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Development of a Bio Pocketbook Learning Resource Based on SETS-I (Science, Environment, Technology, Society, and Islamic Integration) to Enhance Students' Scientific Literacy

Musfirah[1]*, Firdaus Daud[1], Syamsiah[1], Nurhayati B[1], Andi Asmawati Azis[1]

[1]Universitas Negeri Makassar, Makassar, Indonesia.

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Corresponding Author:
Musfirah
musfirah.s22023@student.unm.ac.id

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Abstract: This study aims to produce a science learning resource in the form of a SETS-I based (Science, Environment, Technology, Society, and Islamic Integration) Bio Pocketbook that is valid, practical, and effective. The research subjects consisted of expert validators, three teachers, and students, with the product being validated by experts before being tested. This type of research is research and development (R&D), adapted from the ADDIE development model consisting of five stages: analysis, design, development, implementation, and evaluation. Validity data were collected using a product validation questionnaire on the human respiratory system material. Practicality data were obtained through student and teacher response questionnaires, while effectiveness data were collected through a scientific literacy skills test. The results showed that the average overall validity score of the product was in the very high category (1.00). The response results indicated that the product met the criteria of practicality, as the average student response to the product was in the very practical category (92%), and the average teacher response was also in the very practical category (93.75%). The product development also met the effectiveness criteria, as shown by the average N-gain score of each student, which was in the high category (0.73).

Keywords: Bio pocketbook; Learning resources; Scientific literacy skills; SETS-I.

Introduction

Education is a fundamental process in shaping students into independent individuals who are able to think critically and contribute meaningfully to society (Altan, 2020; Laila et al., 2021). In Indonesia, this process is implemented through Natural Sciences (Ilmu Pengetahuan Alam/IPA) learning, which integrates concepts from biology, physics, and chemistry to help students understand natural phenomena holistically. As a lifelong necessity, education plays a strategic role in ensuring national progress and sustainability, particularly in preparing students to face the challenges of globalization (Amin et al., 2022; Faizal & Ahmad, 2025).

However, one of the major challenges in IPA learning in Indonesia is the low level of students' scientific literacy. International assessments such as the Programme for International Student Assessment (PISA) consistently indicate that Indonesian students' abilities to understand, analyze, and apply scientific concepts remain below the international average (Hopfenbeck et al., 2018; Fitri et al., 2023). This condition suggests that students experience difficulties in connecting scientific knowledge with real-life contexts, which is a core component of scientific literacy. Consequently, the development of innovative, contextual, and meaningful learning resources that systematically enhance scientific literacy has become an urgent need (Vosniadou, 2019; Baran et al., 2021; Firdaus et al., 2023).

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Initial observations conducted at SMP Negeri Satap 3 Bengo further confirm this issue. Students were found to struggle with understanding scientific concepts and relating them to everyday phenomena. This problem is partly caused by the limited availability of learning resources, which predominantly rely on conventional textbooks with minimal variation and contextualization. As a result, student engagement in learning remains low, negatively affecting the development of their scientific literacy skills.

The implementation of the Merdeka Curriculum provides opportunities for teachers to design flexible, contextual, and student-centered learning that aligns with students' needs and real-life experiences (Saa, 2024; Lestari et al., 2025a). Nevertheless, successful implementation of this curriculum requires the support of innovative and diversified learning resources capable of developing essential competencies, including scientific literacy. One potential learning resource that can be developed to address this need is a Bio Pocketbook, a compact and practical learning booklet that enables students to learn independently anytime and anywhere (Triana & Sulistiyowati, 2020; Abdullah et al., 2021; Magdalena et al., 2024). Compared to conventional textbooks, pocketbooks present essential content in a more concise, accessible, and student-friendly format, making them suitable for junior high school students.

