Development of Physics Blended Discovery Learning Tools (PBDLT) in Alignment with the Merdeka Curriculum

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Abstract
Physics learning is inseparable from curriculum updates that always coexist with educational progress. To ensure that students can understand relevant physics concepts/principles/laws and provide them with the skills they need to face problems in the future, it is essential to develop physics learning tools aligned with Merdeka's curriculum. This project aims to provide workable Physics Blended Discovery Learning Tools (PBDLT) for the Merdeka curriculum. Research and development using the ADDIE development model—Analysis, Design, Development, Implementation, and Evaluation—is the nature of this kind of study. In this study, PBDLT development was limited to the development stage with research subjects, i.e., 30 students of class VIII-8 of SMPN 2 Banda Aceh in physics subject and three science teachers. Expert validation questionnaires (material and learning design specialists) and practicality tests were used to gauge the viability of PBDLT. Following data collection, descriptive quantitative methods with percentage analysis were used to examine the data. The learning design expert validation test yielded 91.5% with a very valid category and a rate of 93.25% for the material expert validation exam. Furthermore, the student response exam yielded 93%, an outstanding category, while the instructor response test yielded 92.7%. The Physics Blended Discovery Learning Tools (PBDLT) developed by the researchers are viable for use in large-scale trials in the learning process within the Merdeka curriculum, according to the research's findings.

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1. Introduction

Curriculum renewal and educational development have always coexisted in Indonesia. A prototype curriculum was released by the Ministry of Education, Culture, Research, and Technology (Kemendikburistek) in 2021, and it would be improved into a Merdeka curriculum in 2022 (Sugiri & Priatmoko, 2020). The 2013 curriculum (K–13) was evaluated; the outcome is this curriculum. The existence of the independent learning curriculum (Merdeka curriculum) seeks to address the difficulties facing education in the context of the fourth industrial revolution, which, in order to be realized, requires supporting students' problem-solving, creative, communication, and teamwork skills (Hattarina et al., 2022; Manalu et al., 2022). One of the initiatives introduced by Nadiem Makarim, Minister of Education and Culture, is independent learning. This program establishes a comfortable learning atmosphere where students' differences are considered during teaching and learning. As a result, the Merdeka curriculum highlights the importance of a differentiated teaching strategy. A system known as differentiated learning considers learners' diversity by carefully considering each one's requirements, interests, learning styles, aptitudes, and readiness (Aprima & Sari, 2022). In light of this, the design of the learning process needs to take the diversity of learners into account in order to meet the goals of this Merdeka curriculum.

The complexity of the subject matter in physics and the range of student demands, ability levels, and learning styles make differentiated learning crucial. Since physics content is frequently abstract, several teaching methods are needed to help students with varying comprehension abilities grasp it. Learning physics includes unique qualities that represent the experimental and scientific aspects of the subject (Anies, E., 2017). The emphasis on grasping fundamental ideas by investigation and experimentation is one of the primary features of physics education (Hilarius, J. D., & Herawati, S., 2019). In wave material, many wave concepts are found in real life. Therefore, the process of investigation and experimentation is very suitable to be applied to study this material because the

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method of studying physics places a strong emphasis on applying physics principles to real-world situations, problem-solving, and critical thinking (Wahyuni, S. et al., 2021). Thus, for student involvement to help them comprehend wave material more thoroughly, it is imperative to establish a learning model that enables students to build their curiosity with analytical and critical skills through exploration, experimentation, and observation. According to Paradede (2015), the discovery learning model is a teaching and learning approach that helps students acquire knowledge and develop concepts through self-discovery learning. Using the discovery learning model, teachers can be more creative in their scenario creation and help students gain a more profound knowledge of physics ideas. This approach also motivates students to seek information to tackle difficult and complex problems actively (Maulidar et al., 2016). Students are guided to acquire physics ideas through discovery learning using this paradigm (Meilani, 2022; Ayub et al., 2022). Throughout this learning process, they are urged to examine and contemplate themselves to recognize concepts based on the given knowledge or data (Syukri M. et al., 2020). Fitmawati's earlier studies showed that applying the discovery learning paradigm enhanced students' learning outcomes (Fitmawati, 2016). This demonstrates that teaching physics using the discovery learning methodology is appropriate.

