Jurnal Ilmiah Pendidikan Citra Bakti

p-ISSN 2355-5106 || e-ISSN 2620-6641

https://jurnal.citrabakti.ac.id/index.php/jil

DEVELOPMENT OF INTERACTIVE E-MODULE OF JIGSAW MODEL ON SOLAR SYSTEM MATERIAL INTEGRATED WITH NGADA LOCAL WISDOM IN JUNIOR HIGH SCHOOL

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Article History

Received:
March 30, 2026

Accepted:
April 15, 2026

Published:
May 20, 2026

Abstract

This study aimed to develop an interactive e-module based on the Jigsaw model integrated with Ngada local wisdom on the topic of the solar system and to examine its validity and practicality. The study employed a Research and Development method using the ADDIE model, which consists of analysis, design, development, implementation, and evaluation. The research subjects involved material experts, media experts, language experts, science teachers, and seventh-grade students. Data were collected through observation, interviews, validation sheets, and user response questionnaires, and then analyzed using descriptive quantitative techniques. The results showed that the e-module obtained an average validity score of 3.96, which falls into the very valid category. The practicality test showed percentages of 95.83% from teachers and 98.13% from students, both categorized as very practical. The product also presents the material systematically, supported by illustrations, videos, easy navigation, and Jigsaw learning steps that encourage discussion, responsibility, and active student participation. Thus, the Jigsaw-based interactive e-module integrated with Ngada local wisdom is considered feasible for use in science learning on the solar system, as it supports more active, collaborative, contextual, and student-centered learning and has the potential to improve students' interest in learning and their conceptual understanding of solar system phenomena in a meaningful way.

Keywords: Interactive E-Module, Jigsaw Model, Local Wisdom, Solar System, Science Education

Abstrak. Penelitian ini bertujuan mengembangkan e-modul interaktif berbasis model Jigsaw terintegrasi kearifan lokal Ngada pada materi tata surya serta menguji validitas dan kepraktisannya. Penelitian menggunakan metode Research and Development dengan model ADDIE yang meliputi analisis, desain, pengembangan, implementasi, dan evaluasi. Subjek penelitian melibatkan validator ahli materi, ahli media, ahli bahasa, guru IPA, dan siswa kelas VII. Data dikumpulkan melalui observasi, wawancara, lembar validasi, dan angket respons pengguna, lalu dianalisis secara deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa e-modul memperoleh skor rata-rata validitas 3,96 dengan kategori sangat valid. Uji kepraktisan menunjukkan persentase 95,83% dari guru dan 98,13% dari siswa, keduanya berkategori sangat praktis. Produk ini juga menampilkan materi secara sistematis, dilengkapi ilustrasi, video, navigasi yang mudah, serta langkah pembelajaran Jigsaw yang mendorong diskusi, tanggung jawab, dan partisipasi aktif siswa. Dengan demikian, e-modul interaktif berbasis Jigsaw yang terintegrasi kearifan lokal Ngada dinyatakan layak digunakan dalam pembelajaran IPA materi tata surya karena mampu mendukung pembelajaran yang lebih aktif, kolaboratif, kontekstual, dan berpusat pada siswa serta berpotensi meningkatkan minat belajar dan pemahaman konsep siswa terhadap fenomena tata surya secara bermakna.

Kata-kata Kunci : E-Modul Interaktif, Model Jigsaw, Kearifan Lokal, Tata Surya, Pendidikan IPA

Background

The rapid development of information and communication technology has significantly influenced education, particularly science learning. Science plays an important role in helping students understand natural phenomena and relate scientific concepts to everyday life. According to Zahro and Fauziah (2024), science learning in junior high school should not only emphasize conceptual mastery but also develop critical thinking skills, collaboration, and the ability to connect scientific knowledge with local wisdom. Science education focuses on students' mastery of facts, concepts, and principles. Therefore, introducing science learning from an early age is essential because it can improve students' scientific understanding, support the development of quality human resources, and encourage the application of science in daily life (Dinatha et al., 2022; Agustini et al., 2024; AlAli et al., 2024; Suandayani, 2025). This is also in line with the Merdeka Curriculum, which emphasizes the development of students' competencies and character through meaningful, contextual, and student-centered learning.

In science education, local wisdom has an important role in making learning more contextual and meaningful. Local wisdom allows students to connect scientific concepts with cultural practices, traditional knowledge, and phenomena found in their own environment. This connection is especially important in culturally diverse and multilingual learning contexts, where students may understand abstract scientific ideas more easily when they are linked to familiar cultural experiences. However, in many science classrooms, local wisdom is still rarely used as a learning resource. This condition shows that culturally responsive STEM education has not been fully implemented, particularly in science topics that are abstract and difficult to observe directly, such as the Solar System.

