

Original Research

Development of a Scientific Approach-Based Pocketbook (5M) on the Diversity of Moss Plants in the Sari Embun Lake Area, Tanah Laut Regency

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ABSTRACT

The presence of moss in the environment can be used as a source of student learning. The advantages of using the environment as a learning resource are that it makes students get information based on direct experience, is more communicative, makes lessons more real, and makes students know and love the environment. The purpose of this study was to describe the feasibility, suitability, legibility, and response of students to the pocket book of moss plants around the Sari Dew Lake, Tanah Laut Regency. This research is a research and development with a 4-D (four D) development model. The results of the development of a pocket book based on (5M) material on the diversity of moss plants in the area of Danau Sari Embun, Tanah Laut Regency, obtained an average suitability score of 4.52 for expert subjects, which is categorized as very suitable for learning objectives. The feasibility test got an average feasibility score from expert subjects of 4.33, which was included in the very worthy category for use as a learning material. The readability test got an average readability score by students of 90.45% which was included in the very good category for students to read. The student response test got an average score of 4.67, which was included in the very positive category when used as a learning material in the learning process. Research on the diversity of organisms in the area of Lake Sari Embun, Tanah Laut Regency, can still explore the potential related to local wisdom. Efforts to promote and introduce the Sari Dew lake area are needed so that the area can be utilized optimally, especially in the field of education.

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1. INTRODUCTION

Moss is a low-level plant that belongs to the Bryophyta division. Moss is widely found throughout the world, including in Indonesia. There are approximately 18,000 species of moss recorded worldwide, while around 1,500 species of moss are found in Indonesia (Gibby, 2023; Royana et al., 2025; Susilo et al., 2020).

Moss plants are a transition from thallus to cormus form. Mosses are only a few millimeters high from the ground and do not have true roots, stems, or leaves. The structure of mosses consists of a capsule, seta, leaf or thallus, rhizoids, and calyptra. The life cycle of mosses consists of a gametophyte phase (1n) and a sporophyte phase (2n) (Lukitasari, 2018). Mosses are classified into three classes, namely Hepaticopsida, Anthocerotopsida, and Bryopsida. The three classes have their own characteristics to distinguish one from another (Harahap, 2023; Huttunen et al., 2018). Mosses are actually small plants that grow attached to substrates (rocks, wood, tree trunks, and soil). The lifespan of moss is influenced by environmental factors such as temperature, humidity, and light. Differences in the resistance of each moss species to environmental factors affect the level of adaptation, species composition, and distribution of moss (Cleavitt, 2022; Turetsky et al., 2012).

The types of environments that can be utilized to optimize learning activities in the classroom consist of physical and social environments. The physical environment is everything that is natural and relatively permanent, such as water, soil, rocks, plants, animals, rivers, climate, and air temperature. The social environment relates to children's interactions in social life and can be used to study social and human sciences (Danby, 2009; Hartup, 1979).

Several previous studies have been conducted on learning resources that utilize the surrounding environment. Irwandi and Hery (2019) conducted a study focusing on the use of the environment as a learning resource to increase the interest and learning outcomes of high school students in the coastal area of South Kalimantan. The results showed that learning that utilizes the environment as a learning resource can increase the interest and cognitive learning outcomes of high school students. In addition, the results of Dzulfadli's (2011) research also showed that the use of the environment as a learning resource is effective in improving student learning outcomes in the subject of mosses in class X at the Istiqamah Salumakarra Islamic Boarding School in Noling Village, Bupon District, Luwu Regency. These results are also supported by the results of Sartika's (2018) research, which shows that the activities and learning outcomes of students who use the school environment as a source of learning for biology in the subject of plant classification at SMPN 4 Kluet Utara, South Aceh Regency, are better than the activities and learning outcomes of students who are taught only in the classroom. In learning activities, the role of teachers in selecting learning resources has a significant impact on the quality of learning. Teachers, educators, and facilitators have various options to choose from available learning resources. Of course, choosing the right learning resources will also yield good results. However, choosing the wrong learning resources will also mean that the learning process is hampered and less than optimal (Calverley & Shephard, 2003; Hatch & Dyer, 2004; Pelánek & Effenberger, 2022).

Based on the results of a questionnaire given to biology teachers at SMAIT UKHUWAH, the teaching materials that have been used during biology lessons are limited to textbooks and presentation handouts, so there is a great need for additional learning resources to support learning. A teacher said that she strongly supports the idea of a pocket book containing information about the diversity of mosses as teaching material because the material that is difficult for students to understand is usually about distinguishing between male and female mosses, and the difficulty in finding examples of various types of mosses in the surrounding environment when teaching.

The results of the student needs analysis questionnaire filled out by 41 students from classes X2 and X3 at SMAIT UKHUWAH showed that (1) the learning resources they have been using are textbooks, PowerPoint presentations, handouts, workbooks, modules, posters, videos, and the internet. (2) The causes of their difficulty in understanding the material were 70.7% due to the complexity of the language used, 51.2% due to the lack of examples in the surrounding environment, and 17.1% due to unclear images. (3) 56.1% of the 41 students who filled out the questionnaire were interested in developing teaching materials in the form of pocket books based on the scientific approach (5M) to the subject of moss diversity.

A pocket book is a small book that is easy to carry and fit in a bag (Afifah & Ardianti, 2021; Newbery, 2022). Pocket books are usually 11cm x 8cm in size, easy to carry around, and contain instructions on how to read them. Each page is relatively short with presentations using many pictures and colors to create an attractive appearance. Students tend to prefer reading materials that are interesting, with few explanations and more pictures and colors (Darynes et al., 2023; Hallez et al., 2023; Kao et al., 2016; Liu et al., 2022; Namaziandost et al., 2023).

