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Integrating Local Wisdom into Physics Learning: Developing an Android Application "Perahu Dayung" to teach Physics

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ABSTRAK

Penelitian ini bertujuan mengembangkan media pembelajaran fisika berbasis Android yang mengintegrasikan kearifan lokal *Perahu Dayung* untuk meningkatkan keterlibatan siswa dan pemahaman kontekstual terhadap konsep mekanika Newton. Pendekatan yang digunakan adalah *Research and Development (R&D)* dengan model *Four-D (Define, Design, Develop, Disseminate)*. Tahap *Define* dilakukan melalui observasi kelas, wawancara dengan guru dan siswa, serta studi literatur untuk mengidentifikasi kebutuhan belajar. Media dirancang melalui pembuatan storyboard dan prototipe antarmuka, kemudian dikembangkan menggunakan perangkat lunak Unity 3D. Validasi dilakukan oleh dosen fisika, guru, dan rekan sejawat. Uji coba terbatas melibatkan 10 siswa, sedangkan uji coba lapangan melibatkan 20 siswa kelas X di SMA Ferdy Ferry Putra Jambi dengan desain one-group pretest-posttest. Instrumen penelitian meliputi soal pretest-posttest dan lembar evaluasi produk. Aplikasi yang dihasilkan, *Fisika Asik*, memuat kuis interaktif, animasi, dan konten yang berakar pada budaya lokal. Hasil validasi menunjukkan kualitas tinggi pada aspek materi (4,6) dan media (4,4). Hasil belajar menunjukkan peningkatan sedang dengan nilai gain ternormalisasi sebesar 0,38. Media ini dinilai efektif, menarik, dan responsif terhadap konteks budaya. Penelitian lanjutan disarankan untuk memperluas uji coba dan pengembangan fitur.

Keywords: Media pembelajaran berbasis Android, Pembelajaran kontekstual, Hasil belajar, Kearifan lokal, Pendidikan fisika

ABSTRACT

This study developed an Android-based physics learning media integrating local wisdom—*Perahu Dayung* (Rowing Boat)—to improve student engagement and contextual understanding of Newtonian mechanics. Using a Research and Development (R&D) approach with the Four-D model (Define, Design, Develop, Disseminate), the study began with classroom observations, interviews, and literature review to identify learning needs. The media was designed with a storyboard and prototype, then developed using Unity 3D. Expert validation involved physics lecturers, teachers, and peer reviewers. Trials included 10 students (limited) and 20 tenth-grade students (field trial) at Ferdy Ferry Putra Senior High School, Jambi, using a one-group pretest-posttest design. Instruments included tests and evaluation sheets. The resulting app, *Fisika Asik*, features interactive quizzes, animations, and cultural content. Validation scores were high for content (4.6) and media (4.4). Learning outcomes showed moderate improvement with a normalized gain of 0.38. The results indicate the media is effective, engaging, and culturally relevant. Integrating local culture offers a contextualized learning approach. Further studies are recommended to expand testing and enhance features.

Keywords: Android-based learning media, Contextual learning, Learning outcome, Local wisdom, Physics Education

INTRODUCTION

The rapid advancement of technology in the 21st century presents significant challenges to the preservation of national culture, particularly in the face of modernization and westernization pressures (Ergashev & Farxodjonova, 2020). This global trend has been observed to influence younger generations, leading to a diminished understanding and appreciation of local cultural heritage (Hartono et al., 2022). One contributing factor is the limited integration of local culture into the formal education system, particularly in science education (Pornpimon et al., 2014; Tian et al., 2024). Many students today show a declining awareness and appreciation of local culture, as they tend to disregard cultural values and traditions, focusing instead on smartphone games, social media, and other digital distractions (Delogu & Greenier, 2025). This shift has contributed to a weakening connection between classroom learning and students' cultural identity. Despite Indonesia's rich and diverse cultural heritage (Fatmawati, 2021; Kieven & Antweiler, 2025), younger generations are increasingly drawn to foreign cultures due to the pervasive influence of globalization and digital technology. This shift poses a threat to cultural identity and underscores the need for educational strategies that foster cultural preservation and pride. One promising approach is the integration of local wisdom into science education. Physics, in particular, is often perceived as abstract and disconnected from everyday life, making it difficult for students to engage with and understand. Embedding cultural elements within physics instruction offers a contextualized learning experience that enhances both cultural appreciation and conceptual understanding.

Recent studies have shown that local wisdom-based learning in physics can significantly increase student interest, motivation, conceptual understanding, and higher-order thinking skills (Arisanti et al., 2024; Deta et al., 2024; Festiyed et al., 2024; Habibi et al., 2023; Mirsa et al., 2023; Nadzirin et al., 2024; Rofi et al., 2024; Rohmah et al., 2024; M. R. D. Saputra et al., 2025; Zaini et al., 2024). For instance, integrating traditional technologies or practices with scientific concepts enables students to relate content to their lived experiences. One such example is the traditional rowing boat (Perahu Dayung), still in use in regions such as Jambi Province along the Batanghari River. This traditional mode of transportation embodies several physics concepts such as Newton's Laws, fluid dynamics, work and energy, and power. As a cultural artifact, the rowing boat offers meaningful opportunities for contextual learning, especially for students in regions where this practice is familiar.

