



Development of a Physics Module Using Jampea Island Fishermen's Local Wisdom

Muhammad Qaddafi*, Roni Ririn, Anas Irwan, Muhammad Rusmin

Department of Physics Education, Alauddin State Islamic University of Makassar, Makassar, 90222, Indonesia

*Corresponding author: muhammad.qaddafi@uin-alauddin.ac.id

Received: October 05, 2025; Accepted: December 26, 2025; Published: January 20, 2026

Abstract – Physics education in schools often remains theoretical and disconnected from students' daily experiences, leading to decreased interest and limited conceptual understanding. One way to address this issue is by incorporating local knowledge into teaching materials to make learning more relevant and applicable to real life. This study aims to develop and evaluate the viability of a physics learning module based on the indigenous knowledge of fishermen on Jampea Island, Indonesia, specifically about sea tides, for senior high school students. The research used a development approach with the ADDIE model, which includes analysis, design, development, implementation, and evaluation phases. The module was validated by two experts, and a small trial was conducted with 24 Grade X Science students at SMA Negeri 4 Selayar Islands Regency. Data was collected through validation sheets, student response questionnaires, and learning outcome tests, then analyzed using Aiken's V and descriptive percentage analysis. Results show that the module achieved very high validity, with an average Aiken's V of 0.84. In terms of practicality, 54.7% of students rated the module as very practical, while 45.3% found it practical; all teachers (100%) evaluated it as very practical. Effectiveness analysis indicated that 75% of students attained learning mastery above the Minimum Completeness Criteria, demonstrating the module's success in improving learning outcomes. The novelty of this research lies in the systematic integration of Jampea Island fishermen's local wisdom into physics education through the ADDIE model, supported by empirical validation of its validity, practicality, and effectiveness. In conclusion, this locally based physics module is both feasible and effective for classroom use. It enriches physics education by providing a culturally responsive and contextual learning model that enhances students' conceptual understanding and engagement.

Keywords: ADDIE model; fishermen's; Jampea island; local wisdom; physics module

© 2026 The Author(s). Licensed under CC BY-SA 4.0 International.

I. INTRODUCTION

Education is a fundamental pillar in the development of high-quality human resources. In the Indonesian context, education is expected to foster students' potential holistically, encompassing intellectual, emotional, and social dimensions. Consequently, improving

educational quality remains a central objective of national development. One crucial factor influencing educational quality is the curriculum implemented in schools (Sullivan, 2021). A curriculum that is relevant and adaptive to local needs and potential can significantly enhance the effectiveness of the learning process. In parallel, advances in technology and educational innovation play an important role in modernizing the delivery of instructional materials, making learning more engaging and aligned with contemporary developments (Purwaningsih et al., 2020; Qu et al., 2022).

Despite continuous efforts to improve educational quality, substantial challenges persist in classroom learning practices. One prominent issue is the limited connection between teaching materials and students' surrounding environment and culture. In physics education, many instructional materials remain highly abstract and detached from students' lived experiences, leading to low motivation to learn and limited conceptual understanding. This gap emphasizes the need to develop learning approaches that are more contextual and meaningful. One promising alternative is the development of learning media grounded in local wisdom, which enables students to engage with scientific concepts through familiar contexts derived from their daily lives (Anggereni et al., 2021; Ikbal et al., 2020). Local wisdom encompasses knowledge and practices inherited within communities, shaped by long-term interactions with the natural environment, and thus represents a rich and authentic source for contextual learning (Saleng et al., 2025).

This study focuses on developing physics learning modules based on local wisdom relevant to the fishing community environment of Jampea Island. The local knowledge of fishermen in this region includes an extensive understanding of natural phenomena, such as sea tides and ocean dynamics, which are closely related to fundamental principles of physics. However, current physics learning modules used in schools often overlook this local knowledge. Most modules remain theoretical and fail to connect physics concepts to students' real-life experiences, making abstract ideas hard to understand. In contrast, modules that incorporate local wisdom have the potential to create more contextual, engaging, and environmentally relevant learning experiences (Salmia et al., 2025). Such modules can foster active student participation and improve understanding of physics concepts (ElSayary, 2021).

The primary problem addressed in this study is the scarcity of physics teaching materials that integrate local wisdom into the learning process. In schools on Jampea Island, most existing modules have not incorporated the local knowledge of the fishing community. As a result, students often perceive physics as distant from their everyday lives, leading to reduced interest and limited conceptual mastery. The development of physics modules grounded in local wisdom is therefore considered an effective strategy to bridge this gap. By connecting physics theory with observable natural phenomena familiar to students, such modules are expected to increase

learning motivation, improve conceptual understanding, and foster appreciation for local culture and indigenous knowledge (Sum et al., 2024).

Previous studies have demonstrated that local wisdom-based module development can significantly enhance students' conceptual understanding and learning motivation (Hartini et al., 2018; Mudjid et al., 2022; Sunarti et al., 2025; Susanto et al., 2023; Suyidno et al., 2025). Gisewhite (2023), for instance, integrated Indonesian local wisdom (ethnoscience) into physics learning through a qualitative case study and found that: (1) ethnoscience-based modules improved students' conceptual understanding by linking theory to real-world contexts; (2) students' motivation increased due to the cultural relevance of learning; and (3) such approaches contributed to the preservation of local knowledge. These findings support earlier research indicating that physics learning grounded in local wisdom is effective for contextual and inclusive science education (Mastun et al., 2019; Gisewhite, 2023; Siswanto et al., 2022; Wardani & Mundilarto, 2021). Furthermore, Hidayanto (2016) developed a local wisdom-based physics module that effectively improved students' conceptual understanding. The study reported a high feasibility rate of 94% (Jufrida et al., 2025; Makhrus et al., 2025; Misbah et al., 2024). Similar results were reported by Mariana and Hidayanto (2022), who found that physics modules integrating local wisdom, which demonstrated strong validity and effectiveness in improving students' learning outcomes by connecting theoretical concepts with real-life experiences (Rosa et al., 2025; Umamah et al., 2024).

