



(RESEARCH ARTICLE)



Development of e-modules on global warming: concepts and solutions in senior high school chemistry education

Ratman Ratman ^{1,*}, Kasmudin Mustapa ¹, Detris Poba ¹ and Maryam Amalia ²

¹ Department of mathematics and Sciences, Faculty of Teacher Training and Education, Tadulako University, Indonesia.

² Master Program Science Education Study Program, Tadulako University, Indonesia.

World Journal of Advanced Research and Reviews, 2024, 24(01), 2347–2351

Publication history: Received on 14 September 2024; revised on 23 October 2024; accepted on 25 October 2024

Article DOI: <https://doi.org/10.30574/wjarr.2024.24.1.3201>

Abstract

This research aims to produce a learning product in the form of a flipbook-based e-module that is valid, practical, and effective for X students in the odd semester. Chemistry lesson This development research is based on the unavailability of innovative teaching materials that meet the demands of the merdeka curriculum. Development procedures using the ADDIE model which consists of five stages: analysis, design, development, implementation, and evaluation. E-modules are introduced to be developed into a new medium that is expected to support the diversity of learning resources and maximize learning outcomes. Validation testing was conducted by 3 validators. The validation results obtained were with average percentages of 80%, 85%, and 85%, so it can be said that the e-module is in the valid category and suitable for use. Based on the student response questionnaire, the e-module is also practical for use in X grade chemistry learning, with a practicality percentage of 80.6% and very effective in improving students' thinking skills with an N-gain score of 0.59.

Keywords: Development Questionnaire; ADDIE Model; High School; Global Warming; Merdeka Curriculum

1. Introduction

Learning in this era integrates literacy skills, knowledge, attitudes, and mastery of information and communication technology (ICT) with the aim of enhancing students' thinking abilities in the 4C realm, namely Critical Thinking, Communication, Collaboration, and Creativity and Innovation. The concept of the independent curriculum can be explained as a learning design that allows students to learn in a peaceful, calm, and enjoyable atmosphere, with the hope of showcasing the talents possessed by each individual. The implementation of this curriculum aims to strengthen critical thinking and problem-solving skills, enhance creativity and innovation, as well as develop communication and collaboration abilities [1].

In the merdeka curriculum at the high school level, the subject of chemistry teaches several concepts about real-world problems, such as mathematical calculations, the use of technology, and global warming. Global warming is one of the concepts most closely related to the real world and is important to study because it will help solve social and global issues. Global warming is an environmental issue that requires serious action, and it is hoped that knowledge about its symptoms can be well received. One way to address this issue is by applying green chemistry principles. (green chemistry). Data from interviews with several chemistry teachers in Palu City revealed that students' critical thinking skills and science communication skills at SMAN Palu City are still relatively low, at 35%. This condition occurs due to the use of learning media that is less varied and tends to be monotonous, causing students to feel bored during learning activities. Learning media in the form of e-modules can be used as intermediaries such as images, videos, and animations to visualize chemistry material [2]. E-Module is a form of learning media presented in a structured and organized

* Corresponding author: Ratman Ratman

electronic format. Usually, E-modules can be accessed via the internet [3]. [4] states that students can more easily visualize the lesson material by using learning media that includes audiovisual media such as videos, animations, or interactive games, making the learning process more enjoyable.

2. Material and methods

This research is a development study using the ADDIE model [5]. The ADDIE model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The subjects in this study are three validators who are expert lecturers in the field of assessment and evaluation.