According to Rekha (2018), pocket books have the advantage of allowing students to have teaching materials that can be accessed anywhere, are not easily damaged because they are not in printed form but in software form, and save space because they do not require storage space. Based on the results of the questionnaire that explored information about the needs of teachers and students above, there is a need to minimize the obstacles experienced by students and teachers. This study addresses this urgency by developing teaching materials in the form of a pocket book based on a scientific (5M) approach to the subject of moss diversity. We hope that this development research will help students to learn about and explore moss anywhere

and anytime with clear images and examples of moss in their surroundings, so that the learning process for students and educators can be assisted in achieving learning objectives.

2. METHOD

The type of research conducted uses research and development. The research was conducted through direct research on types of moss plants. This research was conducted in the area of Lake Sari Embun, Bentok Darat Village, Bati-bati District, and was carried out over a period of 6 months (January-June 2022) and the Biology Laboratory of PMIPA FKIP ULM Banjarmasin, including the stages of initial survey of the research site, initial data collection, proposal preparation, data collection, identification of the types of moss plants found, observation using a microscope, and preparation of the final report.

This research method was carried out using a research and development (R&D) approach with a 4-D (Four D) development model consisting of four stages: Define, Design, Development, and Disseminate (Sihombing, 2024). The following is a more detailed description of the steps taken at each stage, the instruments used, and the data analysis relevant to the results and discussion presented:

2.1. Define

At this stage, researchers identified existing problems in the field and formulated the objectives for developing a scientific approach-based pocket book (5M) on the diversity of mosses in the Sari Embun Lake Area. The definition process involved several stages, namely preliminary surveys and needs analysis. In the preliminary survey, observations were made in the Sari Embun Lake Area to identify the diversity of mosses and understand the environmental conditions and challenges in teaching this material. Researchers distributed questionnaires to students and teachers to gather information about learning needs that could help in determining the appropriate type of teaching materials. This instrument was used to identify obstacles, expectations, and factors that influence learning, including perceptions about the use of pocket books based on the scientific approach (5M). The instrument used was a questionnaire on the needs of students and teachers that focused on analyzing the needs for biology learning resources. The questionnaire results were analyzed to explore the main needs of students and teachers for relevant materials and learning resources. Descriptive analysis was used to describe the data comprehensively and identify the main problems in learning.

2.2. Design

At the design stage, researchers designed a pocket book based on a scientific approach (5M) for moss diversity material. The design process included the design and compilation of material. The design of the pocketbook was based on the results of a questionnaire and needs analysis, which guided researchers to design a pocketbook containing material on moss diversity using a scientific approach (5M). This pocketbook was designed to be attractive and easy to understand for students, with many pictures and illustrations from the surrounding environment. The material was compiled based on the applicable curriculum, ensuring that the learning objectives were achieved. In the pocket book, the researchers also included a moss identification guide and a determination key. At this stage, the researchers evaluated the suitability of the designed material with the desired learning objectives, using existing theories and matching them with the results of the previous questionnaire analysis.

2.3. Development

During the development stage, researchers developed a pocketbook based on a scientific approach (5M) by testing its suitability, feasibility, and readability. The development process involved a suitability test in which the designed pocketbook was tested for suitability by experts (biology education lecturers and biology teachers at SMAIT UKHUWAH) using a suitability questionnaire. The suitability questionnaire was adapted from Thiagarajan et al. (1974) and covered aspects of learning objective relevance, material presentation, authenticity of examples, and the author's ability to develop the handbook. The questionnaire data were analyzed to evaluate the handbook's suitability for learning objectives. Next, a feasibility test was conducted, in which the pocketbook was tested for feasibility to ensure that this teaching material was suitable for use in high school learning. The feasibility questionnaire consisted of 11 aspects that measured the packaging of the pocketbook, the availability of additional material, its reusability, and ease of use. The questionnaire results were analyzed to evaluate whether the pocketbook met the feasibility requirements. The pocketbook was also tested for readability by students. Instrument: A readability questionnaire involving 15 aspects, including ease of understanding, clarity of images, and use of easy-to-understand language. The readability questionnaire results were analyzed to assess the quality of the teaching materials and ease of use in the learning process. The data obtained from the suitability, feasibility, and readability tests were analyzed using descriptive statistics to ensure that the pocket books developed met the quality standards for use in the learning process.

2. 4. Disseminate

During the dissemination stage, the developed pocketbook was distributed to students in digital form (PDF) and tested through demonstrations in class. The pocketbook was distributed on a limited basis to students in class X MIPA 3 SMAIT UKHUWAH to be used as teaching material in Biology lessons. A questionnaire was administered to students to gauge their response to the revised pocketbook, and pre- and post-tests were conducted to measure improvements in student learning outcomes. The pre- and post-test results were analyzed to measure the effectiveness of the pocketbook in improving student learning outcomes. Student response data were analyzed to evaluate their perceptions of the pocketbook and identify areas for improvement.

3. RESULTS AND DISCUSSION

3.1. Conformity test

The suitability of the scientific approach (5M) pocketbook on moss diversity in the Sari Embun Lake area was determined through a suitability test using a suitability questionnaire containing 11 items adapted from Thiagarajan et al. (1974). The suitability test was completed by two experts, namely two biology education lecturers and one high school biology teacher from SMAIT UKHUWAH. The results of the pocketbook suitability test are shown in Table 1.

