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VALIDITY OF PJBL-STEAM MODULE ON NATURAL DYE TO ENHANCE SCIENTIFIC LITERACY

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ABSTRACT

PISA 2022 results show that Indonesia's scientific literacy is still low. This is because the learning resources containing local wisdom in learning are very limited. This research aims to analyze the validity of the PjBL-STEAM teaching module containing the local wisdom of natural dye to increase students' scientific literacy. The research method is design research using the ADDIE model with five stages, namely analyze, design, develop, implement, and evaluate. Stage 1) analyze, in the form of an analysis of the curriculum, student characteristics, and existing module products. Stage 2) design, which consists of designing the draft module and research instruments. Stage 3) develop, in the form of collecting validity data through assessments from three experts and two practitioners. Stages 4) implement and 5) evaluate will be carried out in further research. The research results obtained showed content validity of 3.54 (very valid), linguistic validity of 3.49 (very valid), presentation validity of 3.63 (very valid), graphic validity of 3.5 (very valid), and scientific literacy aspect validity of 3.6 (very valid). Based on the assessment results, the PjBL-STEAM module containing the local wisdom of natural dye is valid and can be used to increase students' scientific literacy.

KEYWORDS *Scintifitic literacy, PjBL, STEAM, natural dye sasirangan.*

INTRODUCTION

Science literacy is the ability of students to recognize and identify various problems around them and make solutions to existing problems by using skills to analyze, interpret, and make arguments scientifically (Crismanto et al., 2024). Science literacy skills are needed so that students can understand various issues such as the environment, health, economy, and other relevant problems in modern society related to technology and scientific development (Febriana et al., 2024). Science learning must transform from learning in the form of memorization to meaningful lessons in life. Through mastery of science literacy, students can use science knowledge to explain various phenomena that exist in the surrounding environment in their daily lives (Fatmawati & Hanik, 2024).

Science literacy is currently an important thing to improve so that students can have a perspective on the environment, phenomena, or problems that occur around them using science studies (Ariefianti et al., 2023). This is because modern society lives by relying on technological advances and scientific advances as the standard of social life (Rahayuni, 2016). Various knowledge gained by students through learning in the classroom should be able to lead to an understanding of various events in the surrounding environment scientifically. Therefore, improving students' science literacy must be done to improve individual quality.

Facts obtained by the Organization for Economic Cooperation and Development (*OECD*) through an international research, namely the *Programme for International Student Assessment* (*PISA*) with 15-year-old respondents, show that the level of science literacy in

Indonesia is still very low. In 2022, *PISA* results show that in the science aspect, only 34% of students are able to reach level 2 (the average of all countries is 76% at level 2), and the other 66% are below level 2. Although the science literacy ranking in Indonesia increased by 6 positions from the previous year, Indonesia's *PISA* 2018 science literacy score was 396 and then dropped to 383 in 2022 (OECD, 2023). These findings show that science literacy in Indonesia needs serious attention in order to catch up with other developed countries.

Science literacy can be improved through ethnoscience-based learning. This is because students will make direct observations so that students can identify scientific questions, explain scientific phenomena, and draw conclusions related to natural conditions and changes made through human activities (Pertiwi & Firdausi, 2019). The *STEM* (science, technology, engineering, and mathematics) learning approach can be an alternative to increase science literacy because it requires students to solve a problem and trains students to apply their knowledge as a form of solving problems related to the environment through technology (Rohmah et al., 2019). Based on observations made at *Madrasah Tsanawiyah* (*MTs*) Normal Islam Putera (*NIPA*) Rasyidiyah Khalidiyah (*Rakha*) Islamic Boarding School, learning resources are in the form of textbooks used in the form of books printed by national-scale publishers. The description of *Natural Sciences* subject material is still in the form of concepts and principles that are not related to the environment around students specifically, especially local wisdom.

Natural Sciences subjects study concepts, laws, formulas, and real and abstract phenomena (Gagese et al., 2018). There are many learning materials that must be understood by students, so that it makes students feel difficult and the level of enthusiasm for learning is relatively low (Dwitiyanti et al., 2020). For environmental education to be successful, students must actively interact with objects, and the activities must be in the form of observing and then making concepts (Retnowati et al., 2019). Therefore, it is necessary to develop teaching modules that make scientific social phenomena as a trigger and source of learning. This is in accordance with the demands of 21st-century life, namely learning that is integrated with the life of a social society (Rahayu et al., 2022). The scientific social phenomenon in question is in the form of local wisdom in the process of making natural dye *sasirangan* cloth with ironwood powder, *sappang* wood, turmeric, *ketapang* leaves, and mango leaves.

Local wisdom can be defined as the local idea of a certain society that is wise, virtuous, and established in society and is used as a guide by members of the community. Local wisdom is the way people behave and act in response to changes in the physical and cultural environment (Pornpimon et al., 2014). Local wisdom is a characteristic that comes from an area or region that has cultural values that develop in the local community for generations (Wulaningrum & Wulaningrum, 2017).

Local wisdom that exists around students can help students understand the relationship between the world of their lives and what they learn in science. Through local wisdom, students can learn cultural values and a sense of nationalism that can affect learning outcomes (attitudes, behaviors, and thinking skills) (Laurents et al., 2014). Local wisdom knowledge needs to be integrated in the science learning process to increase students' understanding of learning materials related to the surrounding environment (Abah et al., 2015). Several relevant studies prove that science modules based on local wisdom can improve science literacy (Setiawan et

al., 2017). The use of problem-based learning models with local wisdom oriented to scientific social issues is more effective in improving environmental literacy and conceptual understanding (Lubis et al., 2022). Project-based learning using *Canva* can increase a love for Indonesian culture because learning involves students getting to know local wisdom (Susanti & Wibawa, 2024). Electronic books containing local wisdom of *STEAM-POE*-based *gamelan* can facilitate students' cultural love. The most relevant research is Muskania's dissertation (2023), which develops *STEM-PjBL*-based digital science teaching materials integrated with local wisdom to improve the science literacy of elementary school students. The differences lie in: 1) the art aspect of the learning approach; 2) local wisdom that is the content of the module is a natural dye *sasirangan*. The research that has been conducted has not developed learning materials that contain local wisdom presented with the *PjBL* learning method and the *STEAM* approach to improve science literacy.