In this context, developing a Bio Pocketbook based on the SETS-I approach (Science, Environment, Technology, Society, and Islamic Integration) offers a promising solution. The SETS-I approach facilitates a more comprehensive understanding of IPA concepts by connecting scientific knowledge with environmental issues, technological developments, societal contexts, and value-based reflections (Indri, 2021; Nurohmawati et al., 2023). IPA is particularly well suited to this approach because its concepts are closely related to natural phenomena, ecosystem interactions, technological applications, and social dynamics. Integrating these components is expected to strengthen students' scientific literacy by deepening conceptual understanding and highlighting the relevance of science in real-world contexts (Ulfah et al., 2020; Hardianti et al., 2021; & Lestari et al., 2025b). The inclusion of Islamic integration in this study is not intended as religious instruction, but as character reinforcement aligned with the Pancasila Student Profile, particularly the dimension of faith and devotion to God Almighty, which is a core pillar of the Merdeka Curriculum implemented in public schools, including SMP Negeri Satap 3 Bengo. Through contextual and reflective integration of values, learning is expected to foster ethical awareness, responsibility, and appreciation for natural systems as God's creation, while maintaining the inclusive nature of public education.

Therefore, this study proposes the development of a SETS-I based Bio Pocketbook for IPA learning on the human respiratory system at the junior high school level. The novelty of this research lies in the integration of the SETS-I approach within a pocketbook format specifically designed to enhance scientific literacy while simultaneously supporting character education and curriculum implementation. This learning resource is expected to serve as an innovative and engaging solution that improves conceptual understanding, connects science to everyday life, and ultimately enhances the quality of IPA learning in junior high schools.

Method

The type of research employed in this study is Research and Development (R&D). This development research refers to the ADDIE model (analysis, design, development, implementation, and evaluation). The main product developed is a SETS-I based Bio Pocketbook.

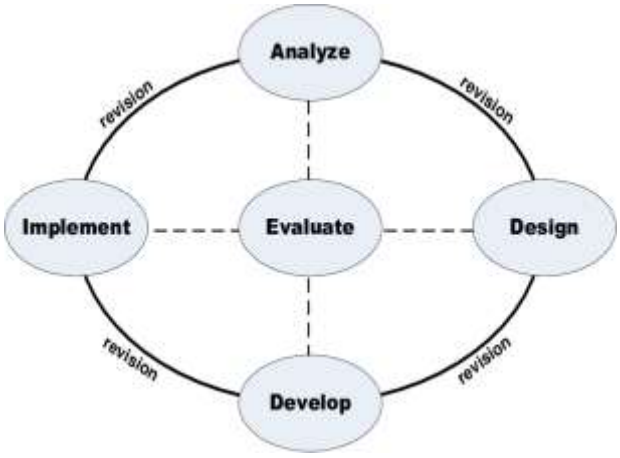

Figure 1. The ADDIE concepts

Analysis

This stage involves conducting a needs analysis of students, an analysis of objectives, and an analysis of the content. The analysis activities can be described in detail as follows.

Needs Analysis

The needs analysis was carried out through field studies and literature reviews. Several aspects were examined in the needs analysis, including analyzing problems in the field that prompted the development, identifying solutions to address those problems, and

comparing the existing conditions in the field with the ideal conditions. The preliminary research included analyzing students' needs through tests and questionnaires.

Objective Analysis

The objective analysis involved determining the indicators and learning objectives to be achieved in the learning process. The formulation of indicators and learning objectives was based on the Learning Outcomes (CP).

Content Analysis

This analysis was conducted by examining the material to be used in the development of the SETS-I based Bio Pocketbook for Grade VIII science at SMP Negeri Satap 3 Bengo, referring to the Merdeka Curriculum. The content analysis included reviewing the material and the learning activities to be presented in the learning resource. This analysis was carried out to identify, specify, and systematically organize the material that students will learn in accordance with the Merdeka Curriculum.

Design

The design stage is carried out by developing the product according to the identified needs. This stage consists of product design, which involves creating the SETS-I based Bio Pocketbook, and research instrument design. The instruments used in this study include the assessment instrument for the SETS-I based Bio Pocketbook, validation sheets for the assessment instruments, student response questionnaires, teacher response questionnaires, and a scientific literacy skills test.