Table 1. Recapitulation of Pockebook Compliance

No.	Aspects	Score			Mean Score
		A1	A2	A3	
1.	Relevance of learning objectives set in accordance with	5	5	4	4,67
2.	Learning objectives are meaningful to teachers	5	4	5	4,67
3.	Learning objectives are meaningful to students	5	4	5	4,67
4.	The source of the learning objectives is clear (other than textbooks)	5	4	5	4,67
5.	Learning objectives come from other sources (other than textbooks)	5	4	5	4,67
6.	Relevance of content to learning objectives	5	5	4	4,67
7.	Theoretical content is presented comprehensively	4	4	5	4,33
8.	Definitions and explanations are presented comprehensively	4	3	5	4,00
9.	Examples are presented clearly	5	4	5	4,67
10.	The examples presented are original, up-to-date, and relevant to everyday life	5	4	4	4,33
11.	The author is skilled at developing pocket books based on the scientific approach (5M) of moss diversity material	5	3	5	4,33
Total of Final Score		53	44	52	49,67
Mean of Final Score		4,82	4,00	4,73	4,52
Conformity score				4,52	
Conclusion of Conformity Score				Very Suitable	

Description: A1 (Expert 1), A2 (Expert 2), A3 (Expert 3)

Based on the data in Table 1, it is known that the suitability test results reached a score of 4.52. Based on the suitability level, the suitability score reached very good/very suitable and can be used without improvement. The table also shows that the aspect with the highest score of 4.67 is found in seven aspects, namely the relevance of the learning objectives set appropriately, the learning objectives are meaningful for teachers, the learning objectives are meaningful for students, the sources of the learning objectives are clearly derived (other than textbooks), learning objectives derived from other sources (besides textbooks), content relevance in line with learning objectives, and examples presented in the scientific approach (5M)-based pocket book on moss diversity research. Meanwhile, the aspect with the lowest score was definitions and explanations presented comprehensively, with a score of 4.00.

The suitability test is a step to describe the objectivity and content of teaching materials in the form of pocket books. This test was conducted by three experts, consisting of two FKIP ULM biology education lecturers and one partner teacher of Biology for grade X SMAIT UKHUWAH. This test was conducted by filling out a suitability questionnaire based on the products that had been developed. The suitability test is useful for determining the suitability of the learning resources developed with the learning objectives that must be achieved by students (Thiagarajan et al., 1974).

The suitability assessment process carried out by experts included 11 aspects, namely: relevance of learning objectives, meaningfulness of learning objectives for teachers and students, clarity of learning objectives, relevance of content, presentation of content, definitions and explanations presented, authenticity and currency of examples presented, and the author's ability to develop pocket books. Based on the results of the suitability test scores, it is known that the teaching materials developed are "Very suitable." Referring to Akbar's (2013) assessment criteria, the teaching materials based on the scientific approach (5M) on the diversity of mosses in the Sari Embun Lake Area, Tanah Laut Regency, received an average suitability score

of 4.52 with a “Very suitable” rating and can be used as teaching materials for the Bryophyta subconcept in high school.

The results of the expert test of the developed pocket book were said to be very suitable after improvements were made in accordance with the suggestions and comments provided by the three validators. Based on the aspects of suitability that were assessed, they were grouped into the suitability of the content with the learning objectives, the suitability of the material presented, and the suitability of the standard format of the pocket book.

The suitability of the content to the learning objectives consisted of the aspects of “relevance of the learning objectives set”, “meaningful learning objectives for teachers”, “meaningful learning objectives for students”, and “relevance of the content to the learning objectives”. Based on the calculation results, the scores were 4.67, 4.67, 4.67, and 4.67, respectively. This shows that the teaching material product in the form of a pocket book has met the suitability criteria based on Akbar (2013).

The grouping of these aspects is based on the similarity of their meanings. The suitability of the content with the learning objectives is interpreted as the teaching material content presented is in accordance with the needs of teachers and students, referring to the curriculum and syllabus analysis used at SMAIT UKHUWAH. According to Ningrum (2018), good teaching materials contain material descriptions that support the achievement of competency standards and basic competencies of a subject. This is in line with Davis & Krajcik (2005) dan Krajcik et al. (2008), who state that the suitability of the selected material with the curriculum is such that the learning objectives contained in the material can be conveyed to students. The meaningfulness of the material to teachers and students will only be achieved when the material is in accordance with the predetermined learning objectives.

Thus, based on the results of the suitability test for these aspects, the pocket book that has been developed has met the learning objectives formulated from the analysis of the needs of teachers and students. Good teaching materials contain material descriptions that support the achievement of competency standards and basic competencies of a subject. The suitability of the content of textbooks can be assessed from the completeness, breadth, and depth of the material.

The material presented reflects an explanation that supports the achievement of all basic competencies and is in accordance with the educational level of the students (Chang, 2006; Srisakda et al., 2016; Yelfianita et al., 2023). According to Bušljeta (2013), Lubis et al. (2023), and Sun et al. (2012), research results in the form of textbooks (teaching media) used for the learning process will greatly help students in understanding the material. Its use can make students more interested in learning and can improve learning outcomes.

The aspects of suitability of the material presented consist of the aspect of “clear learning objectives derived from the source,” the aspect of “learning objectives derived from other sources,” the aspect of “complete theoretical content,” and the aspect of “complete definitions and explanations.” Based on the calculation results, the scores for these aspects are 4.67, 4.67, 4.33, and 4.00, respectively.

This group of aspects is adjusted based on the delivery of teaching materials/content to students. After obtaining the results of the analysis of the needs of students and teachers, the delivery of material is designed in such a way as to achieve a learning process that is in accordance with the objectives that have been formulated. Busnawir et al. (2025) and Nur & Junaris (2023) stated that a learning presentation can run optimally if there is a compatibility of competency standards, basic competencies, completeness of material selection, examples of concept application, evaluation tools, and feedback on the success of the learning that has been implemented. The teaching materials created have the advantage of providing instructions for identifying mosses independently with the help of a determination key contained in a pocket book. This is one form of conformity with the learning materials in accordance with the curriculum. The suitability of the material presented must be in accordance with the basic competencies, indicators, competency achievements, and learning objectives to ensure the achievement of the expected learning outcomes. Conversely, if the material is not compiled with reference to these three things, it will be far from optimal learning outcomes (Hussey & Smith, 2003). The scores for these aspects, based on Akbar's (2013) criteria, were all in the “highly appropriate” category, meaning that the pocketbook developed meets the standards for use by students.