Project-based learning was chosen on the grounds that this model is very appropriate to provide a meaningful learning experience to students to produce works in the form of natural dye *sasirangan* fabrics as local wisdom that is integrated in the teaching module. Through the project of making natural dye *sasirangan* fabrics, it is hoped that it can increase students' science literacy and love of culture. The module is presented with a science, technology, engineering, art, and mathematics (*STEAM*) approach because the process of making natural dye *sasirangan* fabric involves various disciplines according to the *STEAM* approach. This is supported by research by Lubis et al. (2022), which shows that learning with a *STEAM* approach has a significant effect on students' science literacy. In addition, Susanti & Wibawa (2024) prove that the implementation of the *PjBL* model can increase the love for Indonesian culture.

Based on the analysis of the problems that occur in the field, it is necessary to have a science teaching module containing local wisdom of natural dyes from turmeric (*Curcuma longa* L.), *ketapang* leaves (*Terminalia catappa*), ironwood powder (*Eusideroxylon zwageri*), mango leaves (*Mangifera indica*), and *secang* wood (*Biancaea sappan* L.). The study of learning theory and previous research support this idea, so the researcher is interested in conducting research on the development of a *PjBL-STEAM* science module containing local wisdom on natural dyes to improve science literacy.

This research has the main characteristics, namely: a) science teaching modules developed using project-based learning with a *STEAM* (Science, Technology, Engineering, Arts, and Mathematics) approach; b) local wisdom presented in the learning process is *sasirangan* natural dyes from waste from ironwood powder, *secang* wood, turmeric, *ketapang* leaves, and mango leaves so that students are also introduced to local culture and environmental conservation efforts; c) the final project produced by students is a work of ethnoscience value so that students can improve science literacy that displays scientific phenomena.

RESEARCH METHOD

This study uses a development research method introduced by Kent L. Gustafson and Robert Maribe Branch, namely the ADDIE model to produce a PjBL-STEAM science module containing local wisdom in natural dyes to improve students' science literacy with five stages,

namely *analyze*, *design*, *develop*, *implement*, and *evaluate*. The following is a description of the steps carried out by the research.

a. Analysis

The analysis stage is carried out as the first step of research. This is done so that the products produced are in accordance with existing products and needs, curriculum demands, characteristics of teaching materials, and characteristics of students.

Table 1. Analysis Stage

No	Things analyzed	Information
1	Existing products and needs	Analysis of existing products is carried out to obtain information about learning resources used in the classroom and the needs of students. This stage will be the background for the urgency of developing the right product to overcome the problems that arise.
2	Curriculum	Curriculum analysis is carried out by exploring competencies that must be mastered by students based on the independent curriculum.
3	Characteristics of teaching materials	Analysis of the characteristics of the teaching material was carried out to identify the level of depth and breadth of the learning material. The information obtained will be the basis for the researcher to present the teaching material into sub-sub-materials so that students can understand the lesson easily.
4	Analysis of student characteristics	Analysis of student characteristics was carried out to adjust the language and presentation of learning materials according to the level of cognitive development of students.

b. Design

The design stage is carried out to make a design of the product to be developed. At this stage, there are two activities, namely designing learning activities and assessment instruments.

Table 2. Planning Stage

No	What is designed	Information
1	Learning activities	The stage of designing learning activities is carried out by describing the learning outcomes to the learning objectives, creating the flow of learning objectives, criteria for achieving learning objectives, determining time allocation, and learning steps. At this stage, an initial design (prototype) of the product to be developed is also produced, learning models, methods and approaches, media, and student activities at each meeting.
2	Research instruments	This stage is in the form of designing instruments used in collecting research data. The instruments in question are instruments of module validity, module practicality, and module effectiveness.

c. Develop

The development stage is in the form of activities to produce products which are then validated by experts and practitioners. At the development stage, two activities were carried out, namely validation by experts and experts and small-scale trials.

Table 3. Development Stage

No	What to do	Information
1	Module validation	The product design is validated by pkar and practitioners to assess the validity of the product. The results of the assessment and input from the validators are then used as improvement evaluation materials to improve the prototype made.
2	Small-scale trials	Small-scale trials are carried out after the product is declared valid. This stage consists of *a one-to-one* trial involving 5 students and a small group involving 9 students.

d. Implement & evaluate

This research is limited to the *development stage* only. The implementation and evaluation stage will be carried out in follow-up research to obtain information about the practicality and effectiveness of the developed modules.

The subjects of the study were five validators consisting of three experts with a doctoral education background, namely Dr. Suyidno, M.Pd., Dr. Mustika Wati, S.Pd., M.Sc., Dr. Sri Hartini, M.Sc and two practitioners who teach science in schools and have a master's education background, namely Saidatun Navisah, S.Pd., M.Pd., and Maula Ariefianti, S.Pd., M.Pd. The object of the research is the validity of the module which consists of aspects content, linguistic aspect, presentation aspect, graphic aspect, and science literacy aspect.

The research will be carried out in April-May 2024. The module validity assessment developed by experts is located in Banjarmasin City, while the module validity assessment by practitioners in Tapin Regency, South Kalimantan Province.

