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DESIGN AND DEVELOPMENT OF PBL-BASED PHYSICS E-BOOK INTEGRATING LAMPUNG'S CLASSICAL GUITAR LOCAL WISDOM FOR SOUND WAVES CONTENT IN GRADE 11

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ABSTRACT

This ADDIE-based R&D project produced an 11th-grade physics e-book on sound waves integrating Lampung's classical guitar heritage to support the Merdeka Curriculum in West Tulang Bawang Regency, addressing limited contextual resources. Data collection utilized Harwell and Gatti's four-point scale, interpreted via ideal mean (Mi) and ideal standard deviation (SBi) calculations. Evaluation involved two expert validators, four physics teachers, and 36 SMAN 2 Tumijajar students. Content validation averaged 94.85 (valid), and media validation scored 66.00 (valid). Practicality assessment by three physics teachers averaged 34.17 (practical), while student readability reached 114.08 (good), meeting the criterion $\bar{X}i < X \leq \bar{X}i + 1.5$ SBi. These results prove the e-book meets validity and usability criteria, using the Lampung classical guitar to bridge physics and student culture. Consequently, this book can be widely adopted by physics teachers for concrete ethnophysics instruction and serves as a recommendation for policymakers to conduct periodic teacher training in developing digital materials based on local wisdom.

Keywords: physics e-book, local wisdom of the Lampung classical guitar, sound waves

INTRODUCTION

Within Indonesia, substantial educational restructuring is underway to respond to twenty-first-century demands. Learning environments in this era require mastery of the 6Cs, namely critical thinking, creativity, collaboration, communication, character, and citizenship, enabling students to engage in deep learning through discovery and mastery of existing knowledge (Fullan & Langworthy, 2014). Strengthening these competencies remains essential because they equip students to confront challenges and resolve problems more effectively. Growing recognition of twenty-first-century competencies has encouraged diverse initiatives aimed at embedding them into curricular activities, including adoption of the PBL instructional approach (Molla *et al*., 2023). Evidence has confirmed that PBL effectively cultivates advanced thinking abilities, thereby fulfilling contemporary educational expectations (Saavedra *et al*., 2012). At the secondary-school level, physics instruction requires learning resources that extend beyond conceptual delivery and actively support advanced reasoning alongside problem-solving competence. When incorporated systematically into modules or classroom instruction, the PBL approach has demonstrated positive contributions to conceptual mastery, problem-solving capacity, learning participation, and physics achievement among students (Shishigu *et al*., 2018).

The Problem-Based Learning (PBL) model in high school physics has been shown to be more effective at improving conceptual

understanding, learning outcomes, and problem-solving skills than traditional methods. A systematic review demonstrates the positive impact of PBL on academic achievement, critical thinking, and science process skills (Gumisirizah *et al*., 2024). International case studies in Uganda and Nigeria demonstrate that PBL significantly improves students' problem-solving skills and conceptual understanding of topics such as simple machines, forces, motion, and mechanical waves (Kanyesigye *et al*., 2022; Sarkingobir & Bello, 2024; Uwamahoro *et al*., 2024). The effectiveness of PBL in the classroom is further optimized when integrated with supporting tools such as worksheets, modules, e-modules, and digital simulations like PhET (Simangunsong *et al*., 2024). Nevertheless, the successful implementation of PBL in various countries remains highly dependent on teacher readiness, contextual support, learning culture, and the provision of adequate scaffolding for students (Al-kamzari & Alias, 2025).

One important element within the Merdeka Curriculum is the Pancasila Student Profile, designed to prepare students as democratic, accomplished, and productive citizens suited to twenty-first-century society. This profile consists of six principal dimensions: faith and devotion accompanied by noble character, appreciation of culture, mutual cooperation, independence, critical reasoning, and creativity (Satria *et al*., 2022). Synergy between the Merdeka Curriculum and the PBL approach has demonstrated effectiveness in strengthening students' critical reasoning abilities (Ariyatun & Octavianelis, 2020). Beyond critical thinking, implementation of PBL has also contributed to improvements in collaboration, creativity, and communication competencies among students (Ersoy & Başer, 2014; Hartina *et al*., 2022; Hasmiati *et al*., 2018; Mardiyanti, 2020).

