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Development of a Non-Textbook on Biodiversity in Sumatra Based on the Sustainable Development Goals to Improve Critical Thinking and Problem-Solving Skills

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Abstrak

Penelitian ini bertujuan untuk menciptakan buku non-teks keanekaragaman hayati berbasis SDGs di Sumatera yang memiliki aplikasi praktis dan meningkatkan kemampuan berpikir kritis dan pemecahan masalah siswa. Jenis penelitiian ini pengembangan berbasis ADDIE ini melibatkan dua kelas siswa dari kelas X SMA Negeri 1 Paranginan: eksperimen dan kontrol. Uji t sampel independen digunakan untuk menguji kelayakan, kepraktisan, dan efektivitas data penelitian. Studi ini menemukan bahwa buku non-teks keanekaragaman hayati berbasis SDGs di Sumatera bersifat playak, praktis dan efektif dalam mengembangkan kemampuan berpikir kritis dan pemecahan masalah siswa kelas X SMA Negeri 1 Paranginan. Kelayakan terpenuhi berdasarkan hasil validasi dari materi (80,0%), pembelajaran (89,3%), dan pakar media/desain (78,7%) menunjukkan kelayakan. Kuesioner tanggapan instruktur biologi (83,6%) dan kuesioner tanggapan siswa (76,2%) menunjukkan kepraktisan. Hasil evaluasi menunjukkan efektivitas, dengan nilai N-gain 75,7% untuk kemampuan berpikir kritis dan 65,5% N-gain untuk kemampuan pemecahan masalah di kelas eksperimen. Pengujian hipotesis mengkonfirmasi efektivitas (Sig.= 0,000 < 0,05) dan (Sig.= 0,007 < 0,05).

***Kata Kunci**: Buku Non-Teks, Keanekaragaman Hayati Sumatera, Kemampuan Berpikir Kritis, Kemampuan Pemecah Masalah, SDGs.*

Abstract

This study aims to create a non-textbook on SDGs-based biodiversity in Sumatra with practical applications that improve students' critical thinking and problem-solving skills. This ADDIE-based development research involved two classes of grade X students at SMA Negeri 1 Paranginan: the experimental and control groups. Independent-samples t-tests were used to assess the feasibility, practicality, and effectiveness of the research data. This study found that the non-textbook on SDGs-based biodiversity in Sumatra is playful, practical, and effective in developing critical thinking and problem-solving skills of grade X students of SMA Negeri 1 Paranginan. Feasibility was met based on validation results from materials (80.0%), learning (89.3%), and media/design experts (78.7%), indicating feasibility. The biology instructor's response questionnaire (83.6%) and the student's response

questionnaire (76.2%) indicated a practical orientation. The evaluation results showed effectiveness, with N-gain values of 75.7% for critical thinking skills and 65.5% for problem-solving skills in the experimental class. Hypothesis testing confirmed the effectiveness (Sig.= 0.000 < 0.05) and (Sig.= 0.007 < 0.05).

Keywords: Non-Textbooks, Sumatran Biodiversity, Critical Thinking Skills, Problem Solving Skills, SDGs.

A. Introduction

Textbooks and theoretical explanations from instructors dominate 10th-grade biology learning. Students are typically told to memorize information without enough time to assess, evaluate, and apply it to their environment (Amthari, W., Muhammad, D., & Anggereini, 2021). This causes students to lack critical thinking skills, especially in recognizing local biodiversity issues. However, 21st-century learning requires critical thinking to help pupils solve global problems, especially environmental ones (Aprianto, S., Mascita, D. E., & Khaerudin, 2022). Students who participate more will develop critical thinking (Silaban, R., Panggabean, F. T. M., Sitompul, S. M., Simarmata, P. R. S., & Silaban, 2019). Sustainable development education emphasizes critical thinking. The 4.0 industrial revolution also requires motivated, sustainable talent that can create new solutions to sustainability issues (Aprianto, S., Mascita, D. E., & Khaerudin, 2021). 10th-graders at Paranginan 1 High School have low levels of critical thinking, according to observations. In teacher-centred learning, professors present material directly, while students take notes and memorize it, with little opportunity to ask questions or offer comments. Most students replicate replies from more knowledgeable peers, making group discussions ineffective. This stops pupils from learning to analyze problems, apply concepts to real-world phenomena, and draw conclusions from evidence (Budianti, D. A., Roshayanti, F., Hayat, M. S., & Syafiq, 2022).