However, with the diverse characteristics of learners, such as learning readiness, interests, and learning styles, the discovery learning model needs to be integrated with differentiated learning, which is the basic principle of the Merdeka curriculum. The variety of student characteristics must be considered when designing the discovery learning paradigm. Learning platforms like e-learning or Google Classroom are one way that the growth of information and communication technology today can help with differentiated learning (Farhan A. et al., 2023). Students in physics classrooms vary in their aptitude and preparedness to understand physics subjects based on their learning readiness. When using the discovery learning approach, instruction must be planned by modifying the course material based on each student's preparedness and comprehension level. Through learning platforms, various resources and media can be made available to students, allowing them to study according to their level of readiness (Herliana F. et al., 2021). Owing to students' wide range of interests, educators must create engaging and relevant content for them to choose from using the learning platform's discovery learning model. This will boost students' motivation and engagement in the physics curriculum (Susanna et al., 2021). Teachers must create a variety of media utilizing the discovery learning model on the learning platform to accommodate the diverse learning styles of their pupils, including kinesthetic, auditory, and visual (Ibrahim et al.; D. A., 2016). To ensure a successful physics learning process, educators must prepare a variety of digital media inside the learning platform while adhering to a learning model that reflects the unique features of physics learning, including discovery learning. Because the blended learning approach blends traditional education systems with digital ones in the teaching and learning process, learning physics through the discovery learning model in conjunction with different digital learning systems can be referred to as blended discovery learning (Perdana & Adha, 2020). With blended discovery learning, students could learn by the Merdeka curriculum's learning principles at any time and location at their speed. Students can access the Internet to supplement their learning process, receive instruction from teachers, and read books in the classroom (Nugraha, 2020). To enhance student learning outcomes, this knowledge can be applied to solve learning challenges (Simangunso, 2021).

Teachers must prepare for several things while implementing blended discovery learning to meet the learning objectives. Teaching modules, learning resources, learning films, etc., must be created before the learning process in the Merdeka curriculum is carried out (Hanifah et al., D., 2023). Lesson plans have either been eliminated from the Merdeka curriculum or converted into more diversified teaching modules (Maulida, 2022). According to Rahimah (2022), instructional modules consist of media, techniques, instructions, guidelines, and approaches that are methodically created and visually appealing. This teaching module is one of the significant learning tools established in the Merdeka curriculum to optimize students' engagement in the learning process so that the learning process becomes effective and efficient. The Ministry of Education and Culture's Education Development Agency created the teaching module, which is a unit of the most miniature teaching and learning program and which precisely outlines the following: a) students' achievement of general instructional objectives; b) topics that will serve as the foundation for the teaching and learning process; c) students' achievement of specific instructional objectives; d) the primary material to be studied and taught; e) the unit's or module's position and function within a more extensive program unity; f) the educator's role in the teaching and learning process; g) tools and sources that will be used; h) learning activities that students must complete sequentially; i) worksheets that students

must fill out; j) an evaluation program that students will carry out during the learning process (Kosasih, 2021). According to the guidelines established by the Ministry of Education and Culture's Education Development Agency, this lesson plan also includes worksheets that students must complete for the teacher-designed lesson and the Worksheet completed by the students to operate harmoniously.

The development of learning tools using the discovery learning model has been widely developed before and produced positive impacts on physics learning, such as concept understanding, cognitive abilities, and critical thinking (Andayani, S., 2020; Destriana et al., R., 2023; Egista, E. et al., 2022). However, in the process, the application of this model needs to pay attention to the diversity of learners using the advantages of information and communication technology in two learning environments, so students need more flexibility to learn based on their preferences. The existence of physics learning tools that embed various teaching materials and learning media and can be accessed online can help teachers facilitate students' learning of physics based on their preferences. Therefore, to implement the Merdeka curriculum, where the learning process refers to the diversity of learner characteristics adjusted to the characteristics of physics learning itself, which has an orientation on understanding physics concepts through exploration, observation, experimentation, and self-discovery can be carried out, it is essential to develop physics learning tools using the Blended Discovery Learning model called Physics Blended Discovery Learning Tools (PBDLT).

2. Method

This research was conducted using a research and development (Research & development) or R&D approach using the ADDIE development model: Analysis, Design, Development, Implementation, and Evaluation. The main objective of this research is to produce Physics Blended Discovery Learning Tools (PBDLT), which are feasible to use in the Merdeka curriculum. The research stages carried out were limited to the development stage due to the limited time and funds available in this study. The product design was then validated by two material and learning design experts, who tested the product for practicality on research subjects. Thirty students in classes VIII–8 and three physics professors served as research subjects for this study, carried out at SMPN 2 Banda Aceh. Teacher and learner response questionnaires to the produced products and material and learning design expert validation sheets provided to validators served as the study's research instruments.