Development

The development stage aims to actualize all the previously conducted phases and produce the final version of the SETS-I based Bio Pocketbook, which is developed by fulfilling the following criteria: meeting the quality standards of the SETS-I based Bio Pocketbook components to enhance students' scientific literacy skills; containing activity units aligned with the learning outcomes of the human respiratory system material for junior high school level based on the Merdeka Curriculum; being a research-based product developed from reputable sources such as university textbooks, scientific books, and scholarly articles; being designed to improve students' scientific literacy skills; and being equipped with illustrations, learning materials, practice questions, supporting information related to activities, and self-reflection spaces.

Furthermore, the product developed in this stage will be evaluated for its validity and practicality. The validity test will be conducted by two expert validators who are university lecturers in fields relevant to the product. Meanwhile, the practicality test will be carried out by a science teacher as a practitioner and by Grade VIII students of SMP Negeri 3 Bengo who have previously studied the human respiratory system material as prospective users of the product.

Implementation

The implementation phase was carried out through a limited trial involving several eighth-grade students who had previously studied the human respiratory system material at SMP Negeri 3 Bengo to obtain data on the practicality of the SETS-I based Bio Pocketbook. The practicality of the SETS-I based Bio Pocketbook was measured based on the responses of students and subject teachers regarding its use in facilitating students' understanding of the human respiratory system material through a questionnaire.

Evaluation

The evaluation stage is conducted by analyzing the effectiveness of the Bio Pocketbook based on SETS-I for the human respiratory system material. A test is administered to students after using the Bio Pocketbook in the form of a scientific literacy test. The test items are developed and aligned with the scientific literacy indicators that were previously established.

Data Analysis

The data analysis techniques in this study were carried out to produce a feasible and high-quality Bio Pocketbook that meets the criteria of validity, practicality, and effectiveness. The detailed procedures are presented below.

Analysis of Bio Pocketbook Validity Data

Content validation used in this study refers to the Gregory validation technique. The validation data from experts for each assessment aspect were analyzed. Expert assessments covered four aspects: content, presentation, language, and graphics. This validation process was used to determine the level of agreement between two or more experts in evaluating the overall product. According to Setemen (2018) the content validation in this study employed the Gregory formula, which was modified with the following mechanism: the appointed experts assessed the instrument by classifying each aspect as highly relevant (score 3 or 5) or less relevant (score 1 or 2); the experts' assessments were tabulated in a 2×2 matrix; a cross-tabulation was then constructed; and the content validity value was calculated using the following formula 1.

$$CV = \frac{D}{A + B + C + D} \quad (1)$$

Information:
CV: Content Validity
A: number of items according to both experts are less relevant.
B: the number of items considered very relevant by expert I and less relevant by expert II.
C: the number of items considered less relevant by expert I and very relevant by expert II.
D: the number of items considered highly relevant by both experts.

The determination of values, A, B, C and D can be seen in Table 1 below.

Table 1. Gregory matrix validity test

Matrix 2×2		Validators 1	
	Validator ratings	Irrelevant	Relevant
Validators 2	Irrelevant	A (0)	B (0)
	Relevant	C(0)	D(0)

Validity Categories as follows.

Table 2. Validity criteria

Coefficient	Category
0.8–1	Very high validity
0.6–0.79	High validity
0.4–0.59	Medium validity
0.2–0.39	Low validity
0.00–0.19	Very low validity

Analysis of Bio Pocketbook Practicality Data

The data analysis technique for teachers' and students' responses to the use of the SETS-I based Bio Pocketbook learning resource employed data collection procedures aimed at calculating the percentage of practicality based on their responses to the use of the SETS-I based Bio Pocketbook. The response data from teachers and students obtained through the questionnaire were then analyzed using qualitative (percentage) analysis. The analysis used to calculate the percentage of student and teacher responses to each statement in the questionnaire (Widodo, 2020) applied the Formula 2.

Table 3. Product practicality criteria and intervals

Percentage (%)	Practicality Criteria
81 ≤ Ṙ ≤ 100	Very Practical
61 ≤ Ṙ ≤ 80	Practical
41 ≤ Ṙ ≤ 60	Fairly Practical
21 ≤ Ṙ ≤ 40	Quite Practical
0 ≤ Ṙ ≤ = 20	Less Practical

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

Information:
P: Percentage of average response value
f: Total score obtained
N: Number of respondents

This average value is referred to as the interval for determining the level of media practicality (Widodo, 2020), which is presented in Table 3.