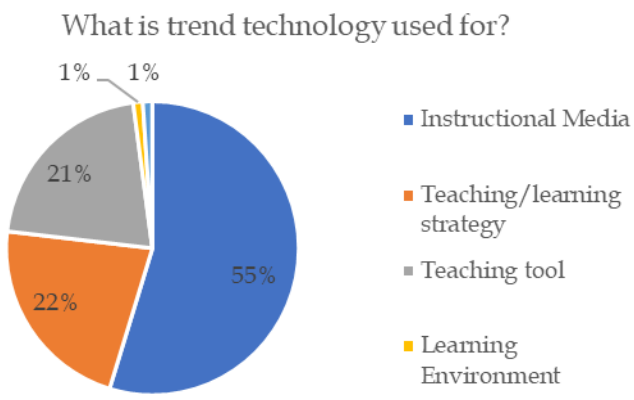


Figure 1. Trend technology used for (source: www.refoindonesia.com)

The integration of local wisdom into physics learning must also leverage technology to maximize its impact in the digital age (Al-Emran et al., 2020; Bernacki et al., 2020). A recent literature review conducted by PT. Reformasi Generasi Indonesia (REFO) analyzing 121 studies from 2021 to 2022 (figure 1) confirmed that technology is predominantly used as instructional media

(52.1%), followed by its role in teaching strategies (21.5%) and teaching aids (20.7%). Android-based mobile learning (AbL) presents a viable solution, offering accessibility, interactivity, and learner-centered design (Bano et al., 2018; Criollo-C et al., 2021; Lai & Bower, 2019). The increasing adoption of mobile learning and Android-based applications in physics education has demonstrated positive effects on student engagement and conceptual understanding (Crompton & Burke, 2018; Osman & Napeah, 2021; Pedro et al., 2018; Qureshi et al., 2020; Ubben et al., 2023).

Despite these promising trends, observations at Ferdy Ferry Putra Senior High School in Jambi reveal that the integration of mobile learning, particularly Android-based cultural media, remains underutilized. Although the school provides Wi-Fi access and permits electronic device use, physics instruction continues to rely on conventional approaches. Moreover, students exhibit low levels of conceptual understanding, as reflected in an average score of 65—below the passing threshold of 70. The absence of culturally integrated media, particularly in physics, highlights a critical gap in the learning process.

The selection of Perahu Dayung (Rowing Boat) as a representation of local wisdom in this study is grounded in its strong cultural relevance and contextual significance within the daily life of communities in riverine areas such as Jambi. This traditional mode of transportation reflects deep-rooted cultural practices and serves as an accessible real-life phenomenon that can be effectively linked to physics concepts, particularly Newtonian mechanic (Pornpimon et al., 2014). Incorporating Perahu Dayung into learning media not only contextualizes abstract scientific principles like force, motion, and acceleration, but also fosters cultural awareness and appreciation among students. By connecting physics content to familiar cultural practices, the media aims to increase engagement, deepen conceptual understanding, and support meaningful learning in line with contextual teaching and learning (CTL) principles.

Given these considerations, this study aims to develop an Android-based physics learning media that incorporates the local wisdom of Perahu Dayung as means to enhance students' learning outcomes. The research seeks to answer the following questions: (1) What is the feasibility of the developed Android-based physics learning media featuring Perahu Dayung? (2) How effective is the media in improving students' learning outcomes in physics?

Thus, the objective of this study is to design, develop, and evaluate an Android-based learning media grounded in local wisdom to promote contextual learning and cultural awareness while improving conceptual understanding of Newton’s Laws in high school physics.

METHODS

This study employed a Research and Development (R&D) approach by adopting the Four-D Model (Define, Design, Develop, and Disseminate) (Thiagarajan, 1974), as illustrated in the development flowchart in Figure 2. In the Define stage, a needs analysis was conducted through literature review, classroom observations, and interviews to identify challenges in physics learning, student characteristics, and the potential integration of local wisdom, specifically the Perahu Dayung (rowing boat) tradition. The Design stage involved creating an initial product prototype in the form of Android-based mobile learning media that integrates the ethnoscience-based physics of Perahu Dayung, along with the development of relevant research instruments. During the Develop stage, the media was developed using 3D Unity software and underwent expert validation by physics lecturers and media specialists. Revisions were made based on expert feedback, followed by a limited trial involving a small group of students.

