



Science E-Modules in the Digital Era: A Bibliometric Analysis of Research Trends and Thematic Development

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Abstract: This study aims to analyze the trends and characteristics of research related to e-module learning media in science education through a bibliometric analysis approach. The research employs a descriptive quantitative method with a bibliometric design. Data were obtained from scientific articles indexed in several academic databases, including Scopus, Web of Science, DOAJ, and Google Scholar, through a systematic search using keywords related to e-modules and science learning. Articles meeting the inclusion and exclusion criteria were analyzed using Bibliometrix software (R-Studio) and VOSviewer. Data analysis includes publication productivity, annual trends, top citation analysis, author collaboration, dominant keywords, and research theme mapping. The results show that publications related to science e-modules have significantly increased in the last five years, with the peak of publications occurring in 2024. The most cited articles are dominated by SINTA-accredited national journals and generally examine the development of e-modules based on the ADDIE model with contextual, scientific, connected, and guided discovery approaches. Dominant keywords such as e-module, science learning, digital learning, and STEM indicate a shift in research focus toward technology integration and the strengthening of 21st-century skills. Thematically, science e-modules are widely developed to improve media validity, learning independence, science literacy, critical thinking, and student learning outcomes. These findings provide a comprehensive overview of the developmental direction of science e-module research and serve as a basis for developing more effective and contextual learning media research and innovation in the future.

Article History

Received: 31-01-2026

Revised: 06-03-2026

Accepted: 25-03-2026

Published: 20-04-2026

Key Words:

E-Modul;
Learning Media;
Science Education;
VOSviewer.

How to Cite: Maghfiroh, A. N., & Ellianawati. (2026). Science E-Modules in the Digital Era: A Bibliometric Analysis of Research Trends and Thematic Development. *Jurnal Paedagogy*, 13(2), 824-834. <https://doi.org/10.33394/jp.v13i2.19526>



<https://doi.org/10.33394/jp.v13i2.19526>

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Introduction

The rapid technological advancements in daily life are driving numerous transformations in all aspects of human existence, particularly in the field of technology. Increasingly sophisticated digital systems and connectivity provide easy and rapid access to information. Advancements in computerization and the internet signify a digital revolution that is creating new habits across all aspects of life, inseparable from the role of technology, including the world of education. (Mulyadi et al., 2021)

The development of information and communication technology has a significant impact on how educators acquire, manage, and deliver learning information. Technology and science now allow educators and students to easily access and utilize learning materials through various learning media that have been provided. Learning media are tools that assist teachers in delivering learning information to students, making it easier to understand (Wulandari et al., 2023). The use of media in learning activities offers benefits such as: 1) Uniformity in material delivery, 2) Clarity and attractiveness of the learning process, 3) More interactive learning continuity, 4) Increased efficiency of time and effort, 5) Improved quality of



learning outcomes, 6) Learning activities can take place anytime, 7) Fostering a positive attitude of students toward the material and learning process, 8) Allowing the teacher's role to become more positive and productive (Supartini et al., 2016). Learning media needs to be packaged attractively to foster students' enthusiasm for learning and make it easier for them to understand the material, so that learning objectives are achieved optimally. The selection and use of appropriate learning media has been proven to increase students' interest and motivation to learn. This increase in interest and motivation directly contributes to improved learning outcomes, as students become more active, engaged, and able to understand learning concepts more effectively and deeply. One of the rapidly developing innovations in learning media is the use of e-modules or electronic modules. E-modules are seen as flexible, interactive learning media that can accommodate independent learning and technology-based learning, aligning with 21st-century skills such as critical thinking, problem-solving, and scientific literacy (Jafnihirda et al., 2023). In the context of science education, e-modules not only serve as a learning resource but also as a means of integrating science content with innovative pedagogical approaches and digital technology.

As the use of e-modules in science learning increases, the number of scientific publications examining the development and implementation of e-modules also shows an upward trend. Various previous studies have reported that e-modules are capable of improving students' conceptual understanding, learning motivation, and learning outcomes in science education. Additionally, e-modules are often developed by integrating learning approaches such as STEM (Nurramadhani et al., 2020), Problem-Based Learning (Aulira & Sari, 2024), and science literacy-based learning (Zainuri et al., 2024). Nevertheless, most of these studies still focus on testing product effectiveness or developing media, while comprehensive reviews mapping global trends, directions, and research focuses on science e-modules are still relatively limited.

