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Developing Physics Teaching Materials Based on Differentiated Merdeka Curriculum Using an Ethnoscience-Integrated Contextual Approach

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Abstract: The availability of Merdeka Curriculum teaching materials in schools is still lacking, so it is necessary to develop Merdeka Curriculum teaching materials to support dynamic learning. For this reason, teaching materials were developed in the form of a book with the title *Student's Book Getting to Know Indonesian Culture and Physics through Various Concepts of Particle Motion Dynamics for Class XI SMA/MA/Equivalent*. This research aims to (1) describe the characteristics, (2) measure and assess feasibility, and (3) measure and assess the practicality of Merdeka Curriculum-based physics teaching materials differentiated with an ethnoscience-integrated contextual approach. The research method used is the research and development (R&D) method with a 4D model (define, design, develop, and disseminate). The define stage involves analyzing needs, the design stage involves designing teaching materials and compiling assessment instruments, the development stage involves realizing the design and assessing feasibility and practicality, and the dissemination stage is carried out through distributing teaching materials. Based on the results of data analysis, this teaching material has characteristics according to students' needs which includes contextual differentiation learning in traditional Indonesian game culture. The feasibility and practicality test results show 91.25% and 87.66% of the materials are in very high criteria.

Keywords: contextual, differentiated learning, ethnoscience, teaching materials

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INTRODUCTION

One effort to improve education is through learning activities in schools. Schools usually use teaching materials compiled in teachers' textbooks, such as textbooks, modules, handouts, student worksheets, and other forms (Putra et al., 2022). Teaching materials are a structured arrangement of learning topics so that they can develop students' knowledge (Istiqomah et al., 2019). They contain content that is designed in a structured manner, show the instructional targets to be achieved, increase motivation, and reduce student difficulties through guidelines that provide summaries and exercises (Subali et al., 2017). Apart from that, limited learning time in class can be fulfilled with students' independent learning process assisted by teaching materials that have been developed and adapted to learning objectives (Puspita, 2019).

The teaching materials developed should be dynamic following curriculum developments in Indonesia, including the Merdeka Curriculum. The main characteristic of this curriculum is the teacher's flexibility in carrying out differentiated learning (Idhartono, 2022), namely being able to provide opportunities for students to learn according to themselves (Utami et al., 2020 & Puspita, 2019), by containing media and models that suit the characteristics of the students (Kuway et al., 2023). However, teachers experience problems with Merdeka Curriculum teaching materials due to their limited availability (Windayanti et al., 2023). In fact, according to observations, the availability of these

teaching materials is still difficult to find in libraries. Thus, it is necessary to develop teaching materials based on the Merdeka Curriculum.

In essence, good teaching materials can stimulate, challenge, and relate abstract concepts such as physics concepts to everyday life, thereby increasing student learning motivation and helping students understand lessons (Haryadi & Nurmala, 2021). Physics lessons often study abstract concepts so previous scientists created models to explain some of these concepts (Pols et al., 2022). However, some of the physics teaching materials used contain text material, a collection of formulas, and practice questions printed on opaque paper with black ink so that students think that physics is boring and difficult to learn (Le et al., 2022). The development of physics teaching materials needs to address cases that are often known or experienced by students through contextual learning, namely learning that can invite students to visualize abstract and impossible material (which cannot be directly observed) in both micro and macro dimensions so that it is easy to understand (Astiti & . Hali, 2019).

The development of teaching materials that are relevant to students also needs to be adapted to students' needs so that they can increase effective, active, and innovative learning so that learning objectives can be achieved (Bujuri & Baiti, 2019). Apart from that, the Merdeka Curriculum also aims to develop basic numeracy and literacy competencies by adapting to local context and content (Putri & Rinaningsih, 2021). Physics teaching materials developed based on local content will be a solution to the moral degradation of the nation's children (Satriawan & Rosmiati, 2017). Apart from that, innovative teaching materials containing topics that are relevant, problematic, and originating from the original culture of the community have not been developed (Ellianawati et al., 2021). The environment and community culture as learning resources can provide students with meaning because they are experienced directly. Based on research by (Fauzi et al., 2020), ethnoscience learning is learning that can introduce realities that grow in society by correlating them with learning topics so that students can easily understand and experience the culture in their environment.

The use of ethnoscience as a contextual teaching material topic to overcome students' misconceptions about physics concepts is deemed appropriate. This is because physics concepts can be illustrated through science which is applied in people's culture in real daily life. The physics concept that experiences problems in learning is the topic of particle motion dynamics (Asmita et al., 2022). This concept is considered difficult for students to understand because it has various alternative conceptions. This concept is often related to reality in everyday life as a cultural phenomenon, especially in traditional Indonesian games. Based on the results of observations and literature studies, physics teaching materials that reveal cultural events based on discussions of the dynamics of particle motion have never been found. Thus, this research aims to develop physics teaching materials based on the Merdeka Curriculum differentiated with an ethnoscience-integrated contextual approach on the material of particle motion dynamics.

METHOD

This research uses research and development methods. The model used is the Four-D Model or 4D model which was first developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel in 1941. This model has four stages as the name suggests, namely define, design, develop, and disseminate stages (Supriadi & Hignasari, 2019). Research activities begin with the define stage from August to November 2023, the design stage from December 2023 to February 2024, the develop stage, namely product validation in March 2024 limited field trials from March to April 2024, and the dissemination stage in May 2024.

