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The Influence of Local Wisdom-Based E-Modules on Science Learning to Improve Student's Learning Outcomes: A Systematic Review

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Abstract

This study presented a systematic review of articles examining the use of local wisdom-based e-modules in science learning, and simultaneously analyzing their implementation, effectiveness, and associated challenges in improving students' learning outcomes. A Systematic Literature Review (SLR) method was employed using PRISMA guideline. Records were collected from Google Scholar and Garuda databases and selected using the inclusion criteria based on the PICO framework. A total of 83 relevant articles were initially identified, of which 11 met the inclusion criteria and were included in the final analysis. The findings revealed that all eleven studies (100%) reported positive effects of local wisdom-based e-modules on students' learning outcomes. Several studies reported moderate-to-high N-gain scores ranging from 0.59 to 0.74, while others demonstrated high levels of effectiveness, learning mastery, and positive student responses. In addition, improvements were observed in learning motivation, engagement, creativity, learning independence, and science process skills. This study highlights the importance of developing culturally relevant and technology-integrated learning media. Furthermore, it provides a foundation for educators to design instructional materials that integrate local wisdom as a valuable learning resource in modern science education.

Keywords:

e-modul, local wisdom, science learning, learning outcomes

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1. INTRODUCTION

Science learning provides students with opportunities to understand scientific concepts and processes. However, science is often perceived as a difficult subject due to the use of complex terminology, unvisualized concepts and processes that are challenging to explain in everyday life (Syarah et al., 2021). In addition, several obstacles still occur in science learning, including the limited use of varied teaching strategies, low student engagement, inadequate facilities, and a lack of instructional innovation (Meilani et al., 2020). A similar thing was also found in Saputra et al (2020). Previous studies also indicated that many teachers still rely on conventional teaching methods with limited variation, contributing to students' low interest and motivation in learning science.

From a constructivist perspective, meaningful learning occurs when students actively construct knowledge by connecting new information with prior experiences (Azzahra et al., 2025). However, in the practice, some teachers only explain the lesson material and then randomly ask students about the material that has been taught.

This reality makes students confuse and thus they become less active. Accordingly, students then tend to be busy playing alone, resulting in a lack of enthusiasm during the lesson. As students could not focus on the teacher's explanation, they are not able to understand the material being taught ([Saputra, 2020](#)). Therefore, learning should be designed to be more contextual, relevant, and connected to real-life situations to enhance students' comprehension ([Aden et al., 2025](#)).

Teachers have the task of providing interesting learning resources to facilitate the learning process so that the lesson material becomes easier to understand as such students are interested in the learning process. One of which is the teaching materials, the tools in the learning process ([Amalia, 2023](#)). Teaching material is a collection of learning materials that are arranged systematically to represent related concepts to support students' learning processes ([Magdalena et al., 2020](#)). Teaching materials are important elements to support the effectiveness of learning. Therefore, choosing good teaching materials can determine a student's learning success ([Aprilia, 2019](#)). On the other hand, some teachers are still rely on limited facilities and teaching materials, such as textbooks provided by school, leading to less motivated and easily feel bored students. All in all, those ultimately result to the non-optimal learning outcomes ([Nasution et al., 2025](#)).

As educators, teachers need to facilitate students' learning process ([Sari & Raihana, 2021](#)). One of the teaching materials that can well facilitate students' learning is using the vast developing technology. Current technological advances enable teaching materials to be made into digital teaching materials which are more practical, effective and efficient to support students study independently at home. One example of these teaching materials is electronic module (e-module) ([Hadawang et al., 2025](#)). E-module is a digital learning media that is structured systematically to achieve predetermined learning objectives. It contains audio and animation navigation, enabling students to learn interactively ([Ananda & Usmeldi, 2023](#)). It is also easy to access that students can use anytime and anywhere, thus it effectively help student's independent learning process ([Sugevin et al., 2022](#)).

Despite these advancements, science learning in many schools is still often less contextual and does not depict students' real-life experiences ([Astiti et al., 2020](#)). Since learning is not appropriate to the conditions around the students, student becomes lack of understanding of the material being studied. In fact, the use of the environment in learning make the teaching and learning process more meaningful, because students are faced with the actual events and natural situations. This limitation can hinder students' understanding of scientific concepts. Integrating local contexts into learning can make the learning process more meaningful by connecting scientific knowledge with real-life situations. One effective approach is the integration of local wisdom into learning. Local wisdom refers to the values, knowledge, and cultural practices that are deeply rooted in local communities and passed down through generations ([Tahir & Rosyidah, 2022](#)). Incorporating local wisdom into learning materials creates a contextual learning environment that helps students better understand scientific concepts.

There are many examples of local wisdom that can be used as learning resources, such as traditional food (bekasam, tempoyak), traditional houses, *ningkuk traditions*, dance traditions, and many others. Integrating local wisdom can be done using teaching materials in the form of local wisdom-based e-modules. Local wisdom based e-modul science teaching materials show a positive response to the learning process and can improve students' cognitive learning outcomes ([Widyaningrum, 2018](#)). Learning outcomes are one of the goals of the learning process to measure the level of success of students in mastering learning material at school. The factors that influence student learning outcomes are internal factors and external factors ([Saputri, 2019](#); [Wibowo et al., 2021](#)). When using e-modules, they can also be integrated with local wisdom as a learning resource. In line with the opinion of [Utari & Degeng, \(2017\)](#) revealed that learning that integrates local wisdom with learning materials will help students achieve learning goals. Research conducted by [Kumalasari et al \(2023\)](#) suggests that the use of e-module teaching materials based on local wisdom is effective in improving student learning outcomes. Teaching materials designed by integrating local regional wisdom and combined with technology are able to attract students to focus more on learning, so that students' learning outcomes can achieve mastery in learning.