In this study, quantitative descriptive analytic approaches were employed for data analysis. In order to assess the viability of the Physics Blended Discovery Learning Tools (PBDLT), the percentage analysis of expert validation results was performed using the equation:

$$P = \frac{\text{Total score of each item}}{\text{Maximal score}} \times 100\% \quad (1)$$

After obtaining the research data, it is then interpreted into the Table 1 validity criteria (Arikunto, 2010):

Table 1. Teaching Module Validity Level Criteria

Feasibility Percentage	Citeria
$01.00\% < P \leq 50.00\%$	Not Valid (NV)
$50.01\% < P \leq 70.00\%$	Valid Enough (VE)
$70.01\% < P \leq 85.00\%$	Valid (V)
$85.01\% < P \leq 100.00\%$	Very Valid (VV)

In order to determine how useful Physics Blended Discovery Learning Tools (PBDLT) goods are, a modest study was carried out with teachers and students receiving response questionnaires. Using the following formula (Arikunto, 2010), the assessment scores were then examined:

$$P = \frac{\text{Total score of each item}}{\text{Maximal score}} \times 100\% \quad (2)$$

After obtaining the research data, it is then interpreted into the Table 2 (Arikunto, 2013).

Table 2. Teachers and Students Response Questionnaire Assessment Score Criteria

Achievement Level (%)	Assessment Category
0-21	Very Poor (VP)
21-40	Not Good (NG)
41-60	Fairly Good (FG)
61-80	Good (G)
81-100	Very good (VG)

Figure 1 provides a clear and detailed view of the research flow:

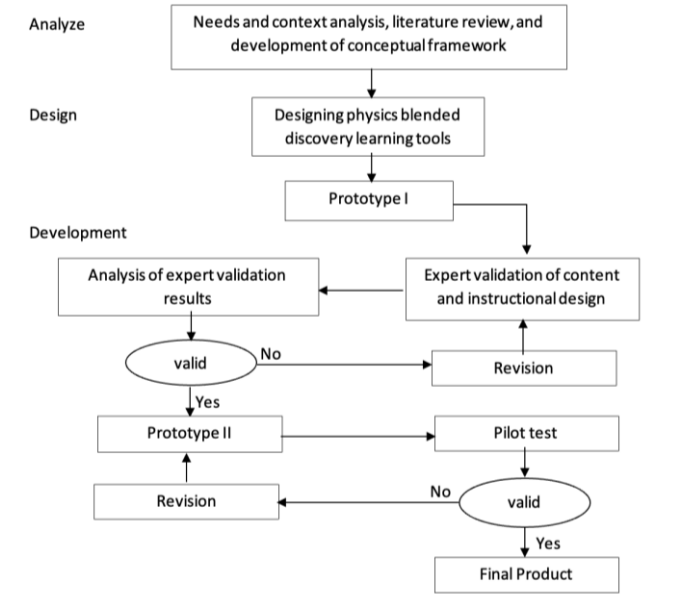
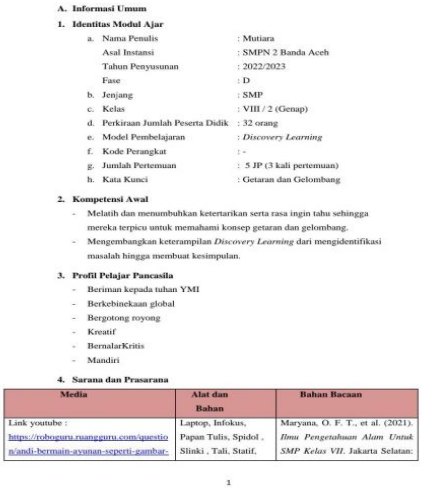


Figure 1. Research Flow

3. Results and Discussion

This research was conducted in several stages: analysis, design, and development. Due to the limited time and funds available to study, the implementation and evaluation stages have yet to be completed. Curriculum, instructional module, and needs analysis were carried out throughout the analysis stage. Data collection was done through curriculum observation, the observation of learning tools, and interviews with three science teachers at SMPN 2 Banda Aceh. During the curriculum analysis exercise, it was discovered that SMPN 2 Banda Aceh had adopted a Merdeka curriculum, ensuring the actual learning process adhered to the relevant curriculum. However, from the results of direct observations at SMPN 2 Banda Aceh and interviews, information was obtained that the learning process had yet to adopt the Merdeka curriculum fully. Practicum activities still need to be carried out on each learning material. This is due to time constraints during the learning process. The learning process is still conventional and does not involve students actively, so students must understand the material better. The teaching module that is the teacher's reference does not show the components stipulated by the Merdeka curriculum, so it is necessary to develop learning tools that can facilitate the active learning process to achieve the demands of the Merdeka curriculum.