This research was conducted at Al-Azhar 15 Islamic High School Semarang and Madrasah Aliyah Al-Asror Semarang. These two schools were chosen because they have student characteristics that are suitable for the development of teaching materials. Apart from that, according to the needs analysis, these two schools need additional references for physics learning resources based on the Merdeka Curriculum. The subjects in this research were established using a purposive sampling technique. This technique was carried out by determining subjects based on characteristics and traits that were thought to have information related to matters appropriate to the research (Hadi et al., 2019). Apart from that, this subject was also chosen based on recommendations from physics teachers at school. The subjects chosen were class XI A students in the physics specialization group for the 2023/2024 academic year with details presented in Table 1.

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Table 1. Research Subject

School	Accreditation	Class number	Students
SMA Al-Azhar 15	A	1	20
MA Al-Asror	A	2	23

Source: Interview with physics teacher

The data obtained from this research are qualitative data (narratives, statements, discourse, and photos) and quantitative data, namely data obtained in the form of numbers (Sugiyono, 2016). These two data were obtained through non-test instruments which were validated first by experts (expert judgment) to produce good and unbiased instruments. Data collection techniques, data collection instruments, instrument analysis techniques, and analysis techniques can be seen in Table 2.

Table 2. Data Collection and Analysis Technique

Data Type	Data Collection Technique	Data Collection Instrument	Data Analysis Technique
Qualitative	Observation	Observation sheet	Descriptive
Qualitative	Interview	Interview guide	Descriptive
Qualitative	Documentation	Supporting document sheet	Descriptive
Quantitative	Questionnaire	Specification requirements questionnaire	Percentage
Quantitative	Questionnaire	Eligibility validation questionnaire	Percentage
Quantitative	Questionnaire	Student response questionnaire	Percentage

The results of qualitative data analysis are presented directly through descriptions, while quantitative data are presented by processing the data using percentages or numbers. Quantitative data in this research were obtained by using a questionnaire regarding teaching material specification requirements, a feasibility questionnaire, and a student response questionnaire to assess the practicality of the teaching material. The method used to calculate the percentage for each answer choice on the needs questionnaire is to use Equation 1.

$$P = \frac{X}{N} \times 100\%, \quad (1)$$

with:
P : Percentage (%)
X : Number of respondents answering
N : Total number of respondents

The assessment of the feasibility and practicality of teaching materials was analyzed using a Likert scale. The Likert scale scoring system modified from Sugiyono (2016) uses 4 scale options which include a score of 4 for a very good assessment, a score of 3 for a good assessment, a score of 2 for an adequate assessment, and a score of 1 for a poor assessment. Next, the data obtained were analyzed using Equation 2.

$$P = \frac{f}{N} \times 100\%, \quad (2)$$

with:
P : Percentage
f : Gained scores
N : Maximum scores.
After that, the results were interpreted based on the criteria from Sugiyono (2016) as shown in Table 3.

Table 3. Student Response Questionnaire Assessment Criteria

Percentage result	Criteria
$85\% < P \leq 100\%$	Very High
$70\% < P \leq 85\%$	High
$50\% < P \leq 70\%$	Medium
$1\% < P \leq 50\%$	Low

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RESULTS AND DISCUSSION

The product resulting from this research is in the form of printed teaching materials with the title *Student's Book Getting to Know Indonesian Culture and Physics through Various Concepts of Particle Motion Dynamics for Class XI SMA/MA/Equivalent*. This teaching material was developed using the 4D model (define, design, develop, disseminate). At the *definition* stage, problems were identified with inhibiting facts and obstacles to the learning process by conducting literature studies and field studies. The literature study was carried out by reviewing previous linear research and literature reviews regarding the objectives of the Merdeka Curriculum. Several previous studies have revealed that ethnoscience-based teaching materials have positive prospects (Ellianawati et al., 2021), improve student morale and character (Hartini et al., 2018), and encourage students' creative thinking (Haspen et al., 2021). However, there are still few teaching materials such as e-modules that integrate ethnoscience (Amaliah, N., Fianto, A. Y. A., & Yosep, 2015) so there is a need to develop ethnoscience-based teaching materials. This is in line with a literature review of the objectives of the Merdeka Curriculum which states that this curriculum aims to implement differentiated learning to achieve basic numeracy and literacy competencies by adapting to context and local content (Idhartono, 2022). Therefore, it has become a mandate of the curriculum to provide learning based on local culture (ethnoscience).

The field study was carried out through direct observation, interviews with physics teachers, and the distribution of questionnaires regarding teacher and student needs regarding teaching material specifications. Based on the results of these observations, the main teaching materials used in schools are printed physics books from commercial publishers with direct and short concepts and formulas. Therefore, this teaching material is not suitable for use by students. Based on the results of the interviews, several problems were found, such as teachers who were unfamiliar with Merdeka Curriculum learning so it was difficult to innovate, supporting teaching materials that were less varied or only came from commercial publishers so students needed to buy them, and teaching materials that did not meet the needs and characteristics of students. Finally, based on the results of the needs questionnaire, teachers and students need teaching materials that can illustrate physics concepts in everyday life (contextual) by raising the topic of traditional game culture (ethnoscience) on the dynamics of particle motion.