Biology teachers also report that contextual difficulties make students less competent to generate logical arguments or alternative answers. Teachers observed that many pupils still use example questions without considering other options (Chaerunisa, Z. F., & Pitorini, 2022). This suggests that 10th-graders at SMA Negeri 1 Paranginan lack 21st-century skills such as critical thinking and problem-solving. Improvements in the learning process are needed to encourage students to be more active and creative and to build critical thinking and problem-solving skills. Most grade 10 pupils at Paranginan 1 State Senior High School scored below the 75 Learning Target Completion Criteria (KKTP). They can solve easy, memorized questions but struggle with analytical or application challenges. Low learning outcomes below KKTP 75 indicate poor critical thinking and problem-solving skills. Thus, learning innovations and teaching materials must encourage students to be more engaged, analytical, and competent in critical thinking and problem-solving to improve learning outcomes in line with standards (Díaz, A. L., & Prados, 2020).

Initial observations indicated that teachers' and students' principal learning source, textbooks from a single publisher, dominates the learning process (Endang, P. R., Sari, T. A., & Pratiwi, 2021). Teachers often assign textbook questions that are inadequate for assessing students' thinking skills, engaging them, and offering opportunities for critical thinking. Textbooks are too long, which bores students and makes them stop reading (Bekteshi, E., & Xhaferi, 2020). We must capture students' attention and interest to achieve learning objectives. Less engaging instruction bores students, affecting learning results (Khairani, D., Permana, D., Fauzan, A., & Musdi, 2024). We can meet learning objectives with the help of good teaching materials. Teaching materials encourage active and communicative learning and diminish instructor domination (Rozalia, A., Kasrina, & Ansori, 2022). Non-textbooks can be utilized as student learning tools in addition to textbooks/packages, modules, and media. Non-textbooks augment and enrich learning at all levels (Rofi'ah, A., Hariani, S. A., & Pujiastuti, 2021). Students do not utilize these books as their main textbooks.

To avoid boredom with textbooks, non-textbooks emphasize pictures and deliver factual information on numerous topics (Yuristia, F., Hidayati, A., & Ratih, 2022). This book enriches readers' understanding and expands their horizons (Aprianto, S., Mascita, D. E., & Khaerudin, 2021). All ages and audiences can read this book, as it is not curriculum-based (Endang, P. R., Sari, T. A., & Pratiwi, 2021). Non-textbooks cover many topics. Indonesia's flora and fauna diversity is a vital area for study. This biodiversity is economically and environmentally valuable; thus, understanding it is vital (Faizah, A. N., & Nugraheni, 2024). Creating a Sumatra biodiversity non-textbook based on the Sustainable Development Goals can boost students' critical thinking and problem-solving skills. (Fau, 2020) (Filho, W. L., Salvia, A. L., & Eustachio, 2023) developed a non-textbook for Cirebon folklore, (Habiba, R., Ngabekti, S., & Indriyanti, 2023) developed one on andaliman in Saloan Dolok, Samosir, (Hidayat & Maulida, 2022) developed one on character values, and Aquatika et al. (2022) developed one on graded lessons. As educational companions, non-textbooks must convey phenomena, data, and facts that engage students' critical thinking. One way is to include SDGs (Harahap, I. H., Restuati, M., & Hasairin, 2021).