The integration of local wisdom into teaching materials has been proven to provide a meaningful learning context and support the knowledge construction process. When students see their cultural practices reflected in the learning materials, they not only gain a deeper understanding of scientific concepts but also develop a stronger academic identity ([Praekanata et al., 2024](#)). The development of digital technology presents opportunities to develop innovative teaching materials such as e-modules. E-modules provide interactive features such as animations, videos, and integrated evaluations that support independent learning ([Solikin, 2018](#); [Perdana et al., 2017](#)). Research conducted by [Iswandayani et al. \(2025\)](#) shows that the use of digital teaching materials can increase motivation and conceptual understanding compared to conventional printed teaching materials. Furthermore, the effectiveness of technology is highly dependent on its pedagogical design and

contextual relevance. Thus, the integration of local wisdom in e-modules has the potential to combine the advantages of digital technology with culturally relevant learning approaches, resulting in a more meaningful science learning experience ([Tohamba et al., 2025](#)).

Research conducted by [Pramana et al \(2020\)](#) found that multimedia-based biology e-modules significantly improved student learning outcomes at the secondary school level. Similar results were also obtained from research by [Aeni and Widodo \(2022\)](#), which showed that interactive e-modules had a positive effect on the motivation and conceptual understanding of high school students. This shows that e-modules can increase student engagement and learning outcomes.

The integration of local wisdom has been widely used in various studies. Research conducted by [Septina \(2025\)](#) shows that the integration of local ecological knowledge in science learning increases motivation and the relevance of learning for students. In addition, research by [Ramadani \(2025\)](#) also suggests that integrating traditional knowledge into environmental science modules helps students connect scientific concepts with everyday practices. Research conducted by [Fatihah \(2023\)](#) also found that the combination of technological sophistication in the form of e-modules and the utilization of local wisdom makes e-modules more interesting and can be used as both a medium and a source of learning.

The research aimed to find out how local wisdom-based e-modules are implemented in science learning, how the wisdom-based e-modules influence students' learning outcomes in science subjects, and whether there are obstacles or challenges in its application. Through this research, it is expected to provide information and evaluation in the utilization of local wisdom as a science learning resource. Furthermore, the findings will help teaching staffs to find out information and gain benefits in understanding appropriate learning media for students and in encouraging the integration of local wisdom as a learning resource in learning.

2. LITERATURE REVIEW

2.1. Theoretical Framework / Conceptual Background 1

Assessment in education has evolved from a focus on measuring learning outcomes to an approach that supports the learning process itself. Three main approaches are commonly identified, namely Assessment of Learning (AoL), Assessment for Learning (AfL), and Assessment as Learning (AaL) ([Nurkamto & Sarosa, 2020](#)). AoL focuses on evaluating learning outcomes at the end of instruction, while AfL emphasizes the use of assessment to improve the learning process. In contrast, AaL positions students as active agents who monitor, evaluate, and regulate their own learning ([Handhika et al., 2020](#)). Theoretically, AaL is grounded in constructivist theory and self-regulated learning. This approach emphasizes metacognitive skills, enabling students to reflect on their thinking processes and adjust their learning strategies accordingly ([Rusdiana et al., 2025](#)). Through self-assessment, reflection, and feedback utilization, students can develop into independent learners. This aligns with the view that learning is an active process of constructing knowledge through interaction with learning experiences ([Depita, 2024](#)). In the context of science learning, AaL is highly relevant as it encourages students to actively engage in the learning process, to reflect on their understanding, and to connect knowledge with real-life experiences ([Nurkamto & Sarosa, 2020](#)). This becomes even more important when learning is supported by innovative media such as e-modules. Digital learning environments enable students to engage in self-directed learning, self-assessment, and reflection, which are core components of AaL.

However, the implementation of AaL in classroom practice remains limited. Several studies indicate that teachers still have a limited understanding of the distinctions between AoL, AfL, and AaL, leading to confusion in their implementation ([Schellekens et al., 2021](#)). This situation is not merely caused by conceptual confusion among teachers but also by several structural factors. First, assessment practices in many schools continue to be dominated by summative assessment aimed at measuring achievement rather than supporting learning processes. Second, professional development programs tend to focus more on assessment administration and grading procedures than on fostering students' metacognitive and self-regulated learning skills. Third, practical guidelines and instructional examples for implementing AaL in everyday classroom activities remain limited. As a result, many teachers experience difficulties in distinguishing AaL from Assessment for Learning (AfL) and often implement assessment activities without explicitly promoting student reflection, self-monitoring, and self-regulation. These conditions contribute to inconsistencies in the implem ([Nurkamto & Sarosa, 2020](#)). entation of AaL despite its recognized potential to enhance learner autonomy and lifelong learning skills

Moreover, the integration of local wisdom into science learning through e-modules can strengthen the implementation of Assessment as Learning (AaL). From a constructivist perspective, students construct new knowledge by connecting scientific concepts with their prior experiences and sociocultural backgrounds ([Piaget, 1972; Vygotsky, 1978](#)). Local wisdom provides authentic and culturally meaningful contexts that enable learners to relate abstract scientific concepts to their everyday lives. This view is also supported by the principles of Culturally Responsive Teaching, which emphasize the importance of connecting learning experiences with

students' cultural identities to enhance engagement and meaningful understanding (Gay, 2018; Ladson-Billings, 1995). When integrated with AaL, local wisdom-based e-modules not only facilitate conceptual understanding but also encourage students to reflect on their learning processes, monitor their progress, and regulate their own learning. Consistent with Earl's (2003) theory of Assessment as Learning, such practices promote metacognitive awareness and position students as active agents in the assessment process. Therefore, this study specifically focuses on Assessment as Learning (AaL) because it supports student-centered learning, fosters metacognitive development, and aligns with the use of digital and contextual learning media such as local wisdom-based e-modules.