Although extensive research has confirmed the effectiveness of local wisdom-based modules across various regional contexts (Sani et al., 2021; Shofa et al., 2021; Zainuddin et al., 2021), studies specifically examining the integration of fishermen's local wisdom into physics learning remain limited (Dewani, 2020; Sartika et al., 2025), especially on Jampea Island. This research gap presents an opportunity to explore how local knowledge from fishing communities can be systematically incorporated into physics education and to evaluate its impact on learning quality and student outcomes.

Therefore, this study aims to develop a physics module rooted in the local wisdom of Jampea Island fishermen and to assess its feasibility in terms of validity, practicality, and effectiveness. Specifically, the study will describe the process of developing the module, examine user acceptance among teachers and students, and evaluate the extent to which the module improves students' understanding of physics concepts. The novelty of this research lies in the systematic integration of the local wisdom of Jampea Island fishermen into physics education. It is expected that the results will help create more contextual and culturally responsive physics teaching, while also providing a model for integrating local knowledge into science education in other regions with unique cultural characteristics.

II. METHODS

This study employed a research and development (R&D) methodology to design and evaluate a physics instructional module grounded in the local wisdom of the fishermen of Jampea Island. The development process adhered to the ADDIE model, encompassing five sequential phases: analysis, design, development, implementation, and evaluation. The research was conducted at SMA Negeri 4 Selayar Islands Regency. Data collection was executed through two primary sources. The first involved expert validators, with two specialists assessing the module's content, presentation, graphics, and language. The second source consisted of trial participants, namely 24 students enrolled in Class X Science 1 at SMA Negeri 4 Selayar Islands.

The module development procedure followed the ADDIE model's systematic steps (Rosa et al., 2025), as illustrated in Figure 1. The analysis stage focused on identifying curriculum demands, student characteristics, and relevant local wisdom related to the fishing community of Jampea Island. The design stage involved structuring the module content, learning objectives, activities, and assessments. Experts produced the module's initial draft during the development stage and subsequently validated it. The implementation stage consisted of a limited trial of the module with students, while the evaluation stage assessed the validity, practicality, and effectiveness of the developed module.

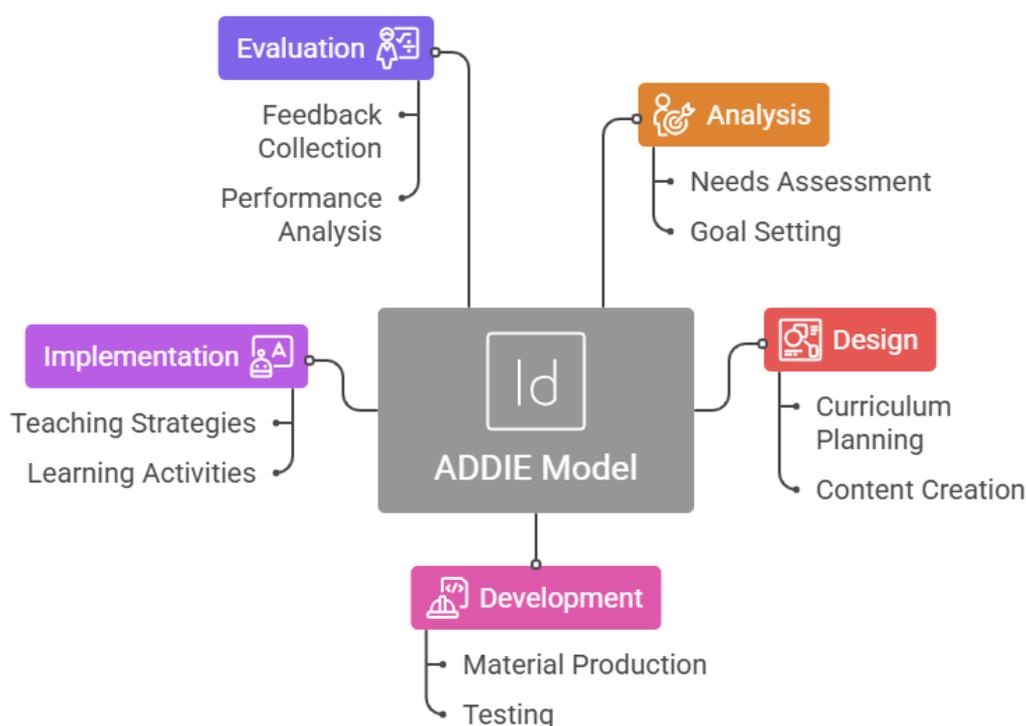


Figure 1. Steps in the ADDIE development model

Data were collected using several research instruments. A product validation sheet was used to assess the module's validity, covering content validity, presentation components, graphic components, and linguistic validity. A student response questionnaire was administered to determine the practicality of the module during learning activities. In addition, a learning outcomes test was used to evaluate the module's effectiveness based on students' achievement after using it.

Data analysis was conducted using both quantitative and descriptive approaches. The validity of the module was analyzed using Aiken's V index, following the formulation proposed by Retnawati (2016), as shown in Equation (1):

$$V = \frac{\sum s}{c(n-1)} \quad (1)$$

where V represents the agreement index among validators, s is the score given by each validator minus the lowest possible score, n is the number of validators, and c is the number of rating categories available. The validity criteria were interpreted as follows: $V < 0.40$ indicates low validity; $0.40 \leq V \leq 0.80$ indicates moderate validity; and $V > 0.80$ indicates high validity (Retnawati, 2016).

The practicality of the module was analyzed descriptively using percentage analysis (Nuridin, 2007), as presented in Equation (2):

$$P = f/n \times 100\% \quad (2)$$

where P denotes the percentage, f represents the frequency of responses, and n is the total number of respondents. The results of the practicality analysis were interpreted using the criteria presented in Table 1.

