Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index

Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

Development of a STEM-Based E-Module on Natural Colorant Ice Cream from Sappan Wood (Caesalpinia sappan L.) as a Local Potential of West Kalimantan to Strengthen the Pancasila Student Profile

Seritami, Dini Hadiarti*, Dedeh Kurniasih
Chemical Education Study Program, Faculty of Teacher Training and Education,
Universitas Muhammadiyah Pontianak, Indonesia.
***Corresponding Author. Email: dinihadiarti@unmuhpnk.ac.id**

Abstract: This study aims to develop an innovative e-learning module focused on STEM education, leveraging the research potential of Caesalpinia sappan L. extract as a natural dye in ice cream production. The module is integrated into the Pancasila Student Profile Strengthening Project (P5) for senior high school students, enhancing understanding of STEM concepts while promoting sustainability and cultural relevance. The research employs the ADDIE development framework, consisting of Analysis, Design, Development, Implementation, and Evaluation stages, alongside the Research and Development (R&D) method. Nine subject matter, media, and language specialists validated the module. Data analysis used a descriptive quantitative approach, with validity assessed via expert validation sheets and practicality evaluated through student response questionnaires. The e-module scored high in validation, with 95.02% for content, 88.14% for media, and 93.96% for language, indicating strong validity. Practicality assessments were conducted in two parts, with a mini-experiment involving 12 students yielding a rating of 79.06% and a larger trial with 60 students achieving 80.35%, both deemed practical. The results position the e-module as valid, beneficial, and applicable for contextual, project-based education highlighting West Kalimantan's local potential.

Article History
Received: 10-06-2025
Revised: 15-07-2025
Accepted: 20-08-2025
Published: 25-09-2025

Key Words:
E-Module, Kayu Secang; STEM; Pancasila Student Profile Strengthening Project; Local Potential..

How to Cite: Seritami, S., Hadiarti, D., & Kurniasih, D. (2025). Development of a STEM-Based E-Module on Natural Colorant Ice Cream from Sappan Wood (Caesalpinia sappan L.) as a Local Potential of West Kalimantan to Strengthen the Pancasila Student Profile. *Jurnal Kependidikan*, *11*(3), 1228-1239. https://doi.org/10.33394/jk.v11i3.16905

https://doi.org/10.33394/jk.v11i3.16905

Introduction

Technological advancements influence various aspects of life, including education. Technological innovations impact education and other facets of life. To generate skilled human resources for the twenty-first century, these advances must propel educational advancements. In response, the Minister of National Education and Culture introduced the Merdeka Curriculum, which emphasizes maximizing students' potential through an exploratory, adaptable method that offers flexibility in the learning process (Maharani et al., 2023). The Merdeka Curriculum incorporates the STEM (sciences, technologies, engineers, and mathema-tics) approach into contextual learning (Hutabarat et al., 2024). This method improves critical and creative thinking abilities, fosters curiosity, and deepens conceptual knowledge (Israwaty et al., 2021). It also encourages self-directed learning, collaboration, and the application of knowing. The Pancasil Leaner Profile Reinforcement Project (P5) incorporates STEM into Merdeka Curriculum and leverages local resources, creativity, and practical problem-solving exercises (Nurhikmayati et al., 2024).

STEM approaches have been applied in a refrigerator project focusing on reaction rates (Baihaqie et al., 2024). STEM integration has also been implemented through a poster

Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

project on chemical equilibrium to develop scientific literacy and critical thinking skills (Dianti et al., 2023). STEM-based projects have also been used in teaching carbon compounds to improve student learning outcomes (Udayani, 2023). At the elementary school level, STEM-integrated P5 projects with a focus on sustainable lifestyle have been implemented (Ufahira, 2024), while at the secondary school level, their implementation has been limited to teacher training (Haryanto, 2024).

Pancasila Student Profile prioritizes character development to improve the quality of education. Instilling belief and obedience to God Almighty, promoting moral principles, encouraging teamwork, accepting diversity in the world, fostering critical thinking, and developing creativity are examples of this. These principles are incorporated into the P5 (Pancasila Students Profile Strengthening Project) project in compliance with the 2021 directive of the Ministry of Education, Culture, Research, and Technology (Irawati et al., 2022; Satria et al., 2022; Sudibya et al., 2022). The P5 program's primary objective is to boost students' motivation to finish assignments that help them define who they are as Pancasila leaners. Additionally, students develop their talents and character through the program's project-based learning activities (Kholidah et al., 2022).