Students need 21st-century critical thinking abilities to attain the SDGs (Ramdani, A., Purwoko, A. A., Sukarso, A., & Sucilestari, 2024). Teachers could incorporate SDG (Sustainable Development Goals) ideals into core competencies and create learning scenarios to improve students' critical thinking on sustainable development concerns (Hartono, A., Hasairin, A., & Diningrat, 2022). Accordingly, Sumatra needs biodiversity non-textbooks based on the Sustainable Development Goals. This research is needed because teachers and students primarily use textbooks (handbooks) and a few alternative resources (Harun, S. C., 2021). Additionally, textbooks cover too much material, which bores students and makes them

stop reading. Many academics have studied non-textbook development using different subjects and methodologies (Septiani, D. E., & Wardhani, 2022). Since Sumatra has no non-textbooks on biodiversity, this investigation is novel. This book improves students' critical thinking using SDG-based ideas. It should help achieve education and environmental SDGs. This SDG-based non-textbook aims to provide students with a critical and sustainable perspective while helping them discover, explain, evaluate, and present biodiversity data, especially in Sumatra.

B. Research Method

The research was conducted at Paranginan 1 State Senior High School, located in North Paranginan Village, Paranginan District, Humbang Hasundutan Regency, North Sumatra, with postal code 22475. The research will be conducted from October to December during the odd semester of the 2025/2026 academic year. The subjects of this study consisted of: (1) a validator team consisting of material experts, learning experts, and design experts to review and assess the non-textbook on biodiversity in Sumatra based on the Sustainable Development Goals (SDGs) that was developed; (2) three biology teachers; and (3) 216 10th-grade students of Paranginan 1 State Senior High School. The sample classes were selected using purposive sampling based on similarity in average Biology grades. In this study, the sample classes were class X-2 as the control class and class X-4 as the experimental class. Meanwhile, class X-1 was the trial class. The object of this research is a non-textbook on Biodiversity in Sumatra based on the Sustainable Development Goals (SDGs) to improve students' critical thinking and problem-solving skills.

This research is a research and development (R&D) study. The development model used is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model (Branch, 2009). The non-textbook on Biodiversity in Sumatra, based on the Sustainable Development Goals (SDGs) in this study, was developed using the ADDIE model. This ADDIE development consists of five steps, namely: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. The following are the systematic stages as follows;

Analysis

Conducting an analysis to gather information related to student needs and analyzing the need to develop a non-textbook on biodiversity in Sumatra based on the SDGs for learning objectives, as well as reviewing literature related to the developed non-textbook. Conducted an analysis to collect information related to student needs and analyze the need to develop non-textbooks on biodiversity in Sumatra based on SDGs in learning objectives, as well as reviewing literature related to the non-textbooks developed. The results of the analysis of 2 (two) existing non-textbooks on biodiversity, including (1) Pehulisa (2024). Flora and Fauna Diversity in the Mangrove Ecotourism Area, Karang Gading, North Sumatra, and (2) Habiba et al. (2023). Encyclopedia of Biodiversity in Jepara Regency

Design

Identifying objectives and creating a draft of a non-textbook on biodiversity in Sumatra based on the SDGs to improve critical thinking skills in 10th-grade high school students, as well as designing the test instruments to be developed. At this stage, the instruments used were also designed as validator assessment instruments for material experts, learning experts, and design experts, as well as critical thinking ability test instruments and problem-solving ability tests for biodiversity material for class X SMA.

Development

At this stage, the designed non-textbook is validated by experts to ensure its quality, content suitability, and suitability as a learning medium. A validation instrument, in the form of an assessment sheet, was developed with indicators covering aspects of content, language, presentation, and graphics. Validators provided scores and qualitative feedback, including suggestions for improvement. The assessment results were then analyzed to determine the product's validity. If weaknesses were identified, the researchers revised the non-textbook in accordance with the validators' instructions, resulting in a more accurate, effective, and standards-compliant final product.

Implementation

Implementing SDGs-based non-textbook learning methods in biodiversity learning for 10th-grade high school students in a real-life classroom setting. This instrument is the stage of implementing SDGs-based non-textbooks in biodiversity learning for 10th-grade high school students in a real-life classroom setting. The non-textbook implementation was carried out in accordance with the biology learning schedule at SMA Negeri 1 Paranginan.

Evaluation

The final stage, which grades the resulting non-textbook on biodiversity in Sumatra based on the SDGs. The evaluation instrument was conducted in 2 (two) stages, namely the initial evaluation (pretest) before using SDGs-based non-textbooks and the final evaluation (posttest) after using SDGs-based non-textbooks. The evaluation was intended to analyze the effectiveness of using SDGs-based non-textbooks to improve students' critical thinking and problem-solving skills in biodiversity learning in class X of SMA Negeri 1 Paranginan.

