Evaluating the Practicality of Socioscientific Issues-Based Learning Materials for Environmental Pollution Topics

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Abstract. This study aims to develop and analyze the practicality of Socio-Scientific Issues (SSI)-based learning materials on environmental pollution topics to improve the problem-solving skills of Grade X students at SMAN 1 Hulu Gurung. The method used is Research and Development (R&D) with the ADDIE model, consisting of the Analysis, Design, Development, Implementation, and Evaluation stages. Research subjects included 15 students in a small-scale trial and 33 students in a large-scale trial selected through cluster random sampling, along with Biology teachers as respondents. Practicality data were collected through teacher and student response questionnaires and analyzed using a Likert scale. The results showed that the SSI-based learning materials were rated as very practical, with an average response questionnaire percentage of 93% from students and teachers. The small-scale, large-scale, and teacher response trials each yielded practicality percentages of 87%, 92%, and 100%, respectively, all of which fall within the very practical category. These findings indicate that the SSI-based learning materials on environmental pollution topics are feasible and practical for supporting the improvement of students' problem-solving skills in Biology learning.
Keywords: Socio-Scientific Issues (SSI), Practicality, Problem-Solving Skills, Environmental Pollution

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1. Introduction

The 21st century is marked by the Industrial Revolution 4.0 era, in which many rapid changes are occurring. A person's ability to succeed in life is partly determined by their thinking skills, especially in efforts to solve the life problems they face (Susilo, 2022). Problem-solving ability is a primary key in determining success in learning, as students are faced with complex, dynamic, and unstructured situations. According to Putri et al. (2019), problem-solving ability can be defined as the process of overcoming difficulties and obstacles encountered in achieving desired goals.

Research from recent years indicates that problem-solving ability in Biology learning at the senior high school level in Indonesia remains low. Research by Chaerunisa and Pitorini (2020) states that the problem-solving ability of Grade X senior high school students in Lampung is still relatively low, with indicator percentages for *define the problem* at 51.06%, *explore the problem* at 59.04%, *plant the solution* 23.40% *implement the plan* 17.02%, and *evaluate at* 32.98%. These figures reflect the problem-solving ability of senior high school students in Biology. A subsequent study by Marsel and Fadilah (2025) showed that students' problem-solving ability was still classified as low to very low, with an average achievement percentage across all indicators of 23.43%. Students showed difficulties in comprehensively understanding problems, formulating relevant solutions, and developing logical and systematic problem-solving steps.

This finding is consistent with the situation of Grade X students at SMAN 1 Hulu Gurung. Based on interviews with the Biology teacher, problem-solving ability was identified as an aspect requiring improvement in learning, and environmental pollution was considered a difficult topic for students. This condition stems from students' limitations in identifying problems, formulating solution steps, and connecting biology concepts to real-world contexts, leading students to memorize concepts rather than applying them analytically, resulting in underdeveloped problem-solving skills. The needs analysis conducted at SMAN 1 Hulu Gurung revealed that students' problem-solving ability in environmental pollution topics is still relatively low. The percentage of students' ability to identify problems was 50%, ask questions and explain strategies was 44%, provide reasoning for strategies used was 46%, and evaluate problem-solving outcomes was 41%. Moreover, the learning materials used in the teaching process had not yet optimally facilitated students' active engagement in solving real-world problems. Therefore, it is necessary to develop learning materials that can connect learning concepts to contextual problems in students' environments.

The *Socio-Scientific Issues* (SSI) learning materials represent an approach that raises complex social issues related to science, requiring students to analyze information and make rational decisions. SSI problems are contextual and unstructured. SSI-based learning not only develops students' scientific knowledge but also promotes intellectual, moral, and ethical development, as well as raising awareness of the connection between science and real life (Nurhalimah et al., 2024).

2. Methods

The method used is Research and Development (R&D). The development model used is ADDIE,, which consists of five main stages: *Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*. The ADDIE model was chosen because it has detailed, systematic stages that are easy for the researchers to understand (Sugiyono, 2022). The sampling technique used is *Cluster Random Sampling*. Menurut Sugiyono (2019), *cluster random sampling* is an area sampling technique used to determine samples when the object to be studied or the data source is very broad. Research subjects included a small-scale test with 15 students, and a large-scale test with 33 Grade X students at SMAN 1 Hulu Gurung, along with student and teacher response questionnaires. Practical validity data analysis used a Likert scale, and the following formula was used to determine the results:

$$percentage = \frac{total\ score\ obtained}{highest\ score} \quad (1)$$

3. Results and Discussion

Research on the development of the practicality of SSI-based learning materials regarding problem-solving ability at SMAN 1 Hulu Gurung used the ADDIE,, which consists of five main stages: *Analysis, Design, Development (Development), Implementation*, and *Evaluation*. The following are the steps in the development research carried out by the researchers:

Research Needs

In the initial stage, needs analysis, student analysis, and material analysis were conducted. The purpose was to identify students' learning problems and identify their needs in the teaching and learning process, so that a product could be developed to meet those needs.

a. Needs Analysis

The first stage, needs analysis, aims to determine the core problem in the learning process and identify what the school requires (Saputri et al, 2025; Wahyudi et al, 2023). This analysis was

conducted through interviews with teachers at SMAN 1 Hulu Gurung and by distributing initial analysis questionnaires to students. The results of this analysis indicated the need for developing practical learning materials to improve students' problem-solving skills.

b. Student Analysis
Based on observations at SMAN 1 Hulu Gurung, students had difficulty with environmental pollution material because of the difficulty in solving problems occurring in their environment, thus requiring contextual learning media in the learning process.

c. Material Analysis
The material analysis phase of the Merdeka curriculum was conducted by observing the learning objectives (ATP) used at school so that the materials in the developed learning media aligned with the learning outcomes (CP). At the end of Phase E, students understand the classification of living things, the roles of viruses, bacteria, and fungi, ecosystems, biotechnology, measurement systems, alternative energy, atomic structure, elemental properties, chemical reactions, as well as basic chemical laws and issues related to environmental change.