Utilizing local natural resources is an important component in the creation of educational initiatives as a way to combine the STEM approach with local knowledge. Sappan wood (Caesalpinia sappan L.), a native Indonesian spice that is frequently found in Java, Bali, Kalimantan, and Sumatra, is one of the locally prized resources. In addition to being a natural food and textile dye, this wood has long been utilized in traditional medicine. Secang is the more common name for sappan wood in West Kalimantan. Flavonoids, lignin, steroids, triterpenoids, and diterpenoids are among the phytochemical substances found in the plant (Sulistiani et al., 2018; Sumardianto et al., 2021). The chemicals brazilin and brazilein, which have anti-inflammatory and antioxidant qualities, give it its characteristic red hue (Salsabila et al., 2023). Additionally, sappan wood is the primary component of air serbat, a traditional beverage of the West Kalimantan Malay population that is usually served during the communal meal practice known as saprahan (Jamilah, 2020). A mixture of spices, including cardamom, cinnamon, ginger, cloves, and sappan wood, is used to make air serbat. However, the younger generation is growing less fond of this traditional drink as time goes on and contemporary cuisine trends gain traction. Using sappan wood as a natural coloring ingredient in ice cream production is an innovative way to ensure its sustainability and create a tasty and nutritious local product (Dini Hadiarti, 2024; Tukiran, 2021).

Making ice cream with sappan wood can be a P5 activity that incorporates STEM and gives students a more hands-on educational experience. The use of brazilin and brazilein, which give the ice cream its red hue and have anti-inflammatory and antioxidant properties, reflects the scientific component. The freezing process of ice cream, which uses a tube filled with salt and ice as a chilling mechanism, demonstrates the technological component. To get the ice cream's ideal flavor and texture, the right engineering formulation is essential. Calculating the exact measurements required for the ice cream-making process involves mathematics. Since this STEM-based ice cream project involves multiple concepts, a clear set of guidelines is essential to ensure that students can follow each step correctly. One effective learning resource that can be used is a learning module.

Module is a learning material that is provided methodically and is intended for students to study on their own, with or without assistance (Siloto, 2023). Modules are available in both electronic and printed formats. Although printed modules are frequently used in education, they have drawbacks, such as limited accessibility, no support for multimedia, and the need for time and money to be updated (Tusyanah et al., 2024). E-

Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

modules, on the other hand, are more flexible because they can be accessed anytime and anywhere using digital devices like computers, laptops, and smartphones (Ayu et al., 2021; Dzakwan et al., 2021). E-modules have the advantages of being more useful, long-lasting, and conducive to interactive, technology-based learning, which raises student engagement and learning efficacy (Ersando et al., 2022). This study is significant as it integrates the local potential of sappan wood (*Caesalpinia sappan L.*) as a natural colorant with the development of a STEM-based e-module. The innovation not only provides an eco-friendly alternative to synthetic dyes but also promotes contextual learning that fosters 21st-century skills such as critical thinking, creativity, and collaboration. Furthermore, the integration of local wisdom into science education contributes to strengthening the Pancasila Student Profile, particularly in the dimensions of critical reasoning, creativity, and cultural awareness. Thus, this research is relevant to improving educational quality while preserving local potential.

This study aims to develop an innovative STEM-based e-learning module by utilizing *Caesalpinia sappan L.* extract as a natural colorant in ice cream production. The selection of sappan wood is grounded in its ecological, economic, and cultural potential as a local resource of West Kalimantan. Integrating this topic into the Pancasila Student Profile Strengthening Project (P5) is intended to enhance senior high school students' competencies, particularly in applying STEM concepts in a practical and contextual manner. Furthermore, this approach is expected to foster awareness of sustainability and the preservation of local wisdom, ensuring that learning not only emphasizes academic achievement but also maintains relevance to the social and cultural contexts of students.

Research Method

ADDIE development was used in the Research and Development (R&D) method. Analysis, Design, Development, Implementation, and Evaluation are the phases of the ADDIE paradigm (Muruganantham., 2015). The analysis stage starts with determining the necessity of creating an e-module that is in line with the P5 program's learning objectives. This entails analyzing typical issues that arise during the learning process, looking at tools and indicators for the e-module, and analyzing the unique traits of the research subjects for the e-module development. By choosing relevant media components, such as layout, font styles, color palettes, and appropriate drawings that meet the demands of the intended users, the design phase focuses on establishing the e-module concept. The following stage is development, which entails producing the e-module according to the predetermined design. A validation procedure to evaluate the e-module's quality is also included in this step. Three knowledgeable reviewers carry out the validation process, which addresses the three main domains of language, media, and content. After development, the verified e-module is integrated into an actual classroom environment during the implementation phase. The final phase, evaluation, is conducted to collect feedback from users. This input is used to improve and finalize the e-module, ensuring it is effective and suitable for use in learning activities.