Based on initial observations conducted by the researchers, the actual learning conditions at SMPS PGRI Bajawa show that the learning process still tends to rely on monotonous, teacher-centered methods and less engaging teaching materials, especially textbooks. As a result, students often find it difficult to understand abstract topics such as the Solar System. At the same time, Ngada Regency has rich local wisdom that can potentially support contextual science learning. However, this local wisdom is rarely integrated into classroom activities. Consequently, students have not been able to clearly see the relationship between the science they learn at school and the cultural life around them. This condition contributes to low learning interest, limited student engagement, and suboptimal understanding of science concepts, particularly in Solar System material (Lasaiba & Lasaiba, 2024; Darmayanti et al., 2025; Wati et al., 2025).

The Solar System is one of the science topics that is abstract and challenging for students to understand when it is delivered only through verbal explanation. Concepts such as planetary motion, rotation and revolution, and moon phases cannot be directly observed by students in the classroom. Therefore, this material requires learning media that can provide visualization and interactive learning experiences (Latif & Nur, 2025). If the topic is presented only through lecture methods, students may struggle to understand the concepts as a whole, and the learning process may become less effective and less interesting. For this reason, interactive e-modules are needed to present visualizations, animations, and learning activities that can help students understand Solar System concepts more concretely. When integrated with Ngada local wisdom related to natural and celestial phenomena, the learning process can become more relevant to students' cultural background and daily experiences (Nonggi, 2024).

One alternative solution is the development of an interactive e-module that presents learning material in an engaging, systematic, and accessible way. The Jigsaw cooperative learning model was chosen because it can encourage students' active involvement through collaboration and shared responsibility within groups. This model was selected because it supports discussion, cooperation, and student participation in the learning process (Erviana, 2024). In the Jigsaw model, each student is responsible for learning and mastering a specific part of the material before sharing it with other group members. This process encourages active interaction, positive interdependence, and effective communication among students. Thus, learning is no longer centered on the teacher but shifts toward a student-centered approach that can increase engagement, deepen conceptual understanding, and create a more active and collaborative learning environment (Hidayat, 2020).

The development of an interactive e-module based on the Jigsaw model and integrated with Ngada local wisdom is important because it addresses both pedagogical and cultural needs. Pedagogically, the e-module can support students in understanding abstract

science concepts through interactive and visual learning. Culturally, the integration of Ngada local wisdom can help students recognize the value of their own cultural heritage and understand that science is closely connected to life, tradition, and the surrounding environment. In this way, learning is not only directed toward conceptual mastery but also toward strengthening students' identity and appreciation of local culture (Hakim, 2024). The integration of Ngada local wisdom also provides added value because it makes science learning more contextual, relevant, and responsive to students' cultural backgrounds (Febrianti, 2024).

Although previous studies have discussed the use of interactive media, cooperative learning models, and local wisdom in education, there is still limited research that specifically integrates Ngada local wisdom into Solar System learning through an interactive e-module based on the Jigsaw model. This gap is important because Solar System material requires visual and contextual support, while Ngada local wisdom remains underutilized as a source for culturally responsive science learning. Therefore, this study seeks to bridge the gap in culturally responsive STEM education by developing learning media that combines technology, cooperative learning, and local cultural values, especially in a multilingual and culturally diverse learning environment.

Based on the explanation above, this research is important to conduct with the aim of developing an interactive e-module based on the Jigsaw model for Solar System material integrated with Ngada local wisdom. This study is expected to produce valid and practical learning media that can support science learning, improve student engagement, strengthen conceptual understanding, and contribute to the preservation of local culture.

Method

This study used a Research and Development approach to develop an interactive e-module based on the Jigsaw cooperative learning model for Solar System material integrated with Ngada local wisdom. The development procedure followed the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

The R&D approach was selected because this study aimed to produce a learning product that is valid and practical for use in science learning. Meanwhile, the ADDIE model was used because it provides a systematic development framework, beginning with the identification of learning needs and ending with product evaluation and revision.

The subjects involved in this study consisted of: (a) Seventh-grade students of SMPS PGRI Bajawa, who studied Solar System material based on the junior high school science curriculum. (b) Expert validators, consisting of a material expert, media expert, and language/instructional design expert. These validators assessed the feasibility of the

developed interactive e-module. (c) Science teachers, who acted as users of the learning media and provided responses regarding the practicality of the e-module in classroom learning.