Table 1. Practicality criteria for the practical module

No.	Formula	Classification
1	$\bar{X} > \bar{X}_i + 1.8 \times S_{\beta_i}$	Very Positive
2	$\bar{X}_i + 0.6 \times S_{\beta_i} < \bar{X} \leq \bar{X}_i + 1.8 \times S_{\beta_i}$	Positive
3	$\bar{X}_i - 0.6 \times S_{\beta_i} < \bar{X} \leq \bar{X}_i + 0.6 \times S_{\beta_i}$	Moderately Positive
4	$\bar{X}_i - 1.8 \times S_{\beta_i} < \bar{X} \leq \bar{X}_i - 0.6 \times S_{\beta_i}$	Less Positive
5	$\bar{X} \leq \bar{X}_i - 1.8 \times S_{\beta_i}$	Negative

(Widyoko, 2014)

The module was considered practical if more than 50% of students provided positive responses to at least 70% of the assessed aspects. When this criterion was met, the developed module was categorized as practical for use in learning activities (Arsyad, 2007). The effectiveness of the module was determined based on students' learning outcomes using mastery learning criteria established by the school. Students were classified as achieving mastery if they

obtained a score of ≥ 70 , while scores below 70 were categorized as non-mastery. According to Arikunto, a learning medium is considered effective if the percentage of classical learning mastery reaches at least 75%.

III. RESULTS

This study explains the process and results of creating a physics module based on the indigenous knowledge of coastal fishermen on Jampea Island, using the ADDIE development approach. The outcomes for each step of the development process—analysis, design, development, implementation, and evaluation.

1. Analysis stage

The analysis stage served as the initial step in identifying the needs, objectives, and the relevance of the developed module to students' characteristics and learning context. The results of the needs analysis revealed that existing physics teaching materials had not yet integrated local wisdom, resulting in less contextual and less engaging learning materials for students. Therefore, the development of this module aimed to produce a more engaging, context-based learning resource that would enhance students' understanding of physics concepts while simultaneously introducing and strengthening their knowledge of local wisdom.

Further analysis showed that students had a stronger interest in learning materials closely connected to their local environment. Based on this, the topic of sea tides was chosen as the main focus of the module, as it relates directly to the daily experiences and local knowledge of fishermen on Jampea Island's coast. As a result, the physics module was designed to combine scientific concepts of tides with the local wisdom of the fishing community.

2. Design stage

The design stage involved selecting the module format and developing the initial layout and structure of the learning materials. This stage encompassed the formulation of learning objectives, content organization, learning activities, and visual presentation. The module was designed using a blue color scheme, symbolizing calmness and harmony with the marine environment, which is closely associated with the lives of coastal fishermen.

The prototype design of the module is presented in Figure 2. At this stage, data on local wisdom were collected through interviews with members of the coastal fishing community of Jampea Island, complemented by information obtained from journals, previous studies, and relevant online sources. The integration of these sources resulted in the initial version of the module, referred to as Prototype I.



Figure 2. Initial prototype design (Prototype I) of the physics module integrating coastal fishermen’s local wisdom on Jamepa Island

3. Development stage

The development phase concentrated on enhancing the initial prototype through thorough validation and revisions. Two expert validators assessed the module, focusing on four key aspects: content validity, presentation components, graphic elements, and linguistic accuracy. Their evaluations aimed to ensure that the module met quality standards across these areas. The validation outcomes, which provide insights into the strengths and areas for improvement, are summarized and displayed in Figure 3. This process was crucial for refining the prototype, ensuring it is both effective and user-friendly before proceeding to further development stages.

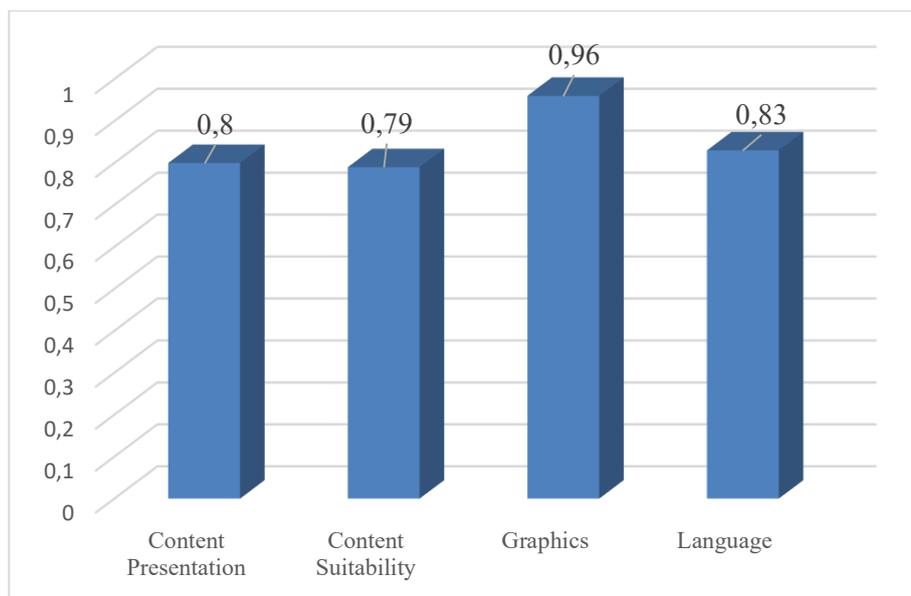


Figure 3. Validation results of the module across four aspects: content, presentation, graphics, and language

The analysis of the validation results showed that the module had an average Aiken's V value of 0.84, indicating high validity. This indicates that the developed physics module met the validity criteria across all assessed aspects. Following the validation process, revisions were made in accordance with the validators' suggestions, resulting in Prototype II, as illustrated in Figure 2. After achieving the required validity level, Prototype II was implemented in classroom learning activities. The limited trial was conducted with 24 students of Class X Science 1 at SMA Negeri 4 Selayar Islands Regency. The trial results were used to assess the practicality and effectiveness of the developed module.

