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Development of a Mobile Pocket Book with a Problem-Based Learning Model to Improve Students' Physics Literacy

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Abstract: Physics learning, especially on heat, often faces various obstacles, such as low student literacy and limited interactive learning media. Mobile pocketbooks come as one of the solutions to overcome these problems. This application-based digital learning media is designed to provide easy access to students ' learning materials through mobile devices. The mobile pocketbook is an application-based digital learning media designed to facilitate students' flexible access to learning materials through mobile devices. Using the Problem-Based Learning (PBL) model in the mobile pocketbook supports Active Learning, where students solve real problems to improve concept understanding and science literacy. This research aims to develop and test the validity and practicality of the product in the form of a mobile pocketbook as a medium to support physics learning, especially on heat material. The research method used was Research and Development (R&D) with the 4D development model (Define, Design, Develop, Disseminate). However, due to time and cost constraints, this research did not reach the dissemination stage. Product validity was evaluated through assessments from experts and practitioners. The results of the expert assessment showed a validity level of 92.50%, while the practitioner gave a validity value of 96.25%, which indicated that the product was very valid. In addition, the product practicality test was evaluated through a questionnaire given to students and teachers. The questionnaire's results show that this media is very practical, with a practicality value from the students' response of 90.76% and the teacher reaching 96.47%. Thus, the mobile pocketbook was designed using a problem-based learning model to improve students' physics science literacy. The results showed that this media is valid and practical for enhancing students' understanding of physics material, especially the concept of heat, as evidenced by the average practicality value of 93.61% in the very practical category. Therefore, this mobile pocketbook is expected to be one of the learning media innovations that can improve the quality of physics learning in schools.

Keywords: Mobile Pocket Book; Problem-Based Learning Model; Science Literacy.

Introduction

The development of education and technology is behind the progress of science education. Every learner must be wise and adapt to science, environment, society and technology [1]. The independent curriculum emphasizes literacy in various aspects, especially literacy in utilizing information and technology [2]. Science literacy skills are essential for learners in analyzing problems and connecting these problems with various scientific facts [3]. Science education will produce learners who have the potential for them to foster the potential for logical thinking and problem-solving skills successfully. According to [4], to improve the quality of Learning, the learning paradigm must be changed from teacher-centred to student-centred Learning. Therefore, a learning model is needed to assist students in training in science literacy skills. One of the learning models that can be used is the problem-based learning (PBL) model.

The PBL model is a learning strategy that centers on students actively learning to solve complex real-life problems. PBL focuses on educators as facilitators and students as learning centers, so using PBL models can help students be more actively involved and independent in solving a problem in the learning process [5]. The purpose of the PBL model is threefold: assisting students to develop inquiry and problem-solving skills, providing opportunities for students to learn the experiences and roles of adults, and enabling students to improve their thinking skills and become independent learners [6]. Factors that affect the learning process in schools are the lack of utilization of learning media in teaching and learning activities, which causes students to be less active and less interested in what is being taught [7]. Thus, the PBL model can specifically support the development of physics literacy in several ways; one is directing learners to face real complex problems, so they must use physics concepts to find solutions. This process encourages learners to understand and apply physics theories in the context of everyday life, which is one of the indicators of science literacy.

Science literacy is understanding, communicating, and applying science skills to solve problems [8]. Science literacy skills are essential for students in analyzing issues and connecting these problems with various scientific facts [9]. The Program for International Student Assessment (PISA) survey results conducted in 2018 showed that Indonesia was ranked 74th out of 79 participating countries. Whereas in the 2022 PISA results, Indonesia's ranking rose by six positions, namely 69 out

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of 82 participating countries. One of the factors that led to Indonesia's PISA ranking was the increase in the number of countries participating [10]. These data show that Indonesian people's interest in reading is still relatively low.

Based on observations and interviews with physics teachers at Senior High School 10 Mataram, it was found that the low literacy skills of students were caused by less conducive Learning in the classroom. Teachers have limited time to explain physics concepts in depth and more often give summarizing tasks and practice questions, which causes students to have difficulty understanding the material. This low science literacy has an impact on their learning outcomes. Teachers also have not used interactive media such as pocketbooks with the PBL method, and students more often use smartphones for things outside of Learning, so the problem approach can be used as a substitute for improving students' science literacy skills because it teaches them how to deal with global problems related to the field studied [11]. So with mobile Learning or M-learning, learners can learn and understand science anytime and anywhere without being limited by time. Mobile Learning in the pocket book is developed because it is practical, lightweight, and easily accessible through mobile devices, allowing learners to learn flexibly anytime and anywhere. In addition, digital pocketbooks can be designed interactively with multimedia features such as images, videos, and simulations, which help visualize science concepts more clearly. Therefore, there is a need for learning media in the form of mobile pocketbooks with problem-based learning models that can facilitate the needs of students to improve science literacy. The purpose of this research is to develop and test the validity and practicality of the product in the form of a mobile pocketbook as a supporting medium for learning physics, especially on heat material.

