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SYSTEMATIC LITERATURE REVIEW: THE EFFECT OF E-MODULE ON STUDENT SCIENCE LEARNING OUTCOMES

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Abstract:

E-modules are multimedia-based learning media modules that involve video, audio, images, and text. Currently, e-modules are widely used in the learning process at school. This study aims to determine the effect of e-modules on students' science learning outcomes. The method used is a systematic literature review. Several journal requirements were used that met the inclusion criteria, namely journals with publications in the last 5 years, indexed by SINTA or Scopus, experimental research types, and covering the scope of science. The results showed that 8 journals met the inclusion and exclusion criteria after going through the search stage and summarized in the form of PRISMA. Based on the review of the 8 articles, it was found that the application of e-modules in learning has a positive effect and significantly improves student science learning outcomes (cognitive, affective, and psychomotor skills) and student learning motivation. Therefore, it can be concluded that e-modules have a positive effect on students' science learning outcomes.

Keywords:

SLR, E-module, Science Learning Outcomes, Effect

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Introduction

Learning media is a very important means of supporting learning to produce more meaningful and interesting learning. The attractiveness of a learning media in presenting material will indirectly increase students' interest in learning. Material that is easy to understand and understand is material that is packaged interestingly and can increase one's interest in learning it (Dwijayani, 2019; Nazmi, 2017). Learning media in the current 2.0 era has evolved from traditional learning to technology-based learning as a form of development of the times. Learning media is an integral part of the learning system, so the media used in learning must follow the advancement of technology and information so that students can have skills in their day (Arikunto, 2006). However, in the process of applying this technology-based learning media, the role of the teacher is needed. The teacher will be the first person who must be able to operate the technology-based learning media to be able to form student skills. The teacher's effort to build high student skills in responding to the challenges of globalization today is to use information technology media in learning (Abdul Labib & Berti Yolida, 2019).

One of the technology-based learning media that is currently often used is e-modules. E-modules or electronic modules are electronic textbooks designed by teachers with the aim that students can learn independently brought by teacher guidance systematically(Hunaidah, Erniwati, & Mahdiannur, 2022). E-modules can help improve students' understanding of the material. Supporting e-module features such as presenting material in the form of text, images, audio, and video can optimize learning and encourage students to better understand learning material (Qotimah & Mulyadi, 2021). e-modules have the properties of self-instruction, self-contained, stand-alone, adaptive, and user friendly which contains one learning material using a method that is not only a lecture but can be combined with practicum so that it can leave an impression in learning (Muzijah, Wati, & Mahtari, 2020).

In its application, e-modules influence student learning outcomes, especially in science learning. Science learning provides opportunities for students to think scientifically and leads students to learn directly with the environment. Combining science learning with technology will create interesting learning (Sahronih, Purwanto, & Sumantri, 2019). Science is a branch of science that requires the help of learning media to visualize the material (Dhaniawaty, Suci, & Hardiyana, 2021). Several e-module development and experimentation studies have been conducted and tested their effect on student learning outcomes, both cognitive learning outcomes and student motivation and interest. Based on the results of research conducted by Hunaidah it shows that the consistent application of the CinQASE E-Module in physics subjects in grade 10 high schools can improve student learning outcomes (Hunaidah et al., 2022).

In addition, a similar study conducted by Samala et al said that the use of interactive e-modules in online and offline learning can make it easier for students to understand the learning material which then has an impact on student learning outcomes that increase (Samala, Ambiyar, Sukardi, Indarta, & Ranuharja, 2022). In line with recent research conducted by Sulisetijono et.al, the research title "The Effectiveness of AR e-module of Flower Structure Material on Biology Students' Science Literacy" shows that the application of AR e-modules is significantly effective in improving students' literacy skills. Based on the data from previous research, the purpose of this study is to determine the effect of using e-modules on students' science learning outcomes (Sulisetijono, Sunarmi, & Rochmah, 2023).

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Method

This type of research is a Systematic Literature Review (SLR). SLR is a research literature review method that identifies, assesses, and interprets findings on a research topic to answer researcher questions (Aliyah & Mulawarman, 2020). This research contains a Research Question (RQ) as an initial basis for searching and collecting research data. The Research question (RQ) of this research are:

1. Does e-module affect students' science learning outcomes?
2. How does an e-module influence students' science learning outcomes?
3. What science learning outcomes can be improved with e-modules?