2.2. Theoretical Framework / Conceptual Background 2

The 21st century learning emphasizes the importance of developing science literacy, and motivation to learn as the main outcomes of effective learning (Basri, 2025). Science literacy is the ability of each individual to use scientific concepts in solving scientific problems in real life. Scientific literacy is defined as an individual's ability to think, solve problems, and draw scientific conclusions (Faridah et al., 2022). In addition, motivation is fundamental for students to achieve maximum learning outcomes, which will then be used as the basis for determining the expected competency levels. The scores obtained in learning outcomes also determine the completeness of student learning, which affects whether or not students advance to the next level (Sabatini et al., 2022).

Constructivism theory states that learners build understanding through active interaction with meaningful material. Thus, teaching materials used in the learning process must be able to connect new knowledge with previous experiences (Azzahra et al., 2025). This is in line with Vygotsky's theory (1978), which emphasizes that social and cultural contexts are an integral part of the cognitive process. In a science learning process, this can be realized by implementing cultural practices, local values, and community knowledge systems into the curriculum (Viola et al., 2024). Recent studies have shown that the integration of local wisdom into science learning facilitates contextual understanding, strengthens conceptual construction, and promotes meaningful learning experiences because students can relate scientific concepts to their sociocultural environments (Rosyidah et al., 2025).

Furthermore, local wisdom serves as a culturally relevant learning resource that bridges scientific knowledge and community practices. Through local wisdom, students are encouraged to interpret scientific phenomena based on authentic experiences within their own cultural contexts. Such contextualization has been found to enhance scientific literacy, conceptual understanding, and students' ability to apply scientific knowledge in everyday situations (Verawati & Wahyudi, 2024; Dini & Rini, 2024).

The integration of local wisdom is also consistent with the principles of Culturally Responsive Teaching (CRT), which emphasizes the importance of connecting learning experiences with students' cultural backgrounds, identities, and lived experiences (Gay, 2018; Ladson-Billings, 1995). According to this perspective, students learn more effectively when instructional materials reflect their cultural realities and values. Empirical evidence demonstrates that science learning based on local wisdom and culturally responsive approaches significantly improves students' learning achievement and engagement because it creates meaningful and culturally relevant learning environments (Saenab et al., 2024).

The advancement of digital technology has expanded opportunities for implementing constructivist and culturally responsive learning through digital teaching materials such as e-modules. E-modules provide multimedia features, interactive learning activities, and flexible access that support self-directed learning. When local wisdom is integrated into e-modules, students can explore scientific concepts through culturally meaningful contexts while engaging in independent learning processes. Such learning environments facilitate active knowledge construction and support deeper conceptual understanding (Rosyidah et al., 2025).

Moreover, the use of local wisdom-based e-modules is highly relevant to the implementation of Assessment as Learning (AaL). Assessment as Learning positions students as active participants who monitor, evaluate, and regulate their own learning through reflective assessment activities (Earl, 2003). Recent meta-analysis evidence indicates that student participation in assessment activities significantly improves learning outcomes and cognitive development, supporting the central principles of Assessment as Learning (Liu et al., 2024). Through local wisdom-based e-modules, students are not only exposed to culturally meaningful learning materials but are also encouraged to engage in reflection, self-assessment, and metacognitive regulation throughout the learning process. Consequently, the integration of local wisdom, digital technology, and Assessment as Learning provides a strong pedagogical foundation for developing meaningful, contextual, and student-centered science learning.

3. RESEARCH METHOD

The research was designed as a Systematic Literature Review, a systematic research method for collecting, critically evaluating, integrating, and presenting findings from various studies of interest topics or research focus ([Pati & Lorusso, 2018](#), [Triandini et al., 2019](#)). The SLR technique was carried out in five steps, namely: (1) formulating research questions, (2) mapping and searching for appropriate articles in various databases (Google Scholar and Garuda) with keywords ("local wisdom" OR "ethnoscience" OR "cultural-based learning") AND ("e-module" OR "digital module" OR "electronic module") AND ("science learning" OR "physics" OR "biology" OR "chemistry") AND ("learning outcomes"), (3) carrying out inclusion/classification and exclusion/evaluation by selecting the articles that have been collected (Table 1), (4) presenting and processing data, and (5) interpreting the findings in the article and ending with drawing conclusions ([Nurfadilah et al., 2022](#); [Fitriani & Putra, 2022](#)).

The first step undertaken by the researchers was to determine the research topic, followed by the development of inclusion and exclusion criteria. These criteria were established to ensure the relevance and suitability of the selected studies for this systematic literature review. To formulate the inclusion and exclusion criteria systematically, the researchers employed the PICO (Population, Intervention, Comparison, and Outcome) framework. ([Ramadhanti et al., 2022](#)): (1) centered on science learning at various levels of education in Indonesia, elementary, middle, and high school (population), (2) focused on the use of e-modules based on local wisdom (intervention), (3) used a comparison group in science learning that did not use e-modules (comparison), and (4) primarily targeted on student learning outcomes in science learning (outcome). A more in-depth explanation regarding the determination of inclusion and exclusion criteria can be seen in Table 1.