Table 2. Summary of observation data

No.	Range	Frequency	Percentage (%)	Description
1	$x > 54$	13	54.7	Very practical
2	$45 < x \leq 54$	11	45.3	Practical
3	$35 < x \leq 45$	0	0	Enough
4	$26 < x \leq 35$	0	0	Less practical
5	$x \leq 26$	0	0	Not practical

The practicality of the module was evaluated based on observation data and student responses, as summarized in Table 2. The results indicate that 13 students (54.7%) categorized the module as very practical, while 11 students (45.3%) categorized it as practical. No students rated the module as moderately practical, less practical, or not practical. These findings

demonstrate that the physics module based on the local wisdom of Jampea Island fishermen is practical for classroom use, as it falls predominantly within the “very practical” and “practical” categories. The revised version of the module, after validation and refinement is presented in Figure 4.

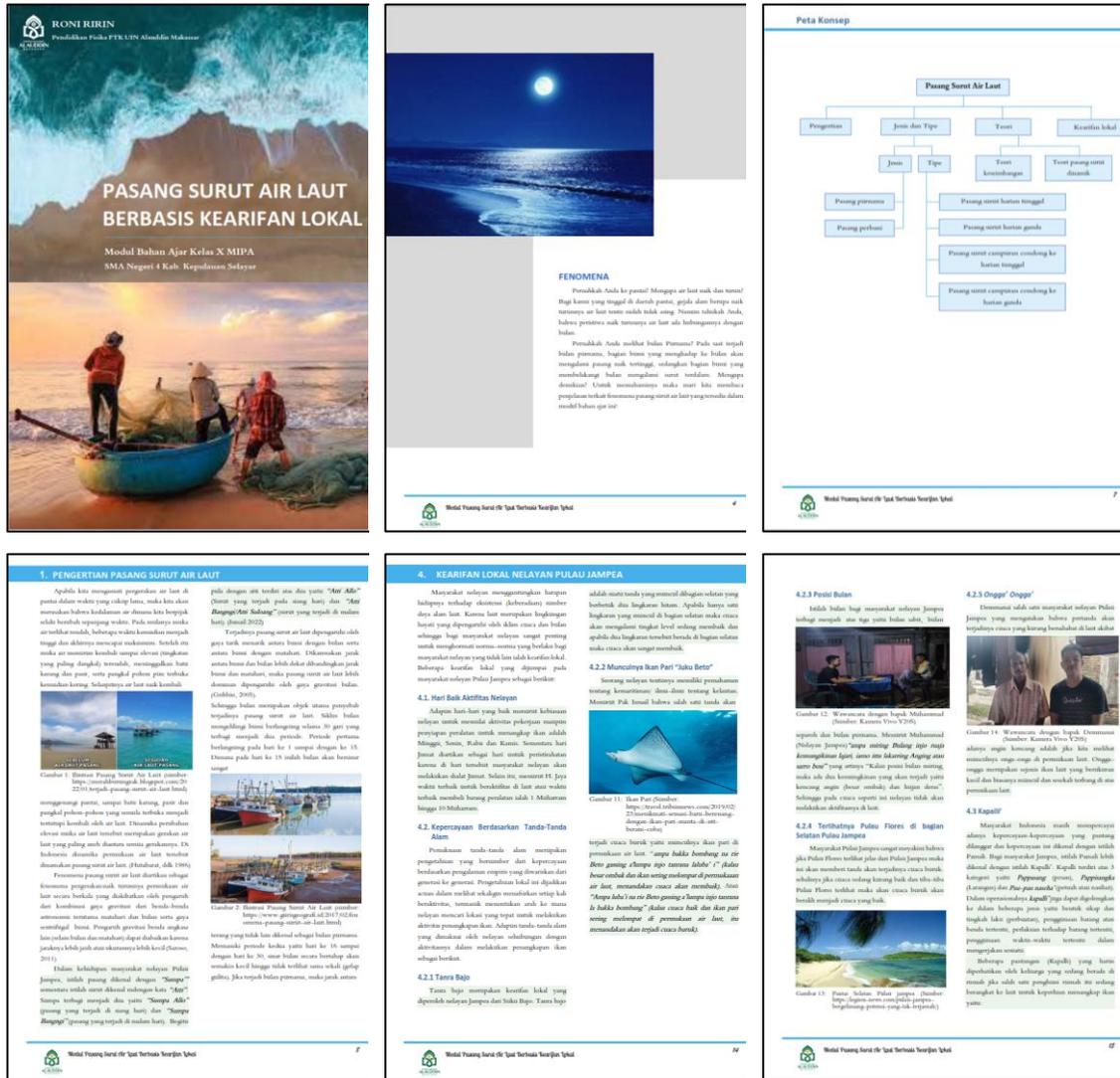


Figure 4. Prototype module after revision (Prototype II)

4. Implementation stage

At the implementation stage, the revised module was applied in real classroom learning settings. Due to practical limitations, the implementation was conducted as a limited trial involving one physics teacher and 24 students from Class X Science 1 at SMA Negeri 4 Selayar Islands Regency. During this stage, observations were conducted to assess students’ engagement and responses to the newly developed teaching materials.

The effectiveness of the module was evaluated by administering a learning outcomes test after students completed learning activities using the module. The results of the learning outcomes test are presented in Figure 5. The analysis shows that 24 students, representing 75% of the participants, achieved scores of 70 or higher. According to the standards of the Ministry of Education and Culture, learning mastery is achieved when students reach an individual mastery level of at least 65%, and classical mastery is achieved when at least 75% of students meet the mastery criterion.