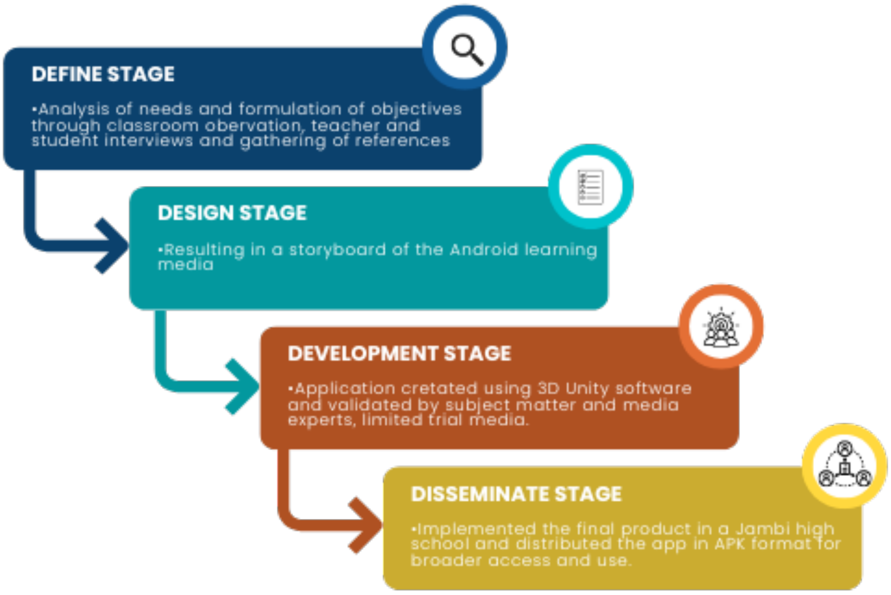


Figure 2. Model 4-D

The Disseminate stage included both limited and field testing to examine the effectiveness of the Android-assisted Perahu Dayung learning media on student physics learning outcomes. The study employed a one-group pretest-posttest design (Creswell & Creswell, 2017) with grade X MIPA 4 students. The material selected for the field test focused on Newton's Laws.

The research sample consisted of 10 students for the limited trial and 20 students from class XI Science 4 at Ferdy Ferry Putra Senior High School, Jambi City, for the field trial. The learning process was conducted using mobile learning media integrated with the local wisdom of Perahu Dayung (rowing boat).

The research instruments consisted of both test and non-test tools. The test instruments included pretest and posttest assessments, while the non-test instruments comprised product evaluation sheets (expert validation forms). The data from the pretest and posttest were analyzed to evaluate the effectiveness of the learning media in improving students' learning outcomes.

The results of the pretest and posttest were expressed in the form of a normalized gain score. According to Hake (1993, p.1), the normalized gain is calculated using the following formula, and the resulting gain score is interpreted based on the criteria presented in Table 1.

$$Std\ gain < g > = \frac{\bar{X}_{Posttest} - \bar{X}_{Pretest}}{X - \bar{X}_{Pretest}}$$

Table 1. Gain Value Criteria

Score <g>	Classification
$<g> \geq 0,7$	High
$0,7 > <g> \geq 0,3$	Medium
$<g> < 0,3$	Low

The validation process was examined utilizing Aiken's V formula to evaluate content validity. Meanwhile, responses from the questionnaires were analyzed employing a five-point Likert scale. The procedures for both analyses are detailed in the following section. The validity of the media was specifically measured through the application of Aiken's V index (Aiken, 1985).

$$V = \frac{\sum s}{n(c-1)}$$

$$s = r - Io$$

Tabel 2. Aiken's V category

Aiken's V Range	Category	Explanation
V ≥ 0.80	Very Valid	The item is highly relevant and appropriate.
0.60 ≤ V < 0.80	Valid	The item is acceptable but may need minor revision.
0.40 ≤ V < 0.60	Quite Valid	The item has moderate validity; revision suggested.
V < 0.40	Less Valid / Invalid	The item is not valid and needs major revision or removal.

The media was evaluated by a panel of experts comprising three lecturers: two experts in Physics Education who assessed the media based on its content accuracy, and one lecturer specializing in information technology who evaluated the media in terms of technical functionality, usability, and audio-visual design. Additionally, one physics teacher and three peers with backgrounds in Physics Education participated in the review process. The determination of the media's validity followed the criteria proposed by Aiken (Aiken, 1985) where the computed Aiken's V value is compared to the critical V value from Aiken's reference table. The media is considered valid if the calculated V exceeds the tabulated V value**.**

RESULTS

This research resulted in the development of an Android-based physics learning application titled "Perahu Dayung", which integrates elements of local wisdom derived from traditional rowing boats. The application was developed in APK format, making it compatible with Android devices. It features 20 interactive and visually engaging scenes designed to convey physics concepts such as Newton's Laws and fluid dynamics through animations, simulations, and practice exercises.

The first phase of the development process is the Define stage, which focuses on conducting an initial needs analysis. The primary goal of this stage is to identify key problems in the current learning environment. Several steps were taken, including interviews with physics teachers and students, as well as classroom observations.

The results of these activities revealed several critical findings, (1) Students in grade X are permitted to use Android devices during school hours. (2) The school provides Wi-Fi access to support digital learning. (3) However, the use of Android-based media for learning is still suboptimal. (4) Teachers have limited skills in developing Android-based instructional materials. (5) There is a lack of integration of cultural values in the available learning media. To address these gaps, this research incorporated local cultural elements into the learning design, particularly using the traditional rowboat (perahu dayung) as the core theme.

The rowboat (figure 3) is a form of cultural heritage that continues to be practiced in various regions of Indonesia. In Jambi Province, for example, annual rowing competitions are held along the Batanghari River. In South Kalimantan, rowboats are commonly used in the floating markets along the Barito River as a means of conducting trade. Communities along coastal areas also still rely on rowboats for sea transportation. Field observations in Jambi revealed that students show low levels of interest in preserving the traditional rowing boat culture. This is evidenced by the declining enthusiasm of youth to participate in or even attend the traditional rowing boat festivals organized annually by the local government. This situation underscores the need to embed local cultural values in educational content to foster cultural awareness and pride among students.