Table 1. Inclusion and Exclusion Criteria Used in the Study

No	Inclusion Criteria	Exclusion Criteria
1	Published between 2017 and 2024	Published before 2017 or considered no longer relevant
2	Focused on science learning at various educational levels in Indonesia	Did not focus on science learning or were not directly related to the application of local wisdom in science learning
3	Examined the application of local wisdom in science learning	Examined topics outside science learning
4	Investigated e-modules integrated with local wisdom	Did not investigate e-modules integrated with local wisdom
5	Reported the impact of local wisdom-based e-modules on science learning outcomes	Did not report the impact of local wisdom-based e-modules on science learning outcomes
6	Were written in English or Indonesian and published in scientific sources	Were not written in English or Indonesian, or were obtained from non-scientific and non-peer-reviewed sources

The research began with searching articles, which was conducted using Google Scholar and Garuda database. The search results were then processed using the PRISMA method ([Haddaway, 2022](#)), as shown in Figure 1.

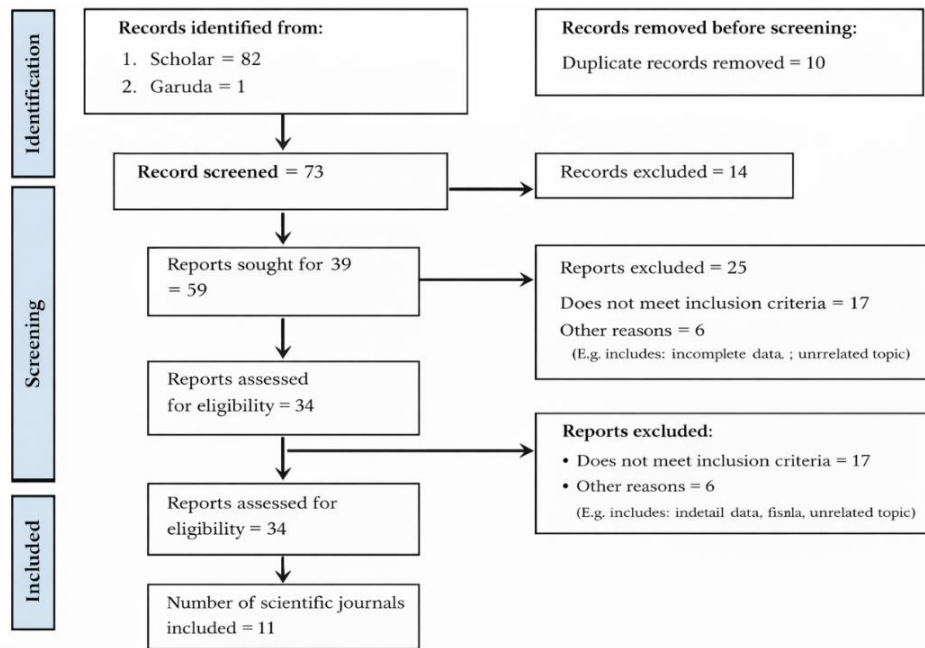


Figure 1. PRISMA Flow Diagram

4. RESULT AND DISCUSSION

4.1. Result

This study employed a qualitative synthesis approach to analyze the selected articles in this systematic review. The analysis was not limited to descriptive summaries but also focused on identifying patterns, trends, similarities, and differences across studies related to the use of local wisdom-based e-modules in science learning. The analysis was conducted through several stages. First, data were extracted from each study, including research objectives, methodologies, sample characteristics, types of e-modules, and reported learning outcomes. Second, the studies were categorized based on key themes, such as the integration of local wisdom, types of digital media, and their impact on students' learning outcomes.

Subsequently, a comparative analysis was conducted to examine how each study integrated local wisdom and how these approaches influenced students' learning outcomes. This process enabled the identification of consistent patterns as well as variations across studies. To enhance the rigor of the analysis, a thematic analysis approach was employed to synthesize the findings and develop broader interpretations. This approach facilitated the identification of major themes, research trends, and gaps in the literature. In addition, the analysis considered the strengths and limitations of the methodologies used in the reviewed studies, resulting in a more critical and comprehensive understanding. This approach provided a more systematic and in-depth analysis compared to a simple descriptive review, as it enabled more critical interpretation of existing studies. Using the PICO approach to search for articles in Google Scholar and Garuda databases, the final result were 11 articles that met the criteria. The characteristics of these articles are shown in Table 2.

Table 2. Characteristics Of The Articles Included In This Study

No	Author, Year & Title	Journal	Design	Purposes
1.	<u>Sari et al., (2021)</u> "Development of an E-Module on Temperature and Heat Material for Class XI High Schools Based on Ethnophysics"	Physics and Science Education Journal (PSEJ)	Qualitative	To develop ethnophysics-based e-modules, assess students' perceptions of the e-modules, enhance conceptual understanding, and evaluate learning outcomes
2.	<u>Fatihah, (2023)</u> "Effectiveness of Practical E-Module Based on Local Wisdom to Increase Creativity and Learning Outcomes of SMA Negeri 4 Cilegon Students"	Journal of Learning and Technology	One Group Pretest-Posttest	To determine the effectiveness of local wisdom-based practicum e-modules which have been created based on certain criteria in increasing student creativity and learning outcomes.