This study applied the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages, to develop an interactive e-module on the Solar System integrated with Ngada local wisdom and based on the Jigsaw learning model. The analysis stage identified learning problems, student characteristics, and abstract Solar System concepts through needs, student, and material analyses. The design stage focused on preparing the module structure, learning objectives, Jigsaw activities, local wisdom integration, and research instruments such as validation sheets and response questionnaires. During the development stage, the initial e-module was created and validated by material, media, and instructional design experts to assess content accuracy, technical quality, readability, and suitability for junior high school students. The implementation stage involved a limited trial with 15 seventh-grade students and one science teacher at SMPS PGRI Bajawa to evaluate practicality and user responses. Finally, continuous evaluation and revisions were conducted to ensure the e-module met validity and practicality criteria.

The instruments used in this study consisted of: (a) Expert validation sheets, used to assess the validity of the e-module. The validation involved material, media, and language/instructional design aspects. (b) Teacher response questionnaire, used to assess the practicality of the e-module from the teacher's perspective. (c) Student response questionnaire, used to assess students' responses toward the attractiveness, ease of use, and usefulness of the e-module. (d) Interview guidelines, used to obtain qualitative data from teachers regarding learning needs, media use, and the practicality of the developed product. (e) Observation sheets, used to record the initial learning conditions and students' responses during the learning process.

The validation instrument consisted of 34 statement items using a four-point Likert scale:

Table 1. Four-Point Likert Scale

Score	Criteria
4	Very High
3	High
2	Moderate
1	Low

Data was collected through observation, interviews, expert validation, and user response questionnaires. Observation was conducted to identify the initial condition of science learning, including the learning process, teaching materials, student engagement, and difficulties in understanding Solar System material at SMPS PGRI Bajawa. Structured interviews with science teachers were carried out to obtain information regarding learning

methods, student learning difficulties, the availability of interactive media, and the integration of Ngada local wisdom into science learning. Expert validation involved material, media, and language/instructional design experts who evaluated the e-module using a four-point Likert scale validation sheet to determine product validity and provide revision suggestions. After revision, a limited trial involving 15 students and one science teacher was conducted. Teacher and student response questionnaires were then used to assess the practicality of the e-module, including its ease of use, attractiveness, clarity, usefulness, and suitability for learning.

The data in this study were analyzed using quantitative descriptive analysis and qualitative thematic analysis. Quantitative analysis was used to determine the validity and practicality of the developed e-module, while qualitative thematic analysis was used to analyze comments, suggestions, interview results, and observation findings.

Validity data were obtained from expert validation sheets. Each item was scored using a four-point Likert scale. The final validity score was interpreted using the following criteria:

Table 2. Validity Score

Score Interval	Category
3.26–4.00	Very High Validity
2.51–3.25	High Validity
1.76–2.50	Moderate Validity
1.00–1.75	Low Validity

The e-module was considered valid if the average validity score was in the “Very High Validity” or “High Validity” category. This calculation was used to determine whether the product was feasible for implementation in the limited trial.

Practicality data were obtained from teacher and student response questionnaires. The questionnaire responses were analyzed using percentage calculation. Each item was scored using a four-point Likert scale. The practicality percentage was interpreted using the following criteria in Table 3. The e-module was considered practical if the practicality percentage reached at least 61%, which means that the product was categorized as practical or very practical.

Table 3. Practicality Percentage Value

Percentage	Category
81–100%	Very High Practicality
61–80%	High Practicality
41–60%	Moderate Practicality
21–40%	Low Practicality
0–20%	Very Low Practicality

Qualitative data was obtained from interviews, observations, and open-ended comments from validators, teachers, and students. These data were analyzed using thematic analysis. Thematic analysis was used because this study did not only measure the validity and practicality of the product numerically, but also needed to understand the reasons behind the scores, the users’ experiences, and the suggestions for improving the e-module.

The use of thematic analysis was aligned with the ADDIE development design because qualitative findings were needed in each stage, especially in the analysis, development, implementation, and evaluation stages. In the analysis stage, qualitative data helped identify learning problems and students' needs. In the development and evaluation stages, qualitative feedback helped the researcher revise the e-module so that it became more valid, practical, contextual, and suitable for science learning in a culturally diverse environment.