The standard format of the pocketbook consists of “examples presented in a pocketbook based on a scientific approach (5M) to the diversity of moss plants,” the aspect of “examples presented are original, up-to-date, and relevant to everyday life,” and the aspect of “the author's ability to develop a pocketbook based on the scientific approach (5M) of moss plant diversity material.” Based on the results of the calculations, the scores were 4.67, 4.33, and 4.33, respectively.

This group of aspects is tailored to the needs of students who want hands-on activities when learning about bryophytes. Bradley & Boyle (2004) state that media development must be designed systematically so that its role in supporting learning can be achieved effectively. Contextual learning is learning that relates material to real situations and encourages connections between existing knowledge so that it can be applied in everyday life. According to Andriani & Suniasih (2021), material/content accompanied by real images from

the surrounding environment can arouse the reader's curiosity to learn the teaching material presented. Based on the results of the calculations, these aspects are very suitable to proceed to the stage of testing the feasibility of teaching materials for students.

The presentation technique consists of consistency in the systematic presentation of activities and the sequence of concepts. The systematic presentation of material is an important aspect in the preparation of textbooks, because a coherent arrangement of material will make it easier to understand the material as a whole (Khoiri et al., 2018). The supporting material in the Pocket Book has been presented in a complete and coherent manner. In addition, the Pocket Book also includes a glossary for terms or words that are difficult to understand and additional information for students.

Based on the calculations, there are the highest and lowest aspects. The highest score of 4.67 is found in seven aspects, namely the relevance of the learning objectives set appropriately, the learning objectives are meaningful for teachers, the learning objectives are meaningful for students, the sources of the learning objectives are clear (other than textbooks), the learning objectives come from other sources (other than textbooks), the relevance of the content

(content) is in line with the learning objectives, and examples are presented in a pocket book based on a scientific approach (5M) to the diversity of mosses based on research. Meanwhile, the aspect with the lowest score was definitions and explanations presented in full, with a score of 4.00.

In the developed pocket book, the condition arises when students can identify macroscopic fungi using the determination guide embedded in the pocket book. In addition, in the exploration guide, the requirement for students to achieve learning objectives is by finding moss plants in the research area or similar exploration areas. Furthermore, objectives are components that can influence other teaching components, such as teaching materials, teaching and learning activities, method selection, tools, resources, and evaluation tools. Therefore, teachers cannot ignore the formulation of learning objectives when planning their teaching, and the source of the learning objectives derived from the curriculum must be clear (Zweris et al., 2023).

The aspect that received the lowest score was "Relevance of content to learning objectives; definitions and explanations are presented comprehensively." This means that the pocketbook that was developed is not yet optimal and still needs additional content to make it richer in information.

3.2. Feasibility test

The feasibility of the pocketbook based on a scientific approach (5M) on the diversity of mosses in the Lake Sari Embun area was obtained from a feasibility test using a suitability questionnaire containing 11 items adapted from Thiagarajan et al. (1974). The feasibility test was completed by two biology education lecturers and one high school biology teacher from SMAIT UKHUWAH. Table 2 is the result of the pocketbook feasibility test.

Table 2. Recapitulation of Pocket Book Feasibility

No.	Aspects	Score			Mean Score
		A1	A2	A3	
1.	Packaging of pocket books based on a scientific approach (5M) to plant diversity material	5	4	4	4,33
2.	Availability of additional materials in accordance with competencies	5	4	5	4,67
3.	Pocket books based on a scientific approach (5M) covering moss diversity can be used repeatedly.	5	5	5	5,00
4.	The scope of learning materials is fulfilled	4	4	5	4,33
5.	Time allocation for the use of pocket books based on a scientific approach (5M) on moss diversity material is available.	4	4	3	3,67
6.	Pocket books based on a scientific approach (5M) covering moss diversity can be used independently.	5	4	5	4,67
7.	The meeting schedule in the scientific approach (5M) pocketbook on moss diversity is presented in full according to the syllabus.				
8.	Guide to using the pocket book based on the scientific approach (5M) on moss diversity material by users available	5	4	4	4,33
9.	Ease of use of pocket books based on a scientific approach (5M) to plant diversity material	5	4	4	4,33
10.	Simplicity of language and terminology in the use of pocket books based on a scientific approach (5M) to moss diversity material.				
11.	Pocket books based on a scientific approach (5M) covering the diversity of mosses are acceptable to educators (teachers/lecturers).	5	3	5	4,33
Final Total Score		51	45	47	47,67
Final Average Score		4,64	4,09	4,27	4,33
Eligibility Score		4,33			
Conclusion of Conformity Score		Very Suitable			

Description: A1 (Expert 1), A2 (Expert 2), A3 (Expert 3)

Feasibility testing is a step to determine whether the developed pocket book can be used in Biology learning. Similar to suitability testing, this test was conducted by two experts, namely biology education lecturers from FKIP ULM, and one partner teacher who teaches Biology in grade X at SMAIT UKHUWAH. This test was conducted by filling out a feasibility questionnaire based on the developed product. The feasibility test is useful for determining whether the product is suitable for use as a learning resource (Thiagarajan et al., 1974).

Based on the results of the feasibility test, the developed pocket book product was classified as very feasible with a total average score of 4.33. This score indicates that the developed pocket book is very feasible to be used as a learning material for the sub-concept of Bryophyta in high school. The development of learning resources requires evaluation or assessment to determine the quality of these learning resources (Alfat & Ardianti, 2021; Efendi, 2024; Kastiniwati & Ferdiansyah, 2024; Khuzaini, 2024). This pocket book is carefully packaged with a special cover, making it very comfortable to use. The developed pocket book has clear usage guidelines, time quotas and schedules, and is not too complicated (simple) in its use of language, so it can also be used independently. It is this structure that makes the pocket book more acceptable to users.