Simultaneously, progress in information technology has accelerated movement from conventional instructional resources toward digital formats such as e-books and e-modules. E-books structured around PBL encourage active student collaboration, supporting dimensions of the Pancasila Student Profile, particularly cultural appreciation. Technological integration within e-books further broadens access to varied learning sources, allowing students to investigate global issues through a critical lens (Ratnawati *et al*., 2024). Numerous investigations have indicated that interactive physics e-books enriched with animations, videos, virtual experiments, exercises, and self-evaluation features are highly appropriate, attractive, and effective for strengthening conceptual comprehension and academic achievement among secondary-school students (Adam & Suprapto, 2019).

The Problem-Based Learning (PBL) model rooted in local culture frames the sound phenomena of the Lampung classical guitar as a contextual problem closely tied to students' experiences, so that the study of sound waves is no longer limited to abstract formulas but stems from real phenomena that can be observed, heard, and analyzed (Aurelia *et al*., 2023). Within this framework, the integration of ethnophysics serves as a contextual stimulus that facilitates students' reconstruction of physics knowledge, as traditional musical instruments provide a bridge between scientific concepts—such as frequency, resonance, amplitude, timbre, and organ pipes—and cultural experiences that are

already familiar to them (Fajar *et al*., 2023; Naba *et al*., 2024).

Conceptually, the relationship between PBL, culture-based learning, and the understanding of sound wave concepts can be explained through the following framework: PBL provides a problem-based learning structure, while ethnophysics based on the traditional Lampung classical guitar provides an authentic problem context; together, these two elements encourage students to investigate sound sources, vibrations, frequencies, resonance, intensity, and the characteristics of the sound spectrum through meaningful situations (Aurelia *et al*., 2023; Harahap *et al*., 2023; Rahmat *et al*., 2023). A number of studies indicate that traditional musical instruments do indeed incorporate comprehensive concepts of sound waves and are suitable as learning resources, such as the Tamburu, which represents sound sources, wave types, frequency, timbre, resonance, and open pipes, as well as the gamelan and Javanese instruments, which incorporate vibration, frequency, amplitude, resonance, and damping (Naba *et al*., 2024; Saputra *et al*., 2025). Therefore, when students are presented with authentic problems—such as why the pitches produced by a guitar's strings or its soundbox differ—they are encouraged to test, discuss, and revise their initial understanding based on empirical evidence, rather than simply accepting the teacher's explanation.

The cognitive mechanism that explains the improvement in learning outcomes lies in the role of local culture as a concrete context that bridges abstract concepts with students' sensory and social experiences. Evidence from various developments in media, modules, worksheets, and videos shows that the integration of local musical instruments helps students connect wave theory with real-world phenomena, making learning easier to understand, more engaging, and more relevant to daily life (Anwar *et al*., 2026; Nartiya *et al*., 2022). From the perspective of meaningful learning, local contexts strengthen the process of assimilating new knowledge, help information be retained longer, and facilitate further learning on similar concepts (Afrizon *et al*., 2020). This aligns with findings that learning based on local wisdom can shift students' views of physics from a collection of formulas to a science relevant to their lives, while also fostering an appreciation for their own culture.

Therefore, PBL based on local culture through the Lampung classical guitar can be positioned as a pedagogical framework that brings together authentic problems, cultural contexts, and the construction of scientific concepts. Within this framework, local musical instruments are not merely illustrations but vehicles for inquiry that help students reconstruct their understanding of sound waves in a more meaningful, contextual, and scientific way while simultaneously strengthening their cultural identity (Naba *et al*., 2024; Wilujeng *et al*., 2019).

From the preceding discussion, a notable gap becomes evident. Although interactive physics e-books, sound-wave learning media, PBL-oriented resources, and local-wisdom-based instructional materials have been produced in multiple regions, no Grade 11 sound-wave physics e-book integrating Lampung local wisdom is currently available. Accordingly, this project seeks to create and develop a PBL-oriented physics e-book utilizing Lampung classical guitar heritage as both the problem context and the source of sound-wave phenomena. Through this approach, the project intends to provide a digital, contextual, and culturally grounded

learning experience while strengthening students' conceptual understanding.