No	Author, Year & Title	Journal	Design	Purposes
3.	<u>Kumalasari et al., (2023)</u> “Development of E-Modules Based on Local Wisdom of the Grobogan Region to Improve Primary School Student Learning Outcomes”	Jurnal Paedagogy: Jurnal Penelitian dan Pengembangan Pendidikan	One Grup Pretest-Posttest	To analyze the effectiveness of e-module teaching materials based on local wisdom in the Grobogan area on elementary school student learning outcomes
4.	<u>Nurvitasari et al., (2022)</u> “Development of Interactive E-Modules with a CTL Approach Based on Local Wisdom Class V Theme 6 Heat and Its Transfer”	Jurnal on Teacher Education	Qualitative	To produce and determine the feasibility of an Interactive E-Module with a CTL Approach based on Local Wisdom Class V Theme 6 Heat and Its Transfer in improving student learning outcomes
5.	<u>Rhohman et al., (2018)</u> “Development of an E-Module for Enriching the Diversity of Tuber Food Plant Types Based on Local Wisdom in Gunung Kidul Regency to Increase the Independence and Cognitive Learning Outcomes of Class X SMA Students”	Jurnal Edukasi Biologi	One Group Pretest-Posttest	To produce a biodiversity enrichment e-module suitable for Grade X high school students and to determine the effectiveness of using the enrichment e-module in enhancing the independence and learning outcomes of Grade X high school students.
6.	<u>Iman et al., (2023)</u> “Development of a Local Wisdom E-Module assisted by the Flipping Book Application on vibration, wave and sound material at SMP Negeri 3 Kabila”	Jurnal Pendidikan dan Ilmu Fisika	Qualitative - Quantitative	To describe the validity, practicality and validity of the Local Wisdom E-Module assisted by the Flipping Book Application on Vibration, Waves and Sound Material, as well as to determine its effectiveness in improving student learning outcomes.
7.	<u>Nanuayo et al., (2023)</u> “Development of an Ethnobotany E-Module Based on the Local Potential of the NoauluMaluku Tribe for High School Students”	Biodik: Jurnal Ilmiah Pendidikan Biologi	Qualitative	To develop and test the feasibility of an ethnobotany e-module based on the local potential of the Noaulu-Maluku tribe, and to determine its effectiveness in improving student learning outcomes.
8.	<u>Firdiana et al., (2023)</u> “Development of the Ethnoscience E-Module "Hortensia Cultivation" Using Android-Based iSpring to Optimize Elementary School Student Learning Outcomes”	Jurnal Ilmu Pendidikan Sekolah Dasar	Pretest-Posttest Control Group Design	To examine the effectiveness of using the Android-based ethnoscience e-module "Hortensia Cultivation" which was developed in optimizing students' science learning outcomes at the elementary school level.
9.	<u>Wati et al., (2021)</u> “Development of a Temperature and Heat EModule Containing Local Wisdom Through the Sigil Application”	Jurnal Inovasi dan Pembelajaran Fisika	One Group Pretest-Posttest	To describe the feasibility of a temperature and heat e-module containing sigil-based local wisdom. Feasibility is seen from the aspects of validity, practicality and effectiveness in improving student learning outcomes

No	Author, Year & Title	Journal	Design	Purposes
10.	<u>Yachod et al., (2024)</u> “Development of E-Module Physics Based on Ethnoscience for Fluid Matter”	Jurnal of Physics Educations	Qualitative - Quantitative	To develop and determine the validity of an ethnoscience-based e-module on fluid physics material for class XI MIPA SMA/MA odd semester, as well as its effectiveness in improving student learning outcomes
11	<u>Siregar et al., (2022)</u> “Development of Chemical E-Modules Based on Papuan Local Wisdom On Reduction Oxidation Reaction Materials To Increase Student Learning Outcomes”	Jurnal Ilmu Pendidikan Indonesia	One Group Pretest-Posttest	To develop a chemistry e-module based on Papuan local wisdom, the feasibility of a chemistry e-module based on Papuan local wisdom, to improve science process skills (KPS) and learning outcomes of class X science students on reduction oxidation and reaction materias.

The effectiveness of using local wisdom-based e-modules on student learning outcomes were analyzed using cross-study quantitative synthesis techniques. The N-gain values and percentages of effectiveness reported in each study were categorized into low, medium, and high effect levels based on [Hake \(2002\)](#) criteria, as seen in Table 3.

Table 3. Effectiveness of Using Local Wisdom-Based E-modules on Learning Outcomes

No	Author & Year	Instrument	Significant Findings
1.	<u>Sari et al., (2021)</u>	Needs questionnaires, observation sheets, interview sheets, expert validation sheet and student perception questionnaire	Effectively improve learning outcomes with a final score of 91.67%
2.	<u>Fatihah, (2023)</u>	Pretest - Posttest learning outcomes	Effectively improved learning outcomes with an N-gain score of 77.35 and learning achievement from 43% to 76%
3.	<u>Kumalasari et al., (2023)</u>	Pretest - Posttest learning outcomes	Effectively improved learning outcomes with an increase of average score <i>N-Gain</i> from 51.2 to 78.5, and a learning achievement rate of 83.3%
4.	<u>Nurvitasari et al., 2 (2022)</u>	validation sheet, student response questionnaire sheet, learning implementation sheet	Very effective with an effectiveness rate of e-module use of 75–100%, and an increase in student test results of 91.7%.
5.	<u>Rhohman et al., (2018)</u>	Expert assessment sheet, biology teacher and student response instrument, student independence assessment instrument, pretest and posttest assessing learning outcomes	Effectively improves learning outcomes with an N-gain score of 0.62, categorized as moderate
6.	<u>Iman et al., (2023)</u>	Validation sheet, Observation sheet, Implementation of Learning, Questionnaire student responses, and sheets observing student activities.	Effectively improves learning outcomes with an average of 87.58%, classified as very good
7.	<u>Nanuayo et al., (2023)</u>	Expert validation sheet, student trial questionnaire sheet	Improves learning outcomes with the average product test score reached 96%, indicating a very high quality level with no need for improvement