Analysis of Bio Pocketbook Effectiveness Data

The effectiveness of the SETS-I based Bio Pocketbook that was developed was analyzed through data obtained from measuring students' scientific literacy skills. This effectiveness was determined by comparing the results before and after the use of the SETS-I based Bio Pocketbook to identify whether there was an improvement in students' scientific literacy skills. The increase was calculated using the normalized gain (N-gain) formula as follows.

$$g = \frac{Smax - Spre}{Spost - Spre} \quad (3)$$

Information:
S_{pre}: Score obtained on students' initial test
S_{post}: Total score on the final test of the students
S_{max}: Ideal maximum score
g: Normalized gain.

The use of N-gain is to determine how much the scientific literacy scores of students at SMP Negeri 3 Bengo have increased individually and overall. The criteria for obtaining N-gain (Meltzer, as cited in Latri et al. (2021) can be seen in Table 4.

Table 4. N-gain acquisition category

Coefficient	Category
0.70 < g ≤ 1	High
0.30 < g ≤ 0.70	Medium
0 < g ≤ 0.30	Low

The SETS-I based Bio Pocketbook can be considered effective in the learning process if the N-gain value falls within the high and moderate categories. This indicates that the SETS-I based Bio Pocketbook is effective in supporting the learning process.

Result and Discussion

Result

The results obtained in this study include the validity test, the practicality test, and the effectiveness test, which serve to demonstrate the validity, practicality, and effectiveness of the SETS-I based Bio Pocketbook.

Validity of the SETS-I Based Bio Pocketbook

The results of the validity analysis of the SETS-I based Bio Pocketbook from the two expert validators can be seen in Table 5.

Table 5. Validity data of the SETS-I based bio pocketbook

Matrix 2×2		Validators 1	
	Validator Ratings	Irrelevant	Relevant
Validators 2	Irrelevant	A(0)	B(0)
	Relevant	C(0)	D(13)

CV= 13/0+0+0+13= 1.00 (Validity is very high)

The assessment results of the SETS-I based Bio Pocketbook from the two validators in Table 5 show that the assessment criteria representing each statement fall into the "Very High Validity" category, with both experts giving a highly relevant score of 1. Therefore, after reviewing all aspects, it can be concluded that the SETS-I based Bio Pocketbook on the topic of the Human Respiratory System is deemed suitable for use after being revised according to the suggestions provided by the two validators.

Practicality of the SETS-I Based Bio Pocketbook

The trial of the SETS-I based Bio Pocketbook was conducted to examine its practicality in the learning process. Practicality was assessed based on the responses of teachers and eighth-grade students at SMP Negeri 3 Bengo, focusing on the ease of use, clarity of instructions, and suitability for classroom implementation. The results of teacher and student responses regarding the practicality of the SETS-I based Bio Pocketbook can be seen in Tables 6 and 7.

Table 6. Results of Data Analysis of Teachers' Responses to the Practicality of SETS-I based Bio Pocketbook

Assessment Aspects	Respond Percentage (%)	Category
Contents of teaching materials	95.83	Very practical
Presentation in teaching materials	91.67	Very practical
Usage	92.50	Very practical
SETS-I based learning	94	Very practical
Language	94.75	Very practical
Overall average	93.75	Very practical

Practicality criteria: 81%-100% (very practical)

The results of teacher responses to the SETS-I based Bio Pocketbook on the topic of the Human Respiratory System in Table 6 fall into the "very practical" category, with an overall average percentage of 93.75%. According to Widodo (2020) practicality criteria, a score of 81 < R ≤ 100 is classified as very practical. Therefore, the developed SETS-I based Bio Pocketbook is considered highly practical.

The results of students' responses to the SETS-I based Bio Pocketbook on the topic of the Human Respiratory System in Table 7 obtained an average score of 92%, indicating that the SETS-I based Bio Pocketbook is considered very practical.

