



# Constructing Students Environmental Sensitivity Through Literacy

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**Abstract:** Sensitivity to the environment is an ability that must be possessed by students to be able to find alternative solutions that are right for solving environmental problems. Therefore, the study aims to develop a SETS-based environmental geography textbook using the ADDIE development model and environmental geography course students as respondents. Data was collected using validation sheets and FGD narratives by experts to maintain textbook quality and descriptive analysis. Using a geographical approach, environmental geography textbooks were developed on the basis of SETS. The textbook contains topic sub-chapters, illustrations in tables and graphs, assignments, and activity-based exercises. Based on SETS, practical steps are used to develop environmental geography textbooks, including presenting contextual science materials; presenting local, national, and international environmental issues; presenting examples of the use of technology in overcoming environmental problems; describing the impact of technology use on the environment and society; and designing evaluations of problem-based textbooks with student activities including SETS elements and involving a geographic approach. This textbook is intended to be used by lecturers of Indonesian environmental geography and subsequent studies as reference material.

**Keywords:** 21st learning; Conceptual model development; Geography textbook; SETS.

## Introduction

Environmental issues are part of the global issues of concern for the education sector. This is because environmental problems that occur in the present time (on a small and large scale) are influenced by human behavior that is not pro-environment. Community environmental concern is closely related to the frequency or absence of guidance on environmental ethics. Formal learning is one of the strategic steps that can be taken to build awareness among the younger generation about environmental issues. This condition requires the education sector to study and provide alternative solutions to these environmental problems.

Increasing awareness and sensitivity to environmental sustainability is an effort in environmental education (Aliman et al., 2019; Sumarmi et al., 2020, 2021). The main goal of environmental

education is environmental literacy (EL). Environmental literacy consists of cognitive and affective components. In environmental literacy, what is assessed is knowledge and concern for the environment. While sensitivity to the environment is a variable that students must first have to reach EL, Environmental sensitivity is an 'empathetic view or understanding of the environment', and is characterized by individuals 'resisting littering on highways and natural areas. Therefore, it is important for educators to build environmental sensitivity among students.

Environmental sensitivity in geography learning in universities requires students to understand, feel, and provide solutions to environmental problems (Kahraman, 2016; Cater, 2021). Efforts that can accommodate learning problems related to student environmental sensitivity are made through adequate

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literacy. Literacy is taught through geography textbooks.

According to (Asakereh 2019), textbooks are essential learning components used at all levels of education. For instance, (Romig 2017) stated that textbooks are used both in classrooms and homes. Indonesia and many other countries use textbooks for classroom learning and giving assignments (Schmidt, et al., 2001; Liang, et al., 2013). Specifically, Indonesia uses its adapted national curriculum (Yang, et al., 2017). According to the (Ministry of Education and Culture of Indonesia, 2013), the government strives to develop textbooks according to the curriculum and students' needs. The government recommends textbook development by educators, as stated by the law. Students and lecturers should appreciate this for better results.

(Law, 2014) challenged by the 21st century's demands for mastery of higher-order and critical thinking, mastering information technology, collaboration, and communication (Osborne, 2013). Students should use these abilities to survive in the 21st century. Moreover, Indonesian textbook development focused on the content, and real-life knowledge application was not used. Geography education dwelled on knowledge, and students were excellent resources to analyze and solve problems. Teaching materials lacked natural phenomena and technological products, indicating that the environmental geography course does not integrate with everyday phenomena. According to (Bratko et al., 2012), knowledge that cannot be used in daily life is meaningless.

A good textbook must fulfill the criteria of study purpose, competencies to be achieved, subject content, supporting information, exercises, evaluation, and its responses. Several things need to be considered in making textbook material, including presenting interesting examples and illustrations to support the teaching material; providing opportunities for students to respond and measure the extent of material guidance through questions and assignments; the presentation of contextual material; and the use of simple language that does not confuse students (Xin, Y.P., 2007).

Existing and developing Indonesian textbooks focus on the content aspect because the thinking context and knowledge application aspects have not been fulfilled. In contrast, in geography education, graduates focus on cultivating knowledge and are expected to be superior resources in their fields (Sumarmi et al., 2021). The geographers understood, analyzed, and solved problems encountered using teaching materials presented in natural environmental events to show geography's integration with daily life. Knowledge loses its meaning if it cannot be applied to everyday life in society (Bratko et al., 2012).