No	Author & Year	Instrument	Significant Findings
8.	<u>Firdiana et al., (2023)</u>	Interviews, learning outcomes tests (pretest – posttest), and student response questionnaire sheets	Valid and practical, with an effectiveness rate of 47% in optimizing learning outcomes
9.	<u>Wati et al., (2021)</u>	Expert validation sheet, student response questionnaire sheet, and pretest - posttest	Effective in improving learning outcomes with an N-gain of 0.59 in the medium category.
10.	<u>Yachod et al., (2024)</u>	Expert validation sheet, and student response questionnaire	Effective in improving learning outcomes with a student response rate of 87.7%, and increasing students' enthusiasm and interest in learning
11.	<u>Siregar et al., (2022)</u>	Expert validation sheets, student and teacher response questionnaires, and pretest - posttest	Effective in improving learning outcomes with an N-gain of 0.74, categorized in the high category

The various types of local wisdom, the topics and classes that researchers used in the learning process can be seen in Table 4.

Table 4. Local Wisdom Used in Science Learning

No	Author & Year	Local Wisdom	Topics	Class
1.	<u>Sari et al., (2021)</u>	Ethnophysics (Traditional medicine, blacksmiths, betangas, lelang bamboo, Jambi batik, Kerinci coffee culture)	Physics : Temperature and Heat	XI
2.	<u>Fatihah,(2023)</u>	Plant	Chemistry: Acids and Bases	XI
3.	<u>Kumalasari et al., (2023)</u>	Grobogan Regional Dance	Science: Human Movement System	V
4.	<u>Nurvitasari et al., (2022)</u>	Kledungkradenan Local Wisdom	Science: Heat and its transfer	VI
5.	<u>Rhohman et al., (2018)</u>	Tubers	Biology: Biodiversity	X
6.	<u>Iman et al., (2023)</u>	Local Wisdom of the Kabila Area	Physics: Vibrations, waves and sound	VIII
7.	<u>Nanuayo et al., (2023)</u>	Plants of the Noaulu-Maluku Tribe	Biology: Ethnobotany	XI
8.	<u>Firdiana et al., (2023)</u>	Hortensia/Plant Cultivation	Science: Plants	IV
9.	<u>Wati et al., (2021)</u>	Dodol Kandangan and Sasirangan Cloth	Physics: Temperature and Heat	X
10.	<u>Yachod et al., (2024)</u>	Banana Leaf Gethek Game	Physics: Fluid	XI
11.	<u>Siregar et al., (2022)</u>	Sago, tubers (taro), and areca nut	Chemistry: Oxidation-Reduction Reactions	X

In this study, we also discovered that the authors used the local wisdom of the local area where they lived. The local wisdom used in this research was also very diverse, from using local natural resources, regional dances and even to regional games. The proportion of each type of local wisdom can be seen in Figure 2.

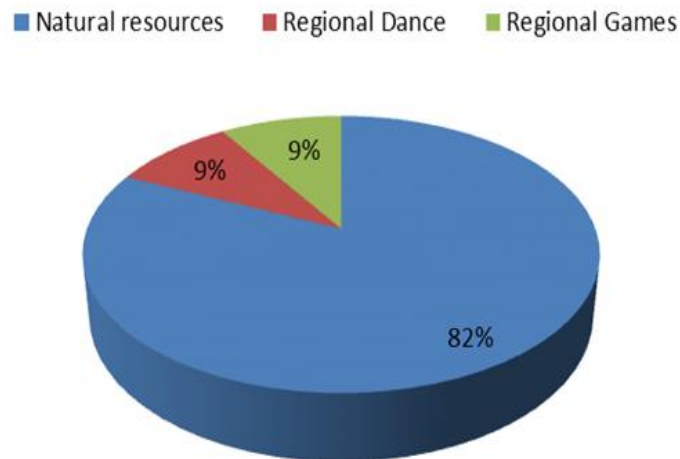


Figure 2. Distribution of local-wisdom learning topics

Integrating local wisdom into the learning process can also be adjusted to the material to be used. Each material can be used on certain topics. The topics used to integrate local wisdom can be seen in Figure 3.

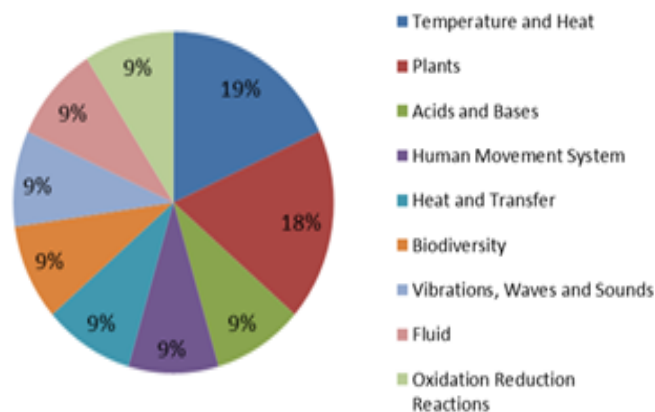


Figure 3. Learning Topics by Integrating Local Wisdom

4.2. Discussion

Based on the results of this study, the implementation of local wisdom-based e-modules demonstrated effective and positive impact on improving student learning outcomes in science subjects. From a constructivist perspective, the integration of local wisdom provides an authentic context that facilitates knowledge construction. Students not only receive abstract scientific concepts but also engage with cultural practices that concretely represent these scientific concepts. This alignment between students' life experiences and formal scientific knowledge contributes to deeper conceptual understanding ([Ansori & Heriansyah, 2025](#)). From the eleven research articles included in this study, using local streaming e-modules that are integrated with local wisdom can significantly improve student learning outcomes. By integrating local culture such as dance traditions, food fermentation processes, traditional games, or even folklore in the learning process, students can learn science through a more contextual, relevant and meaningful approach ([Oktaviana et al., 2024](#)). In regard to contextual learning, the integration of local wisdom potentially increase student engagement ([Kamal et al., 2025](#)). Active student engagement not only enhances a more meaningful understanding of science concepts but also leads to positive changes in the learning process, thereby extending beyond mere cognitive development ([Pepilina et al., 2025](#)).