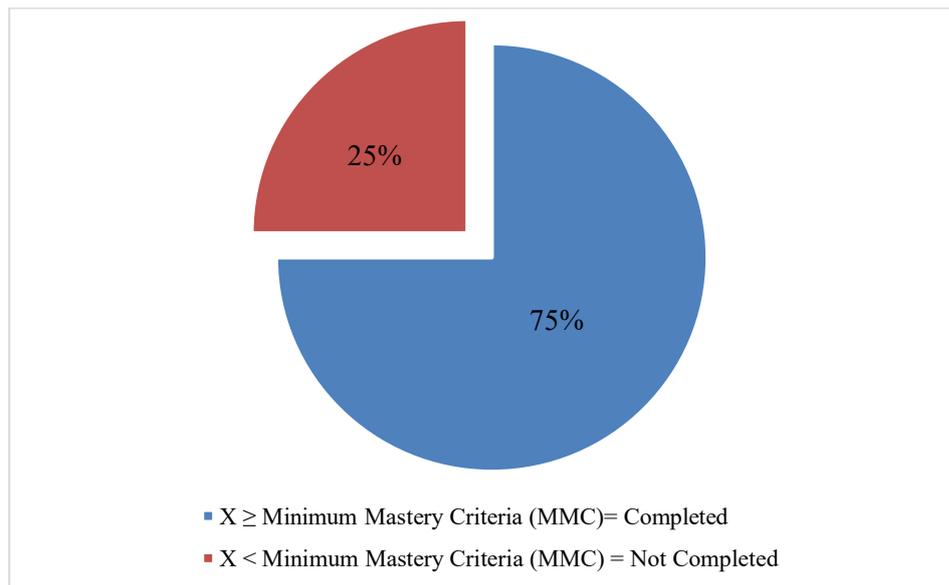


Figure 5. Distribution of students' learning outcome mastery after implementation of the module

Based on these results, the physics module based on the local wisdom of Jampea Island coastal fishermen can be categorized as effective in improving students' learning outcomes. These findings are consistent with previous studies demonstrating that physics teaching materials integrating local wisdom can enhance students' conceptual understanding and learning achievement (Sae et al., 2021; Li et al., 2025; Rahmayani & Atmazaki, 2025).

5. Evaluation stage

The final stage of the ADDIE model is evaluation, which aims to assess the overall quality and effectiveness of the developed learning materials. In this study, evaluation was conducted by administering learning outcome tests to measure students' understanding after using the module. This evaluation provided feedback on the strengths and limitations of the developed module and confirmed its effectiveness as a learning medium. The evaluation results indicate that the locally based physics module positively contributes to students' understanding of physics concepts and supports the achievement of learning objectives (Ningsih et al., 2019).

IV. DISCUSSION

This study shows that the physics module based on the local wisdom of Jampea Island fishermen is valid, practical, and effective for high school physics education. The high validity score (Aiken's $V = 0.84$) indicates that the module meets academic standards in content accuracy, presentation, graphical design, and language use. This confirms that including local wisdom in physics teaching materials does not undermine scientific rigor; instead, it makes the learning materials more relevant to students' real-life experiences. These results align with previous studies that reported high feasibility and validity of local wisdom-based modules in physics education (Mariana & Hidayanto, 2022; Husin et al., 2022; Rosyidah et al., 2025; Zainuri et al., 2025).

In terms of practicality, student responses indicate that the developed module is easy to use and supportive of learning activities. More than half of the students (54.7%) categorized the module as very practical, while the remaining students (45.3%) rated it as practical. This finding aligns with reports that teaching materials grounded in local wisdom enhance comfort and usability during learning. Moreover, the positive response from teachers, who rated the module as very practical, reinforces earlier findings that locally based learning materials facilitate instructional implementation and reduce instructional barriers for educators (Ikbali et al., 2020). These results suggest that local wisdom-based modules are not only pedagogically sound but also operationally feasible in classroom settings.

Although this study emphasizes the integration of local wisdom rather than technology-driven innovation, its findings complement research conducted in diverse educational contexts. For example, Dewani (2020) focused on pop-up card media in science learning, highlighting technological creativity, whereas this study prioritizes cultural relevance as the foundation of instructional design. Despite these differences, both approaches support the principle that learning media aligned with students' contexts, whether cultural or technological, can enhance motivation and understanding. This finding further supports the argument that local wisdom plays a critical role in addressing contemporary educational challenges by grounding abstract scientific concepts in culturally meaningful experiences (Afdalia et al., 2020).

The effectiveness analysis shows that 75% of students achieved mastery learning above the Minimum Completeness Criteria, indicating that the module effectively improves learning outcomes. This result is consistent with previous studies demonstrating that contextual learning grounded in local wisdom enhances students' conceptual understanding and engagement. Rahman et al. (2021), for instance, reported increased student motivation through the integration of local wisdom (*Pappasang*) in physics learning. Similarly, studies by Rosa et al. (2025) and

Umamah et al. (2024) illustrate that identifying physics concepts embedded in cultural practices enables students to better understand abstract concepts such as motion, force, and energy through familiar experiences. These findings reinforce the view that local wisdom-based learning supports meaningful learning by linking scientific theory to everyday life.

Furthermore, research by Sartika et al. (2025) demonstrated that differentiated physics learning media based on local wisdom improved students' understanding of complex topics such as temperature and thermodynamics. Although Elvina et al. (2025) focused on problem-based digital modules rather than explicit local wisdom, their findings similarly highlight the importance of contextualization in improving problem-solving skills and student engagement. Collectively, these studies confirm that context-based learning, particularly when rooted in local wisdom, enhances learning effectiveness and promotes deeper conceptual understanding (ElSayary, 2021; Gisewhite, 2023; Rosa et al., 2025; Sum et al., 2024; Umamah et al., 2024). The findings of this study provide compelling evidence that the development of physics modules rooted in local wisdom from fishermen on Jampea Island is effective in enhancing students' physics learning outcomes. The developed module is not only theoretically sound but also practical and efficacious when implemented in classroom settings. These results demonstrate that integrating local wisdom into physics instruction significantly benefits students' comprehension of physics concepts.