Research Methods

This research is a research and development (R&D). This research design uses the 4D development model. This model consists of four main stages: define, design, develop, and dissemination [12]. However, in implementing this mobile pocketbook development, the research was focused only until the building stage. This restriction was made due to limitations in terms of time and money, which required researchers to complete the research up to the development stage without continuing to the dissemination stage. Nevertheless, the results at the development stage are expected to be sufficient to provide important information related to the validity and practicality of the developed product.

This research was conducted in class XI C Senior High School 10 Mataram in 2024/2025. This study has two types of data: qualitative data, which comes from the results of validation consisting of comments and suggestions, and quantitative data, which comes from the results of validation and questionnaire responses of students and teachers. The validation sheet is used to evaluate the feasibility of the product, including validity and reliability. Five validators carried out the validation process, consisting of 3 experts and two practitioner validators. In addition, the learner and teacher response questionnaire was used to assess the product's practicality.

The assessment of the validation sheet is carried out using a Likert scale, namely 1 to 4, on each criterion, including 1 = invalid, 2 = moderately valid, 3 = valid, and 4 = very valid. The following is the formula for calculating the percentage of product validity based on the validator's assessment, as described in Equation 1 [13].

$$\text{Validity} = \frac{\text{Total scores from the validator}}{\text{Maximum possible score}} \times 100\% \quad (1)$$

The scores from 5 validators will be summed up to get the average percentage, which can be calculated using Equation 2 [14].

$$\bar{X} = \frac{\text{The total value of each validator}}{\text{Number of validator}} \times 100\% \quad (2)$$

The validity criteria of the mobile pocketbook are determined based on the categories listed in Table 1 [15].

Table 1. Validity Assessment Criteria

Percentage Value (%)	Score
81.25 > Score ≤ 100	Very Valid
62.50 > Score≤ 81.25	Valid
43.75 > Score≤ 62.50	Quite Valid
25 ≥ Score≤ 43.75	Invalid

Practicality analysis was conducted using the formula described in Equation 3 [16].

$$\%\text{Prakticality} = \frac{\text{The sum of the scores of the assessors}}{\text{Maximum score}} x100\% \quad (3)$$

The data analysis obtained is then interpreted with the provision that the product in the form of a mobile pocketbook with the PBL model is said to be practical if the assessment meets the valuable and efficient criteria, namely 61% - 100%. Table 2 shows the categories and intervals of practicality as follows [17].

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Table 2. Practicality Criteria

Percentage Value Range (%)	level of Practicality
0-20	Very Impractical
21-40	Less Practical
41-60	Quite Practical
61-80	Practical
81-100	Very Practical

Results and Discussion

Define Stage

The define stage is the initial stage in the learning planning process that aims to obtain relevant information related to the problems that arise in implementing Learning in the classroom. This stage also involves collecting information about the curriculum used by teachers, learning materials, learning models, learning methods, and characteristics of students.

The defining stage includes several steps, namely examining the problems encountered when carrying out physics learning activities in the classroom. Information was obtained at the initial-end analysis stage, namely observation activities and interviews with physics teachers at Senior High School 10 Mataram, and then the characteristics of students were analyzed, which are still related to their science literacy skills—furthermore, concept analysis by identifying and compiling materials that will be studied systematically through flow of learning objectives analysis. The next stage of task analysis is adjusting the materials to be studied systematically and compiling tasks that students will do. The last stage of learning objectives analysis is analyzing learning outcomes.

Design Stage

The design stage, also known as design, is a process carried out to design or design a product prototype in the form of a mobile pocketbook with a problem-based learning model. The preparation of the mobile pocketbook in this study is adjusted to the syntax of the problem-based learning model. This mobile pocketbook learning media has several objectives, including 1) to support active Learning where students are directly involved in problem-solving, thus developing critical and analytical thinking skills by solving real problems related to science concepts, 2) to increase student's interest and motivation in learning physics, because they can learn more interactively and interestingly, 3) to help students learn independently and flexibly so that it can help them prepare for classroom learning and exams. The purpose of using this mobile pocketbook is to improve students' science literacy.