The state-of-the-art study shows that research on e-module science learning media is developing dynamically, both in terms of themes, pedagogical approaches, and learning objectives to be achieved. However, to date, there haven't been many articles that systematically analyze publication patterns, author collaboration, dominant keywords, and shifts in e-module science research themes using a bibliometric analysis approach. Bibliometric analysis offers an objective approach to examining the development of scientific research and is increasingly relevant to addressing the evolving demands of science education in the digital era. Importantly, bibliometric techniques do not merely quantify the number of publications but also uncover the intellectual structure of a research field through patterns of citations, co-authorship, and keyword relationships. Through this approach, researchers can identify emerging trends, research gaps, and potential directions for future innovation in science learning media.

Based on these conditions, the scientific novelty of this study lies in the use of a bibliometric approach to comprehensively map research trends in e-module learning media in science education. This study not only examines the increasing number of publications but also analyzes the intellectual structure of the field of study thru keyword mapping, author collaboration networks, and dominant research themes. Thus, this study offers a macro perspective that has not been widely explored in previous micro and contextual studies. This study aims to analyze and map research trends in e-module science learning media using a bibliometric analysis approach, so that it can serve as a conceptual reference for researchers and educators in developing science learning media innovations that are relevant to current and future learning needs.



Research Method

This study employs a quantitative approach using a bibliometric-based literature review to map research trends in e-module learning media in science education. The research was conducted by analyzing scientific publication data obtained through systematic search of scientific databases using keywords relevant to the topic of e-modules and science learning. The research flow includes the stage of article identification, screening based on inclusion and exclusion criteria, metadata processing, bibliometric analysis, and interpretation of results.

The research population includes all scientific articles that discuss e-module learning media in the context of science learning, while the research sample is in the form of articles that meet the criteria, namely journal articles relevant to the research topic, published in the range of 2021-2025, and have complete metadata. The data collection process was carried out through literature search using keywords such as "*e-module*", "*science learning*", and "*learning media*". Article metadata which includes title, abstract, keywords, author, affiliation, and year of publication is exported in digital format, then a process of filtering and data cleansing is carried out to eliminate duplicate and irrelevant articles. The selected data were then analyzed using VOSviewer and Bibliometrix software as the main tools in bibliometric analysis. The analysis is focused on keyword co-occurrence mapping, grouping research themes through cluster analysis, and identifying publication trends by year.

The data collection process in this study was carried out through several stages, namely: (1) A systematic literature search was conducted using several academic databases, including Google Scholar, Scopus, Web of Science (WoS), and the Directory of Open Access Journals (DOAJ). The search employed keywords related to e-module learning media in science learning to identify relevant and reputable international publications; (2) export of article metadata in CSV format containing title, abstract, keyword, author, and affiliation information; and (3) data filtering and cleansing to eliminate duplicate articles and publications that are not relevant to the focus of the research. The selected data were then analyzed using VOSviewer software to visualize the co-occurrence network of keywords and thematic clusters of the research.

The data analysis procedure includes: (1) keyword co-occurrence visualization to identify keywords that often appear simultaneously as a representation of the research theme; (2) cluster analysis to group keywords into interrelated research themes; and (3) thematic interpretation to understand research directions, trends, and scientific contributions related to the development and utilization of e-modules in science learning. The results of the visualization were analyzed descriptively and thematically to interpret the patterns, directions, and focus of the science e-module research. The process of validating the results of the analysis is carried out through conceptual interpretation that is consistent with the research objectives and refers to the qualitative data analysis framework of (Miles, 2014) which includes data reduction, data presentation, and conclusion drawn.

Results and Discussion

Visualization of E-Module Research in Science Learning

The results of bibliometric analysis using VOSviewer from 496 related articles show that the module is the main scientific finding that acts as a central node in the research keyword network seen in Figure 1.



achieved through conventional learning. This is consistent with the findings of other researchers who reported that PBL-based and inquiry-based modules are able to improve student engagement and the quality of the learning process (Aditiyas et al., 2025).