Students from State Senior High School 10 Pontianak and Mujahidin Private Senior High School Pontianak served as the research subjects. The study sample consisted of 10th-grade students selected using a purposive sampling technique based on specific criteria. The inclusion criteria included students who actively participated in learning activities, attended classes regularly, and were willing to take part in the entire series of trials. Meanwhile, students with health problems, those with high absenteeism rates, or those who did not consent to participate in the research were excluded according to the established exclusion criteria. Students from both schools participated in small-scale and large-scale trials for data collection. A total of twelve students—six from State Senior High School 10 Pontianak and

six from Mujahidin Private Senior High School—took part in the small-scale trial. Meanwhile, sixty students—thirty from each school—participated in the large-scale trial.

The inclusion criteria required that participants be active 10th-grade students who had completed basic science courses relevant to the research topic and were willing to participate with parental consent. The exclusion criteria included students who were absent during data collection, had prior involvement in similar research projects, or were unwilling to complete the assigned tasks. Direct and indirect communication approaches were among the tools and data collection strategies employed in this investigation. Direct communication entailed using an interview guide to conduct in-person interviews with teachers and students. In order to communicate indirectly, Google Forms was used to distribute questionnaires asking about their reactions to the P5 project that was carried out with the e-module. Data analysis was the next step in the research process after data collection was finished. Validity and practicality analyses of the e-module were among the data analysis methods employed. Three validators—a media expert, a content expert, and a language expert—evaluated the Likert scale scoring system used for the validity analysis. With assessment components encompassing their thoughts and feedback on its implementation, the practicality study sought to ascertain how learners responded to using the e-module. A Likert scale with 4 representing "strongly agree" and 1 representing "strongly disagree" was utilized for the validity test.

$$P = \frac{\sum R}{\sum N} \times 100\%$$

P = Validator Percentage Score
$\sum R$ = Total Score Obtained
$\sum N$ = Total Score Value

The validation percentage provided by subject matter, content, and linguistic experts is based on the standards listed in Table 1. The next step is to make the required changes after getting the validators' input. Students who would undertake the experiment would receive the URL to the e-module during the implementation phase. During the first and last field trials, a readability test was used to evaluate the last step. Students at State Senior High School 10 Pontianak and Mujahidin Senior High School were also given response questionnaires as part of this assessment. Quantitative analysis was the data analysis method employed, and the scores were processed and modified by the standards listed in Table 2.

Table 1. Validity Criteria (Rismayanti et al., 2022)

No	Intervals (%)	Criteria
1	25-43	Not Valid
2	44 – 62	Less Valid
3	63 – 80	Valid
4	81 – 100	Very Valid

Table 2. Practicality Criteria (Rismayanti et al., 2022)

No	Intervals (%)	Criteria
1	25-43	Impractical
2	44 – 62	Less Practical
3	63 – 80	Practical
4	81 – 100	Very Practical

Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index
Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

Results and Discussion

Analysis Stage

At this point, the researcher determined the learning needs of the children and examined the issues that both teachers and students were facing. The researcher interviewed two teachers from State Senior High School 10 Pontianak and Mujahidin Private Senior High School Pontianak, in addition to distributing questionnaires to students who will participate in the Strengthening Pancasila Student Profile Project (P5) to collect this data. To determine the fundamental difficulties in putting the P5 curriculum into practice, a needs analysis was also conducted with 26 students from each school. According to the findings of the observation, 20.49% of students thought the P5 activities were dull, 41.02% thought they were fun, and 43.59% thought they were neutral. Furthermore, there were no projects in place at the schools that made use of local potential, so pupils knew very little about the resources in their immediate environment. The utilization of plants that can make natural colors from materials present in the local environment is one example of how learning materials that contain local content are needed. The purpose of this is to help pupils comprehend the advantages of using plants as natural coloring sources.

Design Stage

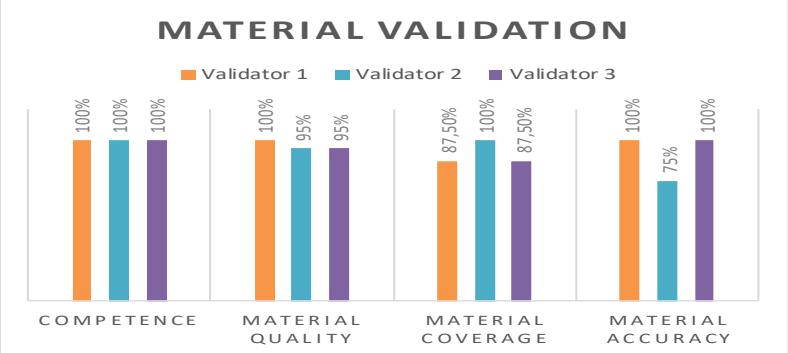
In accordance with the results of the learning material review, the design phase focused on creating media, digital tools, and learning aids for the study of sappan wood plants. An e-module that is simple for teachers and students to access was created by modifying the media design to conform to the study's findings. The e-module was created using A5 sheet format, Arial font size 10, and 1.5 line space. The margins were fixed to 4 cm on the left and 3 cm on the top, bottom, and right. The content was structured into three main sections: an introduction, the main section containing the learning material, and a closing section. At this stage, instruments for validation and questionnaires to gather student feedback were also developed.