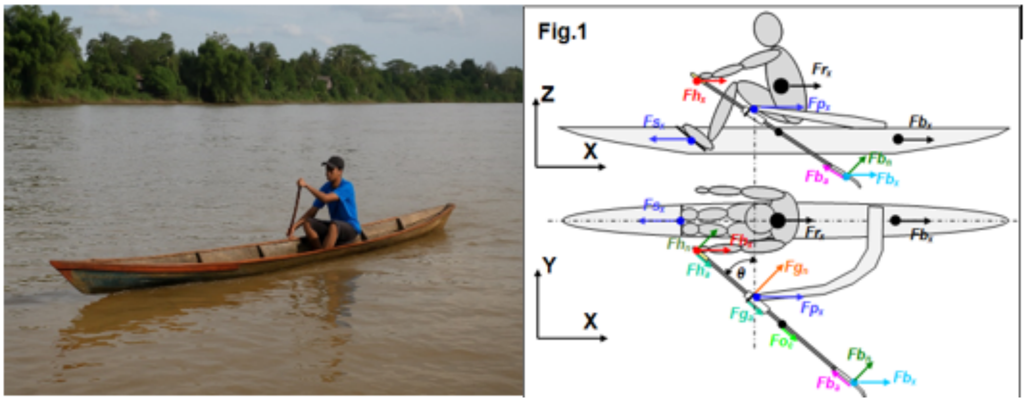


Figure 3. Analysis Force on Rowing boat

The traditional practice of rowing boats incorporates several physics concepts in its implementation (Labbé et al., 2019). Therefore, integrating the rowing boat tradition into learning media represents a strategic and meaningful approach. The analysis of the physics principles embedded in the rowing boat tradition is outlined in Table 3 below.

Table 3. Physics Concepts Represented in Rowboat Phenomena

No.	Phenomenon Observed in Rowboat Activity	Physics Concept Involved	Explanation
1	The boat remains stationary on water without rowing	Newton's First Law (Inertia)	The boat stays at rest because there is no external force acting to change its state of motion. This illustrates the property of inertia.
2	The boat starts to move when rowed	Newton's Second Law (Acceleration)	When the rower applies a force, the boat accelerates. The magnitude of acceleration depends on the net force applied and the mass of the boat.
3	Water is pushed backward by the oar, and the boat moves forward	Newton's Third Law (Action-Reaction)	Action force: the oar pushes water backward. Reaction force: the water pushes the boat forward. This is a direct application of the action-reaction principle.
4	Two boats with different numbers of rowers move at different speeds	Rotational Dynamics & Resultant Force	A boat with more rowers produces a greater total force, resulting in higher acceleration and velocity compared to a boat with fewer rowers.
5	A boat turns when rowed at an angle	Force Composition & Circular Motion	An unbalanced force applied on one side causes a change in direction, making the boat turn due to the resultant torque.
6	Water resistance slows down the boat when rowing stops	Fluid Friction (Drag Force)	Water exerts a resistive force against the moving boat, reducing its speed in the absence of continued propulsion.
7	The boat keeps moving for a while even after the rower stops rowing	Momentum & Impulse	The boat continues to move due to its momentum. External forces such as water resistance gradually decrease its momentum over time.
8	The rower pushes the oar downward and backward during rowing	Lever (Simple Machine)	The oar acts as a first-class lever, helping to generate thrust by using a pivot point at the hand or boat, thereby amplifying the applied force.

The product was designed by creating a storyboard or media blueprint (Figure 4). At this stage, the collection of materials, images, videos, and animations was carried out. The development of the learning media was conducted using the Unity 3D application. The media content focused on physics topics including Newton's Laws, Archimedes' Principle, and Work and Energy.

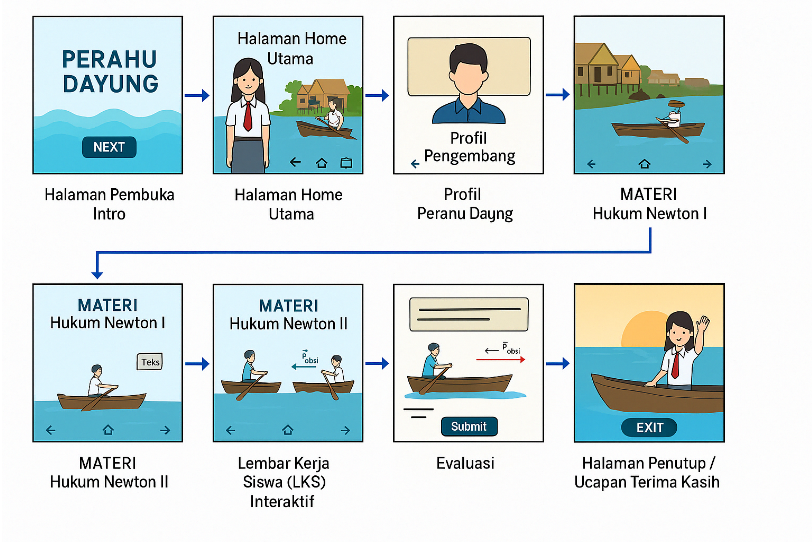


Figure 4. Initial Design Storyboard of the 'Perahu Dayung' Android-Based Learning Media

The visual and navigational elements embedded in the Perahu Dayung Fisika Asik Android-based learning media are outlined in the table 4 below.