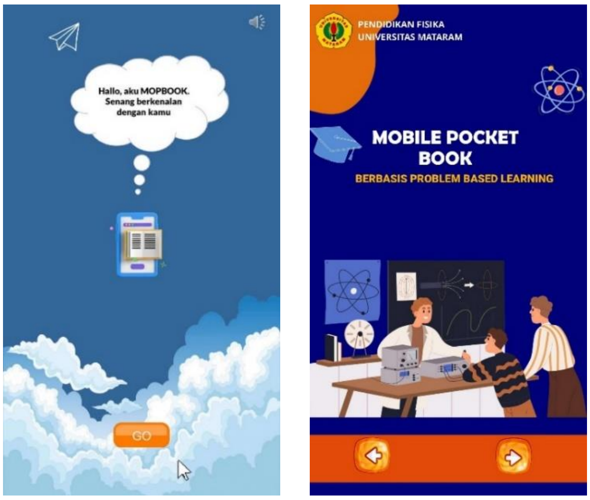

Figure 1. Initial view of the mobile pocket book

The mobile pocketbook consists of several components that can facilitate students' science literacy, especially physics, such as concept maps that help students understand the relationship between science concepts visually and systematically, making it easier for them to build a more thorough understanding, heat material which is the core of learning content that supports students' theoretical understanding. Learning videos that provide concrete visualizations of science phenomena, while WhatsApp links can be used for interactive discussions that support scientific communication literacy, practice questions, and evaluation questions play a role in honing critical thinking, analysis, and problem-solving skills in the context of science, instructions for use that help learners understand how to use pocketbooks effectively for independent Learning while learning outcomes that provide clear guidance on the objectives that need to be achieved so that learners can focus on developing science literacy, and motivational words that encourage learners to continue learning and understanding science more deeply.

The following is the initial appearance of the *mobile pocketbook* with a *problem-based learning* model, which can be seen in Figure 1.

Development Stage

The development stage is the stage to test the validity, practicality, and effectiveness. However, this study did not conduct the effectiveness test due to time and cost constraints. The mobile pocketbook that has been developed, as shown in Figure 1, is the initial display when the application enters the main menu of the mobile pocketbook. In this menu, there is a command dialogue from the application to press the (go)¸button so that it will directly enter the main menu of learning media.

This study obtained an average assessment for the level of validity from expert validators and practitioner validators. Details of the evaluation for each aspect in the mobile pocket book validation sheet by experts and practitioners have the same assessment aspects, as seen in Table 3. The validation results by practitioners are also based on the same assessment aspects as those used by experts, which include several criteria such as material suitability, design quality, and ease of use of the product. Although the assessment aspects used are similar, the results obtained from the practitioners' assessment can differ from those the experts gave. This is due to differences in perspective and experience between practitioners and experts when assessing a product.

Based on the results of calculations using a Likert scale and validity criteria in Table 1, the average percentage value of mobile pocket book validation developed from expert validators was obtained at 92.50%, the same calculation for practitioner validators obtained an average value of 96.25%, which is included in the very valid category. This high validity is supported by an attractive and interactive mobile pocketbook display, which can increase students' learning motivation. This aligns with previous opinions that learning media with visual elements such as animation, colour changes, and sound can stimulate students' interest in learning [18]. Details of the aspects assessed can be seen in Table 3.

The main advantage of mobile pocketbooks is that they are flexible and portable. As digital media, mobile pocketbooks allow students to learn independently anytime and anywhere, without being tied to a particular time or location [19]. Using the PBL model in the mobile pocket book provides a student-centred learning experience, so students are encouraged to identify problems, find solutions, and connect physics concepts with natural phenomena. The mobile pocket book design in the form of an electronic textbook specifically designed for smartphones makes it easier for students to access physical science materials concisely and efficiently.

Table 5. Validation of Mobile Pocket Book Expert Validator

Assessment Aspect	Expert Validator			Score	Validity (%)
	1	2	3		
Suitability of the material to the problem presented.	4	4	4	12	100.00
Suitability of material to learning objectives.	3	4	4	11	91.67
Relevance of material to the PBL model.	4	3	4	11	91.67
Appropriate use of interactivity (images, videos, animations, menus, etc.) with the material.	4	3	3	10	83.33
Readability and completeness of the material presented.	3	4	4	11	91.67
The suitability of problem-based learning ability questions is given with the material.	4	3	4	11	91.67
Ease of user access to material.	4	4	4	12	100.00
Accuracy in using good and correct language when presenting material.	3	4	4	11	91.67
Suitability of the material to problems related to real life.	3	4	3	10	83.33
Logical and easy-to-understand material organization.	4	4	3	11	91.67
Diversity of media used.	4	4	3	11	91.67
Media interactivity with users and materials.	3	4	4	11	91.67
Responsiveness (ease of access by cellphone, laptop or tablet) of media to users.	4	4	4	12	100.00
Ease of use with instructions for use.	4	4	3	11	91.67
Appropriate size for images, videos, text, animations and simulations.	4	3	4	11	91.67
The mobile pocketbook used makes it easier to visualize problems.	3	4	4	11	91.67
Informative use of sound and narration.	3	4	4	11	91.67
Attractive appearance and consistent use of buttons.	4	3	4	11	91.67
Suitability of the media to the material presented.	4	4	3	11	91.67
Suitability of the media quality (video, animation, images, etc.) used.	4	4	4	12	100.00
Average					92.50
Criteria					Very Valid