The research data was collected using module validation instruments. Validity assessment is carried out to measure the suitability of the developed modules with the foundation of relevant knowledge or theory to improve science literacy. The validity of the module includes the validity of the content (content quality, organization, LKPD, evaluation), linguistic validity (communicative, dialogical and interactive, conformity with linguistic rules, straightforwardness, comprehensiveness and collapse of the flow of thought, and conformity to the level of development), validity of presentation (presentation techniques, support for the presentation of material, presentation of learning, and attractiveness), validity of graphography (cover, format, letters, and module size), and validity of science literacy. The validation instrument uses a likert scale with four statement options along with scores, namely scores of 1 (not good), 2 (not good), 3 (good), and 4 (very good).

The data of the module validation results will be calculated using the average score and then the results are interpreted categorically based on the following criteria.

Table 4. Module Validity Criteria

No.	Interval Determination	Interval	Category
1	$X > Xi + 1.8\ Sbi$	$X>3.4$	Very Valid
2	$Xi + 0.6SBi < X \leq Xi + 1.8\ SBi$	$2.8 < X \leq 3.4$	Valid
3	$Xi - 0.6SBi < X \leq Xi + 0.6\ SBi$	$2.2 < X \leq 2.8$	Quite Valid
4	$Xi - 1.8SBi < X \leq Xi - 0.6\ SBi$	$1.6 < X \leq 2.2$	Less Valid
5	$X > Xi + 1.8\ SBi$	$X \leq 1.6$	Invalid

Information:

Xi = ideal average = 1/2 (Maximum score + minimum score)

Sbi = ideal standard deviation = 1/6 (maximum score – minimum score)

X = empirical score.

RESULT AND DISCUSSION

The product that has been developed through this research is the PjBL-STEAM Science module loaded with local wisdom and natural dyes to improve science literacy =. The product is developed based on the research steps of ADDIE model development. The following are the results obtained at each step of the research.

Stages of Analysis

The activities carried out at the analysis stage are presented in Table 5 as follows.

Table 5. Activities and Results of Analysis

Things analyzed	Result
Existing products and needs	1. Learning activities at MTs NIPA Rakha and MTs NIPI Rakha use textbooks published by national publishers. 2. Learning resources loaded with local wisdom are needed to improve students' science literacy. 3. Science literacy scores at MTs NIPA Rakha Amuntai and MTs NIPI Rakha Amuntai 100% require guidance based on *pre-test* scores.
Curriculum	1. Based on the independent curriculum, class VII learning is included in the Phase D element with learning outcomes: Students are able to measure the physical aspects they encounter and utilize various motions and forces (*force*), understand the relationship between the concept of effort and energy, measure the amount of temperature caused by the heat energy given, and at the same time be able to distinguish between insulators and conductors. 2. The objectives of temperature and heat learning are: a) to measure temperature and calculate the conversion of temperature units in the extraction of natural dyes for sasirangan fabrics; b) analyze the effect of temperature on expansion through experiments and calculate the size of object expansion in natural dye liquids for sasirangan fabric; and c) analyze the influence of heat on temperature and shape of objects, heat transfer, and distinguish insulators and conductors in the process of making natural dye sasirangan fabrics.
Characteristics of teaching materials	Temperature and heat matter are divided into three sub-materials, namely a) temperature; b) expansion; and c) heat and displacement. The phenomenon of temperature, expansion, and heat transfer can be observed through the project of making natural dye sasirangan fabrics that involve engineering and art processes. Teaching materials on temperature and heat require an understanding of science and experimentation, application in technology and mathematical calculations. Based on this, teaching materials can be delivered through project-based learning with a STEAM approach.
Analysis of student characteristics	Grade VII students who will use the science module are in the age range of 12-13 years classified as formal operations reviewed based on the level of Piaget cognitive development. Students are already able to think abstractly by using certain symbols or operating the rules of formal logic that are no longer bound by concrete objects, such as increased analytical skills, the ability to develop an existing possibility, the ability to draw generalizations and inferences from a variety of diverse objects. The socio-cultural background of the majority of students is the Banjar tribe who are residents of South Kalimantan, so learning to use science teaching modules

Things analyzed	Result
	containing local wisdom of Sasirangan natural dyes is very appropriate to use.

Design Stage

The design stage is in the form of learning design activities and assessment instruments. The following is a description of the activities carried out at the design stage.

a. Designing learning activities

The distribution of materials, learning objectives, and allocation of learning time are presented in Table 6 as well as the learning approaches, models, methods, and steps in Table 6

Table 6. Design for Material Distribution, Learning Objectives, And Time Allocation

Meeting	Material	Learning Objectives	Time Allocation
First	Temperature	Measure temperature and calculate unit temperature conversion on extraction of natural dyes for sasirangan fabric.	3×40 minutes
Second	Expansion	Analyze the effect of temperature on expansion through experiments and calculate the size of object expansion in natural dye liquids for sasirangan fabrics.	3×40 minutes
Third	Heat and Its Displacement	Analyze the influence of heat on temperature and shape of objects, heat transfer, and distinguish insulators and conductors in the process of making natural dye sasirangan fabrics.	3×40 minutes

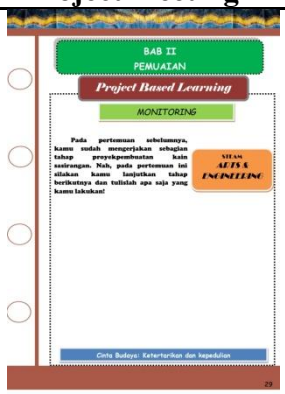
Table 7. Design of Learning Approaches, Models, Methods, and Steps

Approach	Type	Method	Learning Steps
STEAM (*Science, Technology, Engineering, Art, and Mathematics*)	PjBL (*Project Based Learning*)	Experiments, discussions, projects.	A. Introduction 1. The teacher starts the lesson by saying greetings and conveying the learning objectives. 2. Students watched an introductory video of the process of making sasirangan cloth (*Arts*). 3. Determination of fundamental questions (*Science*) B. Core activities 1. Develop a project work plan 2. Create a schedule of activities 3. Monitor the progress of the sasirang fabric making project (*science, technology, engineering, art, mathematics*) C. Cover 1. Assessment and evaluation.