METHOD

This research and development (R&D) project applies a modified version of the ADDIE framework introduced by (Branch, 2009), encompassing the analysis, design, development, and implementation phases, as well as formative evaluation conducted continuously at each stage. Data collection in this study was supported by a questionnaire that had undergone a rigorous validation and reliability testing process to ensure the quality of the data obtained. Item validation was conducted through content validity analysis by two experts to review the accuracy, appropriateness of the material, and linguistic clarity of each statement before the instrument was distributed. After revisions based on expert input, the internal consistency of all questionnaire items was measured using Cronbach's Alpha reliability test, which yielded a coefficient value above the minimum reliability standard threshold; thus, the instrument was deemed highly reliable and suitable for accurately measuring the effectiveness of instructional materials in the class.

During the analytical phase, attention centered on three principal dimensions: student needs, curriculum requirements, and local wisdom. Needs identification was conducted through structured interviews involving four physics teachers and Grade 12 students from five schools within West Tulang Bawang Regency. These findings were reinforced through questionnaire distribution, which revealed a shortage of physics learning modules incorporating local cultural contexts. Curriculum examination subsequently identified sound waves as the topic most compatible with Lampung classical guitar heritage. This topic displayed natural alignment with Phase F learning outcomes within the Merdeka Curriculum. Lastly, exploration of local wisdom was carried out through literature examination and direct observation of Lampung classical guitar preservation and practice within the Tulang Bawang Barat community. This activity aimed to uncover cultural values and scientific concepts relevant for incorporation into the syntactic stages of the PBL approach.

The development process for this educational resource began with a design phase that included preparing the e-book framework and storyboard, developing research instruments, and creating instructional content based on the five stages of Problem-Based Learning (PBL). Within this structure, the cultural heritage of the Lampung classical guitar was integrated as the problem-triggering context at the beginning of each lesson. Moving into the development phase, the conceptual design was transformed into a concrete product in the form of a PBL-oriented physics e-book. The product's feasibility was then assessed by two expert validators and four physics teachers using a four-point Likert scale, after which it underwent repeated revisions until it was deemed ready for field application.

Next, the implementation of learning with e-books is divided into three main activities. The lesson begins with a 10-minute introductory activity. At this stage, the teacher opens the lesson, takes attendance, provides an overview and motivation, and communicates the learning objectives. Next, the 70-minute core activity is conducted using four syntaxes of the Problem-Based Learning (PBL) model. The first phase is orienting students to the

problem, in which the teacher provides stimuli in the form of images and scenarios from the e-book so that students can identify the problem and formulate questions. The second phase is organizing students for learning, which is done by guiding them to study the introductory material on the Lampung classical guitar and sound waves in the e-book.

The third phase—guiding the investigation—involved dividing students into groups of 5–6 members to complete tasks on the Student Worksheet. This phase was followed by the fourth phase: developing and presenting their work through group presentations and question-and-answer discussions. The learning process concludes with the fifth syntax, which involves analyzing and evaluating the problem-solving process for 10 minutes. In this closing session, the teacher helps students reflect on the results of their investigation, provides information on the next learning session, and concludes the class.

Implementation activities took place at SMAN 1 Tumijajar and SMAN 2 Tumijajar through two forms of testing. The first involved a pilot investigation intended to examine student perceptions regarding quality, readability, clarity, and usefulness of the physics e-book integrating both the PBL approach and Lampung classical guitar heritage. This stage engaged a small group consisting of 36 students from Class XI IPA 1 and was conducted at SMAN 2 Tumijajar. Concurrently, a practicality assessment involving three physics teachers from both institutions was also administered.

The second stage consisted of a field trial intended to examine the effectiveness of the physics e-book learning medium that combined the PBL approach with Lampung classical guitar heritage in promoting critical-thinking abilities and strengthening appreciation of culture within the sound-wave topic. Five sessions comprised the field trial, beginning with a pretest and ending with a posttest designed to capture students' initial and final understanding levels regarding sound-wave concepts. Throughout implementation, teachers functioned primarily as facilitators and intervened only when students experienced technical difficulties accessing the e-book through their devices. All participants utilized personal devices to access the module. Information obtained from the pretest and posttest served as supporting evidence for a preliminary appraisal of effectiveness, although a comprehensive effectiveness evaluation remained outside the scope of this project.