Based on the findings of the completed analysis, decisions are taken during the design phase. The steps of the Blended Learning approach-based Discovery Learning model are called the "design stage," which is a methodical procedure. This instructional module has three main components: general information, core components, and appendices. At this point, the methodical preparation of the Worksheet is done along with the design of the instructional modules. Since learning activities refer to the steps of the Discovery Learning model supported by technology and learning media embedded in YouTube links, all activities at this stage of the preparation of the teaching module design contain and modify learning tools by the Discovery Learning model based on Blended Learning (Murtavia et al., 2022). This allows learning materials to be accessed both in and outside the classroom (online). An image of the blended learning-based Discovery Learning teaching module, which was created using the teaching module's three components, may be found below:



A. Informasi Umum

1. Identitas Modul Ajar

a. Nama Penulis : Mutiara
Asal Instansi : SMPN 2 Banda Aceh
Tahun Penyusunan : 2022/2023
Fase : D
b. Jenjang : SMP
c. Kelas : VIII / 2 (Genap)
d. Perkiraan Jumlah Peserta Didik : 32 orang
e. Model Pembelajaran : *Discovery Learning*
f. Kode Perangkat : -
g. Jumlah Pertemuan : 5 JP (3 kali pertemuan)
h. Kata Kunci : Getaran dan Gelombang

2. Kompetensi Awal

- Melatih dan menumbuhkan ketertarikan serta rasa ingin tahu sehingga mereka terpicu untuk memahami konsep getaran dan gelombang.
- Mengembangkan keterampilan *Discovery Learning* dari mengidentifikasi masalah hingga membuat kesimpulan.

3. Profil Pelajar Pancasila

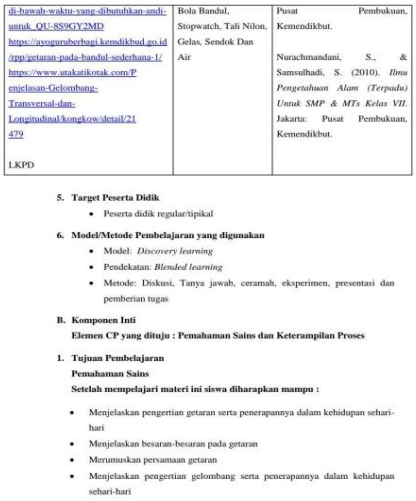
- Beriman kepada tuhan YMI
- Berkebinekaan global
- Bergotong royong
- Kreatif
- BernalarKritis
- Mandiri

4. Sarana dan Prasarana

Media	Alat dan Bahan	Bahan Bacaan
Link youtube : https://roboguru.ruangguru.com/question/andi-bermain-ayunan-seperti-gambar-	Laptop, Infokus, Papan Tulis, Spidol , Slinki , Tali, Statif,	Maryana, O. F. T., et al. (2021). *Ilmu Pengetahuan Alam Untuk SMP Kelas VII*. Jakarta Selatan:

1

Figure 2. General Information



di-bawah-waktu-yang-dibutuhkan-andi-untuk_QU-8S9GY2MD https://ayoguruberbagi.kemdikbud.go.id/rpp/getaran-pada-bandul-sederhana-1/ https://www.utakatikotak.com/Penjelasan-Gelombang-Transversal-dan-Longitudinal/kongkow/detail/21479 LKPD	Bola Bandul, Stopwatch, Tali Nilon, Gelas, Sendok Dan Air	Pusat Pembukuan, Kemendikbut. Nurachmandani, S., & Samsulhadi, S. (2010). *Ilmu Pengetahuan Alam (Terpadu) Untuk SMP & MTs Kelas VII*. Jakarta: Pusat Pembukuan, Kemendikbut.

