

Formulation of Teaching Materials for Environmental Pollution Based on Hybrid Learning to Develop Student Environmental Literacy

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ABSTRACT

Environmental literacy serves as an educational approach leveraging the environment as a key learning resource. This pedagogical strategy intertwines teaching and learning activities with the environment as a pivotal resource. Previous research analysis revealed that students' environmental literacy levels are predominantly moderate to low. Given this observation, there's a pressing need to enhance environmental literacy among students. The assumption is that fostering these competencies can be achieved through instructional materials centered on environmental literacy. These teaching materials were integrated into Hybrid Environmental Pollution courses utilizing the MOLS (Mulawarman Online Learning System). This study adopts a developmental research approach following the ADDIE procedure or model (Analysis, Design, Development, Implementation, and Evaluation). Conducted over approximately 7 months at FKIP Mulawarman University, the research involved environmental literacy assessments followed by the development of teaching materials within the environmental literacy domain. Material expert validation revealed a feasibility score of 92.10%, and media experts provided a score of 93.75%. Thus, it can be inferred that the teaching materials developed for environmental literacy are highly suitable and effective for use as learning resources.

Keywords: hybrid teaching materials, environmental pollution, environmental literacy, ADDIE model.

INTRODUCTION

Environmental literacy is considered as a learning approach that utilizes the environment as a learning resource. This approach connects the environment in teaching and learning activities where the environment acts as a learning resource (Sumberartha et al., 2021). Environmental literacy is not just knowledge of existing concepts in the environment and ecology but also incorporates several in-depth aspects of carrying out behaviors, attitudes, and sustainable care for the environment which then results in a deep motivation to carry out environmental behaviors. (Fah & Sirisena, 2014). Environmental literacy represents a deliberate mindset aimed at maintaining environmental equilibrium. This conscientious

approach embodies the essence of environmental literacy, wherein individuals possess not only knowledge about the environment but also an attitude that drives them to offer solutions to environmental challenges. Environmental literacy involves the capacity to take tangible actions toward preserving the environment, ensuring its continual well-being and sustainability. (Diana Kusumaningrum, 2020). Environmental problems can certainly be overcome by cultivating environmental literacy because environmental literacy is part of environmental education which aims to prepare citizens including students to solve and prevent environmental degradation and this is very important for building a sustainable environment (Hariyadi et al., 2021). Equipping people with the importance of environmental literacy is one way to realize the principle of sustainability in environmental management. (Deswari & Supardan, 2016). Along with the development of technology and industry which results in environmental damage, it is very appropriate if in a lesson the lecturer begins to accustom his students to care for the surrounding environment so that environmental damage can be minimized (Mardikaningtyas et al., 2016). According to (Nasution, 2021), environmental literacy can be measured through tests covering domain 1). Knowledge 2). Cognitive Skills 3). Attitude 4). Behavior

Today's students have a tendency that is far from the values of protecting the environment, where this can be seen by being increasingly consumptive but less productive in protecting the environment (Anita et al., n.d.). Based on the results of the analysis in the previous research researchers know that the condition of the ability or literacy level of the student environment is still classified as "medium and low". There is still a low and moderate level of student environmental literacy, so efforts are needed to develop environmental literacy. Researchers assume that the development of these abilities can be built with teaching materials based on environmental literacy. According to (Gazali, 2016) one of the components of learning has an important role in teaching material. In the learning process that has been going on so far, students also do not have the same teaching materials to use as a guide in the learning process, students obtain learning materials other than the internet and textbooks, so it is necessary to have teaching materials developed by lecturers that will make it easier for students to understand lecture material and to equate the material studied by students, later these teaching materials can be used as a guide in the learning process both by lecturers and by students (Dahlan et al., 2018). According to (K. Hadi & Dazrullisa, 2018) innovation in the development of teaching materials serves to produce new teaching materials to achieve a new teaching material to achieve effective and efficient learning. Teaching materials are something that needs to be improved and developed in the teaching and learning process, with teaching materials it is possible to learn competency sequentially and systematically, to be able to master all competencies as a whole and integrated (Haryonic & Bhakti, 2018). The development of teaching materials needs to be carried out systematically based on interrelated steps to produce quality teaching materials (Danaswari Wahyu et al., 2019).

These teaching materials can later be used in environmental pollution courses in the biology education study program. Environmental pollution is an elective course taken by students of the Biology Education study program at Mulawarman University with a weight of 2 credits. This course is one way to provide good knowledge about the existence of various kinds of pollution on earth. Meanwhile, learning resources in the form of teaching materials do not definitively support theories and concepts related to behavior and attitude to keep the environment from being polluted. The development of this teaching material is made so that it can be used in online and offline meetings. The current situation is urgently needed during the Covid-19 Pandemic. In Hybrid-based learning, it means that students can do online and offline learning. Hybrid learning is a method that can be an alternative in Indonesia facing the digitalization era. Hybrid learning is also more effective and efficient in the learning process, this is supported by (Gultom et al., 2022) that hybrid learning is expected to improve learning outcomes, as well as improve communication relationships from the three learning modes namely the learning environment in the classroom, mixed and fully online. This study aims to develop teaching materials that begin with needs research and then develop them to produce a product that has been tested. The results of this development can be used in learning.