Data processing in this project focused on two assessment domains, namely validity and practicality. Evaluation within both domains employed the ideal mean (Mi) and ideal standard deviation (SBi) procedures proposed by Widoyoko (2011). In this scheme, Mi equals one-half of the sum between the highest ideal score and the lowest ideal score, whereas SBi equals one-sixth of the difference between those two values. Benchmarks used for interpreting validity and practicality outcomes appear in Table 1.

Tabel 1. Validation and Practicality Score Conversion Criteria

Score Range	Category
$X \geq \bar{X}_i + 1{,}8\, SBi$	Very Valid/Practical
$\bar{X}_i + 0{,}6\, SBi < X \leq \bar{X}_i + 1{,}8\, SBi$	Valid/Practical

Source: (Widoyoko, 2011)

The e-book attained acceptance as a valid instructional product whenever its achievement reached, at minimum, the Valid classification. Threshold values applied to every assessment instrument are summarized in Table 2.

Table 2. $\overline{X_i}$, SBi, and X

Instrument	N	Max	Min	$\overline{X_i}$	SBi	X
Physics Teacher Practically	3	37, 56	24	30, 78	2,26	34, 17
Student Readability	36	132, 78	81	106, 89	8,63	114, 08

Practical feasibility was recognized only when the e-book achieved at least the Very Practical classification.

Score Range	Category
$\overline{X_i} - 0{,}6\,SBi < X \leq \overline{X_i} + 0{,}6\,SBi$	Fairly Valid/Practical
$\overline{X_i} - 1{,}8\,SBi < X \leq \overline{X_i} - 0{,}6\,SBi$	Less Valid/Practical
$X < \overline{X_i} \leq \overline{X_i} - 1{,}8\,SBi$	Not Valid/Practical

RESULT AND DISCUSSION

3.1 E-Book Development

An eleventh-grade physics e-book addressing sound-wave concepts through a Problem-Based Learning orientation and incorporating Lampung classical guitar heritage was generated through this project. Canva served as the development platform, allowing the product to be accessed either online or offline through hyperlinks and QR codes. Its organization follows a structured arrangement consisting of introductory sections covering the cover page, contents list, user guide, and competencies; core sections containing learning materials, example tasks, worksheets, and evaluations; and closing sections presenting a glossary, references, and author profile. Content delivery follows the sequence of the PBL framework and is organized into four interconnected units designed to blend sound-wave concepts with knowledge related to the Lampung classical guitar tradition.

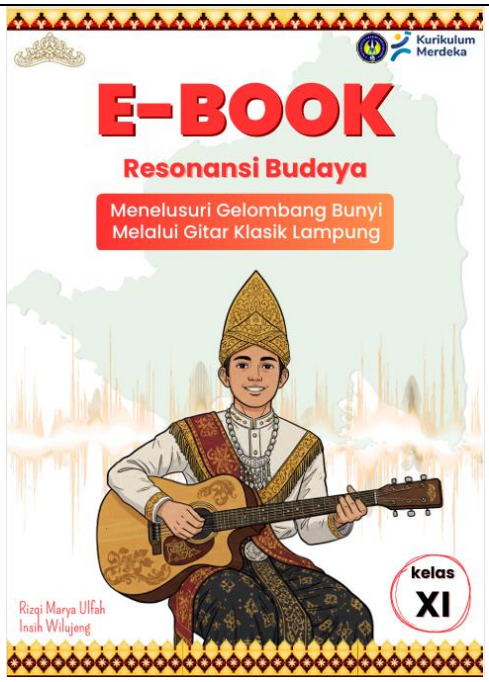


Figure 1. Cover Page Display

In the first phase of Problem-Based Learning (PBL)—namely, orienting students toward a problem (Arends, 2015)—the e-book presents the phenomenon of sound waves as they relate to the Lampung classical guitar. This phenomenon is aligned with the learning material in each chapter and presented through illustrations and contextual narratives. This stimulus is designed to guide students in formulating critical questions regarding the connection between the Lampung classical guitar and the topic of sound waves. Furthermore, in the second phase—organizing students to learn (Arends, 2015)—the e-book not only presents textual content but is also supplemented with images, illustrations, and interactive graphics. When these

interactive images are clicked, students are immediately directed to a YouTube and PhET Simulation page to deepen their understanding. So far, it can be seen that in the e-book, the local wisdom of the Lampung classical guitar is the main topic of discussion, and it helps students understand the material not just from textbooks but by providing real-world examples of how sound wave concepts are contextualized in their immediate surroundings.



