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DEVELOPMENT OF FLIPBOOK-BASED SCIENCE HANDOUTS WITH AN SDGS AND LOCAL WISDOM APPROACH TO ENHANCE HIGHER ORDER THINKING SKILLS OF PGSD STUDENTS

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ABSTRACT

A handout is a written instructional material organized in a concise and systematic manner to assist students in understanding learning content. The use of flipbook-based science handouts can enhance Higher Order Thinking Skills (HOTS) because the visual presentation of the material and flexible navigation enables students to explore science concepts in depth, connect SDGs-based theories with local wisdom phenomena, and increase active engagement as well as independent learning. This study employed a Research and Development (R&D) method using the ADDIE development model, which consists of the stages of analysis, design, development, implementation, and evaluation. The research technique used purposive sampling with a sample of 30 PGSD students at Universitas Serambi Mekkah. Data collection instruments included expert validation sheets, response questionnaires, and HOTS tests in the form of pretests and posttests. The results showed that the average pretest score was 71 and increased to 96 in the posttest. The improvement in students' HOTS was indicated by an average N-Gain score of 0.86 and an N-Gain percentage of 86.05%, which falls into the high category. The practicality test results showed that both student and lecturer responses were categorized as very practical. Therefore, the flipbook-based science handout with an SDGs and local wisdom approach is valid, practical, and effective in improving the HOTS of PGSD students.

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1. INTRODUCTION

The rapid development of science and technology (IPTEK) requires the education sector to continuously innovate in creating learning processes that are relevant to the demands of the 21st century. One of the essential competencies that must be developed among pre-service elementary school teachers is higher-order thinking skills (HOTS). These skills include the abilities to analyze, evaluate, and create, enabling students not only to understand concepts theoretically but also to apply them in real-life contexts.

Local wisdom is a cultural heritage that has developed within society and has proven to endure over time due to its relevance to daily life. Local wisdom represents the accumulation of knowledge, values, norms, customs, and practices formed through continuous interactions between communities and their environment across

generations. However, local wisdom has often not been optimally utilized in the learning process at the higher education level (Desfandi, 2020), including in the development of instructional materials.

The Sustainable Development Goals (SDGs) are a global agenda established by the United Nations (UN) as a continuation of the Millennium Development Goals (MDGs) (Puja Pangestu et al., 2021). The primary objectives of the SDGs are to end poverty, reduce inequality, protect the environment, and ensure peace and well-being for all people worldwide by 2030. In line with these goals, Acehnese local wisdom supports the sustainable use of natural resources through values such as mutual cooperation, environmental awareness, and customary-based resource management.

Learning approaches that integrate local wisdom and the Sustainable Development Goals (SDGs) have not been widely implemented in instructional materials at the higher education level, particularly in the Primary School Teacher Education (PGSD) program. PGSD students require instructional materials that are contextual, systematic, and easy to understand, as well as explicitly connected to the SDGs and local wisdom, to support their mastery of learning concepts while simultaneously developing higher-order thinking skills as prospective elementary school teachers. One instructional material that is accessible and easy to use is a flipbook-based handout. A flipbook-based handout is a digital learning resource that is concisely and systematically organized in an electronic book format, equipped with visual elements and flexible page navigation to help students develop a deeper understanding of science concepts and enhance learning engagement and independence.

In several cases, science learning is still dominated by teacher-centered approaches (Nurkamilah, 2025), which limits students' opportunities to explore, engage in discussions, and construct knowledge through active learning experiences. This condition is directly related to students' low ability to design innovative learning activities when they enter the teaching profession at the elementary school level.

Therefore, innovation in the provision of instructional materials is required to integrate 21st-century competencies, national curriculum demands, and recent technological advancements. One relevant approach is to link science learning with global contexts, such as the Sustainable Development Goals (SDGs), while simultaneously strengthening local wisdom values as culturally based learning resources. When this approach is delivered through digital media such as interactive flipbooks, the learning process has the potential to become more engaging and contextual, thereby more effectively promoting the development of students' higher-order thinking skills (HOTS).