5. Target Peserta Didik

- Peserta didik regular/tipikal

6. Model/Metode Pembelajaran yang digunakan

- Model: *Discovery learning*
- Pendekatan: *Blended learning*
- Metode: Diskusi, Tanya jawab, ceramah, eksperimen, presentasi dan pemberian tugas

B. Komponen Inti

Elemen CP yang dituju : Pemahaman Sains dan Keterampilan Proses

1. Tujuan Pembelajaran

Pemahaman Sains

Setelah mempelajari materi ini siswa diharapkan mampu :

- Menjelaskan pengertian getaran serta penerapannya dalam kehidupan sehari-hari
- Menjelaskan besaran-besaran pada getaran
- Merumuskan persamaan getaran
- Menjelaskan pengertian gelombang serta penerapannya dalam kehidupan sehari-hari

Figure 3. Core Components

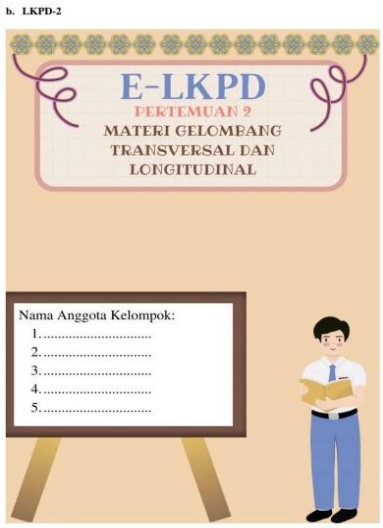


Figure 4. Appendices

The Discovery Learning model's learning steps or syntax, which include stimulation, problem statements and problem identification, data collection and processing, verification and proof, and conclusion drawing, are used to prepare this PBDLT (Wicaksono, 2022). In order to pique students'

curiosity and provide guidance for them to understand the material supplied, teachers use educational movies about waves as examples to show students during the stimulation stage. This video is provided as a link so that users can access it without being limited by time or location. This task has been modified to align with the Worksheet students may encounter during their education. Because of the issue statements stage, which instructs students to be able to locate concepts, and because the responses provided will, after that, become initial hypotheses, the Discovery Learning model-oriented worksheet will provide direct experience and meaningful learning (Sapilin et al., 2019). The following figure illustrates the stimulation stage of PBDLT:

• Apa yang terjadi pada botol di atas air laut yang bergelombang ? 6. Guru bertanya mengenai materi sebelumnya yaitu getaran 7. Guru menyampaikan capaian pembelajaran		
Kegiatan Inti (90 Menit)		
Fase 2 : *Stimulation* (Stimulasi / Pemberian Rangsangan)		
1. Guru menjelaskan secara singkat megenai materi gelombang 2. Guru membagi siswa menjadi beberapa kelompok 3. Guru membagikan LKPD-2 ke pada setiap kelompok 4. Guru menjelaskan petunjuk kegiatan yang akan dilakukan siswa pada LKPD-2 5. Guru memberikan kesempatan pada siswa untuk bertanya jika ada hal yang belum dipahami tentang kegiatan yang akan di lakukan pada LKPD-2 6. Guru memberikan rangsangan untuk memusatkan perhatian siswa dengan menanyakan video untuk mendemostrasikan perbedaan gelombang transversal dan longitudinal (link : https://www.utakatikotak.com/Penjelasan-Gelombang-Transversal-dan-Longitudinal/kongkow/detail/21479 https://youtu.be/lVdQ8JMcmYY	1. Siswa mendengarkan dan mencata poin penting mengenai gelombang 2. Siswa duduk secara berkelompok sesuai dengan arahan guru 3. Siswa menerima LKPD-2 yang dibagikan oleh guru 4. Siswa mendengarkan petunjuk penggunaan LKPD-2 5. Siswa bertanya mengenai hal yang belum dipahami	Sinkronus