The product design in the form of *a module prototype* consists of: cover page, general information (name of compiler, agency, subject, phase, level, class, time allocation, facilities and infrastructure), core components (learning outcomes, learning objectives, learning objectives flow, learning objectives achievement criteria, starter questions, learning steps, learning assessment), prefaces, module usage instructions, table of contents, learning objectives, concept maps, *questioning*, *planning*, *scheduling*, introduction, material description, project activities, scientists' corner, student worksheets, science literacy corner, cultural corner, conclusions, *assessment*, *evaluating*, bibliography, glossary, and answer keys.

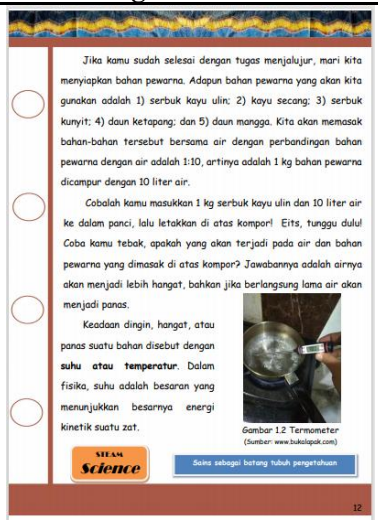
Project-based learning is presented by including a "project activities" section to direct learners to complete the project. The project designed is the treatment of waste and natural materials to be used as dyes in sasirangan fabrics. The presentation of project activities can be seen in Table 8.

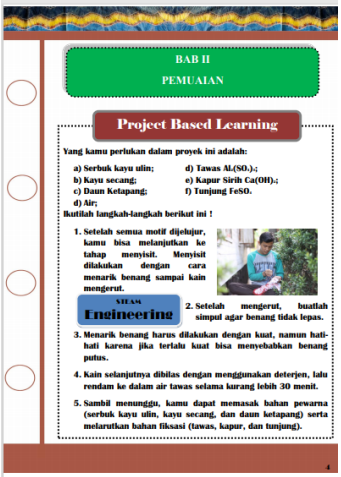
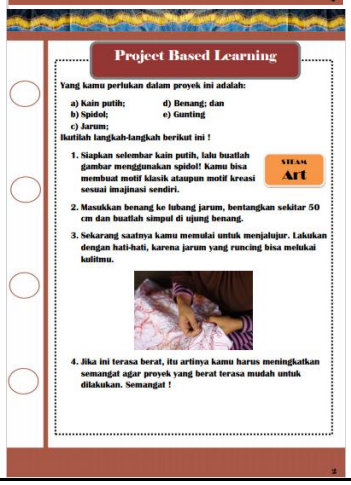
Table 8. Project Activities On Modules

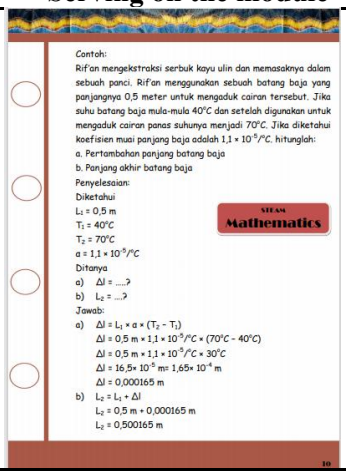
Meeting project 1	Project meeting 2	Project meeting 3
		

The science, technology, engineering, art, and mathematics (STEAM) approach in the module can be seen in Table 9.

Table 9. Presentation of the STEAM approach in the module

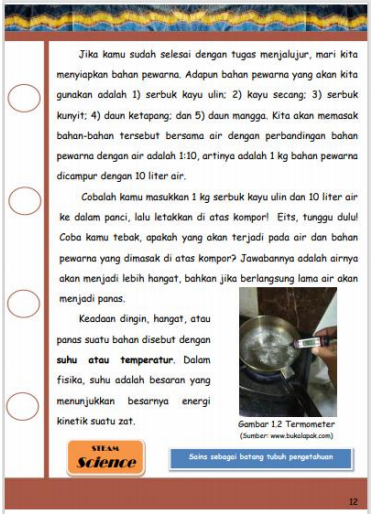
Approach	Serving on the module	Information
Science		The *scientific approach* is presented with regard to the facts, concepts, and principles surrounding temperature, temperature measuring instruments, expansion, heat and displacement.