According to Hamdani in Zahrotissa'adah & Sulistyowati (2021), the structure of a pocket book as teaching material should be made in accordance with the demands of the curriculum and the needs of students. This can be seen in the pocket book, where the usefulness of the material has been adjusted and supplemented with examples of real images found in the environment. Thiagarajan et al. (1974) stated that feasibility tests are useful for determining whether the learning resources developed can be used by students in their learning. Rossiter et al. (2024) also explained that learning resources are generally important for conducting feasibility assessments because these evaluations indicate the quality of the learning resources used in the learning process.

The feasibility instrument consists of 11 assessment aspects, including teaching material packaging, availability of additional materials, reusability of teaching materials, scope of learning materials, time allocation, self-use of teaching materials, meeting schedules, usage guidelines, ease and simplicity of teaching material use, and acceptance by teachers and students. The teaching materials that have been developed are considered very feasible because they have met all aspects of the feasibility assessment. Physical teaching materials that can be used digitally can be used repeatedly. This means that pocket book teaching materials are flexible and can be used anytime and anywhere according to the readiness and willingness of the students, so that students can repeat the material independently without being bound by time and place.

Automatically, the material presented in the developed pocket book teaching materials can stick in the students' memories. This statement is in accordance with what was stated by Abduljawad & Ahmad (2023) that teaching materials that can be used repeatedly make it easy to learn anywhere and anytime, making it more flexible and enjoyable because it can be accessed using a smartphone. The more often students repeat the material, the more they will understand the material that has been presented. Repeated use or learning with high frequency can improve student learning achievement (Haleem & Saeed, 2024).

Second, pocketbook teaching materials are considered to have the necessary requirements, such as usage guidelines, Basic Competencies (KD), Competency Achievement Indicators (IPK), and learning objectives. The user guide and competencies that students must achieve are presented in full in the pocketbook teaching materials that have been developed. This is in line with the opinion of Kotzebue et al. (2021), who stated that as an evaluation tool, the teaching materials presented must be in accordance with the indicators and competencies to be achieved by students in accordance with the applicable curriculum.

Third, the pocketbook teaching materials are easy to use. This is because the pocket books are presented in simple language. In addition, Royana et al. (2025) added that in terms of ease of use, the material presented in the teaching materials is clear and simple, the language used is easy to understand, the font size and type are easy to read, and the size is practical and easy to carry. The availability of a user guide makes it easier for students to understand what they need to do when using the pocket book teaching materials that have been developed.

Based on the table, it can be seen that the aspect with the highest score is the scientific approach (5M) pocket book on moss diversity, which can be used repeatedly, with a score of 5.00. The aspect that received the lowest score was the meeting schedule presented in full in the pocket book in accordance with the syllabus, with a score of 3.67. The aspect of the pocket book based on the scientific approach (5M) of moss plant diversity material that can be used repeatedly is indeed one of the advantages of this pocket book because of its small size and ease of carrying it anywhere and studying it anytime or repeatedly.

The aspect with the lowest score was "the meeting schedule in the scientific approach-based pocketbook (5M) on moss plant diversity material is presented in full in accordance with the syllabus." Experts also recommended that this be added so that the pocketbook would be more suitable for use by students. According to Simkins & Maier (2023), teaching materials need to include time allocation and meeting schedules to

determine the duration of learning activities in the classroom. Time allocation refers to the duration of learning activities carried out in the classroom or laboratory, which is limited by strict time constraints and is usually done by comparing the implementation of several different programs within the same amount of time.

3.3 Readability test

Readability testing was conducted by administering a readability test questionnaire adapted from Thiagarajan et al. (1974), which contained 15 aspects and a total of 30 statements. The readability test was completed using a 1 to 5 Likert scale by six students in class X MIPA 3 at SMAIT UKHUWAH who had previously studied the sub-concept of Bryophyta. The students used for the readability test had different cognitive levels, based on their scores as shown in Table 3.

Table 3. Cognitive level of students based on scores

Minimum Passing Criteria (KKM)	Score	Category	N
70	<70	Insufficient	-
	$70 \leq x \leq 80$	Adequate	3 students
	$81 \leq x \leq 90$	Good	3 students
	$91 \leq x \leq 100$	Very Good	3 students

(source: adapted from the Ministry of Education and Culture, 2019)

Students assessed the pocketbooks that had been developed and improved based on input and suggestions from experts in the suitability and feasibility tests. The results of the readability assessed by the students can be seen in the summary of the pocketbook readability results, as shown in Table 4.