The implications of these findings are particularly significant for the field of physics education, especially in regions characterized by rich local cultural contexts. This study underscores the importance of creating educational materials that not only communicate universal physics principles but also connect these principles to natural phenomena familiar to students in their daily lives. By contextualizing physics concepts through local wisdom, learning becomes more meaningful, relevant, and engaging, thereby increasing students' motivation and active participation in the learning process. Furthermore, this research contributes to the development of a more locally responsive physics curriculum. As a central component of education, the curriculum should reflect local needs, potentials, and cultural contexts. The development of modules based on local wisdom, therefore, offers an alternative approach to designing a curriculum that is more inclusive and adaptive to regional characteristics. The physics module developed in this study may serve as a model for creating teaching materials in other regions that possess distinctive local wisdom that can be meaningfully integrated into physics learning.

The novelty of this research lies in the integration of local wisdom into the development of physics modules for high school students on Jampea Island, Indonesia. While numerous studies have addressed local wisdom in education, most have concentrated on social and cultural disciplines rather than physics learning. This study offers a new perspective by incorporating fishermen's local knowledge, such as their understanding of sea tides, into the physics curriculum,

thereby bridging abstract scientific concepts with students' real-life experiences. In addition, the use of the ADDIE development model provides a structured and systematic framework for integrating local cultural knowledge into physics learning, an approach that has not been widely applied in the Indonesian context. Importantly, this study evaluates not only cultural relevance but also the validity, practicality, and effectiveness of the developed module, offering comprehensive empirical evidence of its impact on student understanding and engagement.

The development of local wisdom-based modules also opens opportunities to design other instructional approaches that connect physics theory to students' everyday experiences. Such approaches can help reduce the abstract nature of physics concepts, making them more accessible and easier to understand. By linking physics content to local knowledge that students are already familiar with, the learning process becomes more engaging, relevant, and enjoyable. Contextual learning of this kind enables students to recognize the relationship between science and their own lives, ultimately improving learning quality and outcomes.

Overall, this study makes a meaningful contribution to physics education, particularly in the development of learning media grounded in local wisdom. The results demonstrate that the integration of local wisdom into physics modules not only enhances students' conceptual understanding but also positively influences their motivation and engagement in learning. Therefore, the continued development and wider implementation of physics modules grounded in local wisdom are essential to enrich students' learning experiences and improve the quality of physics education in Indonesia

V. CONCLUSION AND SUGGESTION

This study successfully developed a physics learning module based on the local wisdom of fishermen on Jampea Island, demonstrating high levels of validity, practicality, and effectiveness. The module was empirically validated with an average Aiken's V score of 0.84, indicating very high validity in content, presentation, graphical, and linguistic aspects. Regarding practicality, student responses showed that 54.7% rated the module as very practical and 45.3% as practical, while all teachers (100%) rated it as very practical. Additionally, the effectiveness analysis revealed that 75% of students achieved learning mastery above the Minimum Completeness Criteria. These findings confirm that the developed module can connect abstract physics concepts to familiar natural phenomena, such as sea tides, by integrating local wisdom, thereby enhancing students' conceptual understanding and learning outcomes.

Despite these positive results, this study has several limitations to consider. The trial involved a small number of participants (24 students) from a single school on Jampea Island,

which limits the generalizability of the findings. Future research should include larger, more diverse samples from different regions and educational levels and explore the long-term effects of local wisdom-based modules on students' conceptual retention and higher-order thinking skills. Nevertheless, this study makes a meaningful contribution to the field of physics education by demonstrating the effective use of the ADDIE development model in designing physics modules rooted in local wisdom. The findings offer empirical evidence that culturally contextualized physics learning materials can be valid, practical, and effective, and they serve as a reference for integrating local wisdom into physics curricula and possibly other scientific disciplines.

REFERENCES

- Afdalia, A., Arsyad, M., & Arafah, K. (2020). Pengembangan modul pembelajaran IPA fisika berbasis kearifan lokal sandeq pada sekolah menengah pertama. *Prosiding Seminar Nasional Fisika PPs UNM*, 2, 68-71. <https://ojs.unm.ac.id/semnasfisika/article/view/12869>
- Anggereni, S., Suhardiman, S., & Amaliah, R. (2021). Analisis ketersediaan peralatan, bahan ajar, administrasi laboratorium, dan keterlaksanaan kegiatan praktikum di laboratorium fisika. *Jurnal Ilmiah Pendidikan Fisika*, 5(3), 414–423. <https://doi.org/10.20527/jipf.v5i3.3925>
- Arsyad, N. (2007). *Model pembelajaran matematika yang menumbuhkan kemampuan metakognitif untuk menguasai bahan ajar*. (Disertasi: Tidak diterbitkan. Surabaya: Universitas Negeri Surabaya).
- Dewani, H. W. (2020). Development of media pop up card folklore to improve the critical reading skills of grade-IV elementary school students. *International Journal of Innovative Science and Research Technology*, 5(1), 901–907. <https://ijsrt.com/assets/upload/files/IJSRT20JAN654.pdf>
- ElSayary, A. (2021). Transdisciplinary STEAM curriculum design and authentic assessment in online learning: A model of cognitive, psychomotor, and affective domains. *Journal of Turkish Science Education*, 18(3), 493–511. <https://doi.org/10.36681/tused.2021.86>
- Elvina, D., Saminan, S., & Evendi, E. (2025). Development of STEM-based student worksheets through a fly repellent project to foster students' creative thinking. *Jurnal Pendidikan Fisika*, 13(3), 329–344. <https://doi.org/10.26618/c92eyw25>
- Gisewhite, R. A. (2023). A whale of a time: Engaging in a war of values for youth activism in science education. *Cultural Studies of Science Education*, 18(4), 1285–1309. <https://doi.org/10.1007/s11422-022-10140-5>
- Hartini, S., Isnanda, M. F., Wati, M., Misbah, M., An'Nur, S., & Mahtari, S. (2018). Developing a physics module based on the local wisdom of Hulu Sungai Tengah Regency to train the murakata character. *Journal of Physics: Conference Series*, 1088(1), 1-6. <https://doi.org/10.1088/1742-6596/1088/1/012045>
- Hidayanto, F., Sriyono, & Ngazizah, N. (2016). Pengembangan modul fisika SMA berbasis kearifan lokal untuk mengoptimalkan karakter peserta didik. *Jurnal Radiasi* 9(1), 24-29. <https://jurnal.umpwr.ac.id/index.php/radiasi/article/download/211/109>
- Husin, V. E. R., Laos, L. E., & Wulandari, H. (2022). Developing physics teaching material Newton's law based on local wisdom: Plait. *AIP Conference Proceedings*, 2542, 020020. <https://doi.org/10.1063/5.0129795>