Development Stage

In the initial development stage, a preliminary design was created, including the front cover, back cover, and contents of the e-module, as shown in Figure 1. E-module was then verified by nine expert validators who provided input on multimedia, languages, and containment. Based on the validators' ratings, e-module was deemed highly valid, with an average score of 95% validity.

Material Aspect Eligibility

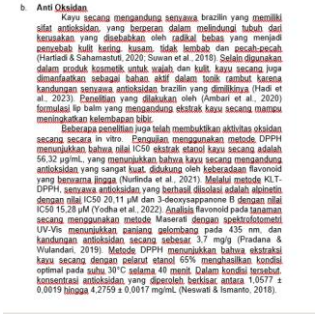
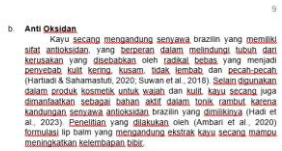
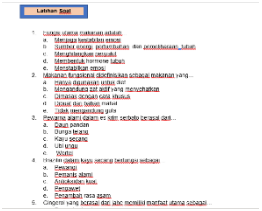
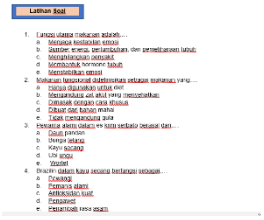
Three specialists in sappan wood (Caesalpinia sappan) from West Kalimantan institutions evaluated the content aspect. Four evaluation criteria—competence, material quality, content coverage, and content accuracy—formed the basis of this assessment. As seen in Figure 1, the competence criterion scored the highest out of all of these, averaging 100%.



Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index
Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

The results in the content feasibility graph improved after revisions were made, as shown in Table 3.

Table 3. Results of Content Expert Revisions

Suggestions	Repair	
	Before	After
"Overly long text should be condensed to make the layout more concise and avoid making it look like a textbook".		
"Ellipsis usage in questions needs to be modified appropriately. When a sentence is in the center, use three dots; when it is at the end of a sentence, use three dots plus a period".		

Media Aspect Eligibility

The evaluation addressed a number of topics in the media feasibility part, such as graphic look, cover design, and the clarity of the text. With a score of 93.75%, the cover design got the highest rating. The content clarity aspect scored 100%, as did the graphic appearance. As seen in Figure 2, these ratings put the media in the "highly valid" group.

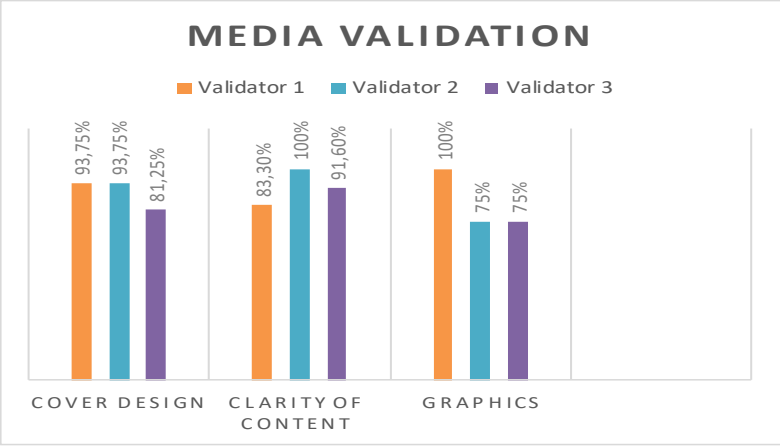
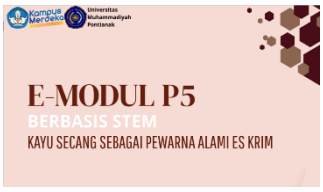
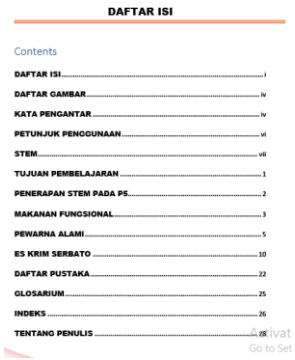
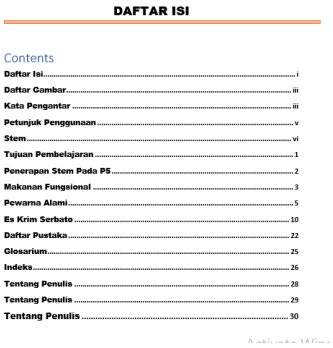


Figure 2. Graph of Media Expert Assessment Results

Suggestions for improvement in the media aspect assessment include font size, the neatness of the table of contents, and the format of embedding video links in the e-module. These points are presented in Table 4.