Table 4. Recapitulation of Pocket Book Readability

No.	Aspects	Mean Score
A. Enjoyable		
1	Learning with pocket books based on a scientific approach (5M) about the diversity of mosses is enjoyable.	4.00
2	Reading a pocket book based on a scientific approach (5M) about the diversity of mosses is enjoyable.	4.67
3	A pocket book based on a scientific approach (5M) on the diversity of mosses, made simple and easy to understand.	5.00
4	Pocket books based on a scientific approach (5M) on moss diversity improve students' reading skills.	4.50
	Pocket books based on a scientific approach (5M) covering the diversity of mosses can improve reading skills.	4.50
B. Stimulation		
5	Pocket books based on a scientific approach (5M) covering the diversity of mosses can increase knowledge (cognitive abilities).	5.00
C. Strength		
6	Pocket books based on a scientific approach (5M) covering moss diversity motivate students to learn.	4.00
D. Effective		
7	Pocket books based on a scientific approach (5M) covering the diversity of mosses can achieve the learning objectives.	4.67
8	Pocket books based on a scientific approach (5M) to moss diversity can improve learning outcomes.	4.33
E. Clarity		
9	Systematic compilation of a pocket book based on a scientific approach (5M) on the diversity of moss plants	4.17
10	Images in the pocket book based on a scientific approach (5M) showing clear and colorful moss diversity.	4.50
F. Relevance		
11	Contents of the scientific approach-based pocket book (5M) learning resource on moss diversity related to the curriculum.	4.17
12	Scientific approach-based pocket book learning materials (5M) on moss diversity related to basic competencies	4.33
13	Development of material in a pocket book based on a scientific approach (5M) on the diversity of mosses related to the theme/topic.	4.67
G. Practical		
14	Pocketbook based on a scientific approach (5M) material on the diversity of simple moss plants, easy to use anytime.	4.67
15	The concepts presented in the pocket book based on the scientific approach (5M) to moss diversity can be easily understood.	4.17
H. Clarity of Language		
16	The language used in the scientific approach-based pocketbook (5M) on moss diversity is easy to understand.	4.50
I. Assisting		
17	Pocket books based on a scientific approach (5M) covering the diversity of mosses help students better understand the concept.	4.50
18	Pocket books based on a scientific approach (5M) covering the diversity of mosses help increase students' interest in learning about the concept.	4.83
J. Conformity		
19	The combination of letters, colors, and images in the pocket book based on the scientific approach (5M) of moss diversity material is appropriate.	4.50
20	Illustrations in a pocket book based on a scientific approach (5M) on the diversity of mosses in accordance with the discourse/reading text.	4.67
K. Beneficial		

No.	Aspects	Mean Score
21	The material presented in the pocket book based on the scientific approach (5M) on the diversity of mosses is useful in everyday life.	4.50
L. Novelty		
22	Pocket book design based on a scientific approach (5M) covering the diversity of colorful and unique mosses.	4.50
23	The material presented in this pocket book is based on a scientific approach (5M) and covers the latest and most up-to-date information on moss diversity.	4.67
M. Importance		
24	Pocket books based on a scientific approach (5M) to moss diversity are important tools for learning.	4.67
25	A pocket book based on a scientific approach (5M) to moss diversity has been developed to aid understanding of the subject matter.	4.83
N. Interesting		
26	The pocket book based on the scientific approach (5M) on moss diversity has an attractive appearance.	4.17
27	The images presented are colorful and attractive.	4.50
O. Efficiency		
28	More efficient learning with a pocket book based on a scientific approach (5M) to moss diversity material developed by.	4.67
29	Pocket books based on a scientific approach (5M) on moss diversity were developed to improve learning outcomes	4.83
Total Score		135.67
Average Readability Score		90.45%
Readability Score		Very Good

The readability test was conducted by six students with high, medium, and low cognitive levels. These cognitive levels were based on Table 4. The readability test was conducted by filling out a readability questionnaire based on the product that had been developed and improved according to the suggestions and input from experts in the suitability and feasibility tests. The students who conducted the readability test had studied the subconcept of Bryophyta in the chapter on biodiversity. The readability test was useful for determining the ease of reading the pocketbook product by students (Thiagarajan et al., 1974). According to Wright & Stenner (2022), readability tests can be conducted with 5 to 10 students.

According to Arshad et al. (2023), readability tests aim to determine student responses that can be used as a benchmark for the quality of learning tools that have been developed from a practical aspect. There are two general factors that influence readability, namely the linguistic elements used to convey the message and the reading skills of the participants. The readability test aspects include the learning experience using the Bryophyta pocket book, the ease of understanding the Bryophyta pocket book, the language and content of the material in the Bryophyta pocket book, the design of the Bryophyta pocket book, and the ability of the Bryophyta pocket book based on a scientific (5M) approach to the diversity of moss plants, which was created to increase student learning motivation.

Based on the readability test results, the pocket book product based on the scientific approach (5M) of moss plant diversity material in the Sari Embun Lake Area, Tanah Laut Regency, which was developed, was classified as very good with a readability percentage of 90.45%. This shows that the pocket book product developed is technically very suitable as teaching material for the sub-chapter on mosses. The pocket book has many pictures, so it is designed to make learning fun for students. The pictures presented are taken directly from nature, which further increases the appeal to students. The layout, colors, and font are neat and easy to understand. Therefore, the pocket book has a very high readability percentage.

According to Sudarmo et al. (2021), good teaching materials must contain adequate substance and be presented systematically to achieve learning objectives. The content of teaching materials should contain material that is easy to understand and can motivate learning and encourage students to learn independently. Students' motivation to learn and interest will increase when they use learning resources that suit their interests and needs. Interesting teaching materials will encourage students to study the material better.

There are differences among students in giving assessments based on criteria from 1-5, because each student has different views and tastes regarding the pocket book developed. This illustrates that students understand the material presented in the pocket book so that overall it can be used as a supplement to Biology lessons in high school.

The instrument used to test readability was adapted from Thiagarajan in 1974, which covers 15 aspects, namely enjoyable, useful, stimulating, powerful, effective, clear, relevant, practical, helpful, appropriate, beneficial, new, important, interesting, and efficient. These aspects can be further categorized based on the filling rubric. The first group includes the aspects of effectiveness, practicality, and efficiency. The second group includes the aspects of enjoyment, stimulus, motivational strength, helpfulness, and attractiveness. The third group includes the aspects of novelty, appropriateness, relevance, and clarity. The fourth group includes the aspects of importance, usefulness, and utility. This grouping is based on the meaningfulness and interconnection of the aspects being tested. The readability test, which includes four assessment aspects,

namely graphic suitability, content suitability, linguistic suitability, and navigation suitability, was conducted to determine how easy it is for students to understand the teaching materials. Overall, the aspects of effectiveness, practicality, and efficiency received scores of 4.50, 4.44, and 4.75, respectively. Yanti et al. (2022) stated that a pocket book is a simple book that can be carried anywhere, containing information in the form of text or images that can be used not only for formal learning but also for other types of learning.