C. Result and Discussion

Based on the Sustainable Development Goals, this project produced a Sumatra biodiversity non-textbook. Since Sumatra has no non-textbook biodiversity research, this research is state-of-the-art and novel. It uses SDG-based innovation to improve students' critical thinking and problem-solving skills and to contribute to SDG education and environmental goals. Using

the ADDIE paradigm, this book was developed through Analysis, Design, Development, Implementation, and Evaluation.

Analysis

This analysis phase also included an analysis of biodiversity material for grade X high school students based on the independent curriculum. Biology learning outcomes in phase E (grade X) based on the independent curriculum have emphasized skills that guide students toward achieving the SDGs. These skills can be achieved through observing, questioning and predicting, planning and conducting research, processing and analyzing data and information, evaluating and reflecting, and communicating through simple projects or simulations utilizing available technology.

Design

The non-textbook on Sumatra biodiversity incorporates SDGs-based innovations to enhance students' critical thinking and problem-solving skills. This Sumatra biodiversity problem is urgent due to the threat of extinction and preservation efforts. Illustrations, content page design, and book cover design are components of the design assessment. These three design elements are tailored to students' and readers' appropriateness, aesthetics, and development. Graphic standards are user-friendly, safe, and comfortable print quality or electronic display requirements. Print, binding, and combing/clean cutting quality are graphic assessment components for printed books.

The expert media/design validator team of the produced SDGs-based non-textbook scored 78.7% for all media/design feasibility indicators, indicating viability. The media expert team found that book size (70.0%), book cover design (75.0%), and content/material design (82.2%) are feasible criteria. The non-textbook on biodiversity in Sumatra based on SDGs has met the feasible criteria based on the media/design aspect, reviewed from the book size indicator, book cover design, and content/material design, and the media/design expert validator team also concluded that it is feasible to be tested and continued at the implementation stage

Development

The eligibility of non-textbooks based on material aspects was reviewed and validated by two Biology lecturers from the Faculty of Mathematics and Natural Sciences, Unimed, as a validator team of material experts, on the indicators of content/material eligibility and presentation eligibility. The results of the assessment by the validator team of material experts are summarized in Table 1.

Table 1. Summary of Expert Validation Results

Indicators	**Expert (%)**		**Average per Indicator (%)**	Criteria
	I	**II**		

Content/Material Suitability	82,0	88,0	Very Eligible	Very Eligible
Presentation Suitability	70,0	65,0	Eligible	Eligible
Overall Indicators	78,6	81,4	Eligible	Eligible

Table 1 shows that the results of the assessment by the material expert team on non-textbooks, for the content/material suitability indicator, the average percentage score was 85.0% or is classified as very suitable, for the presentation suitability indicator, the average percentage score was 67.5% or is classified as suitable, and for all indicators, the average percentage score was 80.0% or is classified as suitable.

The eligibility of non-textbooks based on learning aspects was reviewed and validated by two Biology lecturers from the Faculty of Mathematics and Natural Sciences, Unimed, as a validator team of learning experts, on the indicators of material content, constructive requirements, and didactic requirements. The results of the validator team's assessment of learning experts are summarized in Table 2.

Table 2. Summary of Learning Expert Validation Results

Indicators	Expert (%)		Average per Indicator (%)	Criteria
	I	II		
Material Content	100	90,0	Very Eligible	Very Eligible
Constructive Requirements	88,0	80,0	Very Eligible	Very Eligible
Didactic Requirements	91,4	91,4	Very Eligible	Very Eligible
Overall Indicators	91,4	87,1	Very Eligible	Very Eligible

Table. 2 shows that the results of the assessment by the learning expert team on non-textbooks, on the material content indicator, the average percentage score was 95.0% (very appropriate), on the constructive requirements indicator, the average percentage score was 84.0% (very appropriate), on the didactic requirements indicator, the average percentage score was 91.4% (very appropriate) and for all indicators, the average percentage score was 89.3% or was classified as very appropriate.