The data used by researchers were sourced from search results through "Google Scholer" and "Eric" using the keywords "E-modules" OR "Learning Science outcomes" OR "Cognitive science outcomes", hundreds of articles were obtained. However, after going through the article screening process, 8 articles were selected that met the inclusion and exclusion criteria. The selection and rejection of articles based on the inclusion and exclusion criteria are described in the following table:

Table 1: Exclusion and Inclusion Criteria

Criteria	Description
Inclusion criteria	1. Articles with a publication period of 2019-2023 2. Indexed by “SINTA” journals (S1-S3) for articles published by Indonesian journals and indexed by “Scopus” for articles from International journals. 3. Using experimental research methods 4. Contains topics related to e-modules and student science learning outcomes
Exclusion criteria	1. Articles with a publication period below 2019 2. Not indexed by “SINTA” and “Scopus” 3. Does not use experimental research methods 4. The topic is not related to science concept

The selection of articles that meet the inclusion and exclusion criteria in this study was carried out by screening articles using the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analysis). Several steps are carried out with the PRISMA method, namely formulating (identification), searching for literature systematically (screening), filtering or selecting articles that are considered according to the researcher's title (eligibility), and analyzing articles that have been selected (included) (Zarate, Stavropoulos, Ball, de Sena Collier, & Jacobson, 2022). The following PRISMA diagram shows the flow of the research data screening process:

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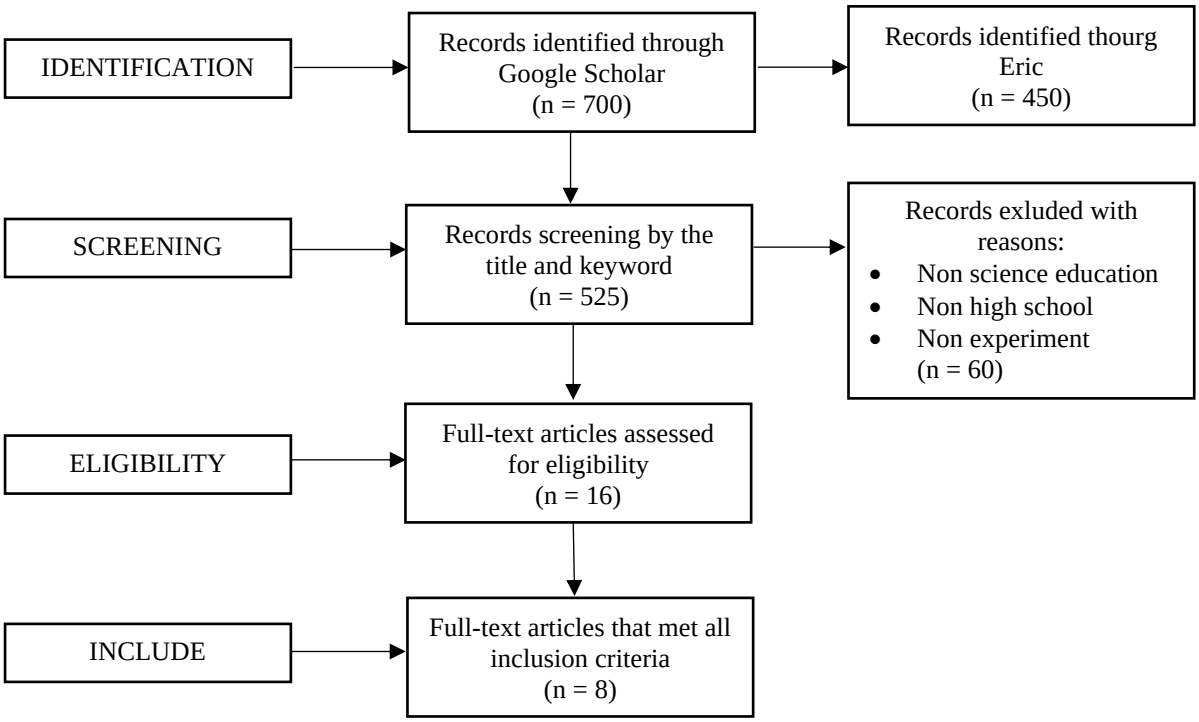

Figure 1: PRISMA Diagram of Exclusion and Inclusion

Result and Discussion

Result

Based on the research data collected, 8 articles were obtained to be further examined. The articles selected are articles published in SINTA and Scopus-indexed journals. The following is the distribution of journals used in this study:

Table 2: Selected Journals for Review

Name of Journal	f	Indexed by
Journal of Biological Education Indonesia	S3	SINTA
Journal of Educatiom Technology	S2	SINTA
Jurnal Inovasi Teknologi Pendidikan	S3	SINTA
Journal of Physics Conference Series	Q4	Scopus
Jurnal Penelitian Pendidikan IPA	S2	SINTA
Jurnal Pendidikan Sains Indonesia	S2	SINTA

Based on the table above, it is explained that there are 8 different journal sources. The 8 journals used are SINTA and Scopus-indexed journals. Following the inclusion and exclusion criteria the articles used are SINTA reputable articles for articles published in Indonesian journals, and Scopus reputable for articles published in International journals. Therefore, the articles reviewed in this study are quality articles and can be accounted for.