Thus, electronic pocket books can be a solution as an appropriate learning medium to support the achievement of learning objectives. The aspects of fun, stimulus, motivational strength, helpfulness, and attractiveness received scores of 4.56, 5.00, 4.00, 4.67, and 4.33, respectively. This indicates that overall, the appearance of the pocket book was rated well. The appeal of a book is inseparable from graphic aspects, such as design/layout, font type and shape, use of color, and illustrations (Kusumowardhani & Maharani, 2023). Interesting teaching materials are those that can create enjoyable learning experiences, thereby helping students understand concepts and learning materials. The content of the pocket book should contain material that is easy to understand and can motivate learning and encourage students to study independently. Students' motivation to learn and interest will increase when they use learning resources that suit their interests and needs. Interesting teaching materials will encourage students to study the material better (Shieh & Hsieh, 2021).

The aspects of novelty, appropriateness, relevance, and clarity received scores of 4.58, 4.58, 4.39, and 4.33, respectively. This indicates that the content presented in the pocket book is easy for students to understand and that the material in the pocket book is in line with basic competencies. Good teaching materials must meet the requirements as supplementary teaching materials to support students in the learning process (Yokubjonova, 2025). According to Yasin & Fajri (2025) and González-Pérez & Ramírez-Montoya (2022) good teaching materials must contain adequate substance and be presented systematically to achieve learning objectives.

The aspects of importance, usefulness, and utility received scores of 4.75, 4.50, and 4.50, respectively. This indicates that students need the development of this pocket book to be used as a learning resource during the learning process. According to Perdanasari & Sangka (2021) the development of teaching materials should be based on the opinions of students in order to improve their critical thinking skills. The development of pocket books in print and distributed digitally triggers students' cognitive abilities. This is based on Maringati & Sahu (2024), who explain that students' cognitive abilities refer to the way students see, pay attention, remember, think, and understand lessons. The pocketbook includes identification methods that encourage students to pay attention and think critically to identify fungi found at the research site or similar locations.

The pocket book developed is classified as very good. The highest score was in the stimulation aspect with an average score of 5.00, while the aspect with the lowest score was the strength aspect with an average score of 4.00. According to the students, the pocket book tested was quite good in increasing their knowledge of mosses but could not fully motivate them because they were more accustomed to regular textbooks.

3.4. Student response test

Student responses were obtained using a questionnaire to assess students responses to the pocketbook that had been revised based on the previous readability test in accordance with suggestions and input from students. The questionnaire was distributed in print form to gather information from students according to the statements in Table 5. The questionnaire was based on an adaptation from Thiagarajan et al. (1974) and contained 19 statements with a Likert scale of 1 to 5. The students who responded to the pocketbook were six students from class X MIPA 3.

Table 5. Recapitulation of Student Responses to the Pocket Book

No.	Statement	Average score
1	Reading a pocket book on mosses based on a scientific approach (5M) covering the diversity of mosses does not waste time when learning.	4.50
2	In my opinion, this pocket book on mosses, based on a scientific approach (5M), covers the diversity of mosses at an intermediate level.	4.67
3	This pocket book on mosses, based on a scientific approach (5M) and covering the diversity of mosses, is very enjoyable.	4.33
4	The scientific approach-based moss plant pocket book (5M) on moss plant diversity can be used independently.	4.83
5	The scientific approach (5M) moss plant pocket book on moss plant diversity provides valuable experience in the learning process.	4.50
6	I prefer reading pocket books on mosses based on a scientific approach (5M) covering the diversity of mosses to reading regular textbooks.	4.00
7	This pocket book based on a scientific approach (5M) to the diversity of mosses is perfect for me.	3.83
8	Learning with a scientific approach (5M) pocket book on moss diversity is more interesting than classroom activities.	4.17
9	I learned many useful things when reading the scientific approach (5M) pocket book on moss diversity.	4.50
10	I enjoy using the scientific approach (5M) moss plant pocket book on moss plant diversity compared	4.67

No.	Statement	Average score
11	to other learning resources. Learning using a moss plant pocket book based on a scientific approach (5M) on the diversity of moss plants makes learning interesting.	4.17
12	Pocket book on mosses based on a scientific approach (5M) with material on moss diversity is better than a regular textbook.	4.00
13	If I were a teacher, I would use this scientific approach (5M) moss plant pocket book on moss plant diversity in my lessons.	4.50
14	I like to use pocket books on mosses based on a scientific approach (5M) with material on the diversity of mosses like this.	4.67
15	I can read pocket books on mosses based on a scientific approach (5M) covering the diversity of mosses continuously.	4.33
16	Reading a pocket book on mosses based on a scientific approach (5M) with material on moss diversity and many pictures does not detract from the meaning of the material.	4.33
17	Learning to use a scientific approach (5M) based moss plant pocket book on moss plant diversity can improve learning abilities.	4.83
18	The material studied using the scientific approach (5M) moss handbook is not easily forgotten by students.	4.83
19	Pocket book on mosses based on a scientific approach (5M) material on moss diversity provides learning experiences.	4.33
Total score		88,67
Average Student Response Score		4,67
Conclusion of Student Response Scores		Very Positive

Based on the results of the table testing students' responses to the book, the final score was 4.67, which is categorized as very positive. The highest score came from the statement that the scientific approach (5M) moss diversity pocket book can be used independently, learning to use the scientific approach (5M) moss diversity pocket book can improve learning abilities, and the material studied with the scientific approach (5M) moss diversity pocket book (5M) moss plant diversity material is not easily forgotten by students with a score of 4.83, while the lowest score came from the statement that the scientific approach-based (5M) moss plant diversity material is suitable for me with a score of 3.83.