This density visualization in VOSviewer simply presents the structure and focus of the research topic based on the co-occurrence of keywords in the assessment of the development of the technology-based science learning model. In this map, increasingly bright colors (yellow-light green) indicate keywords with high frequency and connectivity, while darker colors (bluish green-blue) indicate less frequent occurrences and relationships. The term "module" appears to be the central point of highest density, indicating that the module is the most dominant concept in the examined public domain. This dominance suggests that a significant portion of research focuses on the development, implementation, and evaluation of modules as the primary steps in the process of learning science. The words "based," "problem," "inquiry," "model," and "learning process," which are frequently used in pedagogy particularly in problem-based learning (PBL) and inquiry-based learning appear around this main word.

This connection indicates that the modules developed are typically designed to support students' active participation in the learning process, as well as their higher-order thinking and problem-solving skills. The presence of the keywords "analysis," "implementation," "product," and "outcome" emphasizes that the research not only focuses on the development phase but also analyzes needs, evaluates implementation, and assesses learning outcomes. Aspects of technology are clarified by the emergence of terms like "electronic module," "emodule," "Android," and "technology," which signify a significant shift from analog to digital. This allows researchers to respond to the development of educational technology and the need for more adaptable, interactive, and easily accessible learning materials (Martha et al., 2018). The relationship between the electronic learning module and the terms "science learning" and "science subject" indicates that the primary goal of technology integration is to improve the quality of science education. Furthermore, it is evident that conceptual STEM/STEAM students are highly motivated by the words "STEM," "engineering," "technology," and "art." The emergence of this phrase indicates that module development is not solely focused on science content, but also integrates interdisciplinary research that connects science with technology, research, and science (Juca-Aulestia et al., 2021). This integration aligns with the 21st-century curriculum, which emphasizes creativity, teamwork, and critical thinking skills (Penprase, 2020). In addition, the context of students and the learning environment is derived from the words "siswa," "junior high school student," "society," and "environment," which indicate that as a research study, the characteristics of students as well as social and environmental factors serve as a foundation for the development of the module. This topic is highlighted by the acronym "SSI" (Socio-Scientific Issues), which indicates that scientific concepts are also related to everyday problems in daily life (Mang et al., 2021). Overall, this visualization shows that research was dominated by electronic and problem-based learning modules based on STEM and problem-solving techniques, supported by digital technology, and focused on improving the quality of science education for students, especially in elementary school. The density and interconnectedness patterns of keywords indicate a trend toward holistic research, connecting pedagogical, technological, and social contexts within a single framework for developing learning modules.

Taken together, the results from Figure 1 and Figure 2 reveal the evolution of research concepts in science learning media. Initially, studies focused on the development of

conventional learning modules as instructional materials. With the advancement of digital technology, the concept evolved into electronic modules (e-modules), which provide more interactive and flexible learning resources. More recent research trends show that e-modules are increasingly integrated with modern educational approaches such as STEM and socio-scientific issues (SSI), reflecting a shift in the research paradigm toward technology-enhanced and context-based science learning.

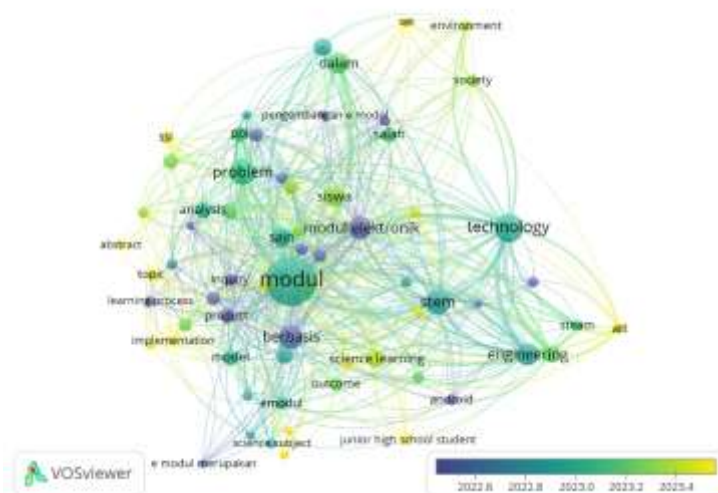


Figure 3. Overlay Visualization

The Figure 3 shows an overlay visualization of keyword developments in research related to science learning modules. The keyword “module” remains the core concept that connects various other research topics. In the early stages, research focused more on developing modules as teaching materials to support the learning process. However, with the development of digital technology, the concept evolved into electronic modules (e-modules) that enable more interactive and flexible presentation of material.