Figure 2. Sample Learning Session Display

Later phases within the PBL sequence, including investigation activities, product development and presentation, together with reflection and evaluation of solutions, were implemented through independent assignments, inquiry-oriented collaborative worksheets, and reflective learning tasks. These activities encouraged students to connect scientific understanding with local cultural knowledge and personal perspectives. Visually, the e-book adopts a color composition inspired by Lampung cultural identity, particularly gold and red tones, complemented by traditional clothing motifs and ornamental elements displayed throughout the pages.

3.2 Validation Results

Feasibility appraisal involved two expert validators, namely Dr. Tsania Nur Diyana, S.Pd., M.Pd. and Dr. Rita Prasetyowati, M.Si., both affiliated with the Master of Physics Education Program at Universitas Negeri Yogyakarta, together with four physics teachers. Interpretation of the validation outcomes followed the score-conversion criteria introduced by Widoyoko (2011).

3.2.1 Material Expert Validation

Table 3. Material Expert Validation Results

Assessment Criteria	Max	Min	$\overline{X_i}$	SBi	X
Content	42,98	27,00	34,99	2,66	38,70
Presentation	38,20	24,00	31,10	2,37	34,00
Language	23,88	12,00	17,94	1,98	22,15
Total					94,86

Table 3 shows that the developed e-book successfully achieved an overall "Valid" rating with a total score of 94.86. The language indicator recorded the highest average score, at 22.15. The content indicator followed with an average score of 38.70, confirming that the product's content is highly relevant and accurate. The presentation indicator rounded out the evaluation results with an average score of 34.00.

3.2.2 Media Expert Validation

Table 4. Media Expert Validation Results

Assessment Criteria	Max	Min	$\overline{X_i}$	SBi	X
Display	42,75	27,00	34,87	2,62	39,54
Usability	28,50	18,00	23,25	1,75	26,46
Total					66,00

Findings displayed in Table 4 indicate that the developed e-book obtained an overall classification of Very Valid with a cumulative score of 66.00. Among all indicators, usability achieved the strongest average value at 26.46, demonstrating that operation and access were considered highly convenient. Complementing this outcome, the presentation component produced an average score of 39.54. Collectively, these achievements verify that the product satisfies required standards and can be directly utilized within instructional activities.

3.3 Practicality Test Results

3.3.1 Physics Teacher Practically

Table 5. Teacher Practicality Test Results (N=3)

Aspect	R1	R2	R3	Total	Cat.
Readiness and Accessibility	8 (100%)	7 (87.5%)	7 (87.5%)	22 (91.7%)	Very Practical
Navigation and Ease of Use	7 (87.5%)	8 (100%)	8 (100%)	23 (95.8%)	Very Practical
Interactivity and Learning Support	8 (100%)	7 (87.5%)	8 (100%)	23 (95.8%)	Very Practical
Relevance to Learning Outcomes	7 (87.5%)	8 (100%)	7 (87.5%)	22 (91.7%)	Very Practical
Total	30 (93.8%)	30 (93.8%)	30 (93.8%)	90 (93.8%)	Very Practical

Every assessed dimension achieved placement within the Very Practical classification. Accumulating a total value of 90, equivalent to 93.8%, and surpassing the benchmark of 163.80 (Mi + 1.5 SBi), the e-book fulfilled the Very Practical criterion established by Widoyoko (2011). The strongest performance appeared within the Learning Outcome Relevance dimension at 91.7%, reflecting positive teacher perceptions regarding the integration of the Lampung Classical Guitar as a bridge between physics concepts and students' daily realities. These observations suggest that cultural integration functions not merely as supplementary content but as a meaningful instructional aid that assists educators in presenting scientific ideas within more contextual learning situations while strengthening student participation.