Limited Dissemination of Scientific Approach-Based Pocket Books (5M) Material on Moss Plant Diversity in the Sari Embun Lake Area, Tanah Laut Regency, in Class X MIPA 3 SMAIT UKHUWAH. Student responses were obtained using a questionnaire to test student responses to the pocketbook that had been revised from the previous readability test in accordance with the suggestions and input from the students. The questionnaire was adapted from Thiagarajan et al. (1974) and contained 19 statements with a Likert scale of 1 to 5. The students who responded to the pocket book test were 6 students from class X MIPA 3. The pocketbook used in the student response test was a pocketbook that had undergone improvements based on suggestions and input from the suitability test, feasibility test, and readability test. According to Garcia-Lopez & Garcia-Cabot (2022), the student response test is used to determine whether the teaching materials are practical to use. Hussaini (2022) stated that the student response questionnaire validation sheet consists of three aspects of assessment: instructions, language, and scope of student responses.

Based on the table of student response test results, the response was very positive with a score of 4.67. According to Wijaya et al. (2021) and Hendrickson (2021), positive student responses indicate that they understand better, are more independent and active in learning, and have a higher interest in learning. This may be because previously, students had never undergone a learning process using teaching materials that utilized facts and direct activities in their surroundings.

According to Sofna et al. (2023), the very positive response of the students indicates that they are interested and find it easy to do the tasks and understand the material. According to Chew & Cerbin (2003), pictures can also attract attention, clarify ideas, and illustrate facts that are usually quickly forgotten by students, making them difficult to forget. This is what can then make students respond positively to pocket books. Based on the research results, the aspect that received the highest score was from the statement that pocket books on mosses based on the scientific approach (5M) on the diversity of mosses can be used independently, learning to use pocket books on mosses based on the scientific approach (5M) material on moss diversity can improve learning abilities, and the material studied with the scientific approach-based moss plant pocket book (5M) on moss diversity is not easily forgotten by students, with a score of 4.83.

Students are not yet completely satisfied with using pocket books rather than other learning resources, because they are accustomed to using textbooks in general during the learning process. Based on direct interviews with students, they feel that learning using pocket books and other textbooks provides broader insight because, in general, moss material is only discussed briefly as it is a sub-concept of the chapter on biodiversity. Students' learning motivation and interest will increase when they use learning resources that suit their interests and needs. Interesting teaching materials will encourage students to study the material better (Kiriana, 2021).

3.5. Limited dissemination

The dissemination of the pocket book development was carried out on a limited basis in class X MIPA 3 SMAIT UKHUWAH. The pocket book was distributed using digital media in PDF format to 24 students. During the dissemination stage, the researcher demonstrated activities using the pocketbook developed as a teaching material in the learning process, starting with a pretest to assess the students' abilities before using the pocketbook and a posttest after the students used the pocketbook. The pocketbook that was distributed was one that had undergone improvements in terms of suitability, feasibility, readability, and student response tests. The dissemination activity was carried out in one meeting with the same pretest and posttest questions. Table 6 shows the results of the pretest and posttest at the limited dissemination stage before and after using the pocketbook.

Table 6. Recapitulation of Pre-test and Post-test Questionnaires for Students

	Pretest	Posttest
Average Score	75.00	83.00
Maximal Score	100.00	100.00

The results of the data analysis show that there was an increase in the average scores obtained by the students. Although dissemination was carried out in a limited and brief manner, the use of pocket books showed an increase. The pocket books were distributed using digital media in PDF format to 24 students. During the dissemination stage, the researcher demonstrated activities using the pocket book developed as teaching material in the learning process, starting with a pretest to test the students' abilities before using the pocket book and a posttest after the students used the pocket book. The pocketbook that was distributed in a limited manner was a pocketbook that had undergone improvements in terms of suitability, feasibility, readability, and student response tests. The dissemination activity was carried out in one meeting with the same pretest and posttest questions.

Based on the results in Table 6, even though there was an improvement in the posttest and pretest, a significant calculation is still needed to prove that there is a significant improvement when using the pocket book as a teaching material. According to Bergman et al. (2015), Delucchi (2014), and Gdugard & Todman (1995), the increase in pretest and posttest scores was due to several factors, such as internal and external factors. Internal factors are factors within the students, and external factors are factors outside the students. Internal factors include motivation, interest, and habits. External factors include the school environment, friendships, and environmental factors.

Although no further research was conducted on the factors that influence students in completing pre-tests and post-tests using pocket books as teaching materials, changes in these factors can be seen from previous questionnaires. The results of the student response test showed that learning using a moss handbook based on a scientific (5M) approach to the diversity of mosses made learning interesting, with a score of 4.17, which is classified as positive. The handbook was able to make most of the students in class X MIPA 3 interested in moss-based learning using the handbook, with only a small number not yet interested.

Interest and learning habits also influence the results of limited dissemination. Interest is basically an acceptance of a relationship between oneself and something else, and the stronger or closer the relationship, the greater the interest. Interest can be expressed through statements that show that students prefer one thing over another, or it can be manifested through participation in activities (Bergin, 1999). Meanwhile, habits are the behavior of students every time they carry out learning activities, because habits contain strong motivation. This is reflected in the students' response test, which states that students are still accustomed to learning resources in the form of lesson texts in general, even though they have a high interest in exploring moss plants.

4. CONCLUSION

The results of the development of a pocket book based on a scientific approach (5M) on the diversity of mosses in the Sari Embun Lake area of Tanah Laut Regency obtained an average suitability score from expert subjects of 4.52, which is classified as very suitable for learning objectives, and a feasibility score from expert subjects of 4.33, which is classified as very feasible for use as learning material. The readability score by students was 90.45%, which is categorized as very good for students to read. The score of 4.67 is categorized as very positive when used as learning material in the learning process.

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There is no conflict of interest in this study.

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ETHICAL STATEMENT

The research has received ethical approval from the Lambung Mangkurat University Ethics Committee.

AI USE STATEMENT

The study findings and their conceptualization are original and are not AI-generated.

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