In addition, the representation of research according to the characteristics of the publication year used is articles published in the last five years starting from 2023, which means that the period used is from 2019-2023

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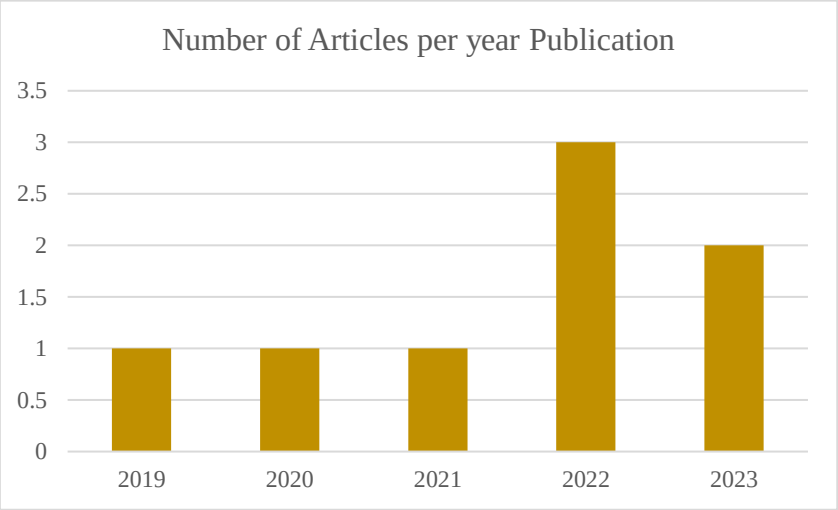

Figure 2: Diagram of the Number of Articles per Year of Publication

The diagram explains that the 8 selected articles discuss the effect of the application or use of e-modules on student science learning outcomes. The 8 articles reviewed were published from the 2019-2023 time span, with 1 article used for the 2019 publication year, 1 article in 2020, 1 article in 2021, 3 articles in 2022, and 2 articles in 2023. Based on these reviews, the most reviewed articles are articles published in 2022 as many as 3 articles. The least reviewed articles are articles published in 2019, 2020, and 2021 as many as 1 article each. Therefore, based on this data, it can be concluded that the articles reviewed are the latest and can be used as references for further research.

The type of research used in the articles reviewed is experimental and quasi-experimental research with data analysis methods using SPSS with the ANOVA formula, T-test, One-way ANOVA, and Normality Test.

Table 3: Research Methodology

No	Method	f	Percentage (%)
1	Experiment	6	75%
2	Quasi experiment	2	25%
	Total	**8**	**100%**

Based on Table 3, it can be seen that the 8 articles reviewed mostly used experimental research, namely 6 articles (75%) to examine the effect of e-modules on student science learning outcomes. Experimental research is research that aims to find the cause and effect between the independent variable and the dependent variable, where the independent variable is deliberately controlled and manipulated (Abraham & Supriyati, 2022). Thus, the articles reviewed are a type of research that directly examines the causal relationship between the use of e-modules in science learning to student science learning outcomes. Thus it can be concluded that the results of these studies directly convey the reality and facts that the use of e-modules in science learning will affect student learning outcomes. The 8 articles that met the inclusion and

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exclusion requirements are summarized in the following table by author, article title, year of publication, journal name, and research results.