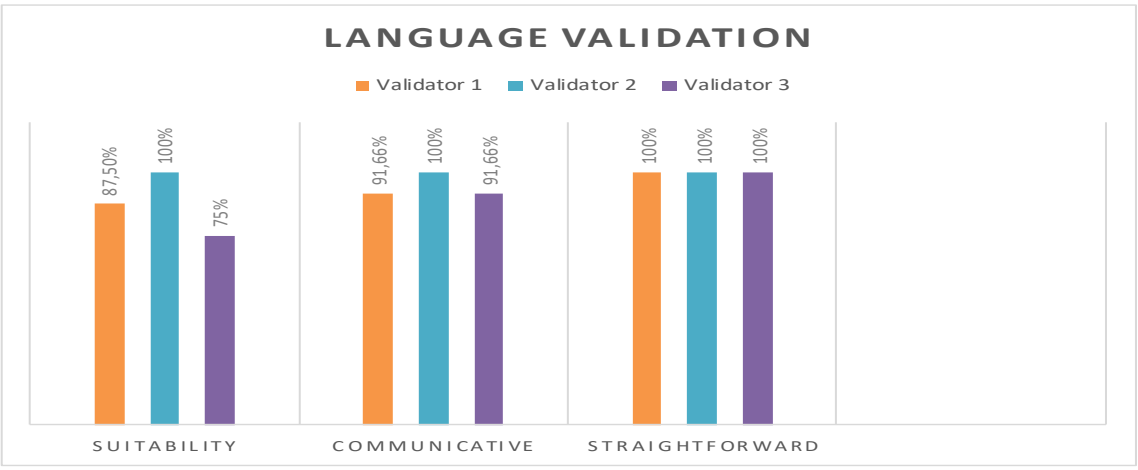
Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index
Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

Table 4. Media Expert Revision Results

Suggestions & Comments	Repair	
	Before	After
To enhance readability and capture the reader's attention, STEM-based titles should be given bright colors to make them clearer and more prominent.		
The table of contents is arranged on a single page to make it more concise and neatly presented.		
Video embedding was revised by using a link, as scanning a barcode requires two access steps.		

Language Aspect Eligibility

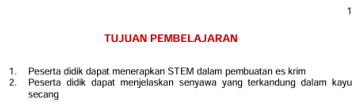
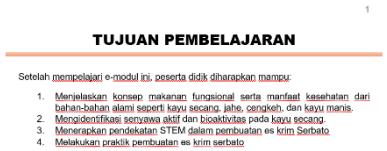
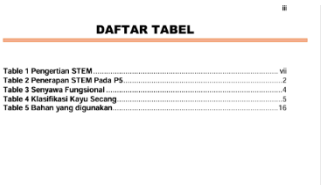
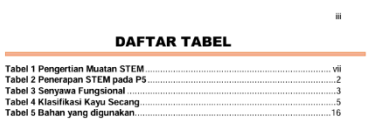
The assessment of the language aspect includes several factors: appropriateness, communicative level, and clarity. The evaluation results show an average score of 81.5%, which falls into the “highly valid” category. As indicated in Figure 3, the relevance aspect received an ideal score of 100%, followed by communicativeness at 100%, and ease of understanding also at 100%. In its application, language must prioritize clarity, effectiveness, and freedom from ambiguity to ensure it is easily understood by users (Vebrina et al., 2024).



Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index
Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

The media expert validators recommended a number of changes, such as converting English words to Indonesian and bolding the page headers to make them stand out. Table 5 displays the comments and recommendations made by the language expert validators.

Table 5. Results of Revisions from Linguists

Suggestions & Comments	Repair	
	Before	**After**
"The instructional text should be written in black to enhance readability, and the quantity should be increased to cover all learning objectives."		
"The use of the word 'tabel' should follow the Indonesian language to ensure consistency throughout the document and to comply with proper language rules in accordance with scientific writing guidelines."		

Implementation Stage

Once all stages of the e-module validation are finished and it is deemed fit for usage, the implementation stage begins. The e-module is currently ready in Word format and will be published to Google Drive later. Throughout the P5 implementation phase, the Google Drive URL will be distributed.

Evaluation Stage

At this point, a STEM-based methodology is used to gauge how useful the e-module is in the P5 activity. The initiative, which is being carried out in two Pontianak schools, SMAS Mujahidin and SMAN 10 Pontianak, entails creating ice cream using natural dye made from sappan wood extract. A small-scale study with 12 respondents and a large-scale trial with 60 respondents are both included in this stage.