Table 4. Visual and Navigational Elements

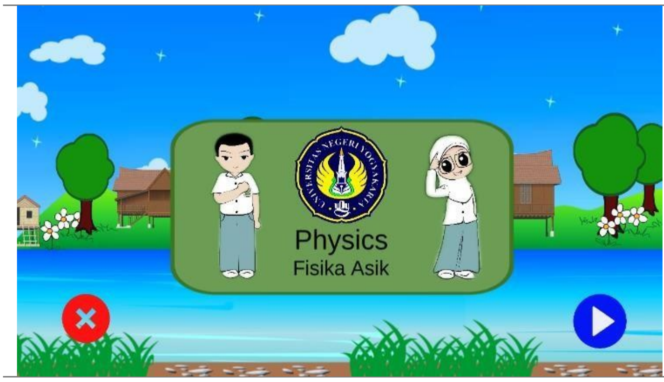
Element	Description
Background & Theme	The theme reflects the local culture of Jambi. It features traditional stilt houses along riverbanks with animated rowing boats, emphasizing regional context.
Visual Characters	Illustrated characters of senior high school students are used to represent the target users of the application.
Navigation	Navigation buttons such as Next, Back, Home, and Exit are consistently available on each scene to facilitate user interaction and seamless page transitions.
Traditional Background Music	Background music features traditional melodies from Jambi Province, enhancing user engagement and reinforcing the local cultural atmosphere.
Content	The media includes physics concepts related to rowing boats, enriched with videos, illustrations, and assessment items directly connected to the learning materials.

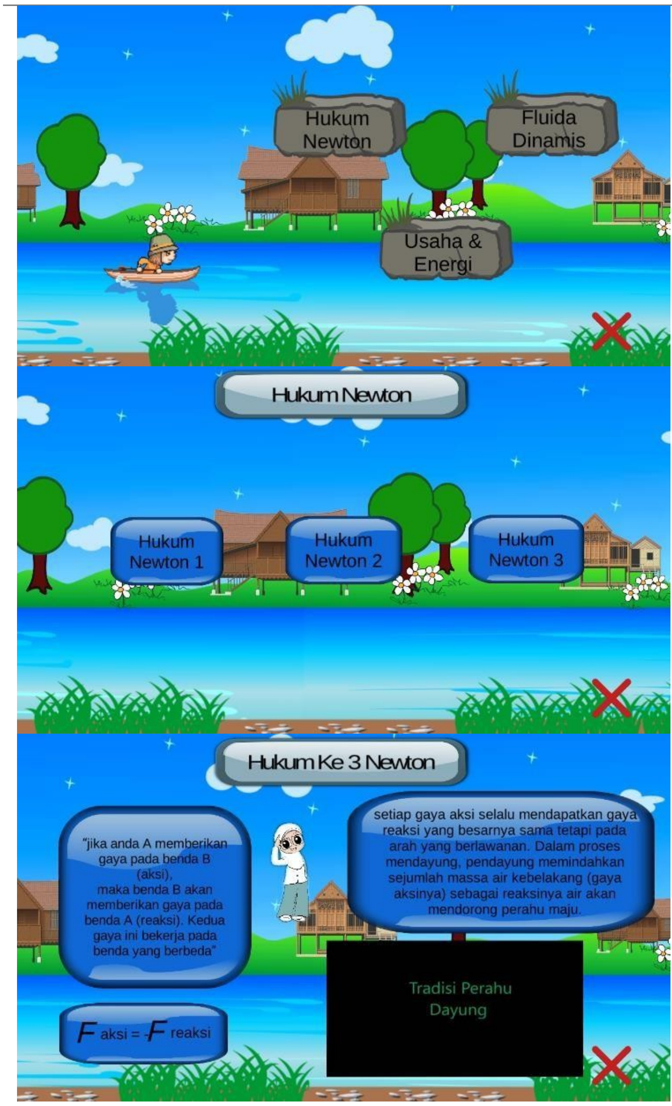
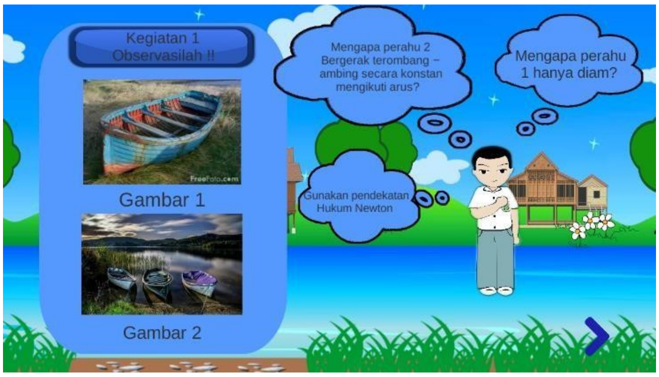
The developed learning media consists of 20 scenes. These scenes include an opening page (Home), a main menu containing developer profiles, information on rowing boat traditions in Indonesia, instructional materials, simulations, and evaluation tasks. Each menu is designed with a simple and user-friendly interface, supported by consistent navigational tools such as home, back, next, and exit buttons on every scene.