Table 7. Results of data analysis of student responses to the practicality of SETS-I based bio pocketbook

Assessment Aspects	Respond Percentage (%)	Category
Aspect of content	91.2	Very practical
Usage	91.8	Very practical
Aspect of appearance	91.6	Very practical
SETS-I based learning	92.3	Very practical
Language	93.1	Very practical
Overall average	92	Very practical

Practicality criteria: 81%-100% (very practical)

Effectiveness of the SETS-I Based Bio Pocketbook

The effectiveness of the SETS-I based Bio Pocketbook can be observed from the improvement in students' scientific literacy skills, as indicated by the comparison of pretest and posttest scores. The results of the effectiveness analysis show that students' scientific literacy scores increased after the implementation of the SETS-I based Bio Pocketbook in the learning process.

Table 8. Average Pretest and Posttest Scores of Students' Scientific Literacy Skills

Test Type	Average Score
Pretest	69.25
Posttest	91.5

Based on Table 8, it can be seen that there is a significant increase in the average score of students' scientific literacy skills from the pretest to the posttest. This improvement indicates that the SETS-I based Bio Pocketbook contributes positively to students' understanding of scientific concepts and their ability to apply these concepts in learning activities.

Furthermore, the effectiveness of the SETS-I based Bio Pocketbook is strengthened by the results of the N-gain analysis. The results of the effectiveness analysis indicate that this learning resource is effective in the learning process, as shown in Table 9, which presents the N-gain test results for the improvement of scientific literacy skills.

Table 9. N-gain test result value of scientific literacy skills improvement

Category	Number of Students	Percentage (%)
High	21	87.5
Medium	3	12.5
Low	-	0.00

Based on Table 9, it can be seen that the development of the SETS-I based Bio Pocketbook learning resource is on average in the high and medium categories, which means that the developed learning resource is considered to meet the effectiveness criteria.

The following figure presents the SETS-I–based Bio Pocketbook design developed using Canva to illustrate the integration of SETS-I components in natural sciences (IPA) learning.

Figure 2. SETS-I based bio pocketbook cover view

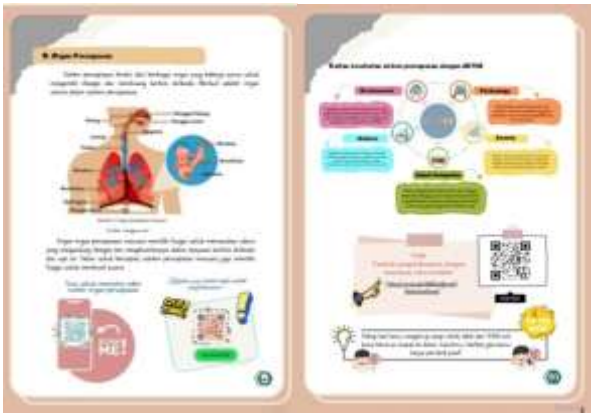

Figure 3. SETS-I based bio pocketbook contents view

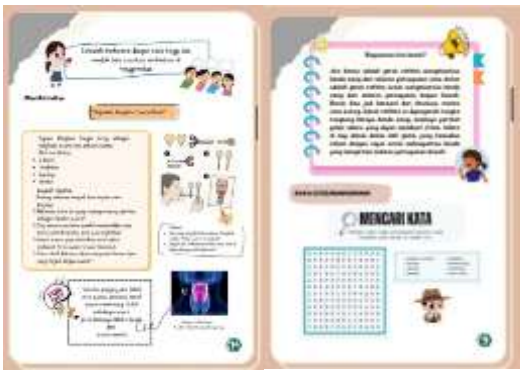

Figure 4. The layout of mini activities and quizzes in the SETS-I based bio pocketbook

Discussion

The development of the SETS-I based Bio Pocketbook aims to produce a science learning resource that is relevant, contextual, and capable of supporting students' scientific literacy achievement in the topic of the Human Respiratory System. The primary objective of this learning material development is to produce a Bio Pocketbook that is valid in terms of content, language, presentation, and design, so that it can be used as a learning medium aligned with the characteristics of the Merdeka Curriculum. The subsequent objectives are to determine the practicality of the pocketbook for teachers and students, and to evaluate its effectiveness in improving conceptual understanding and scientific literacy. This Bio Pocketbook is developed based on the Learning Outcomes (CP) and is equipped with illustrations, contextual discourse, learning activities, and the integration of SETS-I values to enrich students' learning experiences.