The selection of material was based on students' environmental conditions to improve problem-solving skills. Environmental pollution material is difficult to understand if not explained contextually.

Design Stage
In the design stage, the researchers drafted the learning materials based on the needs analysis results. These materials were then tested for practicality to assess ease of use and implementability in learning. The practicality test results showed that the developed materials were easy to use and therefore suitable for supporting Grade X student learning at SMAN 1 Hulu Gurung.

The initial design of the learning materials included: (1) a cover, preface, table of contents, usage instructions, CP, ATP, student worksheets (LKPD), bibliography, and author biography; (2) A5-sized materials containing a brief summary of the material and SSI stages, exercises to practice students' problem-solving skills, and images of environmental pollution from news coverage.

Development and Implementation Stages
a. Development (Development Stage)
The development stage is the stage of drafting and refining the product designed in the previous stage. The initial product was then tested to determine its level of practicality through teacher and student response questionnaires after being used in the learning process. The practicality assessment aims to obtain information on ease of use, content clarity, appearance, and implementability of the materials in the classroom. Feedback and suggestions from teachers and students were used as a basis for product improvement, resulting in practical and easy-to-use learning materials to support the learning process.

1. Student and Teacher Response Questionnaires
At this stage, the researchers used response questionnaire instruments given to teachers and students to assess the practicality of the developed learning materials. Through these questionnaires, feedback was obtained regarding ease of use, attractiveness, and usefulness of the materials in the learning process. The practicality aspects assessed through teacher and student response questionnaires covered: (1) content feasibility, (2) language component, and (3) presentation component.

A summary of the practicality assessment results by teachers and students can be seen in Table 1.

Table 1. Summary of Media Expert Assessment

Response	**Percentage**	Criteria
Student response questionnaire	86%	Very practical
Teacher response questionnaire	100%	Very practical
Average	**93%**	Very practical

Based on Table 1, the student and teacher response questionnaire data obtained an average score of 93%, meeting the practical criteria.

2. Small-Scale, Large-Scale, and Teacher Response Questionnaires

Expert validators assessed various aspects such as general feasibility, content feasibility, completeness feasibility, and Project-Based Learning feasibility.

A summary of the assessments from the relevant expert validators can be seen in Table 2.

Table 2. Material Expert Assessment

Assessment	**Aspect**	**%**	**Criteria**
Small-scale	Content Feasibility Language Component Presentation Component **Total**	87%	Very practical
Large-scale	Content Feasibility Language Component Presentation Component **Total**	92%	Very practical
Teacher	Content Feasibility Language Component Presentation Component	100%	Very practical
	Average	**93%**	**Very practical**

Based on Table 2, the large-scale, small-scale student, and teacher response questionnaire data obtained an average percentage of 93%, meeting the very practical criteria.

Evaluation and Revision Stages

The evaluation stage was conducted to assess the feasibility and practicality of the developed SSI-based learning materials, based on small-scale trial, large-scale trial, and Biology teacher feedback. Formative evaluation was carried out at each development stage to progressively improve the product, while summative evaluation was conducted at the end of the development process to determine the overall practicality level of the product . Based on the response questionnaire results, several inputs were received from students and teachers, including those related to language clarity in student worksheets, the relevance of environmental pollution images and news to the material context, and the readability of instructions at each SSI stage. These inputs served as the basis for product revisions, including simplifying sentence structures for better student understanding,

clarifying task instructions at each problem-solving stage, and adjusting environmental pollution illustrations and case studies to reflect actual conditions in students' environments. After revisions, the learning materials were re-trialed and declared very practical, with an average practicality percentage of 93%, confirming that these materials meet the practicality criteria for supporting the improvement of students' problem-solving skills in environmental pollution topics.

4. Conclusion

Based on the results of the research and development conducted, it can be concluded that the SSI-based learning materials (Socio-Scientific Issues) on environmental pollution topics developed using the ADDIE model are rated as very practical for improving the problem-solving skills of Grade X students at SMAN 1 Hulu Gurung. This is evidenced by the student and teacher response questionnaire results, which obtained an average percentage of 93%, as well as small-scale, large-scale, and teacher response trial results of 87%, 92%, and 100%, respectively, all of which fall within the very practical category. These learning materials have been proven easy to use, clear in terms of language and presentation, and capable of guiding students to connect biology concepts to contextual problems in their surrounding environment. Therefore, SSI-based learning materials can serve as a relevant alternative learning medium to support the development of students' problem-solving skills in environmental pollution topics. Future research is recommended to test the effectiveness of these learning materials more broadly, including their impact on improving students' problem-solving skills quantitatively, as well as their application to other contextual biology topics.

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