The validation instrument, in the form of an assessment sheet, was developed with indicators covering aspects of content, language, presentation, and graphics. The validators provided scores and qualitative feedback, including suggestions for improvement. The assessment results were then analyzed to determine the product's validity. If weaknesses were identified, the researchers revised the non-textbook according to the validators' instructions, resulting in a more accurate, effective, and standards-compliant final product. The following are the modules that have been developed:

Figure 1. Learning Module Display

Table 3. Summary of Design Expert Validation Results

Indicators	Ahli (%)		Average per Indicator (%)	Criteria
	I	II		
Book Size	60,0	80,0	70,0	Eligible
Book Cover Design	70,0	80,0	75,0	Eligible
Content Design	77,8	86,7	82,2	Very Eligible
Overall Indicators	73,3	84,0	78,7	Eligible

Table 3 shows that the results of the design expert team's assessment of non-text books, on the book size indicator, the average percentage score was 70.0% (adequate), on the book cover design indicator, the average percentage score was 75.0% (adequate), on the content/material design indicator, the average percentage score was 82.2% (very appropriate) and for the overall indicator, the average percentage score was 78.7% or classified as appropriate criteria. Based on the assessment results from the design expert team, it was concluded that the non-textbook on biodiversity in Sumatra, developed to meet the SDGs, had met the appropriate criteria for the book size indicator, book cover design, and content/material design**.**

Implementation

The Effectiveness of Non-Textbooks on Students' Critical Thinking Skills

Critical thinking ability (CBT) data between experimental class students and control class students is summarized in Table 4.

Table 4. Description of Students' Critical Thinking Skills Data

Description	Experimental Class		Control Class	
	Pretes	Postes	Pretes	Postes

N (Number of Students)	36	36	36	36
Minimum Score	7	70	27	57
Maximum Score	53	97	57	90
Mean Score	39,53	85,31	41,11	77,89
Standard Deviation	6,007	6,874	7,502	6,964
KS-Test	1,021	0,751	0,596	1,215
Sig.	0,248	0,626	0,869	0,105
N-gain	75,7%		62,5%	

Based on Table 4, the experimental class students had an average pretest score of 39.53 ± 6.007 before the intervention. The normality test revealed a normally distributed data set, with a Kolmogorov-Smirnov (KS) test value of 1.021 and a Sig. value of 0.248 > 0.05. Following the SDGs-based non-textbook intervention, the KBK posttest score averaged 85.31 ± 6.874, with a KS-Test value of 0.751 and a Sig. value of 0.626 > 0.05, indicating normal distribution. The average pretest and posttest scores for students in the experimental class increased by 75.7%, indicating an effective N-gain. For control class students, the average pretest KBK score was 41.11 ± 7.502, and the normality test showed normally distributed data, with a KS-Test value of 0.596 and Sig. value of 0.869 > 0.05. After direct learning actions, the control class students' average posttest KBK was 77.89 ± 6.964, and the normality test showed a normally distributed data distribution with a KS-Test value of 1.215 and a Sig. value of 0.105 > 0.05. Control class students had an N-gain of 62.5% on average across the pretest and posttest of KBK, which is extremely successful.

Furthermore, to assess the significance of the effectiveness of SDGs-based non-textbooks in improving students' critical thinking skills (KBK), an Independent Samples t-test was conducted, briefly summarized in Table 5.

Table 5. Hypothesis Test Results (Independent Sample t-test)

Statistical Test		KBK Pretest	KBK Postest
Homogeneity Test	F (*Levene's Test*)	2,743	0,390
	Sig.	0,102	0,534
	Description	Homogeneous	Homogeneous
Homogeneity Test	t-count	-0,989	4,548
	df	70	70
	Sig.	0,326	0,000
	Mean Difference	-1,58	7,42