The development of the SETS-I based Bio Pocketbook is intended to produce a learning resource that enhances student engagement through a sequence of structured and meaningful activities. The SETS-I approach is designed by systematically integrating elements of science, environment, technology, society, and Islamic values into the learning material, enabling students not only to understand concepts theoretically but also to connect scientific knowledge with real-life phenomena. Consequently, the pocketbook is expected to support the development of critical thinking skills, information interpretation abilities, and the application of biological concepts in various real-world contexts.

The components included in the Bio Pocketbook consist of scientific texts, high-resolution illustrations, concept maps, contextual discourses, and learning activities such as mini activities, crossword puzzles, quizzes, student worksheets (LKPD), and discussion sheets. The varied and non-monotonous visual presentation aims to provide visual stimuli that enhance students' interest in the material. Moreover, the integration of learning video barcodes supports the use of technology as a medium to strengthen conceptual understanding. These modern and engaging design features are expected to create a more enjoyable learning experience and increase active student participation.

The integration of SETS-I elements is evident throughout each subtopic, for example, through contextual texts on air pollution to explore environmental impacts on the respiratory system (Environment), the use of digital media to enhance concept comprehension (Technology), discussion

activities that foster scientific communication (Society), and the inclusion of spiritual values emphasizing gratitude for Allah's creation (Islamic Integration). This integrative approach aligns with the goals of scientific literacy, which emphasize understanding scientific phenomena within social, technological, and ethical contexts.

In addition to content design, the development stage also includes preparing research instruments to assess the validity, practicality, and effectiveness of the pocketbook. These assessment instruments are constructed based on the characteristics of the learning material, including content feasibility, accuracy of information, visual appropriateness, and ease of use. The systematic construction of these instruments enables objective evaluation of the product according to established standards in instructional material development research.

Physically, the Bio Pocketbook is printed in an A7 size (7.4 cm × 10.5 cm), making it easy to carry and use in various learning situations. The selected fonts include Poppins for the main text, Patrick Hand for subheadings, and Comic Sans MS or similar typefaces for chapter titles, with appropriately adjusted sizes to maintain readability. The entire design is created using Canva, allowing for consistent and aesthetic integration of text, illustrations, and graphical elements.

The use of the SETS-I based Bio Pocketbook is believed to support science learning in a more active and contextual manner. Its integration of technological elements and environmental issues provides a more meaningful learning experience, enhances learning motivation, and helps students develop more comprehensive scientific understanding. Thus, this pocketbook has the potential to serve as an effective alternative learning material for improving students' scientific literacy.

The validation results of the learning resource indicate that the average Gregory test score for the SETS-I based Bio Pocketbook is 1.00, which falls into the category of very high validity. This demonstrates that the SETS-I based Bio Pocketbook is appropriate for use as a learning resource in junior high school science instruction. More specifically, the content aspect received an excellent rating because the material aligns with the Phase D learning outcomes and is relevant to the SETS-I approach. The construct aspect was also rated highly valid due to the coherent integration of objectives, materials, exercises, and assessments arranged systematically and logically. Meanwhile, the language aspect met the criteria for clarity, adherence to standard linguistic conventions, and communicativeness for students.

This high level of validity indicates that the SETS-I based Bio Pocketbook meets the principles of scientific accuracy, internal coherence, and didactic feasibility. These findings are consistent with Aufa et al. (2024) and Mahlianurrahman & Rapita (2024) who report that SETS-based learning materials effectively enhance the quality of instruction by linking scientific concepts to real-life contexts and social values. Thus, the SETS-I approach not only increases the relevance of the material but also provides more contextual and meaningful learning experiences for students.