2. RESEARCH METHODS

The research method employed in this study is Research and Development (R&D). R&D is a research method aimed at producing and developing a product (Waruwu, 2024). Research and development is regarded as an effective research strategy or approach for improving and refining existing practices. Systematically, this method is used to design and develop learning programs or specific products to meet predetermined internal criteria.

Based on the developed instructional material, namely the flipbook-based science handout with an SDGs-oriented local wisdom approach, the development process was carried out through five stages, namely:

Figure 1. ADDIE Development Stages (Sugiyono et al., 2022)

This study was conducted with first-semester students of the Primary School Teacher Education (PGSD) Program at Universitas Serambi Mekkah, located in Batoh, Lueng Bata District, Banda Aceh City, Aceh Province, Indonesia. The research was carried out during the odd semester of the 2025/2026 academic year, specifically from November to December 2025. The subjects of this study consisted of 30 first-semester students from Unit 1.

The data collection techniques in this study were intended to obtain preliminary information as a basis for analyzing students' needs in the Science Concepts course. The techniques employed included observation, interviews, and questionnaire distribution.

Data analysis techniques were applied to produce a high-quality product that meets the criteria of validity, practicality, and effectiveness. The quality analysis of the developed product was conducted through both qualitative and quantitative data analysis. The collected data were subsequently analyzed qualitatively by describing respondents' feedback, which was then organized and summarized into clear, systematic, and comprehensible statements.

a. Qualitative Data Analysis
   Qualitative data analysis refers to the analysis of data obtained from suggestions, inputs, comments, and constructive feedback provided by validators. These responses and comments were utilized to improve and refine the flipbook-based science handout with an SDGs-oriented local wisdom approach aimed at enhancing the higher-order thinking skills (HOTS) of PGSD students.
b. Quantitative Data Analysis
   Quantitative data analysis was conducted to process data obtained from validation questionnaires completed by subject-matter experts, media experts, and practitioners. Furthermore, quantitative analysis was applied to pre-test and post-test learning outcome data to determine the effectiveness of the developed instructional materials.
c. Product Feasibility Analysis Based on Expert Validation
   Data analysis techniques refer to the process of processing data to obtain comprehensive understanding and essential information that can be used as a basis for decision-making, commonly known as research data analysis procedures (Nurkamilah, 2025). Data on the validity and effectiveness of the instructional materials and the use of learning media were collected through validation by media experts, subject-matter experts, as well as lecturers and students. The research instruments for validators and for individual, small-group, and limited field trials were designed using a Likert scale consisting of five score levels (5, 4, 3, 2, and 1) with response categories of Very Good, Good, Fair, Poor, and Very Poor. This approach was employed to ensure a clear and accurate assessment of the feasibility of the instructional materials. Therefore, the data were analyzed using the following formula:

$$\text{Score} = \frac{\text{Number of indicators each category}}{\text{Total number of indicators}} \times 100\%$$

Table 1. N-gain Categories

No	Answer	Score
A	Very Good	81% ≤ X < 100%
B	Good	61% ≤ X < 80%
C	Fair	41% ≤ X < 60%
D	Poor	21% ≤ X < 40%
E	Very Poor	0% ≤ X < 20%

3. RESULT AND ANALYSIS

The initial stage conducted by the researcher was needs analysis. This needs analysis aimed to identify students' requirements for the development of a flipbook-based science handout with an SDGs-oriented local wisdom approach to enhance the higher-order thinking skills (HOTS) of PGSD students.

The needs analysis was carried out in collaboration with the lecturer responsible for the Science Concepts course in the Primary School Teacher Education (PGSD) Program at Universitas Serambi Mekkah by preparing several relevant questions. The results of the analysis indicated that science learning still requires instructional materials that are contextual, engaging, and integrated with local wisdom and SDG values. In addition, the instructional materials currently used have not fully encouraged students to think critically or to understand the relationship between science concepts and real-world problems in their surrounding environment.