Figure 5. Stimulation Stage in Lesson Plan

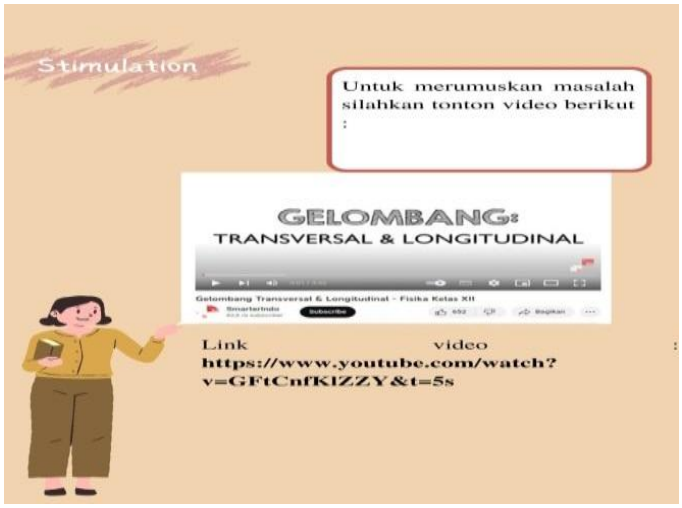


Figure 6. Stimulation Stage in Worksheet

Additionally, throughout the data collection phase, students can validate their hypothesis by communicating the results to their group members through discussion. These results will, after that, be provided to the syntax for data processing. During the data processing phase, students respond to questions from the instructor to interpret their findings, which are then compared to the data collecting table. The following figure illustrates the phases of data processing and collecting in PBDLT:

Fase 4 : *Data Collection* (Pengumpulan Data)		
1. Guru memberikan peralatan praktikum 2. Guru meminta siswa untuk memulai melakukan diskusi dan praktikum berdasarkan petunjuk dan langkah kerja di LKPD-2 secara berkelompok (**Bergotong royong**) 3. Guru membimbing siswa untuk mengumpulkan data hasil percobaan yang telah dilakukan kedalam tabel hasil pengamatan	1. Siswa merancang alat percobaan 2. Siswa memulai diskusi dan praktikum yang sesuai dengan petunjuk atau langkah-langkah yang telah dijelaskan sebelumya secara berkelompok (**Bergotong royong**) 3. Siswa mengumpulkan data pengamatan hasil percobaan yang telah dilakukan ke dalam tabel pengamatan	Sinkronus
Fase 5 : *Data Processing* (Pengolahan Data)		
Guru mengarahkan siswa untuk menjawab pertanyaan di LKPD-2 setelah melakukan percobaan dan sesuai dengan data hasil pengamatan yang telah dilakukan	Siswa menjawab pertanyaan LKPD-2 secara berkelompok dan mendiskusikannya	Sinkronus

Figure 7. Data Collection and Data Processing in Lesson Plan

Figure 8. Data Collection and Data Processing in Worksheet

During the proof/verification phase, students use textbooks and instructional videos teachers offer to support their initial theories and discoveries. They also check to see if their data is consistent with the theory they have learned. Additionally, when drawing conclusions or generalizations, students and group members present their findings based on experiments conducted with group members after obtaining findings deemed correct based on the proof stage. Educators and peers will provide input on this process to complete the understanding received (Dehong et al., 2020; Hamzah et al., 2020). The proof/verification stage and concluding/generalizations in this PBDLT are shown in the following figure:

Fase 6 : *Verification* (Pembuktian)		Sinkronus
1. Guru bertindak sebagai fasilitator membimbing siswa dalam melakukan kegiatan pembuktian. Guru menyiapkan link video sesuai dengan praktikum yang telah dilakukan: https://www.youtube.com/watch?v=Lwf8H3uo24Y&t=44s	Siswa melakukan pembuktian dari hipotesis yang telas di jawab sesuai dengan bahan bacaan dari buku paket dan link vidio yang diberikan oleh guru dengan tujuan menguatkan hasil diskusi dari kelompoknya (**Bergotong royong**)	
Fase 7 : *Generalization* (menarik kesimpulan)		Sinkronus
1. Guru membimbing siswa secara berkelompok menyampaikan hasil diskusi di dalam kelas 2. Guru memberikan kesempatan kepada siswa dari kelompok lain untuk bertanya 3. Guru memberikan aplous kepada siswa yang bertanya dan yang menjawab 4. Guru memberikan penguatan kepada jawaban siswa yang telah diberikan 5. Guru meminta siswa memberikan kesimpulan berdasarkan hasil percobaan yang telah dilakukan di dalam kelas	1. Siswa secara berkelompok meyampaikan hasil diskusi kelompok di dalam kelas 2. Siswa memberikan jawaban atas pertanyaan yang diberikan siswa yang lain di dalam kelas 3. Siswa mencata jawaban yang diberikan oleh guru di buku catatan 4. Siswa memberikan kesimpulan dari percobaan yang telah dilakukan	

Figure 9. Verification and Generalization in Lesson Plan

Figure 10. Verification and Generalization in Worksheet

Knowledgeable validators evaluate the PBDLT during the development phase, which comes after. Teachers and students at SMPN 2 Banda Aceh participated in a short trial to ascertain the validity of the learning resources that had been prepared.