Result and Discussion

Result

At the analysis stage, the researcher conducted a needs analysis, learner analysis, material analysis, and learning objectives analysis. Students tended to memorize concepts without understanding the material in depth. In addition, the e-module used was still sourced from publishers and had not been fully aligned with the needs and characteristics of the students, making the learning process less contextual and not yet able to encourage active student participation.

The learner analysis was conducted through interviews with the science teacher and several seventh-grade students. The results showed that students were less interested in conventional learning. They stated that the lessons often focused only on answering questions without sufficient explanation of the material. The use of monotonous learning media, especially textbooks, also caused students' interest in learning to decline.

In the material analysis, it was found that one of the science topics for Grade VII was the Solar System. Meanwhile, the analysis of learning objectives showed that science instruction in the classroom placed more emphasis on exercises than on practical activities or activities that encouraged conceptual understanding.

At the design stage, the researcher prepared the product design and the assessment instruments for the interactive e-module. This design served as the foundation for the product development process in the next stage. The results of the product design are shown in Figure 2.

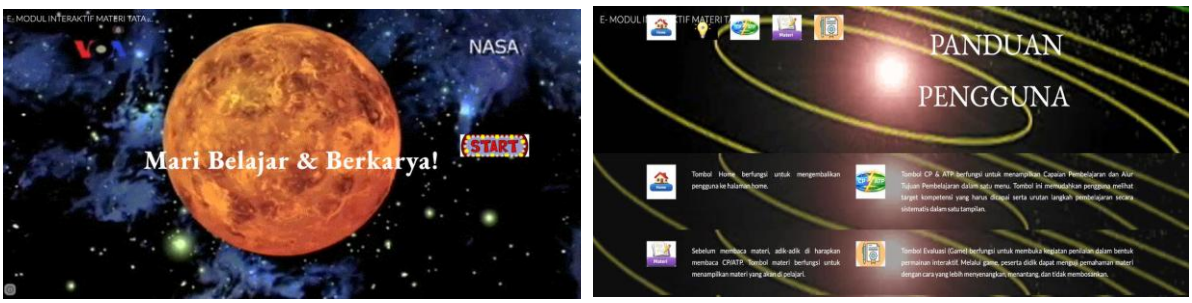

Figure 2. Product Development Results

At the development stage, the researcher revised the product based on suggestions from expert validators. Validation was conducted to ensure that the interactive e-module developed was appropriate for use in learning. After being revised, the product was assessed by three validators, namely a material expert, a media expert, and a language expert.

Expert validation results

A summary of the validation results can be presented briefly as follows:

Table 1. Summary of Expert Validation Results for the Interactive E-Module

Validator	Average Score	Criteria
Material expert	4.00	Very High Validity
Media expert	3.90	Very High Validity
Language expert	4.00	Very High Validity
Overall average	3.96	Very High Validity

Based on these results, the interactive e-module obtained an overall average score of 3.96 and was classified as “Very High Validity”. This indicates that the product has met the content, media, and language aspects, making it suitable to be tested in the implementation stage.

At the implementation stage, the revised product was tested to determine its practicality level. The product’s practicality was measured through teacher response questionnaires and student response questionnaires. The teacher response questionnaire was given to the science teacher at SMPS PGRI Bajawa. The results showed that the interactive e-module obtained a practicality score of 95.83% with the criterion of very practical. This indicates that the e-module is easy to use, visually appealing, has clear instructions, and includes images and videos that help students understand the material. A limited trial was conducted with 5 seventh-grade students. The results of the student response questionnaire showed a practicality percentage of 98.13% with the criterion of very practical. This indicates that students liked the appearance of the e-module, found the material easy to understand, and felt helped by the illustrations, language, and presentation of the content. To make it more concise, the practicality results can be summarized in the following table:

Table 2. Summary of Teacher and Student Responses

Respondents	Percentage	Criteria
Teacher	95.83%	Very High Practicality
Students	98.13%	Very High Practicality

At the evaluation stage, the researcher carried out final revisions based on suggestions from the material expert, media expert, and language expert. The revisions included improving the accuracy of concepts and the completeness of the Solar System material, simplifying the language to make it clearer and easier to understand, and refining the appearance of the e-module, such as layout, design consistency, image or animation quality, and navigation. In addition, the learning activities based on the Jigsaw model were adjusted to be more

systematic and in accordance with the learning steps. The interactive e-module can be accessed through the following link https://sites.google.com/view/tatasuryaines/page.