The use of local content e-modules is significantly more effective in improving student learning outcomes than the use of conventional learning method, which usually relies on textbooks alone ([Amalia, 2023](#)). Conventional method often do not provide contextual learning experiences, so students have difficulties in understanding the material. In science learning, material concepts such as temperature and heat, are often considered abstract by students. By integrating elements of local wisdom, such as the use of Kerinci coffee

culture in discussing temperature and heat ([Sari et al., 2021](#)), students can more easily understand concepts through examples that are relevant to their daily lives. This is consistent with contextual learning theory, which emphasizes the importance of the connection between the subject matter and everyday life ([Nurmalasari et al., 2024](#)). Apart from that, by using e-module, teacher can provide illustrations using interactive animations, pictures, learning videos, infographics and many others, so that it can help students understand the material more concretely ([Ali et al., 2024](#)). Students' intrinsic motivation and cognitive persistence increase when they feel the learning feels personally and culturally relevant ([Utami et al., 2024](#)). The digital format of e-modules further enhances this effect through presentations using visual images, audio (sound/music), video, interactive feedback, and the flexibility of self-paced learning ([Kurniawan et al., 2025](#)).

The use of diverse local wisdom in learning reflects the richness of Indonesian culture and the potential for educational contextualization ([Miranti et al., 2024](#)). With proper integration, learning based on local wisdom can support the development of students' knowledge and character values. Our findings found there are various kinds of local wisdoms integrated in the e-modules of science learning, namely natural resources, regional dances and regional games (Figure 2). The most frequently used local wisdom was natural resources (82%) whereby researchers used various kinds of plants in their respective regions to serve as learning resources. For example, [Firdiana \(2023\)](#) used natural resources, namely hydrangea cultivation in the learning process. Hortensia is a type of subtropical plants that grows well in highland areas. Other study conducted by [Rhohman et al. \(2018\)](#) also used natural resources of “tubers” in Gunungkidul district, revealing that students tend to like fast food and are starting to abandon traditional foods made from tubers. These reflect the threat to the sustainability and existence of root crops among the younger generation. Therefore, integrating local wisdom in the learning can be used as an introduction to students about the potential of root crops and hopefully students can later take part in the use and conservation of root crops as part of regional potential and local wisdom. These 11 articles align with context-based learning theory, which emphasizes the importance of connecting material to students' real lives. For example, research by [Utari & Degeng \(2017\)](#) shows that thematic learning based on local wisdom is able to improve learning outcomes and build character values in students. In addition, we also found other local wisdoms that are used as learning, namely regional dances (9%) and regional games (9%). By using dance culture, complex science concepts (movement systems), namely the function of muscles, bones and joints, can be taught in a contextual, interactive and meaningful way. [Yachod et al \(2024\)](#) used local wisdom in the form of a regional game, namely “banana stem gethek game”. Through this game, the learning process of Archimedes' Law in static fluid materials could be delivered more easily.

Integrating local wisdom in the learning process can be done on many topics, depends on the relevance of the topic to the available local wisdom aspects and learning objectives ([Meilana & Aslam, 2022](#)). Our results showed that the topics most frequently used with the integration of local wisdom are temperature and heat (19%). The topic is most widely used because it is very relevant to everyday life such as cooking, food processing and other cultural activities. One example is the coffee culture in Kerinci, where water is traditionally heated using wood-fired stoves during coffee preparation. This cultural practice provides an authentic context for learning concepts related to temperature, heat transfer, specific heat capacity, and thermal equilibrium. In classroom learning, students can be asked to observe or analyze the coffee-making process to identify forms of heat transfer, including conduction through cooking utensils, convection in boiling water, and radiation from the stove flame. Students may also compare the efficiency of traditional and modern heating methods or investigate factors affecting water temperature during the brewing process. Through such contextual activities, abstract concepts of temperature and heat become more meaningful because students learn them through familiar cultural experiences, thereby promoting conceptual understanding and meaningful learning ([Sari et al., 2021](#)).

Apart from that, temperature and heat are flexible topics for various levels of education. At the basic level, students can learn the basic concepts of heat transfer, while at the advanced level, they can explore the more complex laws of thermodynamics. This flexibility allows this topic to be widely used in various locally based learning designs ([Wilujeng, 2020](#)). Next, we found the second most frequently used learning topic is plants (18%), a topic that is very relevant to community life and local culture. Various local wisdom uses plants, either as food, medicine, or as part of tradition and culture. The of the plant topic is also another reason why this topic is used most often. Various aspects of plant biology are related to other science concepts, such as photosynthesis, ecosystems, or food chains. Through a contextual approach, the plant topic also prioritizes the connection between theory and real practice, thereby providing a deeper and more meaningful learning experience ([Ansya et al., 2024](#)). Other learning topics, namely acids and bases, human movement systems, biodiversity, vibrations, waves and sound, fluids, and oxidation-reduction reactions ranked in the same position (9%) (Figure 3). Integrating local wisdom in the learning process must pay attention to the suitability of the topic with the used

local wisdom that the chosen local wisdom should have a direct link to the taught concept, and support the predetermined learning achievements in the curriculum ([Ansya et al., 2024](#); [Husni, 2024](#)