In addition, mobile Learning, especially mobile pocketbooks, is very relevant to support physics literacy because it integrates interactive elements such as animations, videos, and simulations that help students visualize abstract concepts in physics. Physics literacy is not only the ability to understand concepts but also the ability to think critically, solve problems, and apply knowledge in real situations. Previous research also states that interactive E-books increase reading interest and help students understand the material more deeply through engaging presentations [20]. Therefore, the high validity obtained on this mobile pocketbook confirms that this media effectively delivers material and has great potential to support physics literacy by presenting structured, interactive, and easily accessible content.

The relationship between validity and practicality lies in the ability of the media to be applied in real Learning. A valid mobile pocket book clarifies the material and instructions for use, thus supporting practical use by teachers and students. Therefore, high validity underlies the achievement of practicality, which ultimately increases the effectiveness of the media in supporting students' physics literacy.

The practicality of the developed mobile pocket book can be implemented by distributing response questionnaires to 20 students of class XI C and two physics teachers at Senior High School 10 Mataram. Table 4 and Table 5 below are the details of the results of the response questionnaire of students and teachers.

The analysis of student and teacher response questionnaires obtained a percentage value of practicality of 90.76% and 96.47%, so the average value of practicality was 93.61% with a convenient category. This proves that this media is accessible for teachers and students to use in Learning.

The results of the practicality test by students and teachers found that the mobile pocket book was included in the very practical category. Several measurements in the mobile pocketbook.

The mobile pocket book display is seen from the developed product, namely a pocket book, which was created as an application with an attractive and interactive visual display that can be seen on Android. According to previous researchers, the media is a stimulus tool for students to learn more interactively, especially if the media emphasizes moving elements and interesting visualizations and is digitized in interactive media [21]. In addition, the images displayed are clear, and the presentation of material in this media is more practical. It can help students understand the material's content because it is displayed attractively. This is the opinion of previous researchers who stated that learning media has a function to help students with weaknesses in the form of late receiving and understanding material presented verbally [22]. Another study also revealed that mobile pocketbooks with displays tailored for certain education levels are more effectively accepted by teachers, especially if visual elements, such as icons and colors, are designed by considering the age of the learners [23]. The correct display makes the learning process more efficient and supports practicality in teaching.

Table 4. Results of Practicality Calculations by Students

Number of Respondents	Average Number of Respondent Scores	Maximum Total Score	Response Percentage (%)	Criteria
20	77.15	85	90.76	Very Practical

Table 5. Results of Practicality Calculation by Teacher

Number of Respondents	Average Number of Respondent Scores	Maximum Total Score	Response Percentage (%)	Criteria
2	82	85	96.47	Very Practical

The content/material aspect also affects practicality; the content on the mobile pocketbook is made simpler without reducing the content of the heated material discussed; the media must also be adapted to learning objectives; this is in line with previous research, which states that mobile pocketbooks can be adapted to specific learning objectives, allowing teachers to design activities according to the needs of students [24]. In addition, including interactive elements, such as videos and simulations, will enable learners to understand concepts better and be more interested in using this media. Previous research states that responsive interface design, attractive colors, and easily accessible navigation features make mobile pocket books a practical choice for students [25].

The ease of use aspect is generally categorised as very practical. The achievement of a convenient category is reflected in the results of the teacher's assessment of the elements of ease of use of the mobile pocketbook, so it can be concluded that this media is easy to use by teachers because the instructions in the mobile pocket book are easy to understand and can be used by teachers. Previous research states that teachers will get various kinds of convenience in teaching if they can use learning media as one of the tools when teaching [22]. Other studies have also found that mobile pocket books reduce the time needed to read and study material compared to printed media [26]. This is because digital media allows learners to instantly find the desired topic or information through search features or interactive table of contents.

The benefits of mobile pocket books are included in the very practical category. It is suspected that the mobile pocketbook developed is handy in assisting students in learning independently anywhere and anytime. This is by previous research stating the benefits of media in the teaching process, namely: (1) clarify the presentation of messages so that they are not too verbal (2) overcome the limitations of space, time and sensory power (3) generate learning motivation, enable direct interaction between students and the environment as it is, allow students to learn independently according to their abilities and interests (4) semantra curriculum and subject matter are determined equally for all students can be overcome with educational media [27].

Conclusion

A mobile pocket book with a problem-based learning model is declared very valid and very practical based on the validator's assessment and the response of students and teachers. This media suits limited testing and potentially improves students' physics and science literacy.

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