Further developments show a stronger connection between e-modules and keywords such as technology, engineering, and STEM, indicating that research has begun to integrate digital modules with an interdisciplinary learning approach. This shift is in line with the demands of 21st-century education, which emphasizes critical thinking, problem solving, and technological literacy in science learning (Habibaturrohmah et al., 2022). In addition, the emergence of keywords such as society, environment, and SSI in more recent research periods indicates that e-module development is no longer focused solely on technological aspects but is also beginning to move towards a more contextual and humanistic learning approach. This is related to the increasing global attention to education that supports sustainable development, including the integration of environmental and social issues in science learning. This shift in trend can also be understood as a response to changes in the education system after the COVID-19 pandemic, which has encouraged the wider use of digital learning media. In this context, e-modules have become a medium that can support independent, flexible, and technology-based learning. At the same time, the integration of environmental and social issues in e-modules is in line with global curriculum demands that are increasingly geared towards achieving the Sustainable Development Goals (SDGs), particularly in building students' awareness of environmental and sustainability issues.

Thus, the development of research from conventional modules to e-modules integrated with STEM approaches, socio-scientific issues, and environmental contexts



indicates a paradigm shift in science education. The focus of research is no longer limited to the development of learning media, but also on how these media can support learning that is more relevant to global challenges and the needs of future societies.

E-Module Research Publication Trends in Science Learning 2021-2025

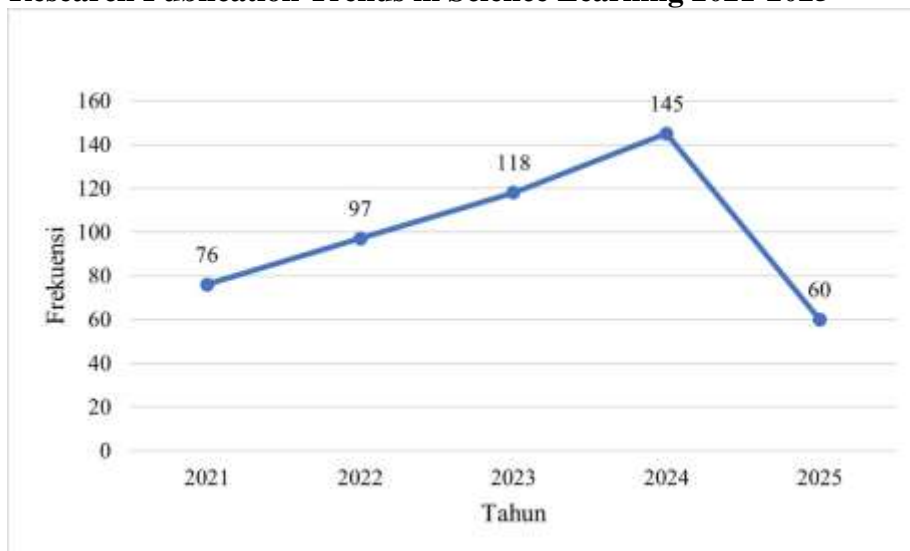


Figure 4. Number of Publications Per Year

The distribution of articles shows an increasing trend in the frequency of research on the use of e-modules in science learning from 2020 to 2024. In 2021, 76 articles were recorded, which increased to 97 articles in 2022 and rose again in 2023 with a total of 118 articles. The sharpest increase occurred in 2024 with 145 articles, indicating high researcher interest in the topic of module development and e-modules for technology-based learning and innovative approaches. Scientifically, this upward trend is influenced by the acceleration of digital transformation in education, as well as the increasing need for learning media that are adaptive, interactive, and support 21st-century skills. The surge in publications in 2024 can also be attributed to the implementation of a curriculum that emphasizes project-based learning, STEM/STEAM, and science literacy, thereby encouraging research on the development and evaluation of electronic modules. The number of articles in 2025 was recorded at 60, which is relatively lower than the previous year. This decline does not indicate a weakening of research interest, but is due to limitations in indexing time because data for 2025 is still ongoing. Thus, overall, the distribution of articles shows an increasing trend, confirming that research on learning modules and e-modules is a continuously developing and relevant field in the study of science education.

