Lensa: Jurnal Kependidikan Fisika
Penerbit: Universitas Pendidikan Mandalika
https://e-journal.undikma.ac.id/index.php/Lensa/index

Dec. 2025, Vol. 13, No. 2
e-ISSN: 2686-0937
pp. 276-295

Development of Ethnoscience-Integrated P5 Teaching Materials on the "Kerupuk Panggang" Production Process Using AnyFlip

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Abstract

The Merdeka Curriculum's Pancasila Student Profile Project (P5) seeks to integrate 21st-century competencies (collaboration, problem-solving, and digital literacy) within Indonesia's pluralistic values. This study develops P5 teaching materials (a teacher's companion book and a student module) that integrate ethnoscience by using Jambi's *kerupuk panggang* production as a cultural context for heat and temperature. Using the ADDIE model, we conducted the development phase and produced a digital flipbook version via AnyFlip, then evaluated feasibility with qualitative and quantitative evidence from expert validators, teachers, and students. Expert reviews yielded mean feasibility scores of 81% for the companion book and 82% for the module (very good category). At the needs and perception stage, 42% of students reported understanding of local wisdom and its linkage to science concepts, and 63.3% indicated good motivation when learning was connected to P5. Teacher and student responses characterized the materials as practical and engaging for P5 activities. These findings support the feasibility and practicality of the materials for subsequent classroom implementation studies; effectiveness on learning outcomes was not tested in this phase.

Keywords: Pancasila Student Profile (P5); Ethnoscience; Contextual learning; Heat and temperature; AnyFlip flipbook

How to cite: Marbun, F. K., Jufrida, J., & Furqon, M. (2025). Development of Ethnoscience-Integrated P5 Teaching Materials on the "Kerupuk Panggang" Production Process Using AnyFlip. *Lensa: Jurnal Kependidikan Fisika*, *13*(2), 276–295. https://doi.org/10.33394/j-lkf.v13i2.16229

INTRODUCTION

Indonesia's Merdeka Curriculum, through the Pancasila Student Profile Project (P5), prioritizes 21st-century competencies such as digital literacy, collaboration, and problem solving within a pluralistic civic framework. The policy intention is clear: classrooms should integrate technology meaningfully and scaffold higher order thinking aligned with contemporary demands (Jayadi et al., 2020). The challenge is that policy aspirations do not automatically translate into robust instructional materials or teacher practices. In many schools, P5 activities tilt toward making products without unpacking the science concepts that should anchor those products. This tension is visible in physics, where conceptual depth is often sacrificed for activity completion.

Local evidence from SMA Negeri 6 Kota Jambi is instructive. The average physics exam score is 58, which falls below the school's minimum mastery criterion. Interviews with physics teachers indicate that existing P5 materials lack contextual content, adequate illustrations, and workable student worksheets. A diagnostic test suggests that only 42% of students can relate physics concepts to everyday phenomena, while student profiling shows that 63.3% report higher motivation when lessons are connected to real life. These figures do not prove causality, but they do point to an instructional gap that materials could plausibly address if those materials make the science explicit and culturally grounded.

One prominent line of argument in the Merdeka Curriculum is to integrate local wisdom into learning design. Schools are encouraged to tailor pedagogies to student characteristics and community context (Rahma & Hindun, 2023). This stance is reinforced by the Head of BSKAP Decree No. 031/H/KR/2024, which emphasizes the P5 dimension of Global Diversity to strengthen students' understanding of local values and cultures. The policy rationale is defensible, yet its effectiveness depends on how well teachers and materials connect cultural practices to disciplinary ideas rather than treating culture as an add-on.

Prior studies offer conditional support. Lestari et al. (2024) argue that P5-themed modules help teachers design projects that fit learner characteristics. Marsithah and Jannah (2024) report positive effects of local-wisdom e-modules on student enthusiasm and skill development. Kriswanti et al. (2020) find that ethnoscience-based materials can improve science literacy and classroom engagement. These findings are promising, but they are not specific to heat and temperature in senior high school physics, and the strength of evidence varies by design and measurement. A careful reader will ask how cultural contexts are operationalized into tasks that elicit and assess physics reasoning rather than general participation.

In Jambi, the traditional food *kerupuk panggang* offers a concrete context for physics. Its production involves heat transfer by conduction, convection, and radiation, which maps directly onto the heat and temperature topic. If designed well, activities around *kerupuk panggang* can make abstract ideas tangible while affirming local culture. Ethnoscience provides a conceptual bridge, linking scientific explanations to lived practices, but its value depends on explicit alignment between cultural processes, scientific models, and assessable learning outcomes (Silla et al., 2023). Without that alignment, "contextualization" risks remaining rhetorical.

The present study responds to these conditions by developing P5 teaching materials that integrate ethnoscience for the senior high school heat and temperature unit, using the *kerupuk panggang* production process as the anchor context. The materials comprise a teacher's companion book and a student module. Development follows the ADDIE model through the development phase, and the outputs are prepared in a digital flipbook format via AnyFlip to support school-level dissemination and classroom use. The study does not claim instructional effectiveness. Instead, it examines feasibility and practicality through expert validation and user responses from teachers and students, while documenting the local needs that motivate the design.

This focus addresses several gaps. First, it moves beyond generic P5 projects by tying a specific local practice to core physics concepts with task designs that can, in later work, be evaluated for conceptual gains. Second, it contributes concrete materials where schools report shortages. Third, it frames ethnoscience not as decoration but as a structured context that can be mapped to learning indicators and future assessments. The goal is to establish that such materials are feasible and usable in this setting, setting the stage for subsequent classroom implementation and effectiveness studies.