- Ikkal, M. S., Rafiqah, R., & Khuzaimah, A. U. (2020). Pengembangan modul pembelajaran IPA fisika berbasis pop-up book. *JPF (Jurnal Pendidikan Fisika) Universitas Islam Negeri Alauddin Makassar*, 8(1), 53–60. <https://journal.uin-alauddin.ac.id/index.php/PendidikanFisika/article/view/12522/0>
- Jufrida, J., Kurniawan, W., Furqon, M., Anwar, K., Falah, H. S., & Riantoni, C. (2025). AI-driven ethnoscience learning: Enhancing physics education through Malay cultural insights. *Journal of Information Technology Education: Innovations in Practice*, 24(13), 1–27. <https://doi.org/10.28945/5520>
- Li, Z., Piao, S., Zhan, J., & Chen, X. (2025). DL-SDE: A deep learning framework for source depth estimation in shallow water using vertical linear array. *The Journal of the Acoustical Society of America*, 158(4), 3547–3567. <https://doi.org/10.1121/10.0039667>
- Makhrus, M., Rahayu, S., Santoso, D., & Annam, S. (2025). Effect of e-module based on sustainable development goals (SDGs) with conceptual change model–cognitive conflict approach (CCM–CCA) integrated with local wisdom on students’ critical thinking skills. *Educational Process: International Journal*, 17, 1–18. <https://doi.org/10.22521/edupij.2025.17.399>
- Mariana, E., & Hidayanto, E. (2022). Penerapan model sole berbantuan m-learning untuk meningkatkan hasil belajar siswa materi trigonometri. *JMPM: Journal of Mathematics and Mathematics Education*, 7(1), 24–37. <https://doi.org/10.26594/jmpm.v7i1.2594>
- Mastun, M., Andrini, V. S., Maduretno, T. W., & Yusro, A. C. (2019). Development of physics learning e-module based on local culture wisdom in Pontianak, West Kalimantan. *Journal of Physics: Conference Series*, 1381(1), 1-7. <https://doi.org/10.1088/1742-6596/1381/1/012045>
- Misbah, M., Hamidah, I., Sriyati, S., Samsudin, A., & Rahman, N. F. A. (2024). Development of fluid physics e-module based on argumentation-driven inquiry laboratory to develop critical thinking skills and problem-solving abilities in prospective physics teachers. *Journal of Engineering Science and Technology*, 19(6), 1–8. https://jestec.taylors.edu.my/Special%20Issue%20ISCoE%202024_1/ISCoE2024_1_01.pdf
- Mudjid, R. M., Supahar, S., Putranta, H., & Hetmina, D. S. (2022). Development of Android physics learning tools based on local wisdom traditional game Bola Boy as a learning source. *International Journal of Interactive Mobile Technologies*, 16(6), 92–112. <https://doi.org/10.3991/ijim.v16i06.27855>
- Ningsih, W. K., Riyanto, Y., & Suyanto, T. (2019). The development of pop-up 3D general map using discovery learning models to improve creativity and learning outcomes of social studies grade V elementary school. *International Journal of Scientific and Research Publications*, 9(7), 599-606. <https://doi.org/10.29322/ijserp.9.07.2019.p9172>
- Nurdin, N. (2007). *Model pembelajaran matematika yang menumbuhkan kemampuan metakognitif untuk menguasai bahan ajar*. (Disertasi: Tidak diterbitkan. Surabaya: Universitas Negeri Surabaya).
- Purwaningsih, E., Sari, S. P., Sari, A. M., & Suryadi, A. (2020). The effect of STEM-PjBL and discovery learning on improving students’ problem-solving skills of the impulse and momentum topic. *Jurnal Pendidikan IPA Indonesia*, 9(4), 465–476. <https://doi.org/10.15294/jpii.v9i4.26432>
- Qu, D., Shevchenko, T., Xia, Y., & Yan, X. (2022). Education and instruction for circular economy: A review on drivers and barriers in circular economy implementation in China. *International Journal of Instruction*, 15(3), 1–22. <https://doi.org/10.29333/iji.2022.1531a>