Tabel 2. Summary of Students' Pre-Test Results

No	Respondent	Pre-Test	Maximum Score
1	ZAH	70	100
2	KA	75	100
3	CR	75	100
4	ZN	72	100
5	JS	74	100

6	II	68	100
7	SY	67	100
8	SR	86	100
9	IK	65	100
10	AJ	68	100
11	AF	68	100
12	RA	70	100
13	NF	69	100
14	CA	90	100
15	RN	75	100
16	CS	92	100
17	NAD	75	100
18	REV	67	100
19	MIS	67	100
20	NLS	70	100
21	HN	72	100
22	KKU	64	100
23	MFT	73	100
24	WAN	67	100
25	YH	66	100
26	NM	72	100
27	SU	67	100
28	AF	65	100
29	FR	69	100
30	RR	76	100
	Mean	71	100

Based on the students' pre-test results, 8 students achieved scores above the mastery criterion of 75, while 22 students obtained scores below the mastery criterion.

Desain Stage

The researcher developed an initial product design in the form of a science handout that integrates local wisdom and is based on the Sustainable Development Goals (SDGs), aligned with the learning outcomes of the PGSD Science Concepts course. This stage began with the formulation of learning objectives, mapping of core materials, and the integration of relevant local wisdom values and SDG goals with science concepts. Subsequently, the researcher designed the structure of the handout, which includes an introduction, material explanations, contextual examples based on local wisdom, learning activities, and practice questions oriented toward higher-order thinking skills (HOTS). The handout design also considered linguistic aspects, visual presentation, and readability to ensure that it is easy to understand and engaging for students. The initial design then served as the basis for the development stage and expert validation.

Development Stage

The handout was developed by considering content completeness, material accuracy, integration of local context, and attractive presentation. The initial product was subsequently validated by subject-matter experts, media experts, and language experts to assess the validity of the content, visual design, and readability of the handout. Feedback and suggestions from the experts were used as the basis for revising the product to ensure that the handout was suitable for use at the implementation stage.

Following validation by the three experts, evaluation results for the media, content, and language aspects were obtained, as presented in the following table.

Tabel 3. Summary of Expert Validation Results

Validation Aspect	Percentage (%)	Feasibility Category
Media Expert	98%	Very Feasible
Content Expert	92%	Very Feasible
Language Expert	98%	Very Feasible
Overall Average	96%	Highly Feasible for Use

Based on the validation results from the three experts, an overall average score of 96% was obtained, which falls into the very feasible category. Therefore, it can be concluded that the flipbook-based handout is highly suitable for use in the Elementary Science Concepts course at the higher education level, particularly for first-semester students at Universitas Serambi Mekkah, without requiring substantial revisions.

Implementation

At this stage, the flipbook-based science handout with an SDGs-oriented local wisdom approach, which had been declared valid and revised based on expert feedback, was implemented in the science learning process for PGSD students at Universitas Serambi Mekkah. The implementation was conducted over several class meetings, with the handout used as the primary instructional material. During the learning process, students were guided to study the material independently through activities provided in the handout, including discussions, analysis of contextual problems, and the completion of HOTS-oriented exercises. At this stage, the researcher also collected data on the practicality and effectiveness of the product through student response questionnaires and learning outcome tests to determine the impact of the handout on students' understanding of science concepts and their higher-order thinking skills. The following describes the implementation activities of the flipbook-based handout in this study:

Figure 2. Pre-test

Figure 3. Implementation of Teaching Materials

Figure 4. Post-test

Evaluation

The evaluation was conducted after the implementation stage and involved 30 first-semester students who had participated in learning activities using the flipbook-based handout. This evaluation comprised two types of assessment: formative and summative evaluation. Formative evaluation was carried out during the development process to improve the product design, while summative evaluation was conducted after the completion of the learning process to measure the effectiveness of the flipbook-based handout in enhancing students' higher-order thinking skills (HOTS).

Tabel 4. Summary of Student Post-Test Results

No	Respondent	Postest	Maximum Value
1	ZAH	95	100
2	KA	90	100
3	CR	100	100
4	ZN	95	100
5	JS	100	100
6	II	100	100
7	SY	98	100
8	SR	100	100
9	IK	100	100
10	AJ	95	100
11	AF	100	100
12	RA	98	100
13	NF	90	100
14	CA	100	100
15	RN	100	100
16	CS	100	100
17	NAD	90	100
18	REV	90	100
19	MIS	92	100
20	NLS	98	100
21	HN	100	100
22	KKU	97	100
23	MFT	90	100
24	WAN	100	100
25	YH	97	100
26	NM	92	100
27	SU	90	100
28	AF	85	100
29	FR	100	100
30	RR	100	100
Average		96	100