3.3.2 Student Readability

Table 6. Student Readability Test Results (N = 36)

Aspect	Items	Total Score	Max	%	Cat.
Layout	11	1473	1584	93	Very Practical
Language	2	271	288	94	Very Practical
Presentation of content and questions	7	938	1008	93	Very Practical
Completeness	5	674	720	94	Very Practical

Usability	2	279	288	97	Very Practical
Total	27	3635	3888	94	Very Practical

Students assigned the Very Practical classification to all five assessed dimensions. Usability received the highest percentage at 97%, indicating that students could operate the e-book independently without requiring further guidance. Completeness attained 94%, while Language likewise reached 94%, demonstrating that the Lampung Classical Guitar tradition effectively served as a contextual anchor connecting abstract sound-wave concepts with familiar cultural experiences. Layout achieved 93%, and Content and Question Presentation also recorded 93%.

In aggregate, the total score of 3,635 exceeded the established benchmark value of Mi + 1.5 SBi, confirming that the sound-wave physics e-book rooted in Lampung Classical Guitar heritage belongs within the Very Practical category regarding readability and usability (Widoyoko, 2011). This outcome reinforces the conclusion that the product possesses strong practicality characteristics for instructional implementation.

DISCUSSION

4.1 Validity

Product validity testing was conducted by a team of expert validators who evaluated three main aspects: content, presentation, and language. Based on the collected assessment data, an analysis was then performed to calculate the average score and determine the suitability category for each indicator. Details of the e-book's suitability validation results, specifically regarding content, can be found in Table 3.

Evidence presented in Table 3 reveals that the developed e-book secured an overall Valid classification with a cumulative value of 94.86. The language component generated the strongest average score at 22.15. Following this, the content component recorded an average of 38.70, indicating strong relevance and accuracy of the instructional material. The presentation component contributed an additional average score of 34.00. Collectively, these feasibility outcomes demonstrate that the product satisfies expected standards and is appropriate for educational use. Similar observations were reported by (Hasannah & Suprapto, 2021), who concluded that physics e-books receiving valid to highly valid judgments from content specialists possess substantial potential to foster higher-order thinking abilities, particularly critical reasoning.

Table 4 further demonstrates that the developed e-book achieved the Very Valid category with an accumulated score of 66.00. The usability dimension produced the highest average value of 26.46, indicating that users perceived access and operation as highly convenient. Meanwhile, the presentation dimension contributed an average score of 39.54, further strengthening the positive evaluation outcome.

The high validity of the PBL-based e-book and the Merdeka Curriculum stems from its design, which places students in contextual problem-solving scenarios; as a result, experts rated its usability and visual presentation as excellent. PBL-based e-book media have been proven to receive the "highly suitable/highly valid" category from validators and very positive feedback from teachers and students, as the PBL

steps, navigation, and problem presentation are systematically organized and easily accessible digitally (Naifah *et al*., 2025). The alignment with the Merdeka Curriculum is evident as the e-book is designed in accordance with the principles of differentiated, contextual, and scientific learning, making it highly suitable and effective in supporting the implementation of the Merdeka Curriculum in schools (Dwikoranto *et al*., 2023).

Incorporation of local cultural wisdom likely contributed substantially to the strong scores obtained for presentation and usability. Numerous investigations have reported that e-books grounded in local wisdom frequently achieve high levels of validity, practicality, and effectiveness while promoting student engagement, cultural literacy, and critical-thinking development (Rafidah *et al.*, 2024). Utilization of culturally familiar contexts enhances visual attractiveness and increases perceived relevance of the content, encouraging validators to assign elevated ratings to dimensions such as visual quality, contextual suitability, and ease of operation.

4.2 Practicality: Teacher Perspective

Teachers' assessment of practicality focused on four indicators: readiness and accessibility, navigation and ease of use, interactivity and learning support, and relevance to learning outcomes. The average scores from the teachers' evaluations for these four indicators were, in order, 91.7%, 95.8%, 95.8%, and 91.7%, resulting in a total of 93.8% and a rating of "very practical". The highly practical category indicates that the e-book was successfully implemented in the classroom and received a positive response. Field findings reinforced these metrics, as both teachers and students agreed that the e-book is user-friendly and easy to operate. Interview data further revealed that integrating sound-wave topics with the Lampung classical guitar made the physics concepts much easier to comprehend, a process significantly enhanced by the e-book's engaging and interactive features. The consistently high ratings given by teachers reinforce the conclusion that this e-book can be used in any school (Tanjung & Faiza, 2019).