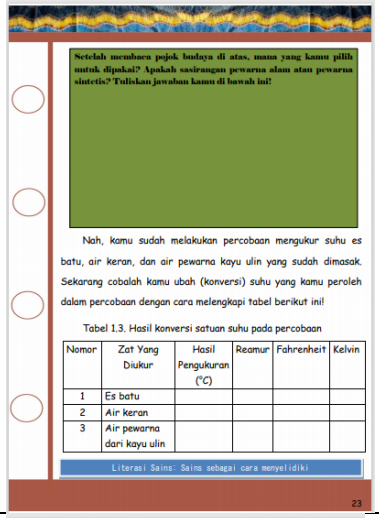
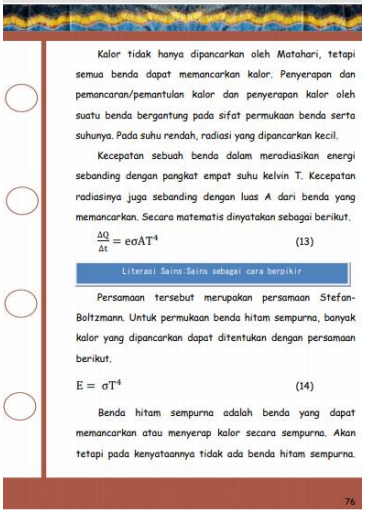
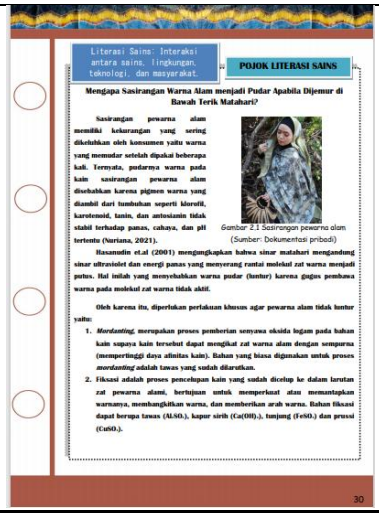
Approach	Serving on the module	Information
Technology		*The technology* presented is a temperature and heat tool or principle that helps human life, such as a digital thermometer, a bimetal on an iron that functions as an automatic switch, and a thermos.
Engineering		The *engineering* approach directs students to be able to process ironwood waste and other natural materials to be used as natural dyes and produce works in the form of natural dye sasirangan fabrics.
Art		*The art* in the module developed is related to the activity of making motifs and producing color gradations on sasirangan fabrics by considering beauty aspects.

Approach	Serving on the module	Information
Mathematics		The *mathematical approach* is concerned with the calculation of temperature, expansion, and heat conversion.

The science literacy aspect in the module can be seen in Table 7

Table 10. Science Literacy Presentation in Modules

Science literacy indicators	Serving on the module	Information
Science as a body		Science as a body of knowledge is related to concepts, laws, and principles on temperature and heat matter.

Science literacy indicators	Serving on the module	Information
Science as a way to investigate		Science as a way to investigate is related to practicum activities, communicate the results of practicums, and understand the results of an investigation on temperature and heat materials.
Science as a way of thinking		Science as a way of thinking is related to activities that require critical thinking, deductive-inductive thinking, analyzing cause-and-effect relationships and analyzing scientific data on temperature and heat materials.
Interaction of science, technology, and society		This section outlines the application of science and technology in people's lives that apply the concepts of temperature and heat.

b. Designing An Assessment Instrument

The assessment instruments used consist of module validity instruments, module practicality instruments, science literacy instruments, and project performance assessment instruments. The indicators on the module validation sheet can be seen in Table 11.

Table 11. Module Validation Indicators

Aspects	Indicators
Content validity	
Content quality	1. Suitability of the material with learning objectives
	2. Suitability of the material with the independent curriculum
	3. Conformity of the material with local wisdom
	4. The concepts presented are in accordance with those presented by scientists
	5. The material presented is elaborated at length
	6. The subject matter is presented in depth
	7. The information conveyed is accurate and factual
	8. There is a concept map that fits the material and is easy to understand
	9. Perception of local wisdom to motivate students to read
	10. Present concrete examples from the residential/school environment
	11. Presenting information about pioneering experts in science development
	12. There is a summary that includes the material presented
	13. There is an explanation about local wisdom raised in the learning module
	14. Updating of the reference sources used
	15. Clarity of the instructions for the use of the module
Organization	16. Modules are presented systematically
	17. The arrangement between subchapters and paragraphs shows a collapse
LKPD	18. The formulation of the objectives of the LKPD is clearly written
	19. The numbering system on the LKPD is clear
	20. Balanced text and illustrations
	21. Space to answer is available and enough for students to write according to the answer key
	22. Systematic LKPD filling procedure
	23. Provides visual stimulation
	24. Conformity of questions with objectives in the RPP and LKPD
Evaluation	25. Evaluation can measure the achievement of learning objectives
	26. The evaluation questions are evenly distributed in difficulty
	27. Answer questions that are relevant to the student's ability
	28. Contains the answer key from the competency test questions for each meeting
Linguistic Validity	
Communicative	1. Information can be understood by the reader
	2. Language suitability with the substance of the message/concept
Dialogical and interactive	3. Ability to interact with readers
	4. The writing invites students to be active and follow the instructions in the module
Conformity with language rules	5. The accuracy of the Indonesian language based on improved spelling (EYD)
	6. The accuracy of the use of the Banjar language in the description of the material and sample questions.
Businesslike	7. Sentence structure accuracy
	8. Standardization of terms
	9. Sentence effectiveness
	10. The Meaning of Words in Chapters/Sub-Paragraphs

