19	42
	Female	26	58
Age	20 years old	14	31
	21 years old	31	69
Degree	Bachelor	45	100

To enhance the generalizability of the results, the sample was selected based on factors such as size, characteristics, age and gender. This sampling method allows the findings to be extended to university students in other countries with similar profiles, particularly those enrolled in academic programs emphasizing skills like writing scientific articles. Moreover, the results are expected to be applicable to universities with comparable curricula, especially those focusing on academic writing and scientific article comprehension. Additionally, the research findings could be relevant to higher education systems in nations with similar educational standards. However, cultural differences and variations in teaching methods should be taken into account, as these factors may impact the outcomes.

Data collection methods involve gathering writing test. The writing test aims to evaluate students' ability to write a scientific article. Writing skills were assessed using two sets of indicators: scientific article structure and grammar. The indicators for scientific article structure included writing the title, abstract, introduction, methodology, results, discussion and conclusion. The grammar indicators covered the use of paragraphs, effective sentences, language rules, systematic writing of articles, and referencing, interview (aspects interviewed include errors in writing scientific article texts, difficulties in writing scientific article texts, factors causing difficulties in writing scientific articles) questionnaire responses from product trials (interest in the module, module usefulness, module usefulness in learning, and module usefulness in students' scientific article writing skills) and expert judgment.

Expert judgments include material expert judgments, learning design expert judgments, and media expert judgments. Material expert judgments include content quality, material presentation, linguistics and use of bibliometric analysis. Assessment of learning design experts, including competency objectives, student characteristics, and methods. Assessment of media experts, including module size, module cover design and module content design). The data processing involved analyzing scores from the scientific article writing test and the percentage results from expert evaluations. Researchers assessed students' writing abilities both before and after implementing the digital module. The expert evaluation data were further examined through the stages of data collection, data reduction, data presentation and drawing conclusions.

4. Results and Discussions
4.1 Problem and Need Analysis

The problem analysis students were assessed through a writing scientific article test. Table 5 displays the outcomes of writing scientific article ability among college students in higher education.

Table 5
The results of writing scientific article test of students based on the indicators

No.	Aspects	Indicators	Score
1.	Structure of Scientific Articles	Writing the Title	50%
		Writing an Abstract	45%
		Writing the Introduction	30%
		Writing Methods	47%
		Presenting Results	40%
		Writing a discussion	23%
		Writing a conclusion	30%
2.	Linguistic rules	Paragraph	45%
		Effective sentence	30%
		Spelling according to EYD	38%
		Systematics of Writing Articles	40%

According to Table 2, the results showed that most of achievement of indicators reach the percentage less than 50%. It means that almost all of indicators of writing scientific article of students is in the low category. In line with researchers, some of the obstacles faced by students in writing are also caused by a lack of understanding of writing techniques and difficulties in finding reference sources [12,11]. In addition, the results of the study showed that students have a level of writing ability that is still in the low category, especially in writing scientific papers and articles [9-11]. The obstacles faced by students in writing cannot be separated from students' writing skills which are not yet adequate. The difficulties often faced by students in writing scientific papers are difficulties in obtaining reference sources and not knowing writing techniques [9].

Based on the results of the questionnaire, 97% of students need e-modules with bibliometric analysis as learning materials of writing scientific article in Compulsory Curriculum Subjects of Indonesian language. Based on the interview results, the reasons why students need e-modules in writing scientific article include: 1) e-modules can facilitate students' understanding of writing scientific article, 2) e-modules can make it easier for students in the process of learning, 3) e-modules can clarify the presentation of materials, 3) e-modules can overcome space and time limitations in learning, 4) e-modules can improve students' knowledge, 5) e-modules are easy to re-learn continuously, 6) e-modules as a reference for writing scientific article, 7) e-modules can increase knowledge and insight, 8) e-modules can deepen the material, and 9) e-modules can improve the effectiveness and efficiency of learning.

Based on the research results, the forms of modules needed in writing scientific article include 1) learning modules in the form of e-modules, 2) modules that cover all learning materials, 3) modules whose contents are interesting for students, 4) modules that are in accordance with existing educational standards and teaching modules that are in accordance with developments over time, and 5) modules that are simple but complete in content so that they are easy to use.

The digital era is often associated with education in the 21st century. Digital learning has a more positive impact on learning motivation compared to traditional teaching methods [113]. Digital learning materials have a positive contribution, including saving printing costs and having easy access. Digital learning materials are easy for students to learn [58]. Based on the results of the study, there is a diversity of types of teaching materials chosen by students, including learning materials in two modes, namely print and digital, digital learning materials and printed teaching materials. The results of the previous study show that students need learning materials that have complete material content [114]. Four key topics were important to explore, including fostering creativity and precision

in writing, effective teaching methods, available learning resources and taking into account students' writing abilities and interests [115].

4.2 Design and Development of Electronic Module with Bibliometric Analysis

The development of electronic module with bibliometric analysis in this research used Android-based products. Android-based media is a learning style in the 21st century generation [63]. The creation of Android-based learning media is essential as it enables students to learn anytime and anywhere with greater flexibility and convenience using a smartphone [64]. Table 6 shows the development of electronic module with bibliometric analysis.