The visual design serves not only as an aesthetic component but also as a contextual and cultural reinforcement, aligning with the local wisdom-based learning approach adopted in this media. Furthermore, to enhance the learning experience, all scenes are accompanied by traditional background music that supports the cultural learning environment. A detailed breakdown of these elements is presented in the table 5.

Table 5. Description of the Main Menu in the "Perahu Dayung" Application

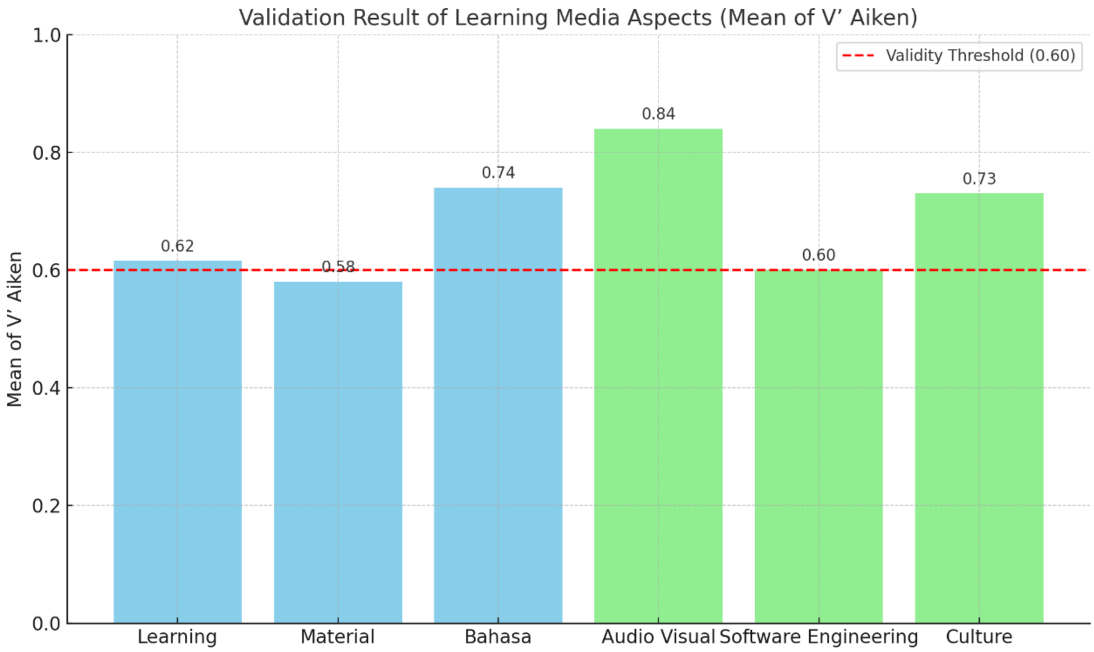
Scene	Description
Home Page	The home page displays a background of traditional stilt houses by the river, representing local culture. The scene features a flowing river and illustrated high

Scene	Description
	school students symbolizing users. Two navigation buttons are provided: a blue "Next" button to continue and a red "Exit" button to leave the application.
Main Menu 	This page includes three primary menu options: Developer Profile, Overview of Rowing Boats, and Learning Materials. The interface features an animated child rowing a boat, integrating local cultural elements that visually and interactively support Newton's Laws learning.
Developer Profile 	This menu presents brief information about the developer's identity and educational background. Its purpose is to increase transparency and provide credibility to users, including both teachers and students.
Overview of Rowing Boats 	This menu introduces the concept of rowing boats as a symbol of local culture, particularly among communities living in riverine or aquatic areas. It explains how rowing boat activities relate to physics concepts, especially Newton's Laws of motion and force. The aim is to contextualize physics learning within students' real-life environments, aligning with the principles of Contextual Teaching and Learning (CTL).
Learning Materials	This menu serves as the core of the learning media. It contains explanations of Newton's Laws I, II, and III, delivered through narrative texts, visual illustrations, rowing boat animations, and interactive exercises. The material is structured progressively—from introductory concepts to real-life applications. The instructional design

Scene	Description
	emphasizes interactivity and active student engagement to enhance conceptual understanding and foster interest in learning physics.
Evaluation 	This scene contains evaluation questions related to real-life contexts involving rowing boats. Users can explore concepts such as force and mass, which can be varied to simulate boat movement based on user-input values, reinforcing understanding through interactive experimentation.

Scene	Description
	

The validation of the media, including both the information technology and physics content aspects, was conducted by a team consisting of two Physics Education lecturers, one physics teacher, and three peer reviewers. The validation score can be seen in the following Graph 1.