The very high scores on the four practicality indicators can be attributed to the combination of the PBL approach, the context of Lampung's local wisdom regarding the classical guitar, and the nature of the sound wave material. The e-book's structure, which follows PBL steps and includes text, images, animations, and quizzes, makes it easy for students to access, navigate, and use the sound wave material; consequently, the readiness, accessibility, and ease-of-use aspects tend to be rated very highly by teachers (Fitri *et al.*, 2023).

Alignment between Lampung classical guitar heritage and sound-wave concepts associated with traditional musical instruments made examples and learning tasks more closely connected to students' experiences. This condition strengthened motivation and achievement in sound-wave learning while simultaneously being regarded as highly relevant by teachers (Uran *et al*., 2024). In addition, the PBL approach has consistently demonstrated effectiveness in improving achievement within sound-wave instruction, leading teachers to perceive the e-book not only as engaging and interactive but also as genuinely supportive of learning-goal attainment (Fitri *et al*., 2023).

Consistent achievement of the Very Practical classification indicates that the e-book can be implemented with minimal modification requirements. Such a characteristic represents a considerable advantage within the Merdeka Curriculum environment, where educators are granted extensive instructional autonomy while simultaneously carrying substantial responsibility for preparing learning resources. Availability of structured, contextualized, and immediately usable materials reduces the necessity for teachers to create local-wisdom-oriented lessons from the beginning, thereby easing instructional preparation demands.

4.3 Practicality: Student Perspective

Across all five assessed dimensions, students categorized the Lampung Classical Guitar-based sound-wave physics e-book as Very Practical. Usability obtained the strongest percentage at 97%, followed by Comprehensiveness and Language, each reaching 94%, while Presentation and Material-and-Question Presentation each attained 93%. The aggregate value of 3,635 exceeded the benchmark of Mi + 1.5 SBi, confirming that the e-book belongs within the Very Practical category with respect to readability and operational convenience.

Additional support emerged from students' written feedback, where many expressed enthusiasm upon encountering Lampung Classical Guitar traditions within physics instruction, describing the experience as more engaging and meaningful than conventional learning approaches. Students further reported that concepts such as frequency, amplitude, resonance, and pitch became easier to comprehend because explanations were connected to familiar local musical instruments and terminology associated with traditional Lampung guitars. These responses suggest that cultural familiarity plays a facilitating role in strengthening conceptual understanding within physics learning.

The high ratings given by students across all aspects of practicality indicate that the design of the sound wave physics e-book is truly well-suited to their needs. The highest Usage score (97%) can be explained by the fact that the e-book is structured like an interactive PBL sound wave e-module equipped with text, images, videos, animations, quizzes, exercises, and navigation that facilitate user interaction, making it feel very practical and comfortable to use independently (Fitri *et al*., 2023). The equally high scores for Comprehensiveness and Language (94%) align with the finding that the systematically developed sound wave e-module, which adheres to the curriculum, is deemed highly appropriate in terms of content and presentation, thereby helping to make difficult concepts easier to understand (Novitasari *et al*., 2022). High scores for Presentation of Content and Questions (93%) are also logical because visuals, examples, and problems are directly linked to local wisdom regarding traditional musical instruments—as demonstrated by the locally-based modules and e-booklets, which were rated as highly suitable and received very positive feedback from students (Uran *et al*., 2024). The integration of PBL into the sound wave material itself has been proven to significantly improve learning outcomes and student responses; thus, it is reasonable that the overall readability and usability scores of the Lampung Classical Guitar local wisdom-based e-book fall into the "Very Practical" category.

CONCLUSION

Overall, the development of a physics e-book based on Problem-Based Learning (PBL) that integrates the local wisdom of Lampung's classical guitar has proven to be valid and highly practical for use in teaching sound waves to 11th-grade students in support of the Merdeka Curriculum. The policy implication is the importance of integrating local wisdom into the national curriculum to ensure that academic content remains contextually relevant. To achieve widespread adoption, practical steps are needed, such as periodic teacher training in the development of digital teaching materials based on local wisdom, as well as the provision of technical support and practical guidelines for educators. As a recommendation for further research, large-scale trials should be conducted across various provinces to test the generalizability of the product, along with comparative studies with non-cultural e-books to conduct an in-depth analysis of the effectiveness of the integrated cultural aspects.

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