t-table	1,665	1,665
Description	Not Significant	Significant

Table 5 reveals that the homogeneity test findings for the KBK pretest data between the experimental and control classes were 2.743 with a Sig. value of 0.102 > 0.05 and 0.390 with 0.534 > 0.05 for the posttest data. The KBK pretest and posttest statistics indicate that both sample groups deviate from the same population, meeting the homogeneity criteria. The hypothesis test using the Independent Samples t-test on KBK pretest data for both groups yielded a value of –1.665 < –0.989 < 1.665, with a Sig. value of 0.326 > 0.05. Therefore, there is no significant difference in the mean pretest of the KBK between the experimental class students (39.53) and the control class students (41.11), with a mean difference of -1.58. The hypothesis test using the Independent Sample t-test revealed a significant difference in KBK posttest scores between experimental and control classes after different treatments (t value = 4.548 > 1.665, Sig. value = 0.000 < 0.05). The hypothesis test demonstrates that SDGs-based non-textbooks (experimental class) improve students' critical thinking skills (KBK) better than the control class. This non-textbook on biodiversity in Sumatra, based on the SDGs, is beneficial for improving the critical thinking skills of grade X SMA students.

The Effectiveness of Non-Textbooks on Students' Problem-Solving Abilities

Problem-Solving Ability (SOL) Data between students in the experimental and control classes. Data collection on students' SOL was conducted through several stages, as follows: Determining Research Subjects, Developing and Validating Instruments, Administering Pre-tests, Providing Learning Treatments, Administering Post-tests, Prerequisite Testing, Data Analysis, Calculating SOL, and Data Presentation. This is summarized in Table 6.

Table 6. Description of Student Problem-Solving Ability Data

Description	Experimental Class		Control Class	
	Pretes	Postes	Pretes	Postes
N (Number of Students)	36	36	36	36
Minimum Score	25	65	20	50
Maximum Score	55	95	55	90
Mean Score	44,03	80,69	43,06	75,42
Standard Deviation	7,253	7,383	9,202	8,567
KS-Test	1,153	0,821	1,002	1,217
Sig.	0,140	0,511	0,268	0,103
N-gain	65,5%		56,8%	

In Table 6. the experimental class students had an average pretest KPM of 44.03 ± 7.253 before the intervention. The normality test revealed a normally distributed data set with a Kolmogorov-Smirnov (KS) test value of 1.153 and a Sig. value of 0.140 > 0.05. The learning intervention employing SDGs-based non-textbooks resulted in an average posttest KPM of 80.69 ± 7.383, with a KS-Test value of 0.821 and a Sig. value of 0.511 > 0.05, indicating a normally distributed data distribution. The fulfillment of this homogeneity assumption indicates that the use of the Independent Sample t-test as a hypothesis test is statistically appropriate. This means that the analysis procedures used do not overlap, because a normality test is conducted to ensure that the data are normally distributed. A homogeneity test is conducted to assess whether the variances are equal between the two groups. Once both prerequisites are met, an Independent-Samples t-test is conducted to examine differences in means between the groups.

The average pretest and posttest KPM for experimental class pupils increased by 65.5%, meeting the criterion for fair effectiveness. For control class students, the average pretest KPM was 43.06 ± 9.202, and the normality test showed normally distributed data, with a KS-Test value of 1.002 and a Sig. value of 0.268 > 0.05. Direct learning using textbooks resulted in an average posttest KPM of 75.42 ± 8.567 for control class students, with a KS-Test value of 1.215 and a Sig. value of 0.103 > 0.05, indicating a normally distributed data distribution. The average pretest and posttest KPM for control-class pupils increased by 56.8%, which is considered extremely effective. Furthermore, to assess the significance of the effectiveness of SDGs-based non-textbooks in improving students' problem-solving abilities (KPM), an Independent Samples t-test was conducted, briefly summarized in Table 7.

Table 7. Hypothesis Test Results (Independent Sample t-test) of KPM Data

Statistical Test		KBK Pretest	KBK Postest
Homogeneity	F (*Levene's Test*)	1,813	0,146
Test	Sig.	0,182	0,703
	Description	Homogeneous	Homogeneous
Homogeneity	t-count	0,498	2,800
Test	df	70	70
	Sig.	0,620	0,007
	Mean Difference	0,97	5,28
	t-table	1,665	1,665
	Description	Not Significant	Significant

Table 7 reveals that the homogeneity test findings for the KPM pretest data between the experimental and control classes were 1.813 with a Sig. value of 0.182 > 0.05 and 0.146 with 0.703 > 0.05 for the posttest data. The KPM pretest and posttest results show that both sample groups (experimental and control) differ from the same population, meeting the homogeneity criteria.