Table 4: Effect of E-modules on Students' Science Learning Outcomes

Author	Article Title	Year	Journal	Result
S Sulisetijono, et al	The Effectiveness of AR E-module of Flower Structure Material on Biology Students' Science Literacy	2023	Journal of Biological Education Indonesia	The result of the effectiveness of the AR Electronic-module based on n-gain calculations obtained a score of 0.7 where on that score the AR e-module was categorized as quite scientific literacy.
Arina Dini, et al	Application of the E-module Combined with The Guided Inquiry Learning Model to Increase Student Motivation and Learning Outcomes on the Structure and Function of Plant Tissues	2023	Jurnal Penelitian Pendidikan IPA	The results showed that there were differences in students' learning motivation ($p < 0.05$), there were differences in increasing learning outcomes ($p < 0.05$), and there was a significant relationship between motivation and student learning outcomes. The conclusion is there are differences in the increasing outcomes after applying learning using e-modules combined with guided inquiry.
A Asrizal, et al	The Impact of Static Fluide E-module by Integrating STEM on Learning Outcomes of Students	2022	Journal of Education Technology	The median and mode values in the experiment group were higher than in the control group. This difference indicates a significant increase in student learning outcomes in the aspect of knowledge with the use of the STEM-integrated static fluid E-module
WI Zakiyah and K Dwiningsih	The Effectivity of Interactive E-module to Increase the Students' Visual-Spatial Intelligence on Ionic	2022	Jurnal Inovasi Teknologi Pendidikan	The result showed that the interactive e-module of ionic bonding material developed is effective in increasing the student ionic learning outcomes

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				and also the visual-spatial intelligence.
M Huaidah, et al	CinQASE E-module: its Effectiveness to Improve Senior High School Students' Physics Learning Outcomes	2022	Jurnal Penelitian Pendidikan IPA	Consistently Implementing the CinQASE e-module can improve physics learning outcomes for all class groups with Sig. (0.161) 5%, which means that there is a significant increase in learning outcomes after application of the CinQASE e-module
R Linda, et al	Improving the Independence and Learning outcomes of Learners through Interactive E-module Integrated Science type Connected on Energy Material SMP / MTs	2021	Jurnal Pendidikan Sains Indonesia	The results showed that students' learning independence increased after using the e-module from 64.69% to 81.04% (medium-high category). Likewise, the increase in student learning outcomes, based on n-gain = 0.76%, is an increase in the medium category.
A Suyatna	ICT Learning Media Comparative Studies: Simulation, e-module, Videos	2020	Journal of Physics: Conference Series	The learning outcomes in which the class was assisted by the e-module ICT media e-model show a higher result.
R Sujanem, et al	The Effectiveness of Problem Basic Interactive Physics E-module on High School Students' Critical Thinking	2019	Journal of Physics: Conference Series	The results show that there is a significant difference in students' CTS before and after using IPEM. The students' CTS after using IPEM is better than before using IPEM in the learning process. That is why the IPEM in the BPBL model is effective in improving the students' CTS oh high school.

Based on Table 4, it can be seen that the application or use of e-modules in science learning can influence students' science learning outcomes. The influence that is present after the application or use of e-modules is a positive influence on student science learning outcomes. Students' science learning outcomes that can be improved after the application of e-modules in

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learning are not only in terms of students' cognitive skills, but motivation and learning independence also increase along with the improvement of students' cognitive skills.

Discussion

Researchers reviewed 8 articles that met the inclusion and exclusion criteria related to the effect of e-modules on student science learning outcomes. Learning outcomes are competencies and skills possessed by students obtained through the learning process. Based on Bloom's Taxonomy, student learning outcomes are divided into 3, namely cognitive, affective, and psychomotor (Andriani & Rasto, 2019). Cognitive (concept understanding) is a student achievement that includes intellectual learning outcomes consisting of 6 aspects, namely knowledge, understanding, application, analysis, synthesis, and assessment. Affective (Attitude) is part of learning outcomes that not only include mental aspects but also include physical responses. Psychomotor (Process skills) are skills that lead to basic mental, physical, and social development as a driver of higher abilities in individuals (Ulfah & Arifudin, 2021). After analyzing the research results from the 8 selected articles, it can be concluded that student learning outcomes that are influenced after applying e-modules in learning are divided into three, namely cognitive, affective, and psychomotor skills

In the process of improving student science learning outcomes, improvements are needed in the presentation and provision of learning media that are in line with current developments. A total of 8 articles reviewed contain the influence of e-modules as a form of today's innovative learning media to improve student learning outcomes, especially in science learning. Sulistijono conducted research related to the effectiveness of E-Modules AR flower structure to improve students' science literacy (Sulisetijono et al., 2023). Science literacy is about mastering the content, process, and context of science (Dwicky Putra Nugraha, 2022). So it can be said that science literacy is one part of student learning outcomes, especially cognitive skills. Based on the results of S Sulisetijono's research show that the application of AR e-modules can improve students' literacy abilities and students' science skills on flower structure material.