The textbook supports students' learning analysis and synthesis with systematic topics for reference and evaluation. Environmental geography aims to prepare students to critically and creatively think, logically analyze and solve environmental problems, and apply analytical techniques to identify and solve environmental problems (Environmental Geography lesson plan 2017). Good learning resources, including textbooks, should support these objectives. The textbook was oriented toward the future, updated, and presented contextual material, raising community problems as case studies to be resolved. According to (Aksa & Handoyo, 2019), a good textbook is assessed based on language, material, and presentation standards.

Binkley et al. (2011) and Voogt et al. (2012) stated that 21st-century educational reform needs are critical topics discussed globally. International organizations, such as the European Union, argue that education is an attempt to ensure citizens acquire the core competencies necessary for a constantly changing world. Wang et al. (2018) stated that 21st-century competence is redefining education and learning outcomes according to the skills required. The textbooks' contents must be designed with a solid concept to improve students' thinking skills in the 21st century (Claudino, 2011). It should have the topic type, depth, scope, presentation order, and learning material treatment. Students learn five categories of capabilities while designing learning materials, including verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills (Schulz et al., 2019). Learning materials organizing strategy involves three stages of the thinking process, including concept formation, interpretation, and principle application. According to Lim et al. (2020), these stages are crucial in designing learning because they increase students' learning interests.

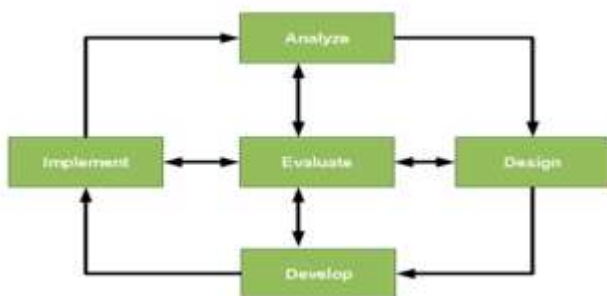
Samudra University's results showed that environmental geography textbooks are separated from 21st-century skills. They focused on the topics to build the students' knowledge. The textbook's contents were not contextualized to encourage students to think critically, solve problems, and be creative (Aksa & Handoyo, 2019). Therefore, textbooks should improve students' thinking skills by being future-oriented, presenting community problems, and involving technology. According to Millah & Budipramana (2012), the Science, Environment, Technology, and Society (SETS) approach is used to achieve goals. SETS is an integrated approach involving elements of science, technology, and society. It promoted students' awareness of science, development, the environment, technology, and society. Rahman (2016) stated that learning based on SETS improved critical thinking skills, creativity, and student learning outcomes, which indicates SETS is effective teaching material.

The study aimed to develop an environmental geography textbook concept using SETS to increase the thinking capacity of students. Geography lecturers should use these study results as a reference and input in developing environmental geography textbooks. Geography learning is considered a science, an education, and an attitude. According to Geography for Life: National Geography Standards, 2nd Edition (2012), geography learning aims at equipping students with knowledge, skills, and perspectives. The teaching materials are not aligned with the curriculum objectives. Moreover, Millah and Budipramana (2012) stated that the extent and depth of topics are unaligned with the curriculum objectives. Tough topics are prepared for high school when they should be meant for universities. According to Romig (2017), this leads to students' difficulty in solving materials. Lecturers should select proportionate topics to be taught in depth and to an extent aligned with the curriculum.

Sanghyun Jan (2014) stated that the fundamental abilities required are achieved through thinking critically, creatively, communicating, and collaborating to succeed in the 21st century. Therefore, the learning should be updated. According to Aksa (2019), the current geography textbooks cannot improve students' creative and critical thinking abilities. This means references and conceptual frameworks fulfilling educational demands are necessary. Additionally, geography textbooks need a conceptual framework aligned with education or teaching (Aksa & Handoyo, 2019).

**Method**

This development study aimed to develop textbook products. The textbook was chosen because it is a source of information that can be redeveloped. Textbooks can also be used as teaching materials, practice materials, and to clarify abstract materials by adding pictures (Suwito et al., 2020). The development procedure used ADDIE model modification (Askun & Akkoyunlu, 2008) because it is appropriate for textbook development. Figure 2 illustrates the ADDIE model as Figure 1.



**Figure 2.** Modification of the ADDIE Model Chart

In Figure 2, textbooks are developed in stages using the ADDIE model, including analyzing, designing, developing, implementing, and evaluating. However, this study uses two stages to produce a conceptual model of environmental geography textbooks that follows the demands of 21st-century education. According to Aksa & Handoyo (2019), the ADDIE model was used in the design stage, which involved an analysis stage in the study entitled requirement analysis of e-content for visual learners.