Highest Citation Analysis

Table 1. Top Five Articles Based on Highest Citation Counts

Rank	Title	Year	Source	Citation	Reference
1	Validity of Interactive E-Modules as Learning Media to Train Spatial Visual Intelligence on Covalent Bonding Materials	2022	<i>PENDIPA Journal of Science Education</i>	117	35
2	E-Module with a Contextual Approach to Science Subjects	2021	Jurnal Ilmiah Pendidikan dan Pembelajaran (JIPP)	112	25



3	Development of Scientific Based Heyzine Flipbook Interactive E-Module Water Cycle Material for Grade V Elementary School Students	2022	Sekolah Dasar: Kajian Teori dan Praktik Pendidikan	106	25
4	Increasing Students' Independence and Learning Outcomes through the Implementation of Connected Type Integrated Science Interactive E-Modules in Junior High School/MTs Energy Materials	2021	Jurnal Pendidikan Sains Indonesia	103	29
5	Development Of Guided Discovery Based Electronic Module For Chemical Lessons In Redox Reaction Materials	2021	<i>International Journal of Interactive Mobile Technologies</i>	98	25

The highest citation analysis shows that the article with the most citations does not always come from highly reputable journals (Q1/Q2), but is dominated by nationally accredited SINTA journals. The first-ranked article (Rank 1) comes from a SINTA 4 journal with 117 citations, followed by three articles from SINTA 2 journals (Rank 2–4) with a range of 103–112 citations, and one reputable Q2 international article (Rank 5) with 98 citations. This finding suggests that the scientific impact of the e-module research is more determined by the relevance of the topic and its contribution to learning practices than by the journal's ranking alone.

The first-ranked article focuses on developing interactive e-modules using the ADDIE model, emphasizing content and construct validity to train visual-spatial intelligence on covalent bonding material. The high citation rate of this article indicates that research deeply examining the validity of media, particularly for abstract science material, has significant academic appeal (Asri & Dwiningsih, 2022). The second-ranked article also uses the ADDIE model, but integrates a contextual approach into the science e-module to increase student learning activity and interest, which is proven by very high validation scores and user responses (Widiastuti, 2021).

The third-ranked article develops an interactive e-module based on a scientific approach using the ADDIE model for water cycle material in elementary school. The high level of feasibility according to experts, teachers, and students indicates that the scientific approach in e-modules effectively supports process-based scientific learning in science from the elementary level (Manzil et al., 2022). The fourth-ranked article (Rank 4) continues the development stage toward the implementation of a connected type integrated science e-module and empirically tests its impact on the independence and learning outcomes of junior high school students, with significant results. This explains the high citation rate because the articles are not only developmental but also evaluative (Linda* et al., 2021).

Meanwhile, the fifth-ranked article from a reputable Q2 international journal developed a guided discovery-based e-module using the ADDIE model for redox reactions. Focusing on guided discovery learning, mobile accessibility, and learning flexibility demonstrates that this approach has global relevance. The inclusion of this article in the top five citations confirms that integrating active pedagogical approaches and digital technology



is a significant trend in the development of science e-modules (Handayani et al., 2021). Overall, the citation ranking analysis indicates that the majority of influential articles utilize the ADDIE model with variations in pedagogical approaches, such as contextual, scientific, connected, and guided discovery. This finding indicates that the consistency of a systematic development design, combined with an innovative learning approach, is a key factor in the high scientific impact of the e-module science research.

The results of this study provide an important involvement for the development of education in Indonesia. First, the dominance of module teaching materials and their development into electronic modules (e-modules) shows that digital learning media is increasingly needed in the science learning process. In line with the transformation of education in Indonesia that encourages the use of digital technology to support learning that is more flexible, efficient, interactive, and easy for students to access independently. Second, the implications of e-modules with STEM approaches, problem-based learning, and SSI show that learning media does not only function as a means of delivering material, but as a tool to develop 21st century skills, such as critical thinking, problem-solving, creativity, and collaboration. This is relevant to the implementation of a curriculum that emphasizes strengthening students' competencies in facing global challenges. Third, the emergence of keywords related to the environment and society shows that the development of e-modules can also be directed to support more contextual and sustainability-oriented learning. This is important for education in Indonesia which has a variety of environmental and social problems, so that science learning is expected to be able to foster students' awareness and responsibility for these issues.