Based on the eleven studies included in this review, local wisdom-based e-modules consistently demonstrated positive effects on science learning. All reviewed studies reported improvements in students' learning outcomes, indicating that the integration of local wisdom into digital learning materials is an effective approach across various science topics and educational levels. The improvements were reflected through increased post-test scores, learning mastery, and N-gain values. For instance, [Fatihah \(2023\)](#) reported an N-gain score of 77.35 accompanied by an increase in learning achievement from 43% to 76%, while [Siregar et al. \(2022\)](#) obtained a high N-gain score of 0.74. Similarly, [Kumalasari et al. \(2023\)](#) reported a learning mastery rate of 83.3%, and [Nurvitasari et al. \(2022\)](#) found that student achievement increased by 91.7% after using the e-module. Beyond academic achievement, the findings revealed that local wisdom-based e-modules contributed to multiple dimensions of learning. Several studies reported improvements in conceptual understanding, creativity, learning independence, science process skills, motivation, enthusiasm, and students' interest in learning science. For example, [Rohman et al. \(2018\)](#) found that the e-module enhanced both learning outcomes and student independence, while [Fatihah \(2023\)](#) reported increased creativity alongside improved academic performance. [Yachod et al. \(2024\)](#) also highlighted increased student enthusiasm and interest in learning physics through ethnoscience-based e-modules.

The effectiveness of these e-modules may be attributed to their ability to contextualize scientific concepts through culturally familiar experiences. The reviewed studies integrated diverse forms of local wisdom, including the Kerinci coffee culture, Dodol Kandangan production, Sasirangan cloth, traditional dances, indigenous plants, traditional games, and Papuan food processing practices. These cultural contexts enabled students to connect abstract scientific concepts with everyday experiences, making learning more meaningful and relevant. Therefore, the significance of local wisdom-based e-modules extends beyond improving learning outcomes, as they also foster student engagement, motivation, scientific understanding, and the ability to relate science concepts to real-life situations.

Although e-modules based on local wisdom offered many benefits, their use also faced several challenges. First, not all schools, especially those in remote areas, had access to adequate computer devices or stable internet connections, making these limitations of technological infrastructure major obstacles. Second, teachers required specific skills to design modules that are relevant to local culture, but they lacked adequate skills in utilizing technology as a learning tool, as such the availability of local wisdom based e-modules remains very limited. Third, integrating local wisdom into learning was not easy because of the enormous regional diversity and variations. Moreover, not all science topics can be easily linked to certain local wisdom elements, while still remain aligned with the curriculum based learning outcomes ([Hekmatyar et al., 2025](#)).

Since this study adopts a Systematic Literature Review (SLR) approach, it does not rely on a cross-sectional or longitudinal research design in the traditional sense. Instead, this study synthesizes findings from multiple empirical studies conducted across different contexts and time periods. Therefore, it provides a broader and more comprehensive understanding of the implementation and effectiveness of local wisdom-based e-modules in science learning. However, most of the studies reviewed in this paper employed cross-sectional designs, which limits their ability to capture changes over time. For instance, studies by [Kumalasari et al. \(2023\)](#) and [Sugevin et al. \(2022\)](#) measured students' learning outcomes only after the implementation of e-modules without conducting longitudinal observations.

This study also identifies methodological limitations in previous research. Most studies used a one-group pretest-posttest design without a control group, thereby limiting the strength of causal inferences. Consequently, the reported improvements in learning outcomes cannot be fully and directly attributed to the use of local wisdom based e-modules, as they may be influenced by other factors such as the novelty effect, learning motivation, or the teacher's role in the learning process. Additionally, there is a potential publication bias, whereby studies with positive results are more likely to be published than those with insignificant results, leading to the appearance of more consistent and positive findings than the actual conditions. Variations in research contexts, such as differences in educational levels, student characteristics, and the types of local wisdom used, also have the potential to introduce uncontrolled heterogeneity in the results. On the other hand, most studies still focused on measuring short-term cognitive aspects, thus long-term impacts, particularly on affective aspects and the formation of cultural identity, could not yet be comprehensively concluded.

5. CONCLUSION

This systematic literature review aimed to examine the integration of local wisdom into science e-modules, evaluate their effectiveness in improving learning outcomes, and identify challenges associated with their implementation. The findings revealed that local wisdom was integrated into various science topics, including

temperature and heat, biodiversity, ethnobotany, vibrations and waves, fluid mechanics, oxidation-reduction reactions, and plant sciences. The forms of local wisdom incorporated into the e-modules were diverse, ranging from traditional food processing, indigenous plants, local dances, traditional games, and community cultural practices to ethnoscience and ethnopysics contexts.

Regarding effectiveness, all eleven studies reviewed reported positive impacts on student learning. The use of local wisdom-based e-modules improved learning outcomes, conceptual understanding, learning motivation, creativity, learning independence, science process skills, and student engagement. The effectiveness was reflected in increased post-test scores, learning mastery, positive student responses, and moderate-to-high N-gain values. These findings indicate that integrating local wisdom into digital learning materials provides meaningful and contextual learning experiences that help students connect scientific concepts with everyday cultural practices.

The review also identified several implementation challenges, including limited technological infrastructure, insufficient teacher competencies in digital material development, and the limited availability of local wisdom-based e-modules. These challenges highlight the importance of providing adequate technological support and professional development programs, making training essential to enhance teachers' competence in developing and implementing local wisdom-based e-modules effectively. Overall, the integration of local wisdom into science e-modules represents an effective approach to promoting contextual and student-centered learning. With a systematic and inclusive approach, this integration can increase learning effectiveness, enrich students' learning experiences, and contribute to the preservation of local cultural heritage while strengthening students' understanding of science.

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