Before the design stage, analysis was conducted to obtain a whole idea of environmental geography textbooks. The study used validated questionnaires from learning, instructional media, and language experts to examine the environmental geography textbook's design quality.

The validation process lasted from April to June 2020, and validators were selected based on their expertise and experience in validating textbook-classified instruments. Material, learning media, and language validators assessed textbooks' suitability with environmental geography materials, assessed textbook designs including layouts, images, tables, and graphics supporting the teaching book, and assessed readability, language consistency, coherence between sentences and paragraphs, and correct spelling according to Indonesian rules, respectively.

$$eligible\ score = \frac{Score}{Maximum\ Score} \times 100\% \tag{1}$$

**Table 1.** The Criteria for Eligibility of the Environmental Geography Textbook

Interval Score	Criteria Information
84%-100%	High eligible
64%-83%	Eligible
45%-63%	Enough eligible
25%-44%	Not eligible

**Result and Discussion**

*The Analysis Stage*

The chapter focused on analyzing the background of textbook development. The analysis includes:

The analysis results of the Course Semester Plan (Rencana Perkuliahan Semester in Bahasa Indonesia (RPS)). The RPS was chosen as an analysis topic because it contained course plans for one semester, including the course objectives, topics, learning models, timeline, and evaluation methods. The analysis showed students could explain and analyze the aspects and approaches of geography to investigate, analyze, and solve environmental problems based on geographic studies.

The students' references are limited and not directed toward achieving the goal.

Interviews with lecturers in the Environmental Geography course. Unstructured interview techniques showed that available references are still limited. References aligned with the demands of the 21st century and aspects of environmental geography materials are missing. The textbooks do not discuss technology and knowledge application in social life. Therefore, an integrated textbook between science, technology, the environment, and society is necessary for students to develop skills to survive in the 21st century.

Environmental Geography course students' interview. The unstructured interview technique showed students difficulty finding valid references, aligning with the taught concepts, and depending on textbooks from lecturers, making new information irrelevant. Students provided Environmental Geography course innovations as inputs, generating creative ideas that can be applied in everyday life.

Results showed that preparing textbooks for Environmental Geography (environmental sensitivity)" should be conducted to support future learning challenges.

#### The Designing Stage

At this stage, products (textbooks) and textbook assessment instruments are developed. The component consisted of several parts, including an introduction, content, and closing. A product validation sheet was used to assess textbooks given to the validator to measure their quality. The assessment aimed to determine the product's functionality, and the developed textbook's validity was measured using instruments (Imanda et al., 2022) Product validation was viewed from the perspective of the topic and displayed design aspects (Andriani et al., 2021). Textbooks use in the learning process should be valid in terms of discussion, presentation, usage, and language. According to Wilson & Narasuman (2020), a good design should proceed to the development stage and be used for further study.

According to construct students environmental sensitivity, the conceptual environmental geography textbook model is designed depending on analysis needs, including the current lack of environmental geography textbooks, curriculum objectives, students' achievement, and society's environmental problems (Wajdi et al., 2022). Development involved various literature reviews, and input from validators was limited during trials. Therefore, the conceptual model improved critical thinking skills and problem-solving abilities (Aksa & Handoyo, 2019). Generally, the conceptual model emphasizes two important textbook components, including the content and the exercise

(evaluation). These components were developed based on SETS and are illustrated in Figure 3.

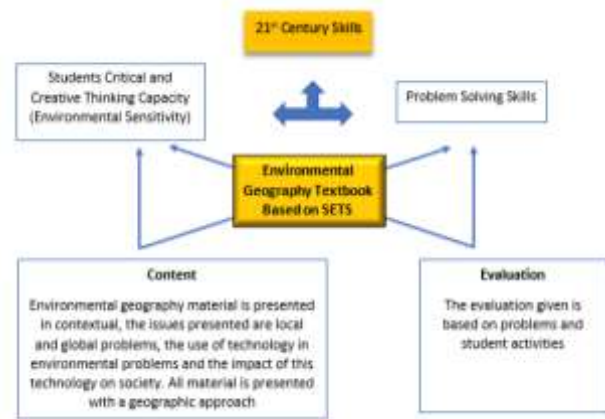


Figure 3. The Environmental Geography Textbook Conceptual Design Chart

In Figure 3, the four elements are interrelated in the Environmental Geography textbook, the contextual science. The contextual subject motivated students to understand the studied subject by relating the material to everyday life. Therefore, students had flexible knowledge and skills that could be applied from one problem to another in life (Schulz et al., 2019).