The hypothesis test using the Independent Samples t-test on KPM pretest data for both classes yielded a t-value of 0.498 < 1.665 and a Sig. value of 0.620 > 0.05. Thus, there was no significant difference in the average pretest KPM between the experimental and control classes before the intervention, with a mean difference of 0.97 (44.03) versus 43.06 (Appendix 29). The hypothesis test using the Independent Sample t-test showed a significant difference in posttest KPM scores between the experimental and control classes, with a mean difference (mean difference) between students in both classes.

The hypothesis test showed that SDGs-based non-textbooks (experimental class) improved students' problem-solving abilities (KPM) more than conventional textbooks in the control class. This non-textbook about biodiversity in Sumatra based on SDGs is excellent for improving grade X high school students' problem-solving skills.

Discussion

The media and design experts who validated the SDGs-based non-textbook scored the media and design feasibility indicator at 78.7%, deeming it "feasible." The media expert panel found that the book size indication was “feasible" (70.0%), the cover design was 75.0%, and the content design indicator was "very feasible" (82.2%). All indicators showed that the SDGs-based non-textbook on Sumatra’s biodiversity met media/design feasibility criteria, including book size, cover design, and content design (Romadhan, S., Fajarianingtyas, D. A., Hidayat, J. N., & Matlubah, 2024). The media and design experts also believed the SDGs-based non-textbook on Sumatra’s biodiversity might be tested in the classroom. (Khairunnisa, 2021)found that the non-textbook or enrichment books developed were suitable for use as learning resources or alternative teaching materials. SDG-based non-textbooks were approved as teaching tools for pupils. A non-textbook is suitable if its concepts and material are current and all its parts are connected (Ramdani, A., Purwoko, A. A., Sukarso, A., & Sucilestari, 2024). The validator team of material experts, learning experts, and media/design experts determined that the SDGs-based non-textbook on biodiversity in Sumatra met the feasibility criteria for material (content/material and presentation) and learning (content, constructive requirements, and didactics). On average, three biology teachers at SMA Negeri 1 Paranginan rated the SDGs-based non-textbook on biodiversity in Sumatra as very practical in terms of ease of use, materials, and language.

The questionnaire responses of 36 students in an experimental class who learned using SDGs-based non-textbooks showed that, on average, they provided practical criteria for the SDGs-based non-textbook on biodiversity in Sumatra. According to the questionnaire responses from teachers and students in the experimental class, the SDGs-based non-textbook on biodiversity in Sumatra was practical and easy to use, and was used by grade 10 high school students to learn about biodiversity. Based on teacher and student questionnaire responses, (Rofi'ah, A., Hariani, S. A., & Pujiastuti, 2021) found that the non-textbook or enrichment book developed met the criteria for practical use as a learning resource or alternative teaching material.

The independent-samples t-test was used to analyze post-test data on critical thinking skills between the experimental and control courses. The results showed a computed t value of 4.548 > 1.665, with a significant value of 0.000 < 0.05. It is concluded that there is a significant difference in post-test mean critical thinking ability between the experimental and control classes after being given different actions, with a mean difference of 7.42. This also shows that SDGs-based non-textbooks (experimental class) improve students' critical thinking more than the control class (Rozalia, A., Kasrina, & Ansori, 2022).

D. Conclusion

Based on the research results and discussions outlined above, the following conclusions were reached: The SDGs-based non-textbook on biodiversity in Sumatra has been declared suitable for use and valid. Non-textbooks on biodiversity in Sumatra, based on the SDGs, are also practical for supporting classroom learning. The implementation of an SDGs-based non-textbook on biodiversity in Sumatra has proven effective, significantly improving students' critical thinking skills. The implementation of an SDGs-based non-textbook on biodiversity in Sumatra has proven quite effective, significantly improving students' problem-solving skills.

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