Expert validators in material and learning design evaluated the created PBDLT. The Likert scale, which ranges from poor to very good, is used to assess. The outcomes of the validation of the teaching module by specialists in learning design and materials are as follows:

Table 3. Material Expert Validation Results

No	Aspect	Percentage Score	Criteria
1	Content Appropriateness	93.5%	VV
2	Language Feasibility Aspect	94%	VV
3	Presentation Aspect	92.25%	VV
	Average Overall Percentage	93.25%	VV

It is evident from Table 3's PBDLT validation results by material specialists that every component on the product assessment sheet fits into the highly valid group. The presenting component has the lowest average percentage (92,25% with extremely valid criteria). This indicates that the validator provided a reasonably high value. Nonetheless, the validators criticized that some

of the writings inside the learning teaching module need more coherence in their presentation systematics. The reason for this is that the educational teaching module consists of many instruments, media, techniques, information, and instructions that are firmly, efficiently, and aesthetically constructed to meet the demands of the students (Sitanggang et al., 2023), so it must be arranged coherently One of the most influential people in the preparation of learning modules is the educator. They are responsible for creating a comprehensive and practical learning module that will motivate students, encourage them to take on meaningful roles in the community and allow them enough room to be creative and accessible according to their interests and abilities.

Table 4. Learning Design Expert Validation Results

No	Aspect	Percentage Score	Criteria
1	Teaching module aspect	91,3%	VV
2	Aspects of LKPD	91,7%	VV
	Average Overall Percentage	91,5%	VV

The outcomes of learning design experts' validation of PBDLT Table 4 shows that all of the PBDLT assessment sheet's components are legitimate, with 91.5% of the total points categorized as extremely valid criteria. The teaching module element has the lowest average percentage (91.3%) with valid criteria. This is because a few learning objectives must align with the selected content. Educators may effectively plan and execute high-quality, well-organized instruction if learning objectives are well-defined and well-coordinated. By creating practical learning objectives, a teacher can schedule appropriate tests and competency achievement indicators for students to complete at the end of the learning process (Muth'im et al., 2021).

After the validator carried out the validation test, the PBDLT of wave and vibration material was limited to the physics subject teacher and class VIII-8 SMPN 2 Banda Aceh students. This limited trial aims to determine the ease and ability of teachers and students in understanding and using PBDLT (Hasanah et al., 2017). The results of the response by teachers in this study can be seen in the following table:

Table 5. Results Teacher Responses

No	Assessment Indicator	Percentage Score	Assessment Category
1	Presentation of material	80 %	G
2	Presentation of teaching modules	100 %	VG
3	Presentation of LKPD	98 %	VG
	Overall Average Percentage	92.7 %	VG

Table 5 shows that the percentage of the PBDLT teacher's assessment findings is 92.7%, falling under the outstanding category. The instructional module presentation indicator has the highest average percentage of 100% with perfect criteria, while the material presentation indicator has the lowest average percentage of 80% with suitable criteria. There are issues with how the content is presented, one of which is that the learning objectives and outcomes must be aligned. It would help if you first comprehended the learning outcomes (CP) before creating any learning programs. A scope of material and a set of competencies are contained in the learning outcomes (CP) itself. The government has also established learning outcomes through the learning competencies that students must meet at each stage (Meisin et al., 2022).

Nonetheless, three physics teachers of class VIII-8 also responded well to the application of PBDLT. This is so because PBDLT complies with the Merdeka curriculum, which already includes attachments, core components, and general information components (Sadieda et al., 2022). PBDLT is also developed with the material's profundity, the students' demands, and the required media in mind. Students can learn at their own pace, anywhere, at any time, with the help of this PBDLT. This is evident from the learning materials, like links and YouTube videos relevant to the PBDLT content, that students can access both within and outside the classroom (Herliana et al., 2022).

Furthermore, PBDLT incorporates a worksheet section that accurately reflects the steps and structure of the discovery learning model, including problem identification, stimulation, data collection, data processing, proof, and concluding (Ana, 2018). This section is designed to support

blended learning by providing students with the necessary worksheets to assist them in concluding the data they have obtained (Nisrina et al., 2020). Teachers should use this PBDLT as guidance when incorporating physics principles into lesson plans.