The average post-test score was 95, indicating an improvement in learning outcomes of 25 points. This improvement demonstrates that the use of the flipbook-based handout had a positive impact on enhancing students' higher-order thinking skills (HOTS) in the studied science material. Although the absolute increase in scores may not appear substantial, this can be attributed to the students' relatively high initial abilities as reflected in the pre-test results, which limited the scope for further improvement. Nevertheless, the progression of scores toward the maximum score (100) remains an important indicator that the flipbook-based handout was effective in strengthening students' mastery of the material and improving the accuracy of their responses.

N-Gain

To determine the effectiveness level of learning outcome improvement, the N-gain calculation was employed:

Table 5. N-Gain

Variable	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain Skor	30	0,57	1,00	0,8605	0,14
N-Gain Persen	30	57,14	100,00	86,05	14,00
Valid N (listwise)	30				

The calculation results showed an average N-gain value of 0.86, which falls into the high category ($g \geq 0.75$). This finding indicates that the use of the flipbook-based science handout with an SDGs-oriented approach and Acehnese local wisdom was effective in enhancing the higher-order thinking skills (HOTS) of PGSD students, particularly in the aspects of analysis (C4), evaluation (C5), and creation (C6) in science learning.

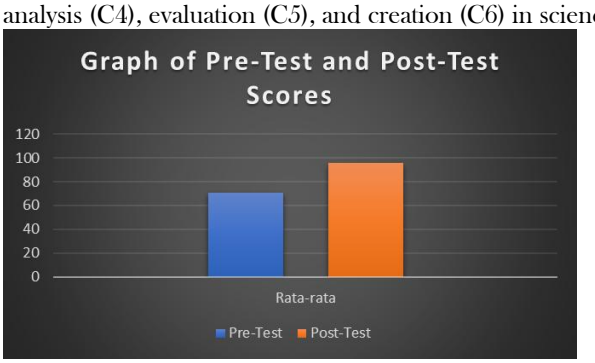

Figure 5. Pre-Test and Post-test Scores

Based on the results of descriptive statistical analysis, the mean N-Gain score was 0.86, which falls into the high category, with a minimum value of 0.57 and a maximum value of 1.00. These findings indicate that the majority of PGSD students experienced an improvement in higher-order thinking skills (HOTS) after participating in learning activities using an SDGs-oriented and Aceh local wisdom–based flipbook IPA handout. The standard deviation value of 0.14 suggests that the distribution of N-Gain scores was relatively homogeneous, indicating that the improvement in learning outcomes was evenly distributed among students. Furthermore, the average N-Gain percentage of 86% demonstrates that the effectiveness of the learning process was classified as high. Therefore, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. In conclusion, the development of an SDGs oriented and local wisdom-based flipbook IPA handout is effective in improving the HOTS of PGSD students.

4. CONCLUSION

Based on the results of the study and discussion, it can be concluded that the SDGs-oriented and local wisdom–based flipbook IPA handout developed using the ADDIE model meets the criteria of validity, practicality, and effectiveness. The expert validation results indicate that the handout is aligned with the learning outcomes of the PGSD IPA course, integrates SDGs and Aceh local wisdom in a contextual manner, uses communicative language, and presents an attractive and interactive media design.

The practicality test results reveal that the flipbook-based IPA handout is easy to use and highly supportive of the learning process. Lecturers considered the handout effective in delivering learning materials systematically and efficiently, while PGSD students provided very positive responses due to its flexibility, ease of access, and support for independent learning. The contextual presentation of materials and the inclusion of tiered HOTS oriented activities enhanced students' active engagement throughout the learning process.

The effectiveness test results demonstrate that the use of the flipbook-based IPA handout significantly improves the Higher Order Thinking Skills (HOTS) of PGSD students. This improvement is evidenced by the increase in students' learning outcomes after using the handout, as indicated by N-Gain values categorized from moderate to high. Therefore, the SDGs-oriented and local wisdom-based flipbook IPA handout is feasible and appropriate to be used as an innovative instructional material in PGSD science learning.

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