METHOD

This research is a type of development research with the ADDIE procedure or model (Analysis, Design, Development, Implementation, and Evaluation) (A. Hadi, 2016). The ADDIE Model is a systematic learning design model. The selection of this model is based on the consideration that this model is developed systematically and is based on a theoretical foundation of learning design. This model is arranged programmatically with systematic sequences of activities to solve learning problems related to learning resources that suit the needs and characteristics of students. This model consists of five steps, namely: (1) analysis (analyze), (2) design (3) development (development), (4) implementation (implementation), and (5) evaluation (evaluation), this is by the statement (Cahyadi, 2019) that the ADDIE instructional model is an instructional process consisting of five phases, namely dynamic analysis, design, development, implementation, and evaluation.

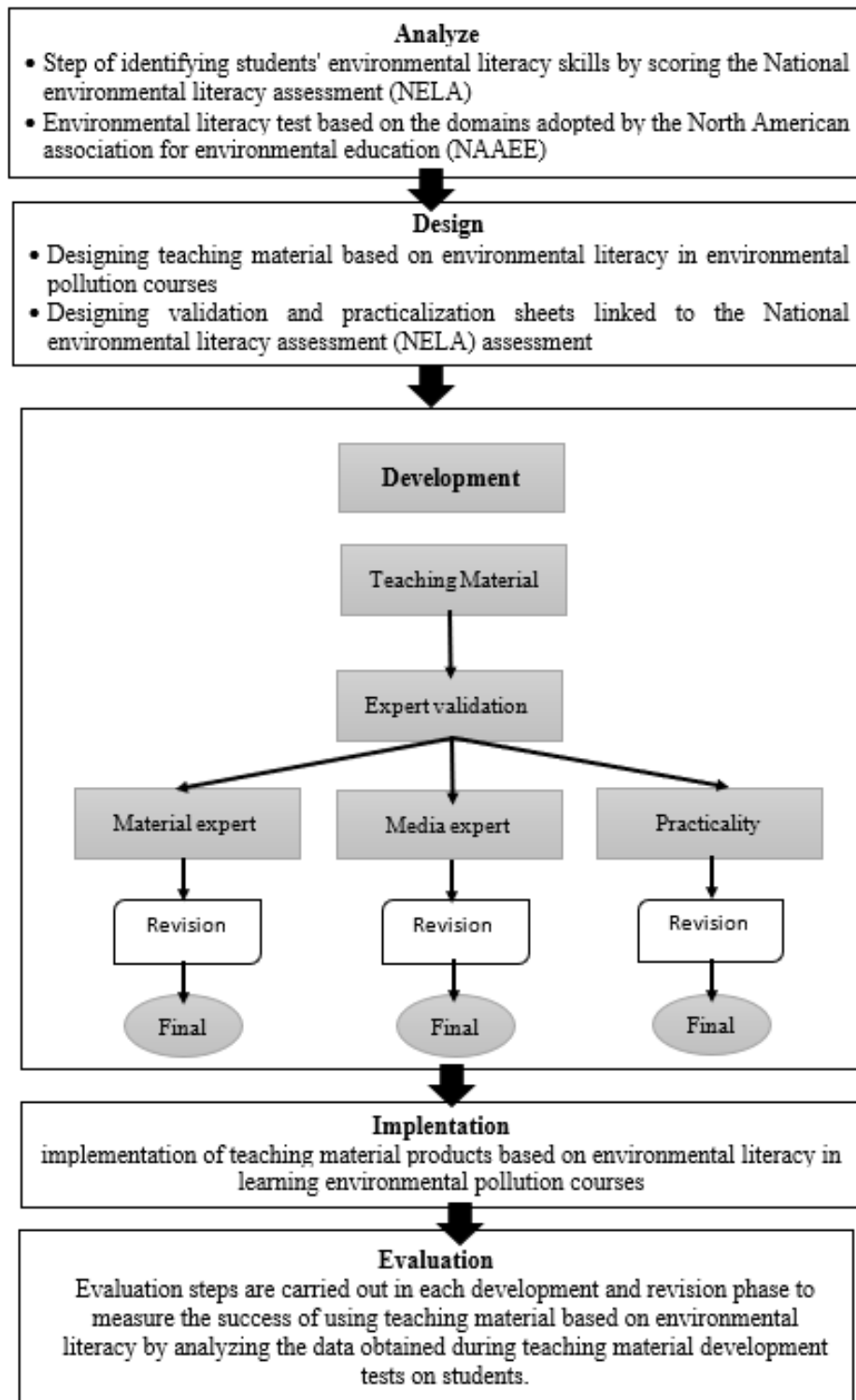


Figure 1. ADDIE stages to develop teaching materials based on environmental literacy