METHODS

This study adopted the ADDIE development model that includes Analysis, Design, Development, Implementation, and Evaluation, yet the procedure was intentionally limited to the Development stage (See Figure 1). The restriction aligns with the study's immediate aim, which was to produce two ethnoscience-integrated P5 products and to establish their feasibility through expert appraisal and user feedback. Focusing on early development allows careful specification of content, media, and tasks before exposure to full classroom variability. We treated expert validation and iterative revision as the main quality gates at this phase. Claims about effectiveness on learning outcomes were not pursued, since such claims require controlled implementation studies that exceed the scope here. The products were a teacher's companion book and a student module for heat and temperature.

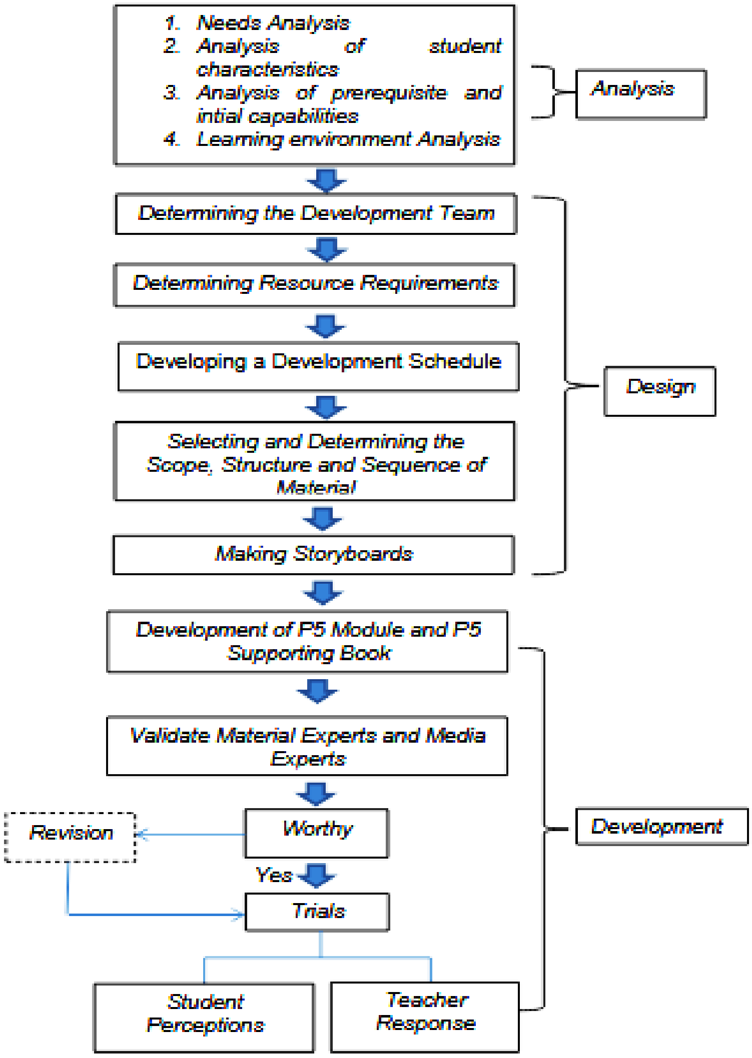

Figure 1. Flowchart of the ADDIE development model

The work took place at SMA Negeri 6 Kota Jambi with Grade XI students as intended users. Students participated to report perceptions of clarity, relevance, and usability rather than to provide evidence of achievement gains. One physics teacher contributed contextual information about current practice and constraints and later evaluated practicality. Two expert validators examined the materials on content and media criteria and supplied written suggestions. This small and purposefully selected group fits the objective of feasibility checking. It also reflects the pragmatic limits of early development, where rapid feedback cycles are more valuable than large samples that cannot yet influence design decisions.

The Analysis stage combined four activities. First, a needs analysis reviewed physics exam records and conducted a structured teacher interview to identify gaps in existing P5 materials. Second, a student characteristics analysis profiled motivation for P5 with a local-wisdom theme using a short questionnaire adapted from prior work. Third, a diagnostic test on heat and temperature established prerequisite and initial understanding so that tasks could be pitched at an appropriate level. Fourth, a learning environment analysis documented teaching methods, teacher–student interaction, available resources, and facilities through an interview protocol. These inputs were triangulated to avoid relying on a single source and to ensure that later design choices responded to documented problems rather than assumptions.

The Design stage converted findings into specifications for two products. A small development team coordinated drafting, while two experts served as validators and the classroom teacher and students acted as users who would later provide feedback. Resource mapping identified people knowledgeable about the focal local wisdom and gathered candidate materials from school texts and digital sources such as e-books, instructional videos, and relevant articles. Materials were screened through content analysis for alignment with learning targets. Scope, structure, and sequence were organized with a concept map that linked cultural practice to scientific models of heat transfer. A storyboard outlined each page or screen to keep messages, prompts, and tasks coherent and to support accessible language and visuals.

During Development, the companion book and module were produced in a digital flipbook format via AnyFlip to support dissemination and classroom access using common devices. The products underwent iterative expert validation focused on two domains. Content validation examined conceptual accuracy, cultural–science linkage, and task alignment with objectives. Media validation examined legibility, layout, image quality, and navigability in the flipbook environment. Written feedback guided revisions that clarified explanations, improved illustrations, and tightened prompts. A small try-out then collected a teacher response on practicality and perceived quality and student perceptions on clarity, relevance, and usability. The try-out was intended to surface issues for refinement rather than to test instructional impact.

Data sources included interview notes and needs documents, expert validation sheets for content and media, a teacher response questionnaire on practicality and perceived quality, and a student perception questionnaire on module qualities. All questionnaires used a four-point Likert scale with the options strongly disagree, disagree, agree, and strongly agree scored from one to four. Quantitative data from expert validation, teacher responses, and student perceptions were converted to percentages by dividing the total obtained score by the maximum possible score and multiplying by one hundred. Interpretation used five qualification bands: very poor, poor, fair, good, and very good. These categories were applied consistently across instruments to summarize feasibility.