The science and other SETS elements were thoroughly described. Students used scientific concepts to form society's technology and considered the benefits and disadvantages of using science in technology. For example, a tractor was used to facilitate farmer work. However, it can cause environmental pollution, and insecticides improve agricultural and plantation products' qualities but pollute the environment. (Ashari et al., 2023) Greenhouse gardens negatively impact drainage, and according to Jitendra et al. (2001), students should think about the various possibilities that led to the change from science to technology.

Evaluation is restricted to the level of conceptual understanding. However, in textbooks based on SETS, the evaluation emphasized learning evaluation relating to science and its application. Conventional evaluation emphasizes using scientific concepts as a crucial component to be measured. The use of evaluation instruments should emphasize application and conceptual understanding (Ginting et al., 2023). Evaluations should be designed based on problems and student activities involving the SETS four elements. For example, students are tasked with analyzing physical and social environmental issues. It was presented as a map where students designed technology to solve environmental and community problems. This trained students' problem-solving and critical thinking skills, which should be mastered in the 21st century (Primastuti & Atun, 2018).

Environmental geography textbook preparation used three geographic approaches, including spatial, environmental, and regional approaches. The spatial approach stated earth surface location differences and dominant factors influencing them. The environmental approach emphasized human-nature relationships (interaction), and the regional approach combined spatial and environmental aspects. Aksa & Handoyo, 2019; Jitendra et al., 2001; Jo & Bednarz, 2009) stated that the area-complex analysis emphasizes a comprehensive study of physical and human elements.

The environmental geography textbook was integrated with a geography approach in the content and learning evaluation. For example, human activities in overexploiting environmental resources negatively impact the environment, presenting environmental problems (Scholz et al., 2014). It presented physical and non-physical elements in an area with distinctive features in the spatial context.

*Design Validation*

This was conducted using materials and learning media experts. The validator was offered a textbook conceptual draft to give a score or feedback. Moreover, a validity test was conducted using the Forum Group Discussion (FGD). The trial stage described the SETS-based environmental geography textbook and conceptual model for experts to comment on and suggest. The results showed that the assessment fulfilled SETS concept standards and was considered in more detail. The textbooks were attractive but needed a concrete illustration. The course studies during evaluation trained students' thinking skills (Ginting et al., 2023).

The non-parametric Mann-Whitney statistical test was used to investigate the most significant differences between experimental groups 1 and 2 and compare the creative thinking ability and writing study proposals between experimental groups 1 and 2. Table 2 illustrates non-parametric results as follows:

**Table 2.** Material Expert Validation Results

Content eligibility	Items	Expert 1	Expert 2	Expert 3
Material scop	Material width	3	4	4
	Material depth	4	4	3
Material accuracy	Facts accuracy	3	3	3
	Concept accuracy	4	4	3
	Relationship of concept and material	4	3	4
Upgrades	Indicator integration	4	4	4
	Confirmity with developing science	3	4	4
	Actuality of examples	3	3	4
Growing curiosity	Actuality of source	4	3	3
	Growing curiosity	3	3	3
	Challenging students to learn more	4	3	3
Total Score		39	38	38
Percentage		88.64	86.36	86.36
Criteria		Eligible	Eligible	Eligible

**Table 3.** Result of Graphic Expert Validation

Content eligibility	Items	Expert 1	Expert 2	Expert 3
Presentation technique	Consistency of presentation systematic in chapter	3	3	3
	Presentation logic	3	3	3
Presentation of learning	Concept demand	4	3	3
	Relationship among facts, concepts, principles, and theories	3	4	3
	Students-centered 6. Students involment	3	4	4
	Conformity with subject characteristics	3	4	3
	Ability to stimulate students deep thinking	4	3	3
Completeness of presentation	Ability to come up with feedback for self-evaluation	3	3	4
	Introduction	3	3	4
	Table of content	4	4	4
	Glossaries	4	4	4
	References	4	4	3
	Summary	3	4	3
	Evaluation	3	4	3
Total score	Items key answer	3	4	4
Percentage		50	54	51
Criteria		78.13	84.38	79.69
		Eligible	Eligible	Eligible