- Rahman, H., Syukri, M., & Judrah, M. (2021). *Pendidikan karakter dalam budaya Bugis Makassar*, 393-403. <https://oarep.usim.edu.my/entities/publication/8c0c50eb-9ecc-4467-9f9c-61494d384b0c>
- Rahmayani, R. D., & Atmazaki, A. (2025). Development of interactive e-LKPD based on Liveworksheets for reading and viewing skills. *Al-Ishlah: Jurnal Pendidikan*, 17(1), 73–89. <https://doi.org/10.35445/alishlah.v17i1.6451>
- Retnawati, H. (2016). *Analisis kuantitatif instrumen penelitian: Panduan peneliti, mahasiswa, dan psikometrian* (Vol. 1). Parama Publishing.
- Rosa, F. O., Aththibby, A. R., Prasasti, A. R., Chomsun, S., & Prameswari, E. (2025). Integrating Lampung local wisdom into science education: Development and validation of a culturally responsive textbook to enhance physics learning outcomes. *Jurnal Pendidikan Fisika*, 13(3), 479–492. <https://doi.org/10.26618/6zf7vb22>
- Rosyidah, F., Susantini, E., Yuliani, Y., & Nisa', K. (2025). Local wisdom and STEM in science education to support SDG-4: A systematic review. *Jurnal Pendidikan IPA Indonesia*, 14(4), 654–666. <https://doi.org/10.15294/jpii.v14i4.34450>
- Sae, F. S., Husin, V. E. R., & Mellu, R. N. K. (2021). Pengembangan bahan ajar fisika berbasis kearifan lokal anyaman nyiru untuk meningkatkan pemahaman konsep siswa. *Variabel*, 4(1), 27–33. <https://dx.doi.org/10.26737/var.v4i1.2321>
- Saleng, S., Ishaq, & Syatriana, E. . (2025). Global trends in local wisdom-based school education: A comprehensive bibliometric review (2009–2025). *Journal of Local Wisdom in Education*, 1(1), 48-71. <https://doi.org/10.26618/8fjph017>
- Salmia, Kadir, D., & Alka, M. (2025). Integrating sipakatau and sipakalebbi values into deep learning approaches for character education in elementary schools. *Journal of Local Wisdom in Education*, 1(1), 1-17. <https://doi.org/10.26618/vz382n59>
- Sani, D. M., Sukarmin, S., & Suharno, S. (2021). The needs analysis for the development of electronic learning module (e-module) based on local wisdom information search in senior high schools' physics online learning during COVID-19 pandemic. *IOP Conference Series: Earth and Environmental Science*, 1796(1), 1-9. <https://doi.org/10.1088/1742-6596/1796/1/012020>
- Sartika, D., Rosman, A., & Intang, N. (2025). Enhancing conceptual understanding of heat and thermodynamics through innovation of local wisdom–differentiated physics learning media. *Jurnal Pendidikan Fisika*, 13(2), 275–290. <https://doi.org/10.26618/tevhqv42>
- Shofa, A., Su'ad, S., & Murtono, M. (2021). Development of learning media technology based on natural science local wisdom materials. *Journal of Physics: Conference Series*, 1823(1), 1-9. <https://doi.org/10.1088/1742-6596/1823/1/012080>
- Siswanto, J., Harjanta, A. T. J., Suminar, I., & Suyidno, S. (2022). Digital learning integrated with local wisdom to improve students' physics problem-solving skills and digital literacy. *Journal of Physics: Conference Series*, 2392(1), 1-5. <https://doi.org/10.1088/1742-6596/2392/1/012025>
- Sullivan, F. R. (2021). Critical pedagogy and teacher professional development for online and blended learning: The equity imperative in the shift to digital. *Educational Technology Research and Development*, 69(1), 21–24. <https://doi.org/10.1007/s11423-020-09864-4>
- Sum, E. S. W., Wong, M. K. Y., Yip, A. Y. T., & Seah, W. T. (2024). Using storytelling to develop fraction concepts with culturally and linguistically diverse learners. *International Journal of Science and Mathematics Education*, 22(3), 633–655. <https://doi.org/10.1007/s10763-023-10388-5>

- Sunarti, T., Suprpto, N., Hidaayatullaah, H. N., Suliyannah, S., Admoko, S., & Jauhariyah, M. N. R. (2025). Evaluating student responses to ethnophysics learning: Improving scientific literacy and problem-solving skills using a PLS-SEM approach. *Multidisciplinary Science Journal*, 7(10), 1-10. <https://doi.org/10.31893/multiscience.2025454>
- Susanto, R., Husen, M. N., & Lajis, A. (2023). The effect of the integration of local wisdom in physics educational applications: A review. *AIP Conference Proceedings*, 2751, 020010. <https://doi.org/10.1063/5.0143441>
- Suyidno, S., Mastuang, M., Komariyah, L., Misbah, M., Qamariah, Q., & Syarkowi, A. (2025). Augmented reality, artificial intelligence, and local wisdom-based renewable energy learning media to improve students' 5C skills. *Journal of Engineering Science and Technology*, 20(6), 1895–1919. https://jestec.taylors.edu.my/Vol%2020%20Issue%206%20December%202025/20_6_13.pdf
- Umamah, C., Irawan, F., Kholida, S. I., & K, E., I. (2024). Identification of physics concepts in local wisdom of pigeon race on Madura Island. *Jurnal Pendidikan Fisika*, 12(2), 87–96. <https://doi.org/10.26618/jpf.v12i2.13912>
- Wardani, Y. R., & Mundilarto, M. (2021). Development of Android-based physics e-book based on local wisdom of traditional game nekeran. *AIP Conference Proceedings*, 2330, 020015. <https://doi.org/10.1063/5.0043767>
- Widyoko, E. P. (2014). *Teknik penyusunan instrumen penelitian*. Pustaka Pelajar.
- Zainuddin, Z., Mastuang, M., & Misbah, M. (2021). The validity of the wetlands-based fluid physics practicum module. *Journal of Physics: Conference Series*, 1760(1), 1-7. <https://doi.org/10.1088/1742-6596/1760/1/012013>
- Zainuri, B. N. S., Gunawan, G., Kosim, K., & Herayanti, L. (2025). The effect of problem-based learning e-modules on students' science process skills. *Journal of Physics: Conference Series*, 3132(1), 1-6. <https://doi.org/10.1088/1742-6596/3132/1/012018>