In addition, the development of the SETS-I based Bio Pocketbook contributes significantly to strengthening students' scientific literacy**.** Scientific literacy involves not only conceptual understanding but also the ability to apply scientific knowledge to explain phenomena, evaluate information, and make evidence-based decisions (Calado et al., 2018; Sembiring & Saronom, 2025). The SETS-I approach supports the achievement of scientific literacy by connecting science with environmental issues, technological developments, societal dynamics, and Islamic values that are close to students' daily lives. This is in line with Bybee (2020), who emphasizes that scientific literacy develops when learners can relate scientific concepts to social and environmental contexts.

The Bio Pocketbook presents science concepts contextualized through real-world phenomena, encouraging students to think critically and apply scientific ideas in their everyday lives. The use of illustrations, diagrams, and other visual elements also reinforces scientific literacy by training students to interpret visual information accurately (Hamzeh et al., 2019). This is supported by Rahayu et al. (2023) and Jannah et al. (2024), who assert that instructional designs incorporating aesthetic features, color, and interactive visuals enhance student engagement, conceptual comprehension, and the processing of scientific information.

Visual quality is another important factor contributing to the product's validity. The Bio Pocketbook is designed attractively using Canva and printed in a practical A7 size, making it easy for students to carry. The proportional font sizes and the use of educational comic-style fonts (such as Comic Sans or Genty Sans) make the appearance communicative and comfortable to read. This aligns with findings from Aldi & Siregar (2024), which show that learning materials with appealing visual designs can enhance students' learning motivation and scientific literacy. Thus, the combination of valid content, engaging design, and the integration of SETS-I values makes the Bio Pocketbook not only academically sound but also effective in improving students'

scientific literacy and scientific character (Adhiyah & Kartika, 2024; Sugmawati et al., 2025).

The product that had been validated and declared valid by expert validators was subsequently implemented through a practicality test involving teachers and students. After the learning resource was provided to both groups, teacher and student response instruments were administered to evaluate the practicality of the material. Based on data analysis derived from these responses, it can be concluded that the SETS-I based Bio Pocketbook is practical to use. According to Arikunto (2019), accurate data will lead to conclusions that reflect actual conditions, and this accuracy is highly dependent on the quality of the instruments used in the research.

The practicality test of the Bio Pocketbook was conducted to examine its practicality from the perspective of teacher and student responses. The teacher response instrument included several aspects: the content of the learning resource, its presentation, usefulness, SETS-I based learning, and linguistic aspects. Meanwhile, the student response instrument assessed the aspects of material content, usefulness, visual appearance, SETS-I based learning, and linguistic clarity. The results showed that both teacher and student responses fell into the category of highly practical.

The percentage score from teachers was 93.75%, classified as very practical. However, this score did not reach the maximum value of 100%, which may be attributed to several factors such as the teachers' unfamiliarity with this type of learning resource. Specifically, the three participating teachers had never used learning materials such as the SETS-I based Bio Pocketbook at SMP Negeri 3 Bengo. The presence of the Bio Pocketbook enabled teachers to deliver information more clearly and accurately, while students could understand the material more quickly and effectively. Teachers also benefited from additional features, such as pictures and video links, which facilitated classroom instruction and helped optimize learning time.

Student responses also showed a very practical rating, with an average score of 92%. The positive responses—surpassing the minimum criteria—from both teachers and students indicate that the SETS-I based Bio Pocketbook can be effectively used as a learning resource in science instruction. These findings support Nieveen's view as cited in Parawangsa & Listari (2023) and Zuliana et al. (2022), which states that the practicality of an instructional product can be seen from the extent to which it is easy and helpful to use. In other words, the easier a learning tool is for teachers and students to use, the higher its level of practicality.

Furthermore, Yogiyatno and Sofyan as cited in Furwasih et al. (2025) emphasize that the practicality of instructional materials is closely related to their design. Effective instructional materials should function well and stimulate users' curiosity when the visual design is attractive, clear, and systematic. This aligns with the characteristics of the SETS-I based Bio Pocketbook, which features appealing visuals, a harmonious color scheme, and a simple yet informative layout that encourages students to be more active and enthusiastic in the learning process. Similarly, Rahman et al. (2025) and Solehah et al. (2025) assert that the incorporation of color variations and visual elements in learning media design can create an enjoyable learning atmosphere and increase students' interest in the subject matter. Therefore, the attractive appearance and concise content of the SETS-I based Bio Pocketbook make it not only practical but also effective in fostering learning motivation, scientific character, and students' scientific literacy (Ningtyas et al., 2024; Pratama et al., 2024).