The design stage was carried out by designing teaching materials according to the results of the definition and preparing instruments for assessing the feasibility and practicality of the teaching materials. This stage began with a reference test on construction criteria in the form of a standard format for writing teaching materials, a questionnaire regarding the specifications for teaching materials, and the results of a study of the curriculum. Furthermore, the selection of development media, namely Microsoft Word and Canva editing media was conducted. After that was the selection of the format which included layout, margins, type, and size of letters, and others that were adjusted to the results of the needs questionnaire. Finally, it was the creation of the preliminary design which consisted of the opening, contents (body), and closing. The structure of each part is shown in Table 4.

Table 4. Teaching Material Design

Component	Structure	Description
Opening	Title Page	A cover containing the title, author's name, and book affiliation
	Introduction	The author's expression to the reader
	Direction to Use the Book	Guidelines for each sequence of content in the book to make things easier for teachers and students
	Learning Style Test	Aiming to detect student learning styles.
	Table of Content	List of each subchapter
	List of Figures and Tables	List of pictures, and a table showing the pages in the book
Content	Chapter Page	Chapter numbers, chapter titles, learning objectives, and keywords
	Concept Map	Graphic illustrations showing the relationship of each concept
	Trigger	An introduction to initial concepts inviting students to deepen the material
	Main Topic	The main content of physics material accompanied by images, narration, formulas, and learning activity features Summary of main topics
	Core	Exercises to test students' understanding

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Component	Structure	Description
	Practice Test	
Ending	Summative Assessment	General introduction to the material containing chapter numbers, chapter titles, learning objectives, and keywords Activities for students who have or have not met achievement standards
	Remedy	
	Glossarium	A collection of definitions of important words or terms
	Bibliography	Collection of reference sources
	Author Profile	Identity and background of the writing team
	Answer Key	Answer key to practice questions and summative assessments
	Back cover	Summary or synopsis of the book

The next stage was the development stage, which is the activity of realizing the design of teaching materials into finished products by showing their characteristics. Apart from that, there was also a feasibility assessment from expert validators and practitioners, as well as a practicality assessment in the form of student responses in limited field trials regarding the use of teaching materials. The teaching materials that have been developed follow the characteristics of teachers and students at the target schools. The main specialty of this teaching material is that its presentation is integrated contextually into ethnoscience so that physics concepts can be illustrated with the life of traditional game culture in Indonesia. The theme raised in this teaching material is "Ethnoscience in the Dynamics of Particle Motion Class XI" which is printed on the back cover of the book. Apart from that, this teaching material also has a distinctive front, and back cover and graphic design for each page that highlights the ethnoscience theme of traditional games. The book cover can be seen in Figure 1.

Figure 1. Title Page

Another characteristic of this teaching material is that it is equipped with a guide, at the beginning of the material in the form of instructions for using the teaching material and an assessment guide, thereby distinguishing it from other teaching materials. This aims to make it easier for users to understand teaching materials so that students can use them for independent learning. The assessment guide is intended to explain general instructions and specific instructions for assessing so that students can do it well without any misconceptions.

This teaching material has a student learning style test with questions adopted from Wiedarti (2018). This test is carried out to facilitate differentiated learning so that it suits students' learning styles. The student learning style test can be seen in Figure 2.

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TES GAYA BELAJAR SISWA

Gaya belajar merupakan berbagai cara yang memengaruhi siswa dalam menyerap informasi ketika pembelajaran di dalam ataupun di luar kelas. Pada umumnya, siswa tidak menyadari bagaimana cara menyerap informasi tersebut, baik melalui penglihatan (visual), menyimak dan berbicara (auditori), maupun mempraktikkannya (kinestetik) agar informasi yang diterima dapat bertahan lama dalam rasa dan memori siswa. Seseorang siswa mungkin dominan belajar dengan menggunakan salah satunya ataupun perpaduan antara visual-auditori, visual-kinestetik, auditori-kinestetik, perpaduan ketiganya secara merata, atau salah satu sedikit lebih dominan dari lainnya. Berikut merupakan kuesioner yang dapat digunakan untuk mengetahui gaya belajar siswa.

Centang jawaban yang paling mewakili bagaimana biasanya Anda bersikap.

1. Ketika saya mengoperasikan peralatan baru, pada umumnya saya:
   A. membaca instruksinya lebih dulu.

Figure 2. Student Learning Style Test

The content of the teaching materials has been adapted to the needs of teachers and students both in terms of graphics, language, content, or material, as well as presentation of content or material. This is because these teaching materials are prepared following standard writing formats and the results of teacher and student needs questionnaires regarding teaching module specifications. The content of the material begins with the lighter case used in the introduction to the chapter in the form of student motivation to preserve Indonesian culture by translating the uniqueness of this culture through the study of physics concepts at school to enrich students' understanding as the nation's next generation as well as young scientists. The teaching material prompter can be seen in Figure 3.

Gambar 3.1 Festival budaya sebagai pelestarian
Sumber : nusantaranews.co

Indonesia adalah negeri yang sangat kaya. Indonesia memiliki 17.508 pulau yang terbentang dari Sabang hingga Merauke. Hal inilah yang menjadi faktor melimpahnya keanekaragaman suku, etnis, ras, flora dan fauna, bahan tambang, bahasa, bahkan budaya di Indonesia. Adapun keanekaragaman budaya ini dapat kita jumpai pada perbedaan rumah adat, senjata tradisional, tarian daerah, alat musik tradisional, pakaian tradisional, hingga permainan tradisional di setiap daerahnya.