Small-Scale Trials

Students from the two schools indicated above were given answer questionnaires to complete as part of the small-scale trial in order to get their opinions on the e-module. This activity's goal was to assess the e-module's viability and degree of usefulness in light of the small-scale experiment. The test findings indicated that the e-module is suitable for use with an overall practicality score of 79.06%, falling into the 'practical' category. Analysis (77.08%), evaluation (78.12%), inference (79.16%), interpretation (80.20%), and reflection (80.72%) are among the specific questionnaire results from the small-scale trial, as indicated in Table 5.

Table 6. Small Scale Trial Results

Aspect	Presentation	Category
Analysis	77,08%	Practical
Evaluation	78,12%	Practical
Inference	79,16%	Practical
Interpretation	80,20%	Practical
Reflection	80,72%	Practical

Large Scale Trials

A large-scale trial with 60 responses from the previously described integrated schools was conducted once the small-scale trial was judged feasible. The large-scale trial's results indicated an 80.35% success rate, which is classified as "practical." Analysis (79.37%), evaluation (80.41%), inference (80.20%), interpretation (80.62%), and reflection (81.14%) are among the specific outcomes of the extensive experiment.

Aspect	Presentation	Category
Analysis	79,37%	Practical
Evaluation	80,41%	Practical
Inference	80,20%	Practical
Interpretation	80,62%	Practical
Reflection	81,14%	Practical

There are a number of benefits to using STEM-based e-modules that incorporate local material to enhance Pancasila Student Profile Strengthening Project (P5) learning. First of all, by relating science and technology to regional culture and issues, these modules assist students in understanding the content in a contextualized manner (Haka et al., 2024). Second, the modules promote active student participation in project-based learning, which supports P5 attributes including creativity, critical thinking, and teamwork (Aswirna et al., 2022).

Furthermore, digital-based e-modules help students become more independent and technologically literate (Prihatiningtyas et al., 2025) and facilitate teachers' ability to provide content in a creative and adaptable way. Enhancing conceptual comprehension, problem-solving abilities, and cultural awareness has all been shown to be successful outcomes of using a STEM approach grounded in local knowledge (Astutik et al., 2025). The findings of this study demonstrate that the development of a STEM-based e-module on natural colorant ice cream from *Caesalpinia sappan L.* contributes to strengthening the Pancasila Student Profile by integrating local cultural resources into science learning. This aligns with previous studies highlighting the effectiveness of contextualized STEM approaches in enhancing students' engagement and problem-solving skills. Beyond the immediate application in West Kalimantan, such an approach can be expanded to other local contexts across Indonesia, thereby promoting both scientific literacy and cultural identity. Furthermore, the integration of digital modules addresses the increasing demand for technological literacy, which is essential for preparing students to face global educational challenges.

Conclusion

STEM-based e-module on making ice cream from sappan wood extract, created for P5 learning, has passed the validation process by content, media, and language specialists, according to the study findings and discussion. The validation, which was carried out by three subject-matter experts, produced ratings of 81.5% for language, 93.75% for media, and 95% for content. Additionally, readability testing of the e-module was conducted through initial and final field trials, which resulted in scores of 80.35% and 79.06%. Therefore, this research proves the validity and suitability of e-modules for high school students.

Recommendation

The research findings suggest that, given the rapid development of digital technology, greater attention should be devoted to designing accessible electronic learning resources. Teachers are encouraged to integrate STEM-based e-modules into classroom practices to make learning more engaging, particularly in the context of P5. Researchers, meanwhile, should expand participant diversity, employ longitudinal approaches, and ensure compliance with ethical standards to strengthen the validity of future studies. At the institutional level, policies and resources that support digital innovation and the integration of local potentials are recommended to ensure relevance and sustainability in education.

References

Astutik, P., Sarwanto*, S., Sukarmin, S., & Daud, A. N. binti M. (2025). Development of E-Module Science Local Wisdom to Improve Students' Global Diversity Character. *Jurnal Pendidikan Sains Indonesia*, *13*(2), 492–507. https://doi.org/10.24815/jpsi.v13i2.44677

Aswirna, P., Samad, D., Devi, I. S., Fahmi, R., & Jannah, R. (2022). STEM-Based E-Module Integrated Local Wisdom of Rice Stem Fertilizers on Students' Critical and Creative Thinking. *Al-Ta Lim Journal*, *29*(1), 15–23. https://doi.org/10.15548/jt.v29i1.764

Ayu, P. E. S., Primayana, K. H., Purandina, I. P. Y., & Wisudayanti, K. A. (2021). Pengembangan E-Modul Pembelajaran Sains Untuk Anak Usia Dini Terintegrasi Kitab Wedangga Jyotisha. *Aulad: Journal on Early Childhood*, *4*(3), 193–199. https://doi.org/10.31004/aulad.v4i3.145