Graph 1. Validation result

The validation process involved expert assessments on various aspects of the learning media, which were grouped into two main categories: Content and Program IT. Each aspect was evaluated using the Aiken's V formula to determine the level of validity. The results are visualized in Graph 1. As shown in the graph, the Content category includes three aspects: Learning (0.616), Material (0.58), and Language (0.74). Among these, the "Material" aspect scored slightly below the standard validity threshold of 0.60, while the others were above the threshold, indicating they are valid. In the Program IT category, all aspects—Audio Visual (0.84), Software Engineering (0.60), and Culture (0.73)—met or exceeded the validity threshold. The highest score was recorded in the "Audio Visual" aspect, reflecting strong multimedia integration. Although "Software Engineering" was at the threshold value, it is still considered valid.

These results indicate that the developed learning media meets the general criteria of validity, particularly in visual and cultural integration, supporting the media's suitability for use in physics education that integrates local wisdom.

Revisions to the instructional media were carried out based on the comments, critiques, and suggestions provided by expert reviewers. The details of these improvements are presented in Table 6.

Table 6. Summary of Expert Review Feedback and Suggested Revisions

Category	Revision
Content (Curriculum)	The implementation of learning aspects related to Core Competencies 1 (KI1) and 2 (KI2) has not yet been clearly demonstrated
	The attainment of learning objectives is not explicitly evidence.
	Relationships Between examples of problems and cultures are less visible because they are planned in real purpose
	Repeated wording, formulas and sentences
	An elusive editor
	The content displayed in the media remains overly monotonous, resembling textbook-style presentation.
Program (IT)	There is inconsistency in font sizing throughout the media
	The placement of images is not appropriately arranged
	The level of interactive engagement within the media needs to be enhanced.

A limited trial of the product was conducted with 10 tenth-grade students at Ferdy Fery Putra High School in Jambi City. The participants, who had heterogeneous academic abilities, were required to use the learning media and complete a student response questionnaire. The findings of the small-scale (small group) trial are summarized in the table 7.

Table 7. Results of the Limited Trial of the Android-Based Physics Learning Media

No	Evaluated Aspect	Trial Result	Description
1	Device compatibility	Operated well on all Android devices except iPhone 6S+	iPhone 6S+ was incompatible (likely due to the iOS platform)
2	Application stability	No bugs, errors, or crashes encountered during use	The media functioned stably throughout the trial
3	Ease of use for students	Students were able to operate the application easily	The user interface was considered user-friendly
4	Student responses to the media	Positive responses and high enthusiasm toward the use of local cultural themes	Regarded as engaging due to the integration of local wisdom
5	Suggestions for improvement	Some students recommended additional features or an iOS version	Further development and broader device compatibility are needed

Based on the results of the limited trial, it can be concluded that the Android-based physics learning media, themed around local culture (rowing boats), demonstrated strong technical and pedagogical performance. The application ran smoothly on almost all student-owned Android devices, except the iPhone 6S+, which is incompatible with Android applications due to its iOS platform. Additionally, no technical issues such as bugs, errors, or crashes were reported during usage, indicating successful debugging during development. From a user experience perspective, students found the interface easy to navigate, reflecting a high level of user-friendliness.

Overall, students responded positively, particularly appreciating the integration of local cultural elements into the learning of physics. This suggests that embedding physics content in a culturally contextualized framework can enhance engagement and learner involvement.

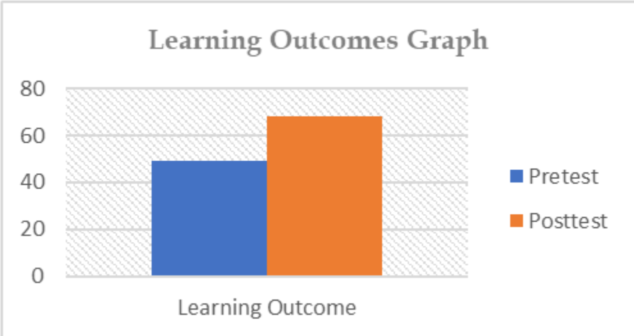
Nonetheless, several students suggested further improvements, such as the addition of features and an iOS-compatible version. Therefore, while the media has been found to be effective and engaging for learning purposes, there remains potential for further enhancement.

The field trial was conducted with 20 tenth-grade students from class X4 at Ferdy Ferry Putra Senior High School, Jambi City, also with heterogeneous abilities. Students were required to use the media and complete a response form.

Table 8. Student Learning Outcomes Data

Variable	Class	N	Average		Average Gain Value	Category
			Pretest	Posttest		

Variable	Class	N	Average		Average Gain Value	Category
			Pretest	Posttest		
Learning Outcomes	Experiment	20	49.15	68.23	0,38	Medium



Graph 2. N-Gain Chart of Learning Outcomes Improvement

Based on Table 8, data from the experimental class consisting of 20 students revealed an average pretest score of 49.15 and an increased posttest score of 68.23. This significant increase indicates the presence of a meaningful difference in learning outcomes before and after the implementation of the learning media.

The average gain score, calculated using the normalized gain (N-Gain) formula, was 0.38, which falls into the medium category based on standard gain score classifications. This suggests that the use of the learning media had a positive impact on students' learning outcomes, although the improvement has not yet reached the high category. The implementation of mobile learning in the classroom has expanded access to learning resources, which can potentially improve student performance and achievement (Yuan et al., 2025; Zhai & Jackson, 2023).