Table 6
Development of electronic module with bibliometric analysis

Electronic Module with Bibliometrik Analysis	Description
	The cover display of electronic module with bibliometric analysis using Android-based products.
	There are some of topics in the homescreen including learning goals, contents, student worksheet, and evaluation.
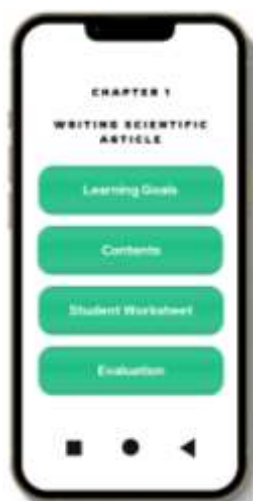
The display of contents related to the writing scientific article.

The development of e-modules for learning to write scientific articles assisted by bibliometric analysis integrates technology with learning to write scientific articles. The advantage of having e-modules is that they provide easy accessibility for students. Through e-modules, students can easily obtain materials, references, examples and exercises in an integrated and directed manner. Other conveniences obtained by students include flexibility in accessing and time to obtain learning. In addition to the advantages obtained, e-modules utilize technology in visualizing bibliometric data interactively and easily understanding and analyzing information better. Students can understand learning to write scientific articles more interactively through these e-modules.

There are various benefits obtained through learning using modules, including 1) students can be responsible for their own learning activities, 2) learning with modules really respects individual differences, so that students can learn according to their ability level, so that learning is more effective and efficient [71]. The use of electronic modules in Indonesian language learning in universities can help lecturers in presenting Indonesian language learning that suits students' needs. The support of learning devices such as electronic modules can help students understand Indonesian language learning taught at the university level.

4.3 Reflections of Electronic Module with Bibliometric Analysis

The reflection of the development of electronic module with bibliometric analysis revealed an improvement in students' writing scientific article. In line with expert validation, the electronic module with bibliometric analysis were systematically arranged for supporting self-instructional learning in higher education. Table 7 displays the levels of mathematics literacy among students before and after using the interactive digital module.

Table 7
Writing scientific article ability of students before and after using electronic module with bibliometric analysis

No.	Aspects	Indicators	Before	After
1.	Structure of Scientific Articles	Writing the Title	40%	80%
		Writing an Abstract	35%	70%
		Writing the Introduction	30%	70%
		Writing Methods	42%	75%
		Presenting Results	36%	75%
		Writing a discussion	23%	70%
		Writing a conclusion	30%	77%
2.	linguistic rules	Paragraph	35%	78%
		Effective sentence	30%	75%
		Spelling according to EYD	38%	77%
		Systematics of Writing Articles	40%	80%

Learning to write scientific articles assisted by bibliometric analysis is one of the effective and innovative approaches in developing scientific article writing skills. Utilizing bibliometric analysis, students can understand the latest research trends, identify relevant sources, and add insight into the topics discussed. Bibliometric analysis provides performance analysis and science mapping [116]. The bibliometric analysis method not only helps students compose scientific articles, but also broadens their understanding of previous research contributions, resulting in the latest research trends on the topics discussed. In addition, bibliometric analysis helps authors identify knowledge gaps and direct their research focus more effectively. Students can explore scientific literature through publish of perish, thus optimizing the selection of relevant and significant research topics.

In terms of challenges or limitations or obstacles regarding the implementation of e-modules in higher education, the obstacles faced in terms of e-modules include dependence on certain applications in the form of devices that are not available or compatible with the devices owned by students. In addition, the quality of content to produce interesting, interactive, and innovative e-modules is one of the concerns. In addition, students have different levels of technological skills so they are not used to or have difficulty using technology. However, there is the gap in access to digital learning resources because not all students have experience or knowledge about how to effectively use e-modules, such as navigating the interface or utilizing interactive features.

In terms of comparing traditional learning and e-module-based learning, e-modules offer greater flexibility, affordability, and accessibility, but challenges such as limited face-to-face interaction, reliance on technology, and the need for self-motivation can be barriers. On the other hand, traditional learning provides more face-to-face and structured interaction, but has limitations in terms of flexibility and accessibility. To assess the effectiveness of e-modules more accurately, a comparative analysis involving both methods is needed, taking into account factors such as learning outcomes, student engagement, and user experience.

Moreover, these results allow readers to understand that although e-modules have great potential to enhance learning, there are various factors that need to be considered to ensure their successful implementation. Consideration of student engagement, access to technology, and varying levels of prior knowledge will help design more inclusive and effective e-modules. For further research, it is recommended to conduct further research to evaluate the extent to which e-modules contribute to long-term improvement in students' writing skills. This research could include measuring retention of writing skills and their impact on overall academic performance. In addition,

it is important to explore how e-modules can be integrated with other learning technologies, such as artificial intelligence or automated evaluation tools, to enhance students' learning experiences.

4. Conclusion

The development of e-module for learning to write scientific articles assisted by bibliometric analysis integrates technology with Android-based products. The results showed that the electronic module with bibliometric analysis has been adapted to the university students' needs in scientific writing. The contents empower students and lecturers with systematically scientific writing guidance. The electronic module with bibliometric analysis was user-friendly designed through Android-based technology. In line with expert validation, the electronic module with bibliometric analysis were systematically arranged for supporting self-instructional learning in higher education. Related to the language skill, the electronic module with bibliometric analysis can foster students' writing skill especially in scientific writing. These results give implications to improve scientific writing skill through electronic module with bibliometric analysis in higher education.

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