Figure 3. Prompter at Introductory Chapter

The explanation of the concept of material content also begins with a brief illustration of cases in everyday life as a trigger for problem-based concepts (problem-based learning). The case is solved with a more detailed explanation through simple narratives, figure visualizations, and formula equations along with explanations. At the end of the explanation, ethnoscience is presented which examines the physics concepts being discussed through culture in the form of traditional Indonesian games. The content of the teaching materials can be seen in Figure 4.

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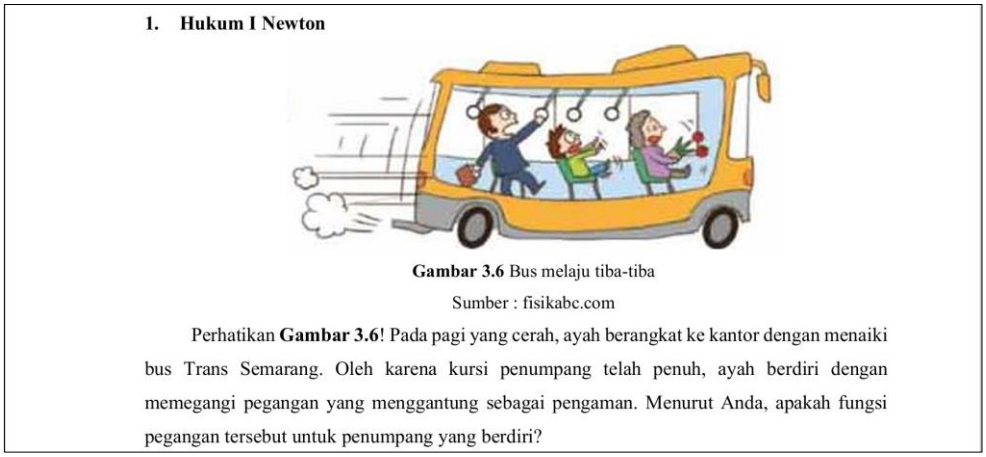
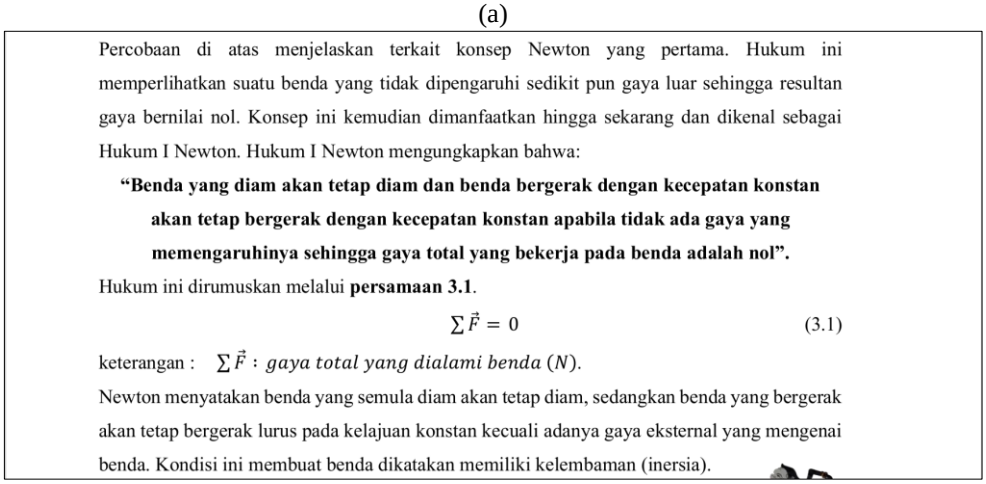


1. **Hukum I Newton**

Gambar 3.6 Bus melaju tiba-tiba
Sumber : fisikabc.com

Perhatikan **Gambar 3.6**! Pada pagi yang cerah, ayah berangkat ke kantor dengan menaiki bus Trans Semarang. Oleh karena kursi penumpang telah penuh, ayah berdiri dengan memegangi pegangan yang menggantung sebagai pengaman. Menurut Anda, apakah fungsi pegangan tersebut untuk penumpang yang berdiri?

(a)



Percobaan di atas menjelaskan terkait konsep Newton yang pertama. Hukum ini memperlihatkan suatu benda yang tidak dipengaruhi sedikit pun gaya luar sehingga resultan gaya bernilai nol. Konsep ini kemudian dimanfaatkan hingga sekarang dan dikenal sebagai Hukum I Newton. Hukum I Newton mengungkapkan bahwa:

"Benda yang diam akan tetap diam dan benda bergerak dengan kecepatan konstan akan tetap bergerak dengan kecepatan konstan apabila tidak ada gaya yang memengaruhinya sehingga gaya total yang bekerja pada benda adalah nol".

Hukum ini dirumuskan melalui **persamaan 3.1**.

$$\sum \vec{F} = 0 \qquad (3.1)$$

keterangan : $\sum \vec{F}$: *gaya total yang dialami benda* (N).

Newton menyatakan benda yang semula diam akan tetap diam, sedangkan benda yang bergerak akan tetap bergerak lurus pada kelajuan konstan kecuali adanya gaya eksternal yang mengenai benda. Kondisi ini membuat benda dikatakan memiliki kelembaman (inersia).