Graph 2 illustrates these findings in the form of a bar chart, visually demonstrating the increase in scores from pretest to posttest. It is evident that the majority of students experienced improvement after using the learning media, indicating its effectiveness in enhancing students' conceptual understanding.

DISCUSSION

The integration of local culture into learning media aims to make educational content more contextual and relevant to students' everyday lives (Deta et al., 2024; Mirsa et al., 2023; Nadzirin et al., 2024; Putri et al., 2024; Rofi et al., 2024; Rohmah et al., 2024; Saphira et al., 2022; M. R. D. Saputra et al., 2025; Wiyono et al., 2024). For instance, a study by Wiyono et al. (2024) revealed that various traditional activities in South Sumatra—such as pempek production and the use of boats on the Musi River—can be explained through physics concepts such as heat transfer and Archimedes' principle.

In this research and development project, the rowing boat—commonly found in the daily life of riverine communities—was used as an example to explain Newton's Second Law of Motion. Students were able to observe and analyze how the force applied during rowing results in the boat's acceleration, and how variables such as boat mass and the number of rowers influence its speed.

(a) (b)

Figure 6. Students are discussing while using worksheets and mobile phones (a); Display of the "Physics Fisika Asik" application on a mobile phone.

The accompanying figure 6 shows students engaging in group learning activities using student worksheets (LKS), supported by Android-based media. The instructional media utilized in this activity is not only digital but also incorporates a local cultural context—namely the rowing boat—as a real-life application of physical principles. Through this media, students explore Newton's Laws, work and energy, and other related physics concepts.

This learning activity also demonstrates that the use of Android-based media enhances students' active engagement in understanding abstract physics concepts through visual representations and contextual narratives (Fu & Hwang, 2018; Gunaifi & Habibulloh, 2023). Technology is employed not only as a visualization tool but also as a medium to reinforce local wisdom, thereby bridging science and culture (A'yun & Wilujeng, 2024; Prahani et al., 2022).

The outcomes are supported by findings showing that mobile learning is significantly more effective than traditional classroom instruction in improving students' motivational outcomes (Furió et al., 2015). By integrating technology and local culture, students experience not only cognitive learning but also develop meaningful connections between science and their social environment (Hamidi & Chavoshi, 2018; Yuan et al., 2025). Overall, these results align with previous studies (Dwijayani, 2019; Novaliendry et al., 2020; Romadiah et al., 2022; M. R. D. Saputra et al., 2025; Suryanda et al., 2019; Troussas et al., 2020; Watin et al., 2023), which indicate that the effectiveness of instructional media can be assessed through improvements in student learning outcomes (Chang et al., 2018). The learning media applied in this study has been shown to enhance students' conceptual understanding, though continued refinement is necessary to maximize its impact.

This approach aligns with the principles of Contextual Teaching and Learning (CTL) and supports the development of the Pancasila Student Profile, which emphasizes meaningful, contextual, and value-based education. The integration of local wisdom through the "Rowing Boat" media makes learning more contextual and meaningful. Students can relate physics concepts such as force and acceleration to familiar real-world activities like rowing, resulting in better conceptual understanding.

Moreover, the use of Android/mobile learning enables students to engage in interactive and independent learning, aligning with the demands of 21st-century education (Metruk, 2022; Osman & Napeah, 2021; Qureshi et al., 2020; Ubben et al., 2023). The combination of technology and local culture offers a richer learning experience, increases student motivation, enhances critical thinking, creativity, independent learning and positive character development such as discipline and responsibility (Mudjid et al., 2022; M. R. D. Saputra et al., 2025; M. R. D. Saputra & Kuswanto, 2019). Blended learning, e-learning, and mobile learning are highly recommended as future directions for modern education (Borba et al., 2016; G. Y. Saputra et al., 2020).

The Android-based physics learning media integrates three components: physics content, local culture (Rowing Boat), and technology (Android platform). This approach aligns with the constructivist learning theory, which emphasizes contextual and culturally relevant learning experiences (Aljasir, 2023; Eirini, 2015; Mohammed & Kınyo, 2020; Waite-Stupiansky, 2022) This media product has undergone thorough analysis and revision through expert validation, small group testing, and field trials, which are consistent with the standard stages of educational media development as outlined by Borg and Gall (1983). Overall, the revised version has demonstrated strong feasibility and effectiveness for educational use, based on usability principles and instructional media design frameworks (Moya & Camacho, 2021). Before wider dissemination, a comprehensive final review and adjustment were conducted to ensure readiness for broader implementation, which is an essential step to ensure the quality and scalability of educational innovations (Howard et al., 2021). The media will be distributed in Android APK format and also made available for desktop use. Additionally, the application will be uploaded to the Google Play Store for public access and download.

CONCLUSION

This study finds that integrating local culture—such as the rowing boat tradition—into Android-based physics media enhances student engagement and understanding of Newtonian concepts. The media proved technically feasible and pedagogically effective through expert validation and field trials. Implication: The results highlight the value of contextual and culturally relevant learning, supporting 21st-century skills and strengthening students' connection between science and daily life. Limitation: The media was tested within a limited demographic and is currently incompatible with iOS devices, limiting broader accessibility. Further studies should explore cross-platform development, long-term learning impacts, and cultural integration in other science topics to expand its effectiveness and reach.

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