Discussion

The results of this study produced an interactive e-module based on the Jigsaw model for the Solar System topic, integrated with Ngada local wisdom for junior high school students. Based on the tests that were conducted, the e-module was found to be valid in terms of content, language, and presentation. It was also considered practical for use in the learning process by both teachers and students. These findings indicate that the product developed is feasible for use as a science learning medium. Therefore, the e-module can be regarded as an appropriate instructional product for classroom implementation.

The strength of this e-module lies in the integration of interactive digital media, the Jigsaw learning model, and the context of Ngada local wisdom into a single learning product. The e-module is equipped with interactive features such as easy-to-use navigation, attractive visual displays, and evaluation activities that support student engagement in learning. This finding is in line with previous studies showing that interactive digital teaching materials can increase students' motivation, participation, and understanding of abstract science concepts. However, this study offers a more specific contribution because the interactive media is not only designed to present scientific content, but also to connect the Solar System topic with local cultural contexts that are familiar to students.

Compared with similar studies that integrate local wisdom into science learning, the present study highlights the uniqueness of Ngada local wisdom as a contextual bridge for understanding astronomical concepts. In several educational contexts, local wisdom has often been used to explain environmental issues, biodiversity, traditional medicine, agriculture, or local ecological knowledge. However, its use in abstract topics such as the Solar System is still relatively limited. This makes the present e-module distinctive because it attempts to connect students' cultural background with a topic that is often perceived as distant from everyday life. Through this approach, local wisdom does not merely function as additional cultural content, but becomes part of the learning strategy to make science more meaningful and relatable.

The implementation of the Jigsaw model in this e-module also supports a more active and collaborative learning process. Through the division of expert groups and home groups, students are encouraged to discuss, exchange information, and participate actively in learning activities. This arrangement helps students become more involved in understanding the material together. It also gives each student a clear role and responsibility during the learning process. These results are consistent with previous findings that cooperative learning models

can improve student interaction, responsibility, and conceptual understanding. In this study, the Jigsaw model becomes more valuable because it is supported by interactive digital media and contextual cultural content, allowing students to learn not only from the module, but also from their peers.

The integration of Ngada local wisdom into the Solar System material was carried out by linking scientific concepts with local cultural contexts that are close to students' lives. This approach makes the learning process more contextual and relevant to the students' everyday experiences. As a result, students can connect new scientific knowledge with the cultural understanding they already have. This connection helps make learning more meaningful and easier to understand. In this way, the e-module supports science learning that is both academically relevant and culturally grounded. The cultural element also has the potential to strengthen students' appreciation of local identity while learning modern scientific concepts.

Nevertheless, several challenges were encountered during the development and implementation process. One challenge was ensuring that the integration of Ngada local wisdom remained scientifically accurate and did not create misconceptions in understanding the Solar System. Another challenge was adjusting the cultural content so that it could support the learning objectives without making the material too broad or unfocused. In addition, the use of interactive digital media requires adequate technological readiness, both from teachers and students. These challenges show that the integration of local wisdom into science learning needs careful planning, especially in selecting cultural elements, aligning them with scientific concepts, and preparing teachers to use the e-module effectively.

Although this study was limited to validity and practicality testing, the results show that the interactive e-module has the potential to support science learning that is more engaging, contextual, and participatory. The findings suggest that the product can contribute positively to the learning process in junior high school science classes. Its combination of interactive features, cooperative learning, and Ngada local wisdom gives it added educational value compared with conventional teaching materials. However, further research is needed to examine the effectiveness of the e-module in improving students' learning outcomes, critical thinking skills, collaboration, and cultural literacy. Future studies may also compare the use of Ngada local wisdom with other forms of local wisdom in different regions to provide a broader understanding of culturally responsive science education.

Based on these results, the interactive e-module based on the Jigsaw model integrated with Ngada local wisdom can be classified as valid, practical, and feasible. Therefore, it is suitable for use in science learning on the Solar System topic at the junior high school level. More importantly, this study shows that local wisdom can be meaningfully integrated into

science learning, even in abstract topics such as astronomy, as long as the cultural context is carefully connected with the scientific concepts being taught.

Conclusion

In conclusion, the interactive e-module based on the Jigsaw model and integrated with Ngada local wisdom is a valid, practical, and feasible learning product for teaching the Solar System topic in junior high school. The results of the study show that the e-module meets the required standards in terms of content, language, and presentation, while also being practical for use by both teachers and students. Its strengths lie in the combination of interactive digital features, cooperative learning activities, and contextual cultural integration, which together support a more engaging and meaningful learning process. Although this study was limited to validity and practicality testing, the findings indicate that the e-module has strong potential to support science learning that is more active, contextual, and student-cantered.

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