Baihaqie, A. G., Kurniasih, D., Kurniawan, R. A., & Nufus, Z. (2024). *Boosting Critical Thinking with STEM-Based Nanolearning in Reaction Rate Studies*. *10*(8), 6132–6141. https://doi.org/10.29303/jppipa.v10i8.8303

Dianti, S. A. T., Pamelasari, S. D., & Hardianti, R. D. (2023). Pendekatan Pembelajaran Berbasis Proyek dengan Pendekatan STEM terhadap Peningkatan Kemampuan Literasi Sains Siswa. *Seminar Nasional IPA XIII*, 432–442.

Dini Hadiarti, H. M. (2024). *Serbato ice cream: Transforming serbat-based ice cream*. *9*(4), 720–726. https://doi.org/https://doi.org/10.31603/ce.11114

Dzakwan, N., Murtinugraha, R. E., & Arthur, R. (2021). Efektivitas Penggunaan E-Modul Pada Mata Kuliah Statistika Di Program Studi Pendidikan Teknik Bangunan Fakultas Teknik Universitas Negeri Jakarta. *Risenologi*, *8*(2), 29–33. https://doi.org/https://doi.org/10.47028/j.risenologi.2021.61b.249

Ersando, E., Muharini, R., Lestari, I., Sartika, R. P., & Rasmawan, R. (2022). Pengembangan E-Modul Pemisahan Senyawa Fenolik dari Fraksi Simpur Air dengan Teknik Kromatografi Lapis Tipis (KLT) Preparatif Sebagai Sumber Belajar Kimia Bahan Alam. *Jurnal Kependidikan Kimia*, *2*(10), 109–121.

Haka, N. B., Pamungkas, M. F., Masya, H., Rakhmawati, I., & Hidayah, N. (2024). Desain, Development, and Evaluation of Biology E-Modules Website Based on Local Wisdom of the Baduy Tribe: Strengthening Pancasila Student Profiles on Ecosystem Material. *E3S Web of Conferences*, *482*. https://doi.org/10.1051/e3sconf/202448205005

Haryanto, P. (2024). *Proyek Penguatan Profil Pelajar Pancasila (P5) Berbasis STEM – Al-Fityan Tangerang*.

Hutabarat, C. E. M., Wulanningtyas, M. E., Hapsara, S. A., & Yuliana, E. (2024). Pembelajaran Berbasis Proyek STEM "Water Level Sensor" Dalam Mendukung Penguatan Profil Pelajar Pancasila Pada Kurikulum Merdeka. *SUBAKTYA: UNPAR*

COMMUNITY SERVICE JOURNAL, *1*(2), 40–47. https://doi.org/10.26593/sucsj.v1i2.7974.40-47

Irawati, D., Iqbal, A. M., Hasanah, A., & Arifin, B. S. (2022). Profil Pelajar Pancasila Sebagai Upaya Mewujudkan Karakter Bangsa. *Edumaspul: Jurnal Pendidikan*, *6*(1), 1224–1238. https://doi.org/10.33487/edumaspul.v6i1.3622

Israwaty, I., Ilmi, N., & Sumaya, A. (2021). PENERAPAN PENDEKATAN STEM (SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS): PEMBANGKIT LISTRIK TENAGA UAP (PLTU) SEDERHANA UNTUK MENINGKATKAN HASIL BELAJAR PADA MATERI ENERGI DAN PERUBAHANNYA SISWA KELAS IV UPT SD NEGERI 229 PINRANG. *Pinisi Journal Pendidikan Guru Sekolah Dasar*, *1*(1), 217–223. https://doi.org/10.70713/pjp.v1i1.25693

Jamilah. (2020). *Air Serbat, Sajian Pedas Manis untuk Mengusir Tamu yang Datang*.

Kholidah, L. N., Winaryo, I., & Inriyani, Y. (2022). Evaluasi Program Kegiatan P5 Kearifan Lokal Fase D di Sekolah Menengah Pertama. *Edukatif : Jurnal Ilmu Pendidikan*, *4*(6), 7569–7577. https://doi.org/10.31004/edukatif.v4i6.4177

Maharani, A. I., Istiharoh, I., & Putri, P. A. (2023). Program P5 sebagai Implementasi Kurikulum Merdeka: Faktor Penghambat dan Upayanya. *Atmosfer: Jurnal Pendidikan, Bahasa, Sastra, Seni, Budaya, Dan Sosial Humaniora*, *1*(2), 176–187. https://doi.org/10.59024/atmosfer.v1i2.153

Muruganantham., G. (2015). Developing Of E-Content Package By Using ADDIE Model. *International Journal of Applied Research*, *1*(3), 52–54.