Therefore, this study shows that the development of technology-based e-modules that are integrated with STEM approaches and sustainability issues have great potential to support science learning innovations in Indonesia. The use of e-modules not only improves the quality of learning, but can also help prepare students to have competencies that are relevant to the demands of 21st century education and sustainable development.

Conclusion

According to this bibliometric analysis, research on scientific e-modules exhibits a steady and noteworthy growth tendency, especially after 2021, suggesting that scholarly attention to digital learning media in science education is growing. The most cited publications show that methodological rigor, practical applicability, and instructional relevance rather than journal rank alone are the main factors influencing the scientific impact of e-module research. The majority of significant research integrate cutting-edge educational techniques including contextual learning, scientific approaches, connected learning, and guided discovery with systematic development models, primarily ADDIE. The results also show that e-modules are increasingly assessed for their impact on higher-order learning outcomes, such as visual-spatial ability, learning independence, conceptual understanding, and learning achievement, in addition to their validity and viability.

The predominance of national journals with high citation counts indicates that regionally based research that addresses actual classroom requirements is essential to the advancement of science education study. All things considered, the study demonstrates that e-module-based learning has developed into a significant and important area of study in modern science education.



Recommendation

Future research should not only focus on evaluating the effectiveness of science e-modules but also provide strategic directions for the development of next-generation learning media. After the widespread use of instructional design models such as ADDIE, which primarily support the development of relatively static e-modules, learning media developers are encouraged to move toward more dynamic, adaptive, and data-driven learning systems. The next stage of development should emphasize interactive digital learning environments that integrate emerging technologies such as artificial intelligence, learning analytics, and adaptive learning systems to personalize learning experiences based on students' needs and learning progress. In this context, science e-modules should evolve from static content repositories into interactive learning platforms that support inquiry-based activities, simulations, and real-time feedback to enhance students' scientific literacy and problem-solving skills.

In addition, developers and researchers need to consider implementation challenges that may influence the effectiveness of e-modules in real educational settings. Issues such as limited digital infrastructure, unequal access to devices, and teachers' readiness to integrate digital technology into classroom practice remain significant barriers in many educational contexts. Therefore, future initiatives should involve collaboration between researchers, learning media developers, and educators to design more accessible and contextually relevant e-modules. Expanding research contexts through cross-country or cross-curriculum comparisons may also enhance the global relevance of science e-modules while supporting the development of learning media that respond to contemporary educational demands, including digital transformation and sustainability-oriented education.

References

- Aditias, S. E., Rosana, D., Pratiwi, I., Nisa, K., Hanindya, Y., Putri, S. A., & Chen, D. (2025). Development of Google Sites Based E-books on Sound Wave Material with STEM-PBL Model to Improve Mathematical Literacy and Critical Thinking Skills. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, 10(1), 104–124.
- Asri, A. S. T., & Dwiningsih, K. (2022). Validitas E-Modul Interaktif sebagai Media Pembelajaran untuk Melatih Kecerdasan Visual Spasial pada Materi Ikatan Kovalen. *PENDIPA Journal of Science Education*, 6(2), 465–473. <https://doi.org/10.33369/pendipa.6.2.465-473>
- Aulira, I., & Sari, M. P. (2024). DEVELOPMENT OF SHARED-TYPE INTEGRATED SCIENCE E-MODULE BASED ON PROBLEM-BASED LEARNING ON THE TOPIC OF ENVIRONMENTAL *Universe*. <http://universe.pj.unp.ac.id/index.php/universe/article/view/572>
- Habibaturrohman, Z., Parno, P., & Fitriyah, I. J. (2022). Pengembangan Buku Ajar IPA Berbasis PBL-STEM dengan Asesmen Formatif untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa Kelas VII SMP pada Tema Pencemaran Lingkungan. *Briliant: Jurnal Riset Dan Konseptual*, 7(4), 826. <https://doi.org/10.28926/briliant.v7i4.1054>
- Handayani, D., Elvinawati, E., Isnaeni, I., & Alperi, M. (2021). Development Of Guided Discovery Based Electronic Module For Chemical Lessons In Redox Reaction Materials. *International Journal of Interactive Mobile Technologies (IJIM)*, 15(07), 94. <https://doi.org/10.3991/ijim.v15i07.21559>
- Jafnihirda, L., Rizal, F., & Eka Pratiwi, K. (2023). Efektivitas Perancangan Media Pembelajaran Interaktif E-Modul. *INNOVATIVE: Journal Of Social Science Research*, 3, 227–239.