Aspects	Indicators
Comprehensive and collapse of the mindset	11. Relationship between chapters/subchapters/paragraphs/sentences
Compatibility with developmental level	12. The suitability of the language used with the level of thinking (cognitive) development of students
	13. Suitability of the language used with the social-emotional development of the student
Presentation validity	
Presentation technique	1. Consistency of the Wording in the Chapters
	2. Presentation logic
	3. Conceptual collapse
Material presentation support	4. Accuracy of illustrations with material
	5. Presentation of images accompanied by reference sources
	6. Presentation of images and tables accompanied by image and table identities
	7. Accuracy of image and table numbering
	8. There is a motivation to learn at the beginning of the chapter
	9. Include a foreword
	10. Listing information about the local wisdom of natural dyes
	11. List projects as PjBL traits
	12. The material is presented using the STEAM approach
	13. Listing a summary
	14. List bibliography
	15. Customize the glossary
Presentation of learning	16. Student involvement in knowledge exploration
	17. Student-centered in exploring knowledge
	18. Suitability of the presentation of the material with the characteristics of the subject
	19. The ability to stimulate students' depth of thinking through illustrations and practice questions
Attraction	20. The composition of the dye used has an appeal
	21. There are illustrations to convey a clear and attractive message
	22. Interesting module cover
Graph validity	
Cover	1. Cover layout is appropriate
	2. Attractive cover typography
	3. The illustration on the cover represents the content of the learning module
	4. Use of letter combinations
Format	5. The use of columns according to the shape and size of the paper
	6. Compatibility of the layout and typing format with the paper format (vertical or horizontal) used
Letter	7. Shape and font size are consistent in the chapter
	8. Easy-to-read shapes and letters
	9. Accuracy of capitalization
	10. spacing, the spacing between the headings and the first line is consistent
	11. There is a variation in the type of letters in the description of the material in the chapter
Module size	12. Module paper size suitability according to standard size
Validity of science literacy	
Science as a body of knowledge	1. Presenting the facts
	2. Presenting concepts

Aspects	Indicators
	3. Presenting principles
	4. Presenting the laws
Science as a way to investigate	5. Require students to answer questions through tables
	6. Requires students to explain the answer
	7. Engaging students to conduct experiments
Science as a way of thinking	8. Showing the historical development of an idea
	9. Discussing facts and evidence
	10. Presenting scientific methods and problem-solving
Interaction between science, technology, and society	11. Describe how science in technology can be used for society
	12. Showing the negative effects of science and technology on society
	13. Discuss social issues related to science and technology

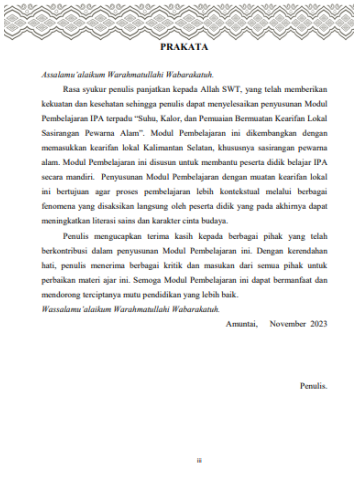
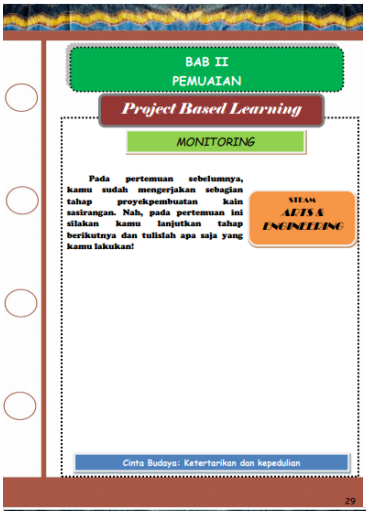
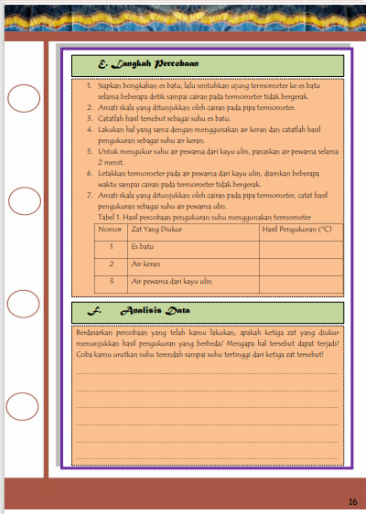
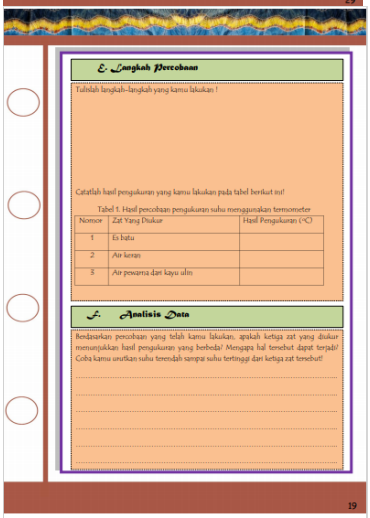
Development Stage