Based on the learning design steps using the ADDIE approach, the description of this design will begin with analysis, design, development, implementation, and evaluation activities (Goddess, 2018). This study is a sequential endeavor following prior research conducted by the researchers. Therefore, the application of the ADDIE Model in this study commences at the Design stage. However, it is noteworthy that this research progresses only until the Development phase within the ADDIE Model. The rationale behind this limitation is rooted in the fundamental principles of developmental research, which inherently involve iterative validations and revisions.

The design stage aims to design a product to be developed (Shofiyah et al., 2020). These stages include making a task list, setting performance objectives, and selecting a testing strategy. At this stage, the selection of teaching material designs is carried out which includes media selection, format selection, and the initial design of teaching materials (Khadija et al., 2020). At this stage, the researcher compiled and designed teaching materials in the form of modules based on environmental literacy in environmental pollution courses. At this stage, the researcher also compiled and designed a validation and radicalization sheet that was linked to the scoring of the National Environmental Literacy Assessment (NELA).

In development stage, researcher compiling module content, selecting supporting media, developing guidelines for users, and carrying out formative revisions. The experimental subjects at this stage were two experts to validate teaching materials and student representatives who were used as validators for readability. Material and media expert in this development research is lecturer Atin Nuryadin, M.Pd, Ph.D. as an environmental science expert, and Dewi Rosita, M.Kom as a media expert. Both of them validated the results of the formulation of teaching materials for environmental pollution courses based on environmental literacy that had been made. In order to find out the criteria of the teaching material, researcher use this percentage score formulation.

$$P = X \ 100\% \frac{f}{N}$$

Information :

P = Percentage number or rating score

f = The percentage that is being searched for

N = Number of frequencies / maximum score

Table 1. Feasibility Scale Table

Eligibility Score	Criteria
0 - 20%	Not feasible
21% - 40%	Not worth it
41%-60%	Pretty decent
61% - 80%	Worthy
81% - 100%	Very worth it

RESULT AND DISCUSSION

1. The process of developing teaching materials and validation sheets

At the Design stage, teaching material is produced. In preparing this teaching material, good and easy-to-understand language is used, the presentation is presented attractively and is complemented by pictures along with complete descriptions, and the contents of the book describe according to the author's ideas and are arranged based on the applicable curriculum, this is supported by the statement (Meilan, 2005) that in selecting, determining, and developing a teaching material or teaching materials must pay attention to the criteria or characteristics of teaching materials. At this stage validation and radicalization sheets are also produced which are linked to the scoring of the National Environmental Literacy Assessment (NELA), which will later be submitted to the validator for an assessment to be carried out.

2. Validation Results by the validator

At the Development stage, the data obtained in the preparation of this teaching material is in the form of qualitative and quantitative data, this is following the statement's Sujarwanto (2015) where in quantitative data is in the form of questionnaire scores from the validator's assessment results, while the qualitative includes scores obtained from the validators' assessments via questionnaires. Meanwhile, the qualitative data encompasses responses and suggestions provided by the validators regarding the teaching materials. Several aspects assessed by the validator in validating this teaching material consist of

preliminary, content, and evaluation aspects. Where each of these aspects has assessment criteria which will later be assessed according to the existing assessment score. Score 4 for very good, 3 for good, 2 for poor, and 1 for bad.

In the preliminary aspect, the assessment criteria consisted of clarity of learning instructions which received a score of 4 (very good), and clarity of learning outcomes which received a score of 3 (good). In the Content Aspect, the assessment criteria consisted of conformity with the RPS with learning objectives with a score of 4 (very good), Suitability of the material with the needs of remedial teaching with a score of 3 (good), Misconceptions in the material with a score of 4 (very good), Depth of the material with score 3 (good), Novelty of the material with a score of 3 (good), Suitability of the material with the tropical rain forest environment with a score of 4 (very good), Suitability with the environment in Indonesia with a score of 4 (very good), Loading domain knowledge on causative aspects environmental pollution with a score of 4 (very good), Loading domain knowledge on various aspects of environmental pollution (protecting the environment, environmental impact analysis, environmental change analysis) with a score of 4 (very good), Loading the domain of cognitive skills on aspects of Issue Identification, Issue Analysis, Environmental Issues Investigation Plan with a score of 4 (very good), Loading the attitude domain on aspects of thinking about the environment, environmental sensitivity, your feelings towards the environment with a score of 4 (very good), Loading the behavioral domain on the aspect of being responsible for the environment with a score of 4 (very good), Clarity of instructions for working on questions with a score of 4 (very good), the sequence of questions presented with a score of 3 (Good). In the evaluation aspect, the assessment criteria consist of the difficulty level of the questions with a score of 4 (very good), Appropriateness of exercises/tests with learning outcomes with a score of 3 (good), Balance in the proportion of questions with a score of 4 (very good). So that a total frequency of 70 is obtained, with a total frequency or maximum score of 76. The results of validating the formulation of teaching materials for environmental pollution courses based on hybrid learning to develop student environmental literacy can be stated in Table 2.