The results of the response by students in this study can be seen in the Table 6:

Table 6. Students Response Results

No	Assessment Indicator	Percentage Score	Assessment Category
1	Ease of use of Student Worksheet	93.2 %	VG
2	Ease of following the learning process	93.3 %	VG
3	Assistance of students in understanding the material using the Student Worksheet	93.3%	VG
4	Students' assistance in the learning process	93.3 %	VG
	Overall Average Percentage	93 %	VG

Table 6 indicates that the total % of students' PBDLT evaluation results is 93%, falling in the outstanding category. The indicators of how simple it was to follow the learning process, how well students understood the material using the Worksheet, and how well students assisted in the learning process had the highest average percentage (93.3%) with perfect criteria. In comparison, the indicator of how easy it was to use (93.2%) had the lowest average percentage (93.2%) with perfect criteria. This is because students are not permitted to bring cell phones to class, making it difficult for them to access the YouTube links provided by the Worksheet. Educators must employ learning resources besides printed books, such as projecting instructional movies on a screen. This supports the findings of Hamka and Effendi, who claim that using the right learning resources can improve learning effectiveness, creativity, and quality. Using technology-based learning resources is one of them (Hamka & Effendi, 2019).

Students responded positively to this PBDLT, as shown by the percentage obtained. Enthusiastic student participation in the learning process using the blended learning-based discovery learning paradigm is visible when learning occurs in the classroom. The ease with which students can follow the physics learning process using PBDLT increases their learning independence and eliminates their dependence on the schedule and location determined for instruction. This is one of the many advantages of implementing mixed learning combined with the discovery learning model because the learning process can be carried out anytime and anywhere (Damka et al., 2020).

This was proven during the learning process using PBDLT at the initial stage of the Discovery Learning syntax; students were given trigger questions via WhatsApp Group as a form of stimulus for students before studying the material, and a learning video was presented which students could access via a YouTube link to answer questions from the teacher. Students can determine the problem from the video watched (problem statement). When implementing the Discovery Learning model without a blended learning approach, this stage is carried out in class, so it takes longer to complete one material (Nurcahyo et al., D., 2018). With Blended Learning, this activity can be carried out outside physics study hours in class so that students have initial knowledge regarding the material to be studied in class so that study time in class can be used to explore other learning activities (Herliana, F. et al. ., 2023). Next, students carry out the stages of data collection, data processing, verification, and generalization in the classroom with direct guidance from the teacher. At this stage, students are actively involved in group discussions to collect data through practicum; students answer questions on the LKPD; students analyze data based on data obtained from practicum results; and finally, students prove the hypothesis and make conclusions (Widiadnyana et al., 2014). The existence of LKPD, which is equipped with links to teaching materials and online learning media in PBDLT which can be accessed by students anytime and anywhere, allows students to repeat the stages of data collection, data processing, verification, and generalization that have been carried out in the classroom so that Students' understanding of the material studied is more optimal because learning is carried out in two learning environments (Syukri, M. et al., 2022). The freedom for students to learn using PBDLT supports the implementation of the Merdeka curriculum, where students are given the freedom to learn according to their individual preferences (Mulyasa, H.E., 2023). This shows that PBDLT can help teachers in facilitating students to learn physics without the limitations of space and time so that the blended learning-based Discovery Learning paradigm is

effective in increasing student engagement and learning outcomes (Burhendi, F.C.A., et al., 2019; Mulyanto B.S. et al. l., 2020). Based on the description above, the Physics Blended Discovery Learning Tools (PBDLT) is suitable for use in large-scale assessments during the physics learning process by implementing the Merdeka curriculum.

4. Conclusion

The Development of Physics Blended Discovery Learning Tools (PBDLT) in Alignment with the Merdeka Curriculum has met the very appropriate criteria based on the validity analysis of material experts with a percentage score of 92.25% and learning design experts with a percentage score of 91.5% in the very valid category, according to the research's findings and discussion. Aside from that, the instructor responses comprised 92.7% of the outstanding category's results for the feasibility test, while the student responses yielded a 93% percentage for the same category. Thus, the Physics Blended Discovery Learning Tools (PBDLT) is suitable for large-scale assessments during the physics learning process by implementing the Merdeka curriculum.

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