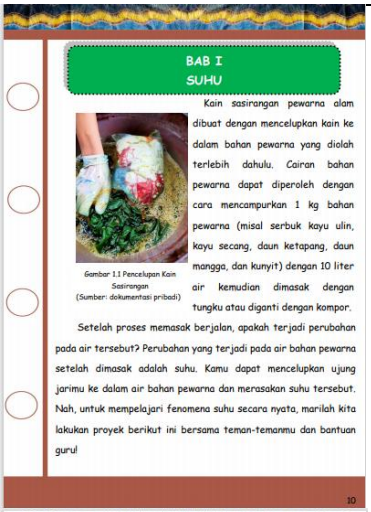
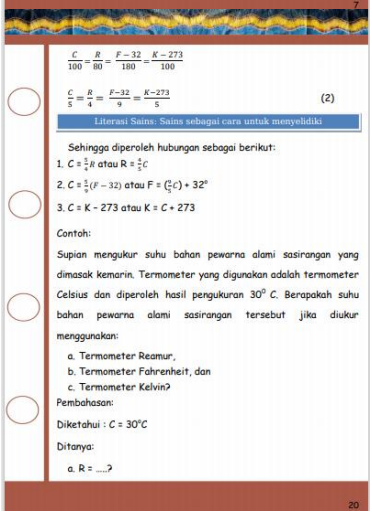
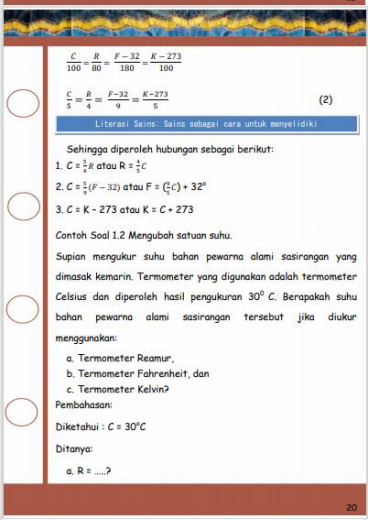
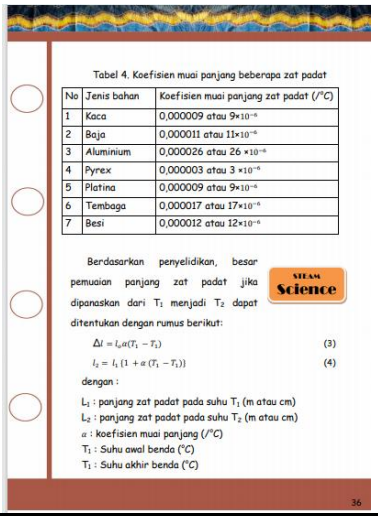
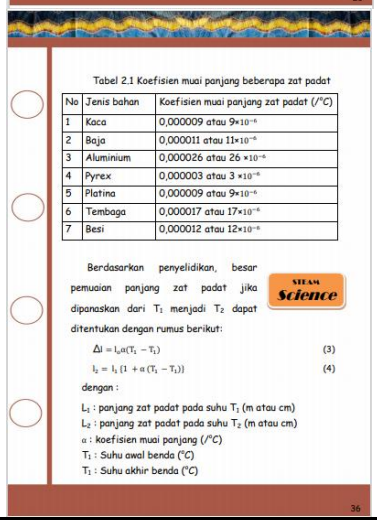
a) Assessment of expert validators and practitioners

Prototype that has been designed to enter the development stage to be reviewed, assessed, and evaluated by validators. Suggestions from validators will be used as revision material for product improvement before being used in small-scale trials and field implementations. Suggestions from validators for the PjBL-STEAM Science module can be seen in Table 12.

Table 12. Suggestions from Validators and Improvements Made

No	Suggestion	Repair	
		Initial view	Final look
1	Fix the cover page with a shorter title, the order of the author's name, and add a semester caption.		

No	Suggestion	Repair	
		Initial view	Final look
2	Add a thank you to the various parties who helped compile the module in the preface section		
3	The project step in project-based learning should be designed by the students themselves and is an eengineering approach.		
4	The experimental steps in the LKPD are simply blanked so that students write their own experimental steps independently.		

No	Suggestion	Repair	
		Initial view	Final look
5	The numbering of the figure/table should be written with two digit numbers, the first digit indicating the chapter and the second digit indicating the order of the picture/table.		
6	Sample questions should be written with a two-digit question number accompanied by question indicators.		
7	The writing of physics symbols should be consistently italicized or in upright letters.		

Other suggestions from the validator are that the word "you" is consistently replaced with "you" or "you", citations from references of more than 2 people are written with abbreviations et al, as well as writing in the teaching module and its supporters to be in accordance with the general guidelines of Indonesian spelling. Related to learning, the project is not just about

making sasirangan but relating the concept of physics in the process of making the sasirangan fabric which must be explained by students.

The validity of the module is assessed by five validators through a validation sheet. A summary of the results of the validity of the PjBL-STEAM science module containing local wisdom of natural dyes is presented in Table 13.

Table 13. Module Validity Results

Aspects	Validator Score					Average	Criterion
	1	2	3	4	5		
Fill	3,54	3,11	3,71	3,68	3,68	3,54	Very valid
Language	3,38	3,00	3,69	3,69	3,69	3,49	Very valid
Serving	3,41	3,41	3,91	3,68	3,73	3,63	Very valid
Graphic	3,42	3,00	3,67	3,75	3,67	3,50	Very valid
Science literacy	3,69	3,00	3,85	3,69	3,77	3,60	Very valid

The validity of the module is seen based on the feasibility aspects of content, language, presentation, and graphography (Azhari, et al. 2024). In developments related to science literacy, module validation is coupled with aspects of science literacy with four aspects of review, namely science as a body of knowledge, science as a way of thinking, science as a way of investigating, and the interaction of science, technology, and society (Adawiyah, et al, 2024).

The validity of the content in the developed module obtained an average score from five validators of 3.54 with a very valid category. This very valid predicate can be obtained because the modules developed are prepared by paying attention to the quality of the content, are organized, include good LKPD, and contain evaluation materials.

In terms of content quality, the material presented is in accordance with the learning objectives and the independent curriculum, displaying the content of local wisdom of natural dye sasirangan fabric, the concepts presented in accordance with those put forward by scientists, are described in depth and extensively, accurately and factually. The teaching module includes a concept map that is appropriate and easy to understand, the presentation of local wisdom in the introduction can motivate students to learn accompanied by concrete examples from the living/school environment. Pioneering experts in science, especially related to the concept of temperature and heat, are presented through the scientists' corner in the module. The material presented in the module is also summarized in the summary section so that it can help students to remember the outline of the material, as well as the latest reference sources used in the module.

The organizational aspect shows that the modules are presented systematically and the arrangement between subchapters and between paragraphs shows a collapse of discussion. The LKPD in the module lists the formulation of the objectives clearly, uses a clear numbering system, balanced text and illustrations, there is enough space for students to write answers, systematic filling procedures, provides interesting visual stimuli and there is a suitability of questions with the objectives in the LKPD and RPP. The module has an evaluation component that can measure the achievement of learning objectives. The questions presented are evenly distributed in difficulty, according to the student's ability to answer, and there is an answer key that helps students conduct an independent evaluation of the competencies they have mastered.