Nurhikmayati, I., Kusumah, Y. S., & Darhim, D. (2024). Mathematical Critical Thinking Skills through STEM/STEAM Approach: A Systematic Literature Review. *The Eurasia Proceedings of Educational and Social Sciences*, *35*, 145–160. https://doi.org/10.55549/epess.810

Prihatiningtyas, S., Shofiyah, N., Yunus, S. R., Ma'arif, I. B., & Putra, I. A. (2025). Enhancing science literacy through flipbook-based STEM Qur'an e-modules: a case study in Islamic boarding schools. *Humanities and Social Sciences Communications*, *12*(1), 1–12. https://doi.org/10.1057/s41599-025-05054-w

Rismayanti, T. A., Anriani, N., & Sukirwan, S. (2022). Pengembangan E-Modul Berbantu Kodular pada Smartphone untuk Meningkatkan Kemampuan Berpikir Kritis Matematis Siswa SMP. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(1), 859–873. https://doi.org/10.31004/cendekia.v6i1.1286

Salsabila, A. F., Fuadi, A. M., Surakarta, U. M., & Tengah, J. (2023). *Jurnal Teknik Indonesia*. *2*(April), 87–99. https://doi.org/10.58860/jti.v2i2.16

Satria, R., Adiprima, P., Wulan, K. S., & Harjatanaya, T. Y. (2022). *Panduan Pengembangan Projek Penguatan Profil Pelajar Pancasil*.

Siloto, E. N. T. (2023). Pengembangan Modul Ajar Berbasis Kurikulum Merdeka Pada Materi Bentuk Aljabar Di Kelas Vii Smp Negeri 13 Medan. *Sepren*, *4*(02), 194–209. https://doi.org/10.36655/sepren.v4i02.1155

Sudibya, I. G. N., Arshiniwati, N. M., & Sustiawati, N. L. (2022). Projek Penguatan Profil Pelajar Pancasila (P5) Melalui Penciptaan Karya Seni Tari Gulma Penida Pada Kurikulum Merdeka. *GETER : Jurnal Seni Drama, Tari Dan Musik*, *5*(2), 25–38. https://doi.org/10.26740/geter.v5n2.p25-38

Sulistiani, N. D., Anam, C., & Yudhistira, B. (2018). Karaktersitik Tablet Effervescent Labu Siam (Sechium edule Sw.) dan Ekstrak Secang (Caesalpinnia sappan L.) dengan Filler Laktosa-Manitol. *Jurnal Teknologi Hasil Pertanian*, *XI*(2), 99–109.

Vol. 11, No. 3 : September 2025
E-ISSN: 2442-7667
pp. 1228-1239
Email: jklppm@undikma.ac.id

https://doi.org/https://doi.org/10.20961/jthp.v11i2.40086

Sumardianto, Riyadi, P. ., Anggo, A. ., Romadhon, & Rianingsih, L. (2021). Phenol content and antioxidant activity in seaweed fermented with lactic acid bacteria. *Food Research*, *5*(S3), 7–13. https://doi.org/10.26656/fr.2017.5(S3).006

Tukiran, A. K. S. dan. (2021). *UNESA Journal of Chemistry Vol. 10, No. 3, September 2021*. *10*(3), 307–317. https://doi.org/https://doi.org/10.26740/ujc.v10n3

Tusyanah, T., Pujiati, A., Ismiyati, I., & Rachmadi, M. F. (2024). *Perencanaan Pembelajaran dengan Pembuatan Modul Ajar Berbasis Kurikulum Merdeka bagi Guru di SMKN 9 Semarang Learning Planning by Making Teaching Modules Based on Independent Curriculum for Educators at Vocational High School 9 Semarang*. *9*(3), 601–612. https://doi.org/https://doi.org/10.31849/dinamisia.v8i1.16486

Udayani, A. A. M. (2023). *Penerapan Model Pembelajaran Project Based Learning Dengan Pendekatan Stem Dalam Meningkatkan Hasil Belajar Kimia Pada Materi Senyawa Karbon Siswa Kelas Xii Mipa 2 Sma Negeri 7 Denpasar Tahun Pelajaran 2022/2023*. *24*(1). https://doi.org/10.5281/zenodo.7812422

Vebrina, K. Y., Kinasih, L., Muddalifa, K., Wulandari, L. P. R., Rosid, M. H. Al, & Arum, D. P. (2024). Strategi Komunikasi Efektif Dalam Bisnis Penerapan Kalimat Yang Tidak Ambigu Untuk Menghindari Gagal Paham. *Journal of Management and Innovation Entrepreneurship (JMIE)*, *1*(3), 492–497. https://doi.org/10.59407/jmie.v1i3.609