(b)

Gambar 3.9 Permainan bakiak
Sumber : freepik.com

Selain fenomena di atas, konsep hukum ini juga dijumpai pada salah satu budaya Indonesia yaitu pada permainan tradisional bakiak seperti **Gambar 3.9**. Pernahkah kamu bermain bakiak? Apakah kamu pernah terjatuh atau terdorong saat bermain bakiak seperti **Gambar 3.10**? Kini, permainan bakiak masih terus dimainkan oleh anak-anak. Ternyata pelaksanaan permainan tradisional ini dapat dijelaskan secara fisika.

(c)

Figure 4. (a) Prompting Case, (b) Solution, and (c) Ethnoscience Concept

This teaching material has learning features in "material content" which is aimed at explaining concepts and developing students' collaboration, literacy, and affective and psychomotor skills. This learning feature also supports all learning styles that each student has, whether visual, auditory, or kinesthetic, because the presentation is packaged through a variety of original figures and cartoons, podcasts or songs, and projects or practicums. Apart from that, this learning activity feature is also presented with a distinctive name according to the form of activity which can be shortened to the name of a Javanese wayang character as shown in Figure 5.

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Figure 5. Characters' names as learning features

Some of the characters used as feature names include the characters "Abyasa (Come on, ask questions about the chapter!)" which has one activity, "Adirata (Come discuss with us)" which has four activities, "Semar (A glance at the material)" which has ten activities, "Prabu (Knowledge of various cultures)" which has 12 activities, "Pandu (My simple practice)" which has five activities, "Gareng (Joint activities)" which has four activities, "Petruk (Project about our cultural diversity)" which has two activities, and "Laksmi (Competency training around the material)" which totals four activities. The characters and traits of the characters are explained through instructions for using the book as well as how to use its features. Through this naming, it is expected that it will be able to introduce Javanese wayang culture to increase students' sense of love for their homeland. One example of this learning feature can be seen in Figure 6.

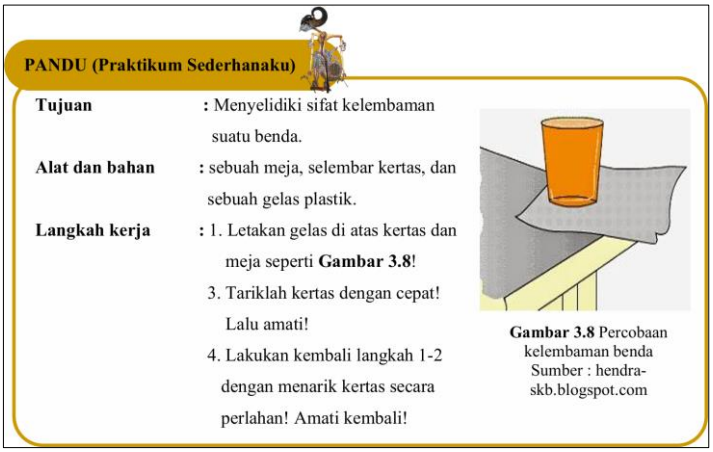

Figure 6. One of the learning features

At the end of each sub-chapter, this teaching material is equipped with a summary that is presented in various forms of presentation, such as important narrative points that contain the main idea of the discussion or a barcode presentation which is used to access a summary video explaining the concept. The summary of the teaching materials in the form of narrative points and bar codes can be seen in Figure 7.

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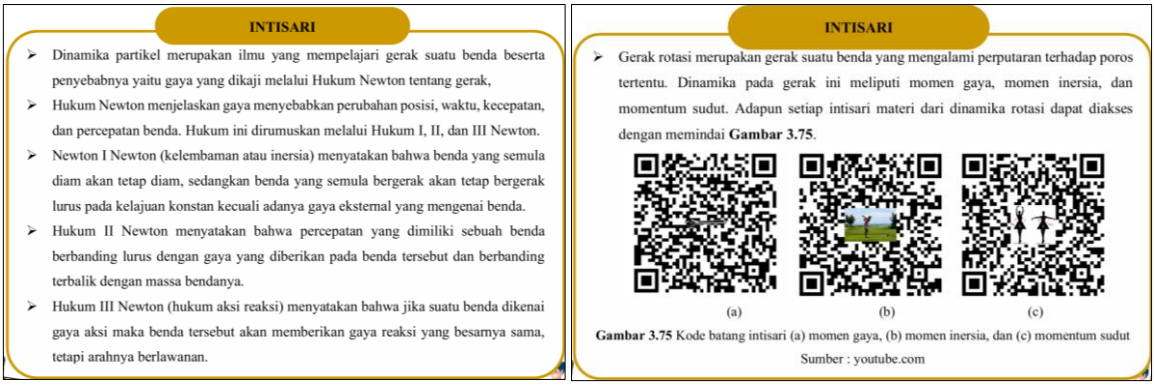

(a) (b)

Figure 7. (a) Summary with Main Points and (b) Summary in Video Form

Apart from that, this teaching material is also equipped with a summative assessment that follows indicators of achievement and cognitive level according to Bloom's taxonomy. A summative assessment is an assessment at the end of the learning process which is carried out to determine the achievement of learning objectives (Mujiburrahman et al., 2023). All questions in this assessment are also prepared with good question stems consisting of figure illustrations, work instructions, and answer options. This assessment also supports the increase of literacy and numeracy in students as shown in Figure 8.