In the field of biological science, research in 2023 was also conducted by Dini, related to the use of e-modules combined with guided inquiry learning models to increase student motivation and cognitive skills learning outcomes (Dini, Rahmatan, Muhibbudin, Nurmaliah, & Safrida, 2023). Arina examined, the motivation and learning outcomes of students on the material of the structure and function of plant tissues before and after using e-modules with guided inquiry learning models, and showed the results that e-modules that were designed to be attractive and interactive significantly increased the learning motivation of grade XI students in high schools. In addition, along with the increase in student learning motivation, students' understanding of concepts in structure and tissue material also increases. So that the application of this e-module improves student learning outcomes (cognitive skills).

Of the 8 articles reviewed, the most widely used articles were articles published in 2022. Research conducted by Asrizal on the impact of static fluid e-modules by integrating STEM on student learning outcomes showed an increase in student learning outcomes in terms of cognitive skills. In addition, Asrizal also examined the effect of using static fluid e-modules integrated with STEM on student attitudes (affective skills). The results showed that the value of student attitudes in the experimental class was higher than in the control class. In the experimental class, students can work well together, tolerate, and be responsible for group

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assignments. Then, the science process skills in the experimental class also increased compared to the control class (Asrizal, Zan, Mardian, & Festiyed, 2022).

In the same year, research conducted by Zakiyah related to the effectiveness of interactive e-modules in improving students' visual-spatial intelligence in subjects also showed positive results. Three tests were conducted to measure the effectiveness of interactive e-modules, namely the N-Gain test, Normality Test, and t-test. The overall test results showed good results of 0.81 with a high category (Zakiyah & Dwiningsih, 2022). According to Triutami, visual-spatial intelligence is the skill of learning students by using visual images. This intelligence also has advantages in terms of imagination of visual forms and being able to repeat these forms well relatively likes to engage with visual objects compared to abstract symbols, and is better able to absorb learning well if presented with the help of visual objects. Therefore, visual-spatial intelligence is part of students' cognitive skills (Triutami, Novitasari, Tyaningsih, Elvierayani, & Lu'luilmaknun, 2021).

In line with research conducted by Hunaidah also shows the same results, namely the application of the CinQASE e-module is significantly effective in improving student cognitive skills learning outcomes in grade 10 high school in physics subjects (Hunaidah et al., 2022). Supported by previous research conducted by Linda also shows positive results, namely the application of integrated science interactive e-modules can improve student learning outcomes in terms of cognitive skills in junior high school students. In the same study, an experiment was also conducted to test student learning outcomes in terms of affective skills (attitudes), namely independent attitudes and the results showed that there was an increase in students' independent attitudes from 64.69% to 81.04% (medium-high category) (Linda, Zulfarina, Mas'ud, & Putra, 2021).

A number of other previous studies also support the results of the above studies, including research conducted by Suyatna related to "ICT Learning Media Comparative Studies: Simulation, e-module, Videos" on science learning in junior high school students. The results of A Suyatna's research show that the use of ICT (Information and Communication Technology) based learning media, namely e-modules, shows the highest effect in improving students' science learning outcomes from a cognitive perspective compared to videos and simulations (Suyatna, 2020). Then the next research also shows the results that the application of e-modules in science learning can improve students' critical thinking skills. This research was conducted by Sujanem to examine the effectiveness of problem-based physics interactive e-modules. Critical thinking is reflective and reasoned thinking that focuses on making decisions about what to believe or do (Sujanem, Nyoman Putu Suwindra, & Suswandi, 2019). The concept of critical thinking skills in students means that students are required to be able to analyze arguments, make conclusions using inductive and deductive reasoning, assess or evaluate, and make decisions and solve problems (Nurazizah, Sinaga, & Jauhari, 2017). According to a cognitive psychologist, CT is the use of cognitive skills or strategies that increase the probability of desired results (Alsaleh, 2020). CT becomes one unit with cognitive skills, because in one of the concepts of cognitive skills, namely the ability to think of students, so it can be said that CT is part of cognitive skills. Based on the results of R Sujamen's research, after the use of problem-based e-modules in physics subjects can improve students' thinking skills.

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Conclusion

Based on the 8 articles reviewed, it can be concluded that e-modules can have a positive influence on student science learning outcomes. Learning outcomes influenced by e-modules can be in the form of cognitive, affective, and psychomotor skills. The dominant learning outcomes influenced by e-modules in science learning are students' cognitive skills. In addition, several other aspects also increase with the use of e-modules in science learning such as student learning motivation and independence in learning. It is hoped that this research can become literature for readers or future researchers to find out the effect of using e-modules on student science learning outcomes.

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