Table 2. Material Expert Validation Results

No	Assessment criteria	Score
1	Clarity of study instructions	4
2	Clarity of learning outcomes.	3
3	Compatibility with lesson plan with learning objectives	4
4	Compatibility of the material needs teaching improvement	3
5	Misconceptions about the material	4
6	Depth in the material	3
7	Novelty in the material	3
8	suitability material with a tropical rainforest environment	4
9	Compatibility with the environment in Indonesia	4
10	Loading domain knowledge on aspects of the causes of environmental pollution	4
11	Contains domain knowledge on various aspects of environmental pollution (preserving the environment, environmental impact analysis, environmental change analysis)	4
12	Loading the domain of cognitive skills on aspects of Issue Identification, Issue Analysis, and Issue Investigation Plan on the environment	4
13	Loading the attitude domain on aspects of thinking about the environment, environmental sensitivity, your feelings towards the environment	4
14	Loading the behavioral domain on environmentally responsible aspects	4
15	Clarity of work instructions	4
16	The sequence of questions presented	3
17	Difficulty level of questions	4
18	Appropriateness of exercises/tests with learning outcomes	3
19	balance of proportions	4

As for the feasibility according to media expert show the average score in the very worth it category.

Table 3. Media Expert Validation Results

No	Assessment Criteria	Score
1	The attractiveness of the title of learning media	3
2	Instructions for using teaching materials are clearly available	4
3	Correspondence of letters in and numbering in chapters	4
4	Consistent use of spaces, titles, subtitles, and typing of material	3
5	Completeness of the components in each chapter of teaching materials	4
No	Assessment Criteria	Score
6	The accuracy of the presentation of the material	4

7	Accurate placement of charts, tables, or illustrative images	4
8	Projected visuals are legible and easy to read	4
9	Images can awaken the imagination of the reader	3
10	The use of fonts and sizes does not distract the reader	4
11	The use of language that is easy to understand in the media	4
12	The table presented is easy to understand	4

In order to determine the results of percentage score of the assessment using the calculation formula. Based on the results calculation of the assessment score, obtained a result of 92.10%. So it can be said that the formulation of teaching materials for environmental pollution courses based on hybrid learning is included in the criteria of being very suitable for use as teaching materials to develop student environmental literacy. These teaching materials can then be implemented as environmental literacy-based teaching materials to support student learning outcomes. As for the validation process, comments and suggestions regarding the development of environmental literacy-based textbooks are also included, including improving the layout format of the overall contents of the book, making sure the content of the material and formative tests are in accordance with the learning objectives, Pay attention to the use of numbering, Pay attention the use of pictures and tables, pay attention to writing molecular symbols.

At several validation points, the material expert gave a score of 3 on point 7 namely novelty of the material. This is because the material presented has similarities in material with other books because the books made are textbooks so it can be ascertained that there are many things in common. On other points that were also commented on by material experts related to abbreviations for words that are compounds, they must be written down at the beginning so that they are known more clearly.

There are no comments that are urgent so that the results of the validation calculations get a high score and are interpreted as worthy of being used as a textbook. One comment that is also related to the writing structure is in paragraphs where the number of sentences is only one. Whereas in writing a paragraph consists of at least 2 sentences. As in picture 2.



Figure 2. Material expert comments



Figure 3. Comments regarding grammar

Based on the validation results, the material experts and media experts received a lot of input regarding the future development of this textbook. So that the writer also continues to try to improve so that development results are obtained which are towards perfection by the learning needs in environmental pollution courses. It is hoped that the points developed in this environmental literacy-based textbook will easily capture students' interest and concern for the

environment because the location of this literacy approach leads to high awareness and concern for the environment.

CONCLUSION

The developed teaching materials for environmental pollution courses in hybrid learning meet the criteria exceptionally well, achieving a rating of 92.10%. These materials are deemed suitable for enhancing student environmental literacy within environmental pollution courses. Furthermore, in line with the study's conclusions, experts have provided suggestions for improvement: enhance the overall layout format of the content in the book, ensure alignment of material content and formative tests with the learning objectives, pay careful attention to the use of numbering, pictures, tables, and molecular symbols, clearly explain abbreviations upon their first appearance within sentences, sequentially number tables and figures according to chapter numbers.

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