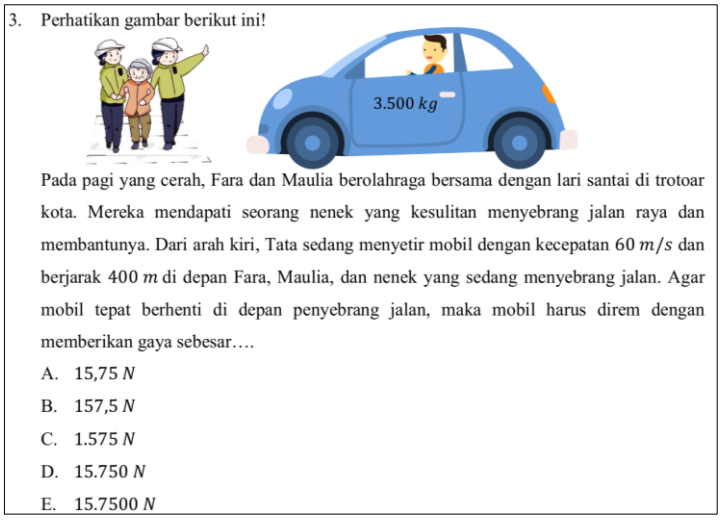

Figure 8. An Example of an Assessment Question

This teaching material is also equipped with enrichment for students who are deemed to have exceeded the minimum completeness of the curriculum (Dewantara, 2019) and remedy for students who have not reached the minimum mastery criteria according to the curriculum (Cebri et al., 2020). At the end of the teaching materials, there is also a glossary, bibliography, author profile, and closes with cover. The glossary contains a list of important words or terms with definitions to help students know and understand them; the bibliography contains a list of reference sources for teaching materials; the author profile contains brief biographies of parties who support the process of writing the teaching materials; and the book cover contains a synopsis that provides a general overview of the teaching materials.

After the development process, the teaching material was tested for suitability with the help of five validators who were experts in motion dynamics material or learning device experts who were physics lecturers at the State University of Semarang. Apart from that, the validators were also five practitioners as physics subject teachers. Assessment of the appropriateness of teaching materials includes several aspects, including appropriateness of the content, presentation, language, and graphics. The results of the feasibility test analysis of this teaching material can be seen in Table 5.

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Table 5. Analysis Result of Product Feasibility Test

No.	Aspect	Percentage (%)	Criteria
1.	Content Eligibility	90.6	Very High
2.	Feasibility of Presentation	94.6	Very High
3.	Linguistic Feasibility	91.3	Very High
4.	Graphic Eligibility	88.5	Very High
	Average	**91.3**	**Very High**

Based on Table 5, the assessment of the appropriateness of the content of teaching materials includes aspects of material suitability including completeness (97.5%), correctness (87.5%), depth (85.0%), and clarity of subject matter (90.0%). This is because the teaching materials presented are stated to be complete, correct, in-depth, and clear. After all, each subject has been adjusted to the student's competency achievements. Apart from that, content appropriateness also includes aspects of contextual integration including presentation (87.5%) and accuracy of presentation (85.0%). Contextual concepts in this teaching material are presented through several prompter cases, such as two children playing with a slingshot, a passenger who is pushed backward when the bus suddenly starts moving, pushing a table which is easier than pushing a cupboard, using a hammer to nail a wall, car tires and sandal wear, ball rolling phenomenon, swing motion, and collision between two cars. Apart from that, there are other prompter cases such as using wrenches, playing golf, and twisting movements in ballet dancers. Another aspect in assessing the appropriateness of content is the integration of ethnoscience which includes the ability of the teaching materials to provide views that are closely related to science (97.5%), culture (92.5%), and accuracy and clarity of concepts (92.5%). Several physics concepts are illustrated through traditional gaming culture, such as Newton's First Law which is explained through the concept of clogs; Newton's Second Law through the concept of a top; Newton's Third Law through the concept of a slingshot; gravity through the stilts concept; normal style through the dam-daman concept; friction force through the concept of steak pull; centripetal force through the concept of speed; momentum, impulse, and impact through the concepts of swings, lato-lato, and marbles; as well as the dynamics of rotational motion through the concept of seesaws and tops.

The assessment of teaching materials based on the appropriateness of presentation includes aspects of presentation technique which include conceptual demands (90.0%) as well as consistency and systematic attractiveness (85.0%). This is because the teaching materials are presented using coherent, consistent and interesting techniques starting from basic to more in-depth sub-chapters. Another aspect is the adequacy of the presentation which includes the presentation of instructions for using the module (95.0%), the presentation of the opening section (97.5%), the presentation of the content section (100%), and the presentation of the closing section (100%). This presentation is adapted to the standard format for writing good teaching materials.

Furthermore, the assessment is based on linguistic aspects which include an assessment of readability which includes an assessment of clarity of information (92.5%), consistency of use of terms (92.5%), suitability of good and correct Indonesian language rules (87.5%), and accuracy of use. words in regional or foreign languages (92.5%). The language and readability in this teaching material are presented according to the linguistic rules of the General Guidelines for Indonesian Spelling (PUEBI) combined with everyday language so that it is more down-to-earth and not stiff. The everyday language used can be regional languages, regional terms, foreign terms, popular words, or exclamation words which are presented in italics according to the correct rules.