- Juca-Aulestia, M., Zúñiga-Tinizaray, F., & ... (2021). Instrumentation, Implementation and Tools in STEM-STEAM Education: A Systematic Literature Review. *World Conference on ...* https://doi.org/10.1007/978-3-030-72660-7_18
- Linda*, R., Zulfarina, Z., Mas'ud, M., & Putra, T. P. (2021). Peningkatan Kemandirian dan Hasil Belajar Peserta Didik Melalui Implementasi E-Modul Interaktif IPA Terpadu Tipe Connected Pada Materi Energi SMP/MTs. *Jurnal Pendidikan Sains Indonesia*, 9(2), 191–200. <https://doi.org/10.24815/jpsi.v9i2.19012>
- Mang, H. M. A., Chu, H.-E., Martin, S. N., & Kim, C.-J. (2021). An SSI-Based STEAM Approach to Developing Science Programs. *Asia-Pacific Science Education*, 7(2), 549–585. <https://doi.org/10.1163/23641177-bja10036>
- Manzil, E. F., Sukanti, & Thohir, M. A. (2022). *Pengembangan E-Modul Interaktif Heyzine Flipbook Berbasis Scientific Materi Siklus Air bagi Siswa Kelas V Sekolah Dasar*.
- Martha, Z. D., Adi, E. P., & Soepriyanto, Y. (2018). E-book berbasis Mobile learning. *Jurnal Kajian Teknologi Pendidikan*, 1(2), 109–114.
- Miles, M. . , & H. A. . (2014). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks.
- Mulyadi, G. A., Firman, F., & Rusdinal, R. (2021). Pembelajaran Ilmu Pengetahuan Sosial sebagai Sarana Pembentukan Karakter Siswa Menghadapi Revolusi Industry 4.0. *Syntax Idea*, 3(3), 520–532. <https://doi.org/10.46799/syntax-idea.v3i3.1081>
- Nurramadhani, A., Lathifah, S. S., & Permana, I. (2020). Students' generated questions quality by developing STEM-based e-module in science learning. *Scientiae Educatia: Jurnal Pendidikan ...*
- Penprase, B. E. (2020). *STEM Education for the 21st Century*. Springer. <https://doi.org/10.1007/978-3-030-41633-1>
- Supartini, M., Ilmu, P., Sosial, P., & Sarjana, P. (2016). PENGARUH PENGGUNAAN MEDIA PEMBELAJARAN DAN KREATIVITAS GURU TERHADAP PRESTASI BELAJAR SISWA KELAS TINGGI DI SDN MANGUNHARJO 3 KECAMATAN MAYANGAN KOTA PROBOLINGGO. In *Jurnal Penelitian dan Pendidikan IPS (JPPI)* (Vol. 10, Number 2). <http://ejournal.unikama.ac.id/index.php/JPPI>
- Widiastuti, N. L. G. K. (2021). E-Modul dengan Pendekatan Kontekstual pada Mata Pelajaran IPA. *Jurnal Imiah Pendidikan Dan Pembelajaran*, 5(3), 435. <https://doi.org/10.23887/jipp.v5i3.37974>
- Wulandari, A. P., Salsabila, A. A., Cahyani, K., Nurazizah, T. S., & Ulfiah, Z. (2023). Pentingnya Media Pembelajaran dalam Proses Belajar Mengajar. *Journal on Education*, 05(02), 3928–3936.
- Yunita, S. (2024). *PENGEMBANGAN E-MODUL INTERAKTIF DENGAN PENDEKATAN STEM MENGGUNAKAN APLIKASI CANVA UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR ...* repository.radenintan.ac.id. <http://repository.radenintan.ac.id/32260/>
- Zainuri, B. N. S., Gunawan, G., & ... (2024). Local Wisdom Integration in Problem-Based Learning E-Modules: Impact on Science Literacy and Science Process Skills. ... *Journal of STEM ...* <https://journal.publication-center.com/index.php/ijse/article/view/1627>