The effectiveness of the developed product was determined through an evaluation in the form of a scientific literacy test to measure students' improvement after the learning process. The increase in students' scientific literacy occurred because they engaged in cognitive processes throughout the learning activities. This learning approach emphasizes the process of searching for and constructing knowledge independently through discourse, reflection, and discussion conducted during instruction.

The results of the scientific literacy evaluation indicate that the effectiveness criteria were met, as the test scores fell within the high and medium categories. This shows that the learning resource successfully facilitated students in organizing their learning activities more effectively, which in turn contributed to the improvement of their scientific literacy skills. The scientific literacy assessed in this study covered seven key indicators: identifying valid scientific arguments; conducting effective literature searches; understanding elements of research design and their implications for findings; constructing accurate graphs from data; solving problems using quantitative skills including basic statistics; understanding and interpreting basic statistical information; and making inferences, predictions, and drawing conclusions from quantitative data.

The analysis revealed improvements across all indicators. In the indicator of identifying valid scientific arguments, students became more capable of distinguishing between evidence-based statements and opinions. This improvement was supported by reflective features in the SETS-I based Bio Pocketbook, which encouraged students to think critically about

scientific phenomena by connecting them with social aspects and Islamic values. This aligns with the findings of Aini et al. (2022) and Yerimadesi et al. (2022), who reported that the SETS approach enhances students' critical thinking and ability to validate scientific arguments.

For the indicators related to conducting effective literature searches and understanding research design, students showed significant improvement after using the Bio Pocketbook. Learning activities that guided students to gather information from scientific sources helped them understand the importance of methodology and data validity. This result is consistent with Erwin & Mohammed (2022), who found that instructional materials integrating science and technology improve students' information literacy and methodological understanding.

The indicators involving graph construction, quantitative problem-solving, and interpreting basic statistical information also demonstrated substantial improvement. Students were increasingly able to analyze observational data, represent it in graphical form, and draw logical conclusions based on numerical evidence. These improvements were strongly influenced by the quantitative and visual tasks incorporated into the Bio Pocketbook. According to Fauziah & Nurlaili (2023), presenting data visually through contextual learning media strengthens students' numeracy skills and scientific interpretation.

In the final indicator, making inferences, predictions, and conclusions based on quantitative data, students demonstrated enhanced inductive and deductive reasoning. They successfully connected their analyses to real-world phenomena, such as the relationship between the respiratory system, environmental conditions, and air filtration technologies, which is consistent with previous studies that reported that SETS-I-based learning positively influences students' reflective thinking and scientific decision-making.

Overall, improvements across all seven indicators confirm that the SETS-I based Bio Pocketbook functions not only as a science learning resource but also as a comprehensive tool for strengthening scientific literacy. Its engaging design, integration of Islamic values, and interdisciplinary approach (science, environment, technology, and society) encourage students to become more active, analytical, and reflective learners. These findings are also supported by Afriana et al. (2016), Pratiwi et al. (2023), and Fitria & Ayani (2025) whose perspectives indicate that 21st-century scientific literacy requires critical, quantitative, and socially contextualized thinking skills that are integrated with real-life situations.

Conclusion

The SETS-I–based Bio Pocketbook (Science, Environment, Technology, Society, and Islamic Integration) developed for the official junior high school subject Science (IPA) on the human respiratory system was produced using the ADDIE development model, which consists of the analysis, design, development, implementation, and evaluation stages. The validation results indicated a very high level of validity, with an average validity coefficient of 1.00, reflecting perfect agreement among validators. The practicality evaluation showed that the Bio Pocketbook was very practical, as evidenced by an average teacher response score of 93.75% and an average student response score of 92%. Furthermore, the effectiveness test based on students' scientific literacy skills demonstrated that the product met the effectiveness criteria, as indicated by an average N-gain score of 0.73, which falls into the high category. These findings confirm that the developed SETS-I–based Bio Pocketbook is valid, practical, and effective as a science learning resource for junior high school students.

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