**Table 4.** Linguist Validation Results

Content eligibility	Items	Expert 1	Expert 2	Expert 3
It Fits students development level	Conformity with students thinking development level	3	3	4
	Conformity with students emotional development level	4	3	4
Communicative	Students understanding toward messages	4	4	4
	Illustration conformity with message substances	4	4	4
Dialogical and interactive	Ability to motivate students to respond to the message	3	3	3
	Motivation for students to think critically	3	4	4
Straightforward	Sentence structure accuracy	4	4	3
	Terminology standards	4	3	4
Coherence of train of thought	Linkage among chapters, between chapters & sub-chapters, among paragraphs in sub-chapters	4	3	3
	Linkage among sentences in one paragraph, between chapters & sub-chapters, among paragraphs in sub-chapters	4	3	3
	Meaning integrity chapters, sub-chapters, and meaning in one paragraph	4	3	4
Conformity with the correct Indonesian language	Grammar accuracy	4	4	4
	Spelling accuracy	3	4	4
Total Score		48	45	48
Percentage		92.31	86.54	92.31
Criteria		Eligible	Eligible	Eligible

Table 2 shows that the presentation of environmental geography textbook material feasibility by experts 1, 2, and 3 was 88.64, 86.36, and 86.36, respectively. This represented 84%–100%, showing the environmental geography textbook materials were highly eligible for use.

Based on Table 3, the percentage of eligibility for textbook presentations by experts 1, 2, and 3 was 78.13 (64%–83%) = eligible to use, 84.38 (84%–100%) = very eligible to use, and 79.69 = eligible to use, respectively.

In Table 4, the environmental geography textbook language percentage of experts 1, 2, and 3 was 92.31, 86.54, and 92.31, respectively. This was equivalent to 84%-100%, showing that the environmental geography textbooks were very eligible for use.

Validation was conducted using FGD, which provided many conceptual model inputs from textbooks. The experts stated that combining the four SETS characteristics in environmental geography textbooks (content and topic arrangement) into one unit was necessary for students to think while using environmental geography textbooks based on SETS.

The environmental geography textbook did not reduce environmental geography's importance. This was maintained to create a geographic approach in its content description. Textbooks were aligned with the philosophy of environmental geography.

Experts' inputs were used as revision sources for the conceptual model of environmental geography textbook development based on SETS. Moreover, they were also used for improving the conceptual model. This was done in the textbook content, evaluations, and concrete steps in the development of the textbook. The steps were used as environmental geography textbook references (Fetiana et al., 2022; Wahyuni et al., 2022).

Validation is written on a validation sheet with four validators for environmental geography textbooks. The results are valid for the content, method, media, and language, with revisions. The media and content validators gave values of 85 and 82, respectively. These values were above 80 and valid. However, the validator suggested the probability of designing environmental geography textbooks.

**Table 5.** Expert Validation Results

Validator	Suggestion	Revision
Content Expert	The essence of geography must be more sharpened	Examples of cases or problems are written by applying the concept of geography
	Examples of problems that occur in the environment must be more accurate, hence, it is easier to stimulate students critical and creative thinking skills	The local environmental problems (problems around students) are then integrated with regional, national, and international problems
	The application of technology in society, local wisdom, or customs are added as the science that has existed in society for centuries	Adding local wisdom or customs as a form of science that has existed in society for centuries

Validator	Suggestion	Revision
	The figure presented should be obtained directly from the field	Collecting existing figures in the surrounding environment that matches the topic
Media Expert	Displaying more pictures or infographics that support the textbook to be more attractive To support learning in the 21st century, the textbook should be available in digital form	Focus on the visualization of the presentation in the textbook It will be investigated for further study

These suggestions helped improve the concept of environmental geography textbooks in the 21st century. The following stages, such as development, implementation, and evaluation of the development study, will be continued based on the results of the conceptual design.

The results showed that the concept of SETS-based environmental geography textbooks can present science material contextually. SETS also presents environmental issues of a local, national, and international nature. SETS can also present and describe the impact of technology use on the environment and society. Therefore, there needs to be a problem-based evaluation design and textbook involving a geographical approach and including elements of SETS

## Conclusion

Managing teaching materials as a source of literacy in shaping environmental sensitivity must collaborate with the three approaches to geography: spatial, environmental, and regional complex. This aims to increase students' environmental sensitivity and maintain the geography concepts in the textbook. The textbook evaluation model is at the conceptual design stage. This research examines the conceptual model for developing students' source literacy. Therefore, further research is needed to produce environmental geography textbooks with reference to the conceptual model in this study. The textbook should be able to be used to increase students' environmental sensitivity.

## Author Contributions

Zukya Rona Islami: methodology, writing—original draft preparation, formal analysis, investigation, and visualization. Fadhil Sidiq: writing—review and editing, Formal analysis, Investigating. Rizkei Kurniawan: Visualization, editing, resources.

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## Conflicts of Interest

The authors declare no conflict of interest.

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