The linguistic validity got an average score of 3.49 which means it is very valid. When compared to other aspects, linguistic validity is the lowest aspect. This happens because the language used is less interactive, there are some sentences that are less effective, and they have not fully implemented the general guidelines for Indonesian spelling.

Despite the shortcomings, the validity of the linguistic category is very valid. This category can be achieved because the language used shows the collapse of the mindset and corresponds to the level of development of the learner. The information in the module can be understood by the reader, the language used according to the substance of the message, being able to interact with the reader, the appropriate use of Banjar terms in some parts of the module, and the language used according to the level of thinking (cognitive) and social-emotional development of the students. The sentence description in the module shows the connection and integrity of meaning between chapters/subchapters/paragraphs/sentences.

The validity of the presentation obtained an average score of 3.63 with a very valid predicate. The average score on the validity of the presentation received the highest score compared to other aspects. This shows that the modules that are developed are superior from the aspect of presentation techniques, presented with adequate material support, learning materials are well presented, and have attractiveness. In the aspect of presentation techniques, the module is presented using a presentation systematics in consistent, logical, and sequential chapters. The module does not only present learning materials, but is also equipped with supporting materials such as pictures and tables, motivational generators in the form of information about local wisdom to foster love for culture, the existence of a project section that is characteristic of project-based learning, presented with a STEAM approach, and equipped with introductions, summaries, bibliographies, and glossaries. Learning materials are presented by inviting students to be actively involved in exploring knowledge, student-centered, and able to stimulate students' depth of thinking through illustrations and practice questions. The module is arranged to pay attention to the aesthetics of the presentation so that it has a good appeal by arranging the color composition, adding image illustrations, and an attractive cover.

The validity of the graph received an average score of 3.5 with a very valid category. This is because the modules are arranged by paying attention to the cover, writing format, letters, and paper sizes that are in accordance with the standards for grade VII students. The module cover displays three photos that represent the contents of the module, namely the process of walking, a pot filled with dye that is on top of waiting for the fire, and a sasirangan cloth that is being dried and equipped with writing from various different types of fonts to produce a harmonious combination of letters. The typing format and layout are adjusted to the size of the paper. The module is typed using a variety of types and font sizes but consistent in each chapter, this is so that the information in the module can stimulate students' interest in reading. The font size, the spacing between the lines, and the spacing between the title and the first line are adjusted according to the student's development and the size of the paper.

The validity of the science literacy aspect in Table 10 received an average score of 3.6 with a very valid category. This can be achieved because the modules contain science information as the body of knowledge, science as a way to investigate, science as a way to think, and the interaction between science, technology, and society. The aspect of science as the body of knowledge, the module contains facts, concepts, principles, or laws on temperature and heat matter. In the aspect of science as a way to investigate, the module directs students to answer questions through tables, explain answers, and involve students to conduct experiments. The aspect of science as a way of thinking, the module shows the historical development of an idea, especially through the scientist's corner, discusses facts and evidence, and presents scientific methods and problem solving. The module also provides information about science and technology that exists in society through social issues related to science and technology, the role of science and technology for society, and the negative effects of science and technology on society.

Based on the five aspects measured in the validity of the module, the average score given by the five validators was 3.55 with the category of very valid. The results of this validity show that the PjBL - STEAM Science module containing local wisdom is valid based on aspects of

content, language, presentation, graphics, and science literacy so that it can be used for the learning process. The validity of the modules can be obtained because the modules are arranged according to their purpose with systematic presentations (Sumarsih, et al 2022), the material can provide meaningful learning (Setiawan, et al, 2022), and is loaded with local wisdom through the utilization and exploration of local regional potentials so that it makes it easier for students to achieve learning goals (Fatmawati & Hanik, 2024).

One-to-one trial

Products that have been validated and revised according to input from validators are then tested *one to one* or individually by involving five students who have low, medium, and high abilities. This trial aims to obtain information on the readability of the developed modules, minimize typo errors, and attractiveness of the display. Trial participants were asked to use the PjBL-STEAM science module loaded with local wisdom on natural dyes independently.

Based on input from *one-to-one* trial participants, information was obtained: a) there are foreign terms that are not included in the glossary, b) there are typos and page order errors, c) the appearance of the module is attractive. The module was then revised by improving typing, page order, and adding foreign or rare vocabulary to students in the glossary section.

Small group trials

The small group trial was attended by 9 students from MTs NIPA Rakha Amuntai and 1 teacher. In this small group trial, it was carried out according to the learning steps. For teachers, the trial was conducted to obtain information on the ease of use of the module in the PjBL model syntax.

The results of the small group trial showed that teachers did not encounter severe obstacles when using the modules through project-based learning. The information presented in the module can be understood well by the trial participants. The liquid practicum activity found an obstacle because the water in the capillary pipe did not show a change in volume when heated. The sasirangan work project experienced obstacles because the trial participants had difficulty inserting the thread into the needle. The revisions made after the small group trial were: a) replacing the rubber cover of the erlenmeyer tube with a larger size; and b) provide an aid to insert the thread into the needle.

CONCLUSION

The modules developed using the ADDIE model have been declared valid across all assessed aspects, including content (3.54), linguistic (3.49), presentation (3.63), graphic (3.5), and science literacy (3.6), all categorized as very valid. These results indicate that the *PjBL-STEAM* teaching module, which incorporates local wisdom through the use of natural dyes, is suitable for use in learning and has the potential to enhance students' science literacy. For future research, it is recommended to implement and evaluate the effectiveness of this module in classroom settings to measure its impact on students' learning outcomes and science literacy development over time.

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