Finally, graphic feasibility includes graphic aspects including assessing variations in illustrations and graphics (82.5%), suitability of illustration selection (90.0%), and suitability of layout or component layout (87.5%). The graphics in this teaching material are adjusted to the results of the needs questionnaire so that it contains varied, interesting, and colorful content. Another aspect is the assessment of the cover design which includes assessing the composition and size of layout elements (90.0%) as well as the harmony of color elements and layout (92.5%). The front cover is also presented with good composition, layout, and harmony linked to the ethnoscience theme of traditional Indonesian games. Based on all feasibility assessments, this teaching material received an assessment with very high eligibility criteria in every aspect of the assessment. Thus, it can be stated that the developed teaching materials are suitable for use in learning. Apart from providing assessments, each validator also

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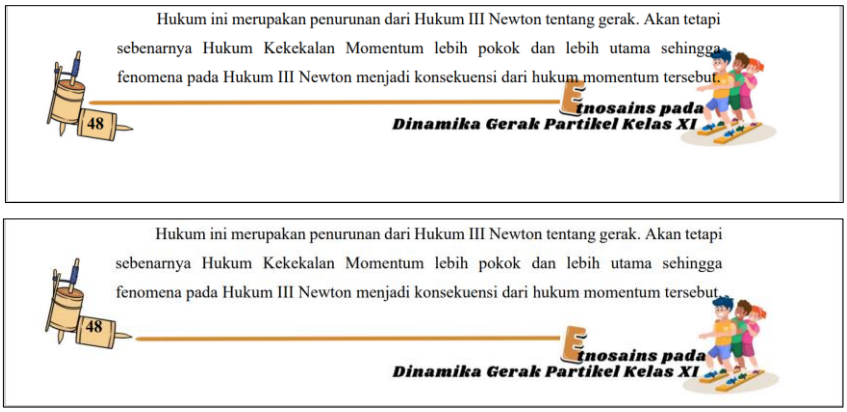
provides suggestions and comments to improve the product. Some suggestions and comments can be seen in Table 6.

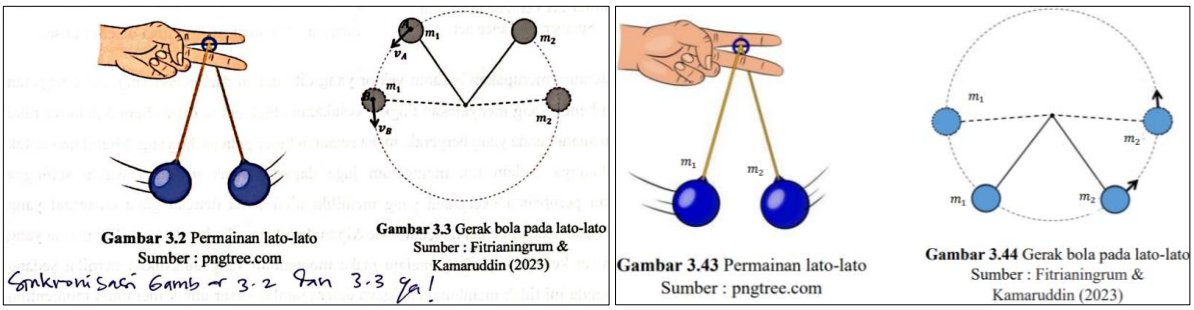
Table 6. Validator Comment and Recommendation

Comment and Recommendation	Correction
The bottom of the page (footer) is too close to the final paragraph.	Improvement of the bottom of the page by providing space between the footer and the final paragraph so that it is not too cramped
The game figures and the lato-lato ball movements are not synchronous (in harmony).	Improvement of the figure concept by aligning the game and movement of the lato-lato ball
The space collision diagram figure is not clear.	Improvement by clarifying the space collision diagram figure

Some of the results of improving teaching materials according to validator comments and suggestions can be seen in Figure 9.



(a)



(b)

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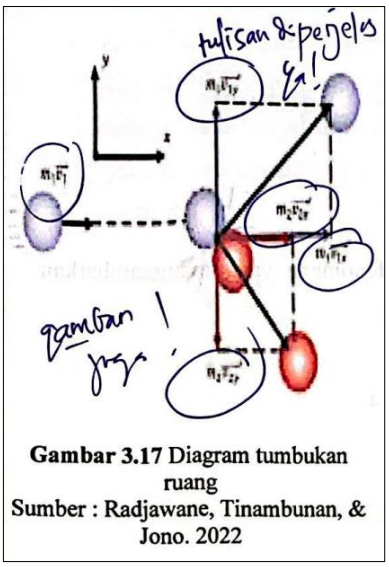
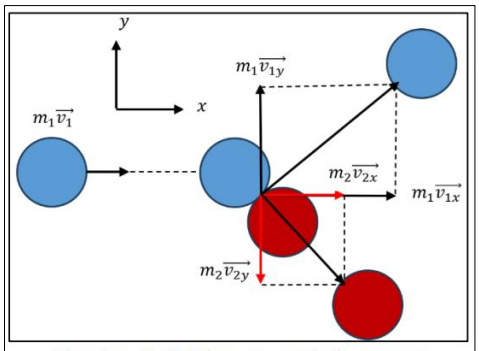


Gambar 3.17 Diagram tumbukan ruang
Sumber : Radjawane, Tinambunan, & Jono. 2022



Gambar 3.58 Diagram tumbukan ruang
Sumber : Radjawane, Tinambunan, & Jono. 2022

(c)