Table 1. Percentage-based qualification criteria for validation sheets, teacher responses, and student perceptions

No	Percentage	Category
1	81 – 100 %	Very good
2	61 – 80 %	Good
3	41 – 60 %	Fair
4	21 – 40 %	Poor
5	0 – 20 %	Very poor

Qualitative data consisted of expert comments and interview material. These were analyzed using the interactive model of Miles and Huberman, which cycles through data reduction, data display, and conclusion drawing with verification. The process emphasized recurrent issues in content clarity, media layout, and task design and was used to prioritize revisions with the greatest expected benefit for feasibility. Together, the quantitative summaries and qualitative insights provided convergent evidence about whether the products were ready for subsequent classroom implementation studies. The present phase ends at feasibility and practicality. Future work should examine conceptual gains in heat and temperature and observed alignment with assessed P5 dimensions under real classroom conditions.

RESULTS AND DISCUSSION

Analysis

The needs analysis drew on two sources: Grade XI physics test records and a structured interview with a physics teacher at SMA Negeri 6 Kota Jambi. The average score was 58, below the school's mastery threshold. Heat and temperature repeatedly appeared as weak points. On its own, a low mean does not tell us which concepts are stumbling blocks, but it flags a performance problem that warrants design attention. The teacher added that students disengage when lessons remain theoretical and detached from everyday practice, which narrows the likely causes to relevance and task design rather than hardware or time-on-task alone.

Interpreting these signals, we argue that a contextual, project-oriented approach is appropriate to test in development. The claim is not that projects automatically improve achievement. Rather, projects can supply the missing bridge between abstract models and observable processes if tasks ask students to reason with evidence. The teacher's observation about disengagement supports this line, but it is still preliminary. We use it as a design hypothesis: materials should situate heat transfer in a local practice that students recognize and care to examine.

To profile learner readiness, we administered a short motivation questionnaire focused on P5 activities linked to physics. Among 30 respondents, 63.3 percent fell in the "good" category. Motivation measures are self-reports and can overstate classroom behavior, so the number should be read cautiously. Even with that caveat, the result suggests students are open to projects when the work feels authentic. This finding informed a choice to include roles and deliverables that make collaboration visible and to embed frequent low-stakes check-ins rather than a single culminating task.

We probed prerequisite and initial understanding with two diagnostic items tied to the *kerupuk panggang* process and heat transfer concepts. Forty-two percent displayed a good grasp of the cultural practice and could link it to science ideas, while 58 percent did not. A two-item probe cannot support strong inferences about individual mastery, and we do not treat it that way. Its utility here is directional. It indicates that many students are familiar with the practice but lack a schema that connects observations to conduction, convection, and radiation. This points to the need for explicit mapping tasks and representational supports.

The learning environment analysis found adequate basics: classrooms, whiteboards, and projectors are available. The constraint is curricular, not infrastructural. There are no P5 modules or companion books that integrate ethnoscience with physics, and current P5 enactment is generic. Culture is mentioned, but the connection to disciplinary reasoning is weak. This gap matters because teachers lack ready-to-use prompts, data sheets, and rubrics that make reasoning visible. Without such tools, activities drift toward making products rather than explaining phenomena.

Taken together, the four analyses justify moving to design with calibrated expectations. The low average score and teacher testimony indicate a need. The motivation profile suggests students will engage if tasks are meaningful. The diagnostic points to missing conceptual links. The environment scan shows a material shortage, not a technology failure. None of these findings proves that an ethnoscience approach will lift outcomes. They do, however, identify where a well-specified module and companion book could plausibly help.

These findings translated into concrete design requirements. Tasks must anchor heat transfer in the *kerupuk panggang* process and ask students to collect or interpret simple data. Representations should include annotated diagrams of conduction, convection, and radiation within the cooking setup. Prompts should require students to justify claims with observations or temperature readings. Teacher guidance must outline discussion questions, anticipated misconceptions, and criteria for evidence-based explanations. A digital flipbook via AnyFlip was chosen to simplify access while preserving layout control.

Finally, we note the limits of the analysis evidence and how we plan to mitigate them in later phases. The motivation measure is brief and based on self-report. The diagnostic uses only two items. The teacher interview reflects a single site. To counter these constraints, the development phase emphasizes feasibility and practicality rather than effectiveness. Subsequent implementation work should add a longer concept inventory for heat and temperature, inter-rater–checked rubrics for P5 indicators, and lesson transcripts to test whether the designed tasks actually elicit the intended reasoning.

Design

The design phase specified how the ethnoscience-integrated P5 materials would be built and prepared for feasibility checks. We first fixed the development structure to keep decision making accountable and iterative. The core team comprised the authors, an academic supervisor, and two external experts who later served as validators—one for content, one for media. This small team was selected to balance subject-matter scrutiny with practical layout considerations. The team arrangement does not guarantee quality, but it clarifies roles for feedback cycles, which is essential when the study stops at development rather than full implementation.

Resource mapping then identified users and cultural informants. Target users were Grade XI students and a physics teacher at SMA Negeri 6 Kota Jambi. Cultural resources included community figures familiar with *kerupuk panggang* to ensure depictions of materials, tools, and procedures were accurate. This mapping reduces the risk of treating "local wisdom" generically. It also helps translate cultural practice into task prompts that can be interrogated with physics ideas. The approach is appropriate to the goal of contextualization, while recognizing that accuracy of cultural detail must be checked repeatedly during drafting.

Scheduling proceeded in three tracks: advisory meetings, expert validation, and a small try-out. The calendar began after the analysis observations and interviews, then moved to drafting, validator review windows, and finally a limited classroom-adjacent try-out for teacher and student feedback. Staging in this order enables quick revisions after each review without implying any measurement of effectiveness. The schedule was a project tool, not a treatment timeline, so dates were aligned to validator availability and school activities rather than fixed lesson periods.

Content scope, standards, and sequence were determined with the dual purpose of supporting teacher enactment and making student reasoning visible. The teacher's companion book was structured into three chapters: (I) *Kerupuk Panggang* (including a short historical note), (II) Production Process (components and step-by-step procedure), and (III) Ethnoscience Concepts (linking ingredients and production steps to heat and temperature, with explicit references to conduction, convection, and radiation). This sequence moves from cultural description to procedural detail and then to disciplinary explanation. The intention is to foreground science models only after students have a concrete process to analyze, which is consistent with the project's contextualization aim.

A storyboard was drafted for both the companion book and the student module to visualize page flow, prompts, and media placement. Each spread indicated the targeted idea, the expected student action (observe, annotate, compute, explain), and the artifact to be produced (notes, diagram, short justification). By simulating the reading and task flow, the storyboard exposed overloaded pages, ambiguous instructions, and missing transitions. This is not a substitute for classroom piloting, but it is a low-cost method to catch design defects before validation. Revisions at this stage focused on shortening prompts, aligning figures with nearby text, and adding "why" questions to move beyond description.

Product specifications were defined along pedagogical and non-pedagogical lines. Pedagogically, both products required tasks that explicitly map observations in the cooking setup to the three heat-transfer mechanisms and invite short evidence-based explanations. Non-pedagogically, the module used A4 landscape pages with 3–4 cm margins, justified text, and an orange-gray image palette; the companion book used A5 portrait pages with 2.54 cm margins and a blue-white palette. Fonts were Times New Roman with sizes ranging from 31–36 pt for covers, 28 pt for chapter titles, 15 pt for front matter, and 12 pt for body text and captions. These choices favor readability and printing practicality; they are conventional rather than innovative, which suits the feasibility focus.

Finally, a first prototype of each product was produced as a digital flipbook via AnyFlip to simplify access and preserve layout. The prototypes were submitted to content and media experts for structured validation, followed by revision cycles addressing accuracy, coherence, and usability. The try-out collected teacher responses on practicality and student perceptions of clarity and relevance. These activities provide evidence about feasibility and user fit, not learning gains. The design phase, therefore, culminated in revised prototypes that are ready for subsequent classroom implementation studies where effectiveness can be examined with stronger instruments.

Development

(a) Development of the P5 module and companion book

After the design decisions were fixed, we produced first prototypes of two products: a student module and a teacher's companion book that integrate ethnoscience with the heat–temperature unit. Development began with front matter because it shapes readers' first contact and signals the local context. The companion book cover includes institutional identifiers and two photographs—one of the grilling process and one of finished kerupuk panggang—to foreshadow the cultural anchor (Figure 2). The module cover mirrors this approach with Merdeka Belajar logo, the full title, author names, and the P5 theme. These choices establish relevance, but cover imagery alone does not guarantee conceptual engagement; the body must make the science explicit.

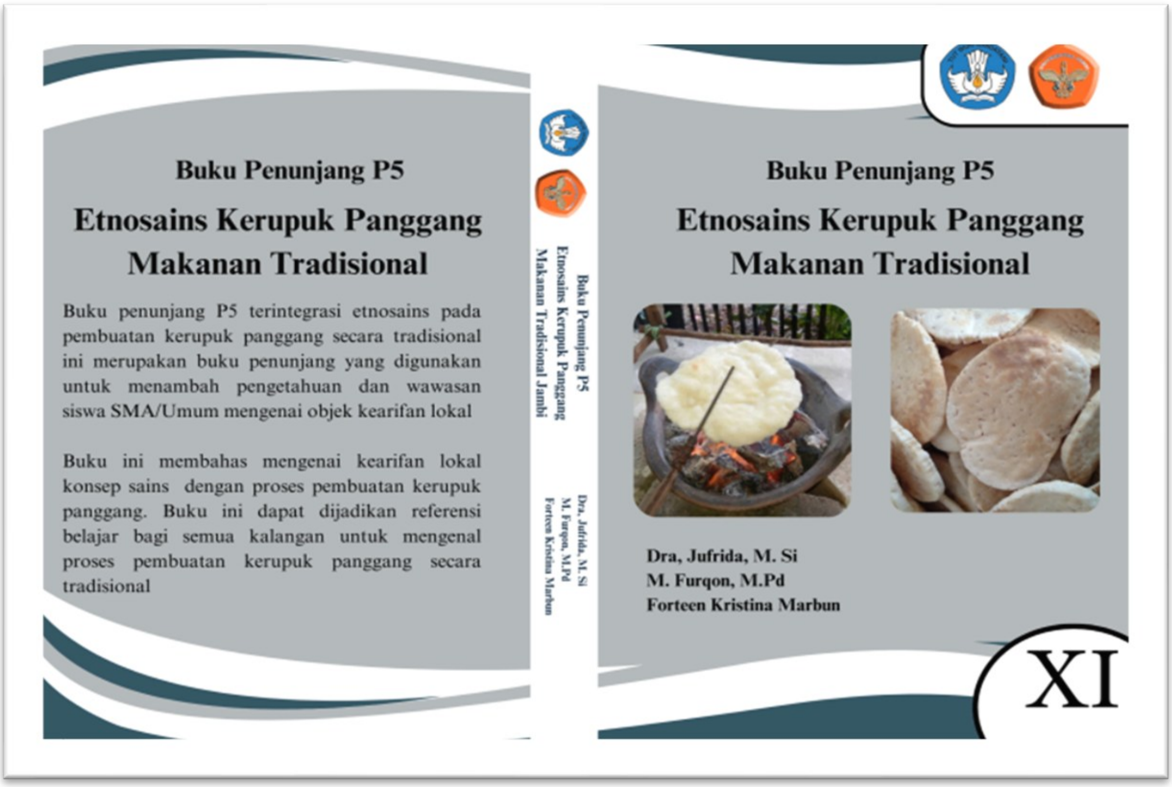

Figure 2. Cover design of supporting book P5

Navigation and identity pages were then prepared to support classroom use and citation. Each product includes an identity page (title, book type, intended audience, author details, and physical specifications), a concise foreword that motivates the ethnoscience focus without claiming untested effects, and a table of contents with page numbers. The companion book adds dedicated lists of tables and figures. These pages are practical rather than decorative: they reduce search time when teachers reference tasks or examples during discussion. The same typography and margin conventions adopted in the design phase were retained so that figures sit near the text they explain and page turns do not interrupt a single idea.

The body of the companion book is organized into three chapters that move from context to disciplinary explanation. Chapter I introduces *kerupuk panggang* with a short historical note to justify its use as a learning context. Chapter II describes components and step-by-step production, giving a concrete process that students can observe and reference. Chapter III makes the ethnoscience link explicit by mapping ingredients and production steps to heat transfer mechanisms (conduction, convection, radiation). The student module mirrors this sequence with tasks that require students to annotate diagrams, interpret simple temperature observations when available, and write short claims backed by evidence. The design assumption is that structured prompts—not the cultural story alone—will elicit physics reasoning.

Back matter was added to sustain comprehension and transparency. A glossary defines terms that may be unfamiliar from both cultural and scientific registers, lowering vocabulary barriers. The reference list documents sources for cultural descriptions, scientific explanations, and illustrative materials so teachers can verify details or extend discussion. These sections acknowledge provenance and help readers see where claims come from. The prototypes were exported as digital flipbooks via AnyFlip so layout fidelity is preserved across devices commonly available in classrooms. The digital format is convenient, but it also raises routine considerations about access and bandwidth that teachers will need to check locally. In sum, the development output consists of coherent first versions ready for expert review: covers that signal purpose and context, identity and navigation pages that support use, body sections that connect the *kerupuk panggang* process to heat-transfer models through tasks, and back matter that supports comprehension and citation. At this stage, the products are not evidence of effectiveness; they are testable designs. Consistent with the study scope, both the module and the companion book proceeded to expert validation before any teacher response or student try-out was collected.

Expert validation and revisions of the P5 module and companion book

The first content validation assessed whether the companion book conveyed accurate explanations and guided teachers toward disciplinary reasoning. Results indicate a solid baseline with room to sharpen sequencing. The overall mean was 79.5 percent in the "good" band, driven by strong content adequacy and slightly weaker presentation. These scores justify targeted edits rather than wholesale redesign. Revisions specified learning objectives at the section level, added short "why it matters" notes after procedures, and removed repetitive sentences to improve flow. The aim was to make evidence and reasoning more visible to teachers without inflating page count.

Table 2 summarizes the companion book's content results for the first round and provides the quantitative anchor for the changes described.

Table 2. First-round content validation of the companion book

Component	Percentage (%)	Category
Content feasibility	81	Very good

Component	Percentage (%)	Category
Content presentation	78	Good
Mean	**79.5**	**Good**

The first content validation for the student module examined whether tasks pushed learners from observation to explanation rather than description. Scores reached 76 percent on average, with content at 78 percent and presentation at 74 percent, placing the module in the "good" band yet highlighting presentation as the weaker link. This profile aligns with reviewer notes that prompts should make the intended heat transfer mechanism explicit. Revisions introduced claim–evidence–reasoning frames, margin cues that link photographs to conduction, convection, or radiation, and a reordering of two activities to stage observation, annotation, and written justification. These changes target the documented gap between context and concept. Table 3 reports the student module's content scores for the first review and anchors the rationale for revision.

Table 3. First-round content validation of the student module

Component	Percentage (%)	Category
Content feasibility	78	Good
Content presentation	74	Good
Mean	**76**	**Good**

Media quality influences legibility and how ideas are supported visually. The companion book's first media validation yielded an average of 78 percent. Typography was very strong at 88 percent, while image quality scored 70 percent, reflecting concerns about resolution and contrast. Actions taken included replacing grainy photos, increasing contrast on darker backgrounds, standardizing captions, and adjusting white space so figures appear adjacent to the sentences they support. We also drafted alt-text equivalents in the manuscript to facilitate future accessibility work, even though these were not scored in this round. Table 4 lists the companion book's first-round media results and clarifies which elements required attention to reach classroom-ready clarity without changing the core narrative.

Table 4. First-round media validation of the companion book

Component	Percentage (%)	Category
Typography	88	Very good
Imagery	70	Good
Media function	79	Good
Media benefit	75	Good
Mean	**78**	**Good**

Language clarity and graphic consistency in the student module formed the focus of the first media review. The average reached 78.5 percent, with language at 84 percent and graphics at 73 percent. This pattern suggests that written instructions were largely clear, while diagram conventions needed unification. Revisions simplified long multi-clause directions, harmonized iconography and line weights, and corrected two mislabeled arrows in the heat transfer schematic. These edits reduce cognitive noise and keep attention on reasoning about mechanisms. The goal was not to beautify pages but to prevent visual inconsistencies from masking the intended ideas. Table 5 presents the quantitative results for this review and documents the basis for the targeted graphical corrections applied to the module.

Table 5. First-round media validation of the student module

Component	Percentage (%)	Category
Language	84	Very good
Graphics	73	Good
Mean	**78.5**	**Good**

A second content validation of the companion book measured whether prior edits improved enactment guidance. The mean remained at 75 percent, with both content and presentation rated "good." Reviewers judged the material serviceable, while recommending richer use of measurable observations. We responded by appending optional temperature probe activities and inserting prompts that press for explicit evidence, for example identifying which observation signals convection and why. The stable mean indicates adequacy without overclaiming. It also clarifies where subsequent classroom work should concentrate, namely on making evidence gathering routine. Table 6 provides the companion book's second-round content scores that guided these additions and frames the next steps for strengthening evidence-centered discussion.

Table 6. Second-round content validation of the companion book

Component	Percentage (%)	Category
Content feasibility	75	Good
Content presentation	75	Good
Mean	**75**	**Good**

The second content validation of the student module showed marked improvement after scaffolds were added. The average rose to 87.5 percent in the "very good" band, with content at 88 percent and presentation at 87 percent. Reviewers noted that the re-sequenced tasks and evidence frames made the pathway from observations to claims more transparent. Remaining edits were minor: smoothing page turns, removing one redundant image, and ensuring every activity culminates in a written claim justified by at least one observation. These refinements aim to keep momentum without diluting accountability to evidence. Table 7 summarizes these improved scores and supports the conclusion that the module's content structure is now classroom-ready for limited try-out.

Table 7. Second-round content validation of the student module

Component	Percentage (%)	Category
Content feasibility	88	Very good
Content presentation	87	Very good
Mean	**87.5**	**Very good**

The companion book's second media validation confirmed gains in legibility and visual support. The average reached 85.5 percent in the "very good" band. Typography scored 93 percent, images 80 percent, media function 88 percent, and media benefit 81 percent. These values indicate that the earlier photo replacements, contrast adjustments, and caption standards achieved their purpose. Remaining polish involved harmonizing header levels, tightening a crop on one figure to highlight the relevant surface, and locking templates for captions and numbering to prevent drift in future edits. Table 8 details these outcomes and documents that the companion book's visual system is adequate for feasibility-stage use in classrooms.

Table 8. Second-round media validation of the companion book

Component	Percentage (%)	Category
Typography	93	Very good
Imagery	80	Good
Media function	88	Very good
Media benefit	81	Very good
Mean	**85.5**	**Very good**

The second media validation for the student module produced a stable profile suitable for classroom deployment. The overall mean was 83 percent, classified as "very good," with language at 81 percent and graphics at 85 percent. Final harmonization standardized two captions and confirmed that print-ready and AnyFlip exports preserved layout fidelity. These results, together with the improved content scores, indicate that the module advanced from "good" to "very good" across both dimensions, while the companion book reached "very good" on media and remained "good" on content. Table 9 presents the student module's second-round media results and closes the feasibility argument for proceeding to limited try-out in a subsequent phase.

Table 9. Second-round media validation of the student module

Component	Percentage (%)	Category
Language	81	Very good
Graphics	85	Very good
Mean	**83**	**Very good**

The second-round media results for the student module (Table 9) indicate a classroom-ready visual and linguistic standard, but they do not guarantee learning gains. The language score suggests instructions are sufficiently clear to support task execution, while the graphics score shows that diagrams now carry meaning without distracting conventions. These judgments rest on two expert reviewers and rubric scope, so they should be treated as feasibility evidence, not proof of impact. The appropriate next step is a limited implementation that tracks how students actually use diagrams and prompts, pairs tasks with short concept checks on heat and temperature, and examines whether evidence-based explanations appear without heavy teacher prompting.

Teacher response

The teacher response survey was used to judge classroom feasibility and perceived usefulness of the companion book. The physics teacher rated practicality at 94% and perceived effectiveness at 91%, yielding a mean of 92.5%, which falls in the "very good" band (81–100%). These scores suggest that the companion book is easy to operate in real class conditions (clear structure, workable pacing, and accessible navigation) and that it is viewed as capable of supporting lesson goals. Because the evidence comes from a single respondent, the claim is bounded: it shows strong perceived fit in this setting, not general effectiveness. Still, the alignment between high practicality and high perceived benefit supports proceeding to limited classroom try-out. Table 10 summarizes the results of teacher response to the P5 companion book.

Table 10. Teacher response to the P5 companion book

Component	Percentage (%)	Category
Practicality of the companion book	94	Very good
Perceived effectiveness	91	Very good
Mean	**92.5**	**Very good**

The student module received similarly positive judgments, with a notable pattern across dimensions. The teacher rated practicality at 88% and perceived effectiveness at 94%, giving a mean of 91% in the "very good" band. This suggests the module is slightly less effortless to run than the companion book, yet it is viewed as even more promising for advancing lesson aims, likely due to the evidence-focused prompts and clearer progression from observation to explanation. We note an inconsistency in the narrative source that re-stated practicality as 94% and the mean as 94%; our analysis follows the tabulated data (88%, 94%, mean 91%) to avoid overstatement. These scores justify piloting with brief concept checks to see whether perceived benefits translate into learning. Table 11 presents the module results.

Table 11. Teacher response to the P5 student module

Component	Percentage (%)	Category
Practicality of the module	88	Very good
Perceived effectiveness	94	Very good
Mean	**91**	**Very good**

The first-round content review of the student module (Table 3) places the product in the "good" band with a mean of 76%, combining 78% for content feasibility and 74% for content presentation. This profile signals that core ideas and examples were present but that the pathway from observation to disciplinary explanation was not yet tight. Reviewer notes converged on prompts that tended to remain descriptive, leaving the intended heat-transfer mechanism implicit. In response, the module was revised to include claim–evidence–reasoning frames, margin cues that tie photographs to conduction, convection, or radiation, and a reordering of two activities so students first observe, then annotate, and finally justify a written claim. These edits target the documented gap between context and concept without expanding page count.

Student perceptions

A perception survey was administered to 30 Grade XI students to judge the student-facing quality of the validated module. Ratings used five categories (very good, good, fair, poor, very poor) and targeted three aspects: learning material, language, and overall module feasibility. Scores place the module in the "very good" band, with the learning material component highest at 90 percent, followed by language at 88 percent and feasibility at 86 percent. These values suggest that students find the content clear and the writing accessible, and they view the module as workable in class. This is perception data, so it signals usability rather than learning gains. The quantitative summary is presented in Table 12.

Table 12. Student perceptions of the P5 module

Component	Percentage (%)	Category
Learning material	90	Very good
Language	88	Very good
Module feasibility	86	Very good
Mean	**88**	**Very good**

The pattern shows that learning material scored the highest, language followed, and feasibility came next. This ordering is reasonable, since feasibility depends on pacing, task load, and classroom routines that students experience unevenly. The results justify a limited pilot with brief concept checks to test whether positive perceptions coincide with evidence-based explanations on heat and temperature. Limits remain: a single school, self-reported ratings, and no triangulation with performance data. These limits call for cautious interpretation and for pairing future trials with short outcome measures and observation notes on how students actually use diagrams and prompts.

This study positioned the development of ethnoscience-integrated P5 materials squarely as research and development that examines feasibility through descriptive percentages from validators and users. That stance is methodologically modest and consistent with the idea that early R&D asks whether a product is sound enough to use, not whether it changes outcomes (Rokhim et al., 2020). The data reported here support a narrow conclusion: the companion book and the student module achieved ratings in the good to very good range across content and media, and teachers and students at the study site viewed them as usable and valuable for P5 activities on heat and temperature. Any claim beyond that would outpace the design.

A first set of results arises from the Analysis stage. Test records showed an average physics score of 58 at the site, which is below mastery. On its face, a single average cannot diagnose which concepts are fragile, yet the teacher interview and diagnostic probe triangulate to heat and temperature as a recurring problem. The teacher attributed weak participation to theory-heavy delivery that was not tied to everyday experience. That interpretation is plausible rather than proven, but it aligns with the observation that students often "finish the activity" without building explanatory links. The diagnostic result that 42 percent could relate steps in *kerupuk panggang* production to conduction, convection, and radiation suggests that many students lack a schema that connects observation to model. The patterns are directional, not definitive, yet they justify a design that makes the observation-to-explanation path explicit for heat transfer. Prior work that argues for contextualized thermodynamics in familiar practices is consistent with this reading, though it does not compel it (Safitri et al., 2024).

The student motivation profile added a second line of evidence. Sixty-three point three percent of students reported "good" motivation when lessons connected to real life. Self-reports can overstate classroom behavior, yet the ordering of evidence here matters: motivation was stronger when the context was familiar and discussable. Observations from small-group administration of the questionnaire indicated that attention and participation rose when students could reference daily heating phenomena and talk through them with peers, which echoes classroom reports that authentic contexts invite engagement when the talk is structured (Tabina et al., 2024). The study does not test whether motivation translates to understanding, but the profile helps explain why a design that leans on a culturally salient cooking process might be received positively by students.

A third anchor is the environment scan. Classrooms, boards, and projectors were available, but there were no P5 materials that tied local wisdom to physics. The absence of such materials is not a proof of need by itself, yet it describes a structural gap that can explain why projects skew toward making products rather than explaining phenomena. In that sense, feasibility for new materials depends less on technology and more on whether the materials provide concrete prompts, diagrams, and short tasks that ask for evidence-based claims. The present products were built to address that precise gap.

The Design choices follow directly from these analyses and can be evaluated through the validation results. The companion book was organized to move from cultural context to process to mechanistic explanation. The student module mirrored that arc, but operationalized it through tasks. The core design move was to insert claim-evidence-reasoning frames, margin cues that tie photographs to the specific heat-transfer mechanism, and a re-sequencing that requires observation before annotation and explanation. This is a defensible interpretation of what it would take to help students build a bridge from practice to principle, even if it is not the only possible interpretation. The select literature that links ethnoscience to science literacy gains and engagement supports such an approach, although the strength of evidence varies across studies (Kriswanti et al., 2020; Marsithah & Jannah, 2024; Lestari et al., 2024).

Validation outcomes provide the clearest quantitative view of what the design achieved. On content, the student module moved from 76 percent to 87.5 percent, a shift that coincided with adding evidence frames and revising sequence. The simplest reading is that the revised prompts and representations made the intended reasoning pathway more legible to experts who judge alignment and clarity. On media, the module's language and graphics reached 83 percent in round two, which indicates that instructions were clear enough to follow and diagrams were coherent enough to carry meaning. None of this demonstrates that students will learn more, but it does show that the representations and prompts do not, in themselves, obscure the target ideas.

The companion book shows a different profile. Media rose to 85.5 percent after image replacement, contrast adjustments, and caption standards, while content held at 75 percent in the good band. This asymmetry has a straightforward explanation. Legibility fixes are largely mechanical and respond quickly to targeted edits. Content scores, by contrast, depend on whether examples and prompts press teachers to surface evidence about mechanism rather than to narrate the process. Validator notes pointed to a need for clearer use of measurable or observable indicators. The manuscript additions addressed that critique by adding optional measurement tasks and evidence-press questions. The result is a product that is easy to read and serviceable in guidance. That is neither a weakness nor a triumph; it reflects the book's role as a support for enactment rather than a script for instruction.

Teacher and student responses triangulate the expert judgments from a user perspective. The teacher rated the companion book at 92.5 percent and the module at 91 percent in the very good category, with a pattern that is intelligible. The book scored slightly higher on practicality, which is consistent with its function as a planning and facilitation aid, while the module scored slightly higher on perceived effectiveness, which fits a task set that pushes students to make and justify claims. It would be a mistake to read these scores as proof that the materials cause better learning, but they do indicate that, in a real classroom rhythm, the products are seen as workable and useful for lesson aims. This reading also fits with policy arguments that emphasize contextualization and local wisdom within P5, as long as the connection to disciplinary reasoning is explicit rather than decorative (Rahma & Hindun, 2023).

Student perceptions tell a compatible story. An average of 88 percent across learning material, language, and feasibility places the module in the very good band. The ordering of components is informative rather than surprising: learning material scored highest, language followed, feasibility came next. Students appeared to value the substance and could understand the prose, while feasibility reflects pacing and routines that are shaped by class context. These ratings align with the idea that anchoring tasks in a familiar practice can support interest and sense-making, a point reported in other ethnoscience-context modules as well (Nihwan & Widodo, 2020; Jumriati et al., 2023). Again, the data speak to usability and perceived clarity, not to concept gains.

A note on the physics modeling inside the products is warranted, because choices about idealization influence how students read examples. The companion book includes a worked idea that treats heat during grilling under a simplifying assumption to make a calculation tractable. Such idealizations are standard in introductory thermodynamics and can be pedagogically useful if marked as assumptions rather than as literal truth. Validators did not flag this as a flaw, but the point bears mentioning, since careless language about "no heat lost to the environment" can mislead. The manuscript labeling keeps the assumption visible as a modeling step, which is a reasonable way to avoid confusion while keeping the worked idea short and teachable (Faisal et al., 2024).

The choice to deliver both products as digital flipbooks is not a result in itself, but it affects how other results should be read. Validator comments tied gains in legibility to figure–text proximity, which the flipbook format preserved across devices. Teacher practicality ratings likely reflect this frictionless navigation, since flipping to a figure that is divorced from its caption can slow a lesson. At the same time, the flipbook format does not create clarity by magic. It can only preserve what the layout and writing already achieve. The media scores therefore credit both the layout decisions in design and the stability of that layout in delivery.

Situating these findings in the literature helps gauge how unusual or expected they are. Reports that ethnoscience-based materials support engagement and aspects of science literacy are not new, and several studies have documented positive classroom reception for modules tied to local practices (Kriswanti et al., 2020; Marsithah & Jannah, 2024; Nihwan & Widodo, 2020; Jumriati et al., 2023). The present results neither confirm nor challenge those outcome claims. What they do is fill a gap in topic specificity and product detail. The materials target senior high school heat and temperature, and they operationalize contextualization through concrete representational supports and prompts. In that sense, the study shows how the general argument for ethnoscience within P5 can be translated into task designs that validators and users judge to be coherent and usable.

The R&D framing also aligns with methodological guidance that descriptive summaries are adequate for judging feasibility in the absence of an intervention design (Rokhim et al., 2020). The use of percentage bands to classify products as very poor through very good provides a stable way to talk about readiness without drifting into claims about causation. This matters for how the current results should be read. A validator's 87.5 percent on content does not imply that students will achieve at a rate that reflects that number. It implies that, in the expert's judgment, the materials represent the intended ideas clearly and align with their goals. The teacher and student ratings then show that these materials are experienced as usable and clear in the specific setting studied.

One can also read the asymmetries across products as a function of role. The companion book is a guidance tool. It improved most on media because legibility and layout are the levers that guidance tools can pull quickly. Its content rating at good is consistent with a document that points teachers toward lines of questioning and optional measurements rather than scripting every move. The student module is an enactment tool. It improved most on content because the core of the revision was to make students write claims supported by observations, a change that validators see as conceptual alignment rather than as polish. In that interpretation, the two products are doing the different jobs they were built to do.

Finally, the findings speak to the specific value of using *kerupuk panggang* as a context for heat and temperature. The context is not a generic "local wisdom" placeholder. It is a sequence of steps that expose distinct heat transfer mechanisms in ways that students can see and discuss. The validation comments and the user ratings suggest that this concreteness made it easier to tie an observation to a mechanism when the prompt demanded it. This does not elevate cooking above other possible contexts. It says that, for this site and topic, a familiar cooking practice provided a tractable substrate for tasks that press for evidence. That point is substantive because it clarifies which feature likely drove the positive feasibility profile: not culture as a theme, but culture as analyzable procedure that maps to disciplinary models.

In summary, the study's results show that the developed materials achieved expert ratings from good to very good on content and media, that teachers judged the products practical and capable of supporting lesson goals, and that students perceived the module as clear, readable, and workable. The patterns across Analysis, Design, and Development are coherent: local need was documented, designs addressed the specific missing bridge from observation to explanation, and validators and users recognized those features in the products. The claims remain bounded by the R&D scope. They concern feasibility and clarity in one setting for one topic. Within that boundary, the findings are internally consistent and compatible with prior arguments for ethnoscience in P5 when cultural processes are explicitly mapped to scientific mechanisms.

CONCLUSION

This study produced two ethnoscience-integrated P5 products for the senior high school heat and temperature unit: a teacher's companion book and a student module anchored in the *kerupuk panggang* production process. Development followed the ADDIE pathway through three phases completed in this work: Analysis (needs, learner characteristics, prerequisite understanding, and learning environment), Design (scope and sequence, storyboard, and product specifications), and Development (realization as digital flipbooks via AnyFlip). The products underwent expert validation for content and media, then were appraised by one physics teacher for practicality and perceived effectiveness, and by 30 Grade XI students for clarity, language, and feasibility.

Feasibility and usability indicators were consistently strong. Expert validation placed both products in the "very good" category for overall feasibility. Teacher responses rated the companion book at a 92.5 percent mean and the student module at 91 percent, each classified as very good. Student perceptions of the module averaged 88 percent across learning material, language, and feasibility, also very good. Taken together, these results indicate that the materials are clear, workable, and contextually appropriate for P5 activities on heat and temperature in this setting. Claims are limited to feasibility and practicality; effectiveness on learning outcomes was not assessed in this phase.

RECOMMENDATION

Future work should extend the unfinished ADDIE stages to include implementation and evaluation so that product effectiveness can be measured with learning evidence rather than feasibility ratings. The companion book would benefit from a deeper treatment of physics concepts embedded in the *kerupuk panggang* process, with clearer links between observations and the mechanisms of conduction, convection, and radiation. Comparative development using other traditional foods could test whether the ethnoscience integration remains coherent across contexts and topics. For product quality, images should be sourced from high-resolution, author-owned documentation to ensure clear, accurate visuals in both print and digital formats.

ACKNOWLEDGEMENT

The authors thank Universitas Jambi, the academic supervisor, and all colleagues and community members whose guidance and support made this study possible.

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