Figure 9. (a) Footer, (b) Improvement of the Lato-Lato Concept, and (c) Improvement by Clarifying the Figure Before and After Revision

Assessment of the practicality of teaching materials is obtained from the results of student response questionnaires regarding products in limited field trials. The trial was carried out by distributing printed teaching materials or via electronic media in the form of portable document format (PDF) as reference material for students studying independently at home. Apart from that, classroom learning was also carried out as assistance to explain how to use teaching materials and explain ethnoscience concepts. As for supporting learning, several traditional games were shown directly in the teaching materials so that concept explanations were carried out contextually. Then, students responded to the questionnaire by completing it at once. The results of the assessment of the practicality of teaching materials are shown in Table 7

Table 7. The results of the practicality assessment recap are based on the results of student responses to teaching materials

No	Aspect	Percentage (%)	Criteria
1.	Completeness of teaching materials	87.6	Very High
2.	Use of teaching materials	86.6	Very High
3.	Contextual integrated learning materials in ethnoscience	88.7	Very High
4.	Readability of teaching materials	86.6	Very High
5.	Physical appearance of teaching materials	89.3	Very High
	Average	**87.7**	**Very High**

Based on Table 7, the assessment of the practicality of the developed teaching materials is assessed based on the very high aspect of completeness because these teaching materials are equipped with instructions for use that are easy to understand (91.1%), the material is highly in line with the scope of learning outcomes (CP) based on competency standards (88.7 %), ability to help students achieve learning outcomes (CP) according to competency standards in particle motion dynamics material (85.7%), presenting activity steps that are very easy to follow and implement (90.5%), and being equipped with evaluation and assessment following achievement indicators (82.1%). Apart from that, based on the aspect of use, this teaching material is also stated to be very practical. This is because the teaching materials present interesting discussions (85.1%), improve physics concepts (81.6%), increase understanding of particle motion dynamics material (86.9%), increase enthusiasm for reading (86.3%), increase enthusiasm for studying physics (86.3%), are more practical than other teaching materials (88.7%), and use learning methods that are more interesting than other teaching materials (91.1%). Furthermore, based on the assessment of contextual integrated learning materials on ethnoscience, the developed teaching materials are stated to have a very high level of practicality. This is because the teaching materials can help students relate physics material to real life (88.7%). Apart from that, the

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teaching materials also help students develop science process skills which include observing, classifying, measuring, predicting, communicating, interpreting data, using tools, conducting experiments, and concluding (85.7%); increasing students' understanding of cultural literacy so that they can understand and behave toward Indonesian culture as national identity (89.9%); helping students relate physics material to cultural elements (89.9%); helping students understand physics concepts through various cultural case examples (89 .3%), helping students to become more familiar with Indonesian culture (88.7%), and making students more aware of the importance of preserving Indonesian culture (88.7%)

The assessment of the readability of the teaching materials is also stated to have a very high level of practicality because it uses informative and easy-to-understand language (88.7%); presents coherent, clear, and systematic explanations (89.9%); presents explanations in foreign languages or the regional language studied (84.5%); and using sentences that do not give rise to ambiguity that causes multiple interpretations (83.3%). Finally, the assessment of physical appearance with a very high level of practicality is also because this teaching material has a cover design that adds attractiveness to learning (85.7%), presents attractive figures (91.1%), and presents figures and illustrations, which helps students understand the material well (91.1%). Based on all assessments of student responses, the teaching materials received an assessment with very high practicality criteria in every aspect of the assessment. Thus, it can be stated that the teaching materials are practical to use in learning.

The developed physics teaching materials that have been declared feasible and practical are continued at the dissemination stage. The distribution of books was carried out in two schools according to the needs and characteristics of the students. The distribution stage began with packaging the books by printing books for some students at the target school so that students could take them home and it became reference material for independent study at home. Apart from that, electronic media was also provided in the form of portable document format (PDF) so that students could access the teaching materials anytime and anywhere via their respective gadgets. Apart from that, the teaching materials were promoted and socialized in schools to be adopted in the classroom learning process.

CONCLUSION

This research produces physics teaching materials based on the Merdeka Curriculum with an ethnoscience-integrated contextual approach with the title *Student's Book Getting to Know Indonesian Culture with Physics through Various Concepts of Particle Motion Dynamics for Class XI SMA/MA/Equivalent* with characteristics according to the needs of teachers and students. The main characteristic of this teaching material is that its presentation is integrated contextually with ethnoscience so that physics concepts are illustrated through local cultural wisdom that is familiar to students, namely traditional Indonesian games. This book has learning features to explain concepts and develop students' collaboration, literacy, and affective and psychomotor skills. Features are presented to support differentiation learning in student learning styles both visually, auditorily, and kinesthetically through a variety of original figures or cartoons, videos, podcasts, songs, and projects or practicums. Another unique thing is that the name of the feature is shortened to wayang characters so it is expected that it will increase students' sense of love for their homeland.

The results of the feasibility test of the developed teaching materials in terms of content, presentation, language, and graphic feasibility aspects by five expert validators and five practitioner validators produced an average percentage of 91.3% with a very high feasibility criteria value. The practicality test results obtained from the student response questionnaire resulted in an average percentage of 87.7% with very high criteria. Thus, the teaching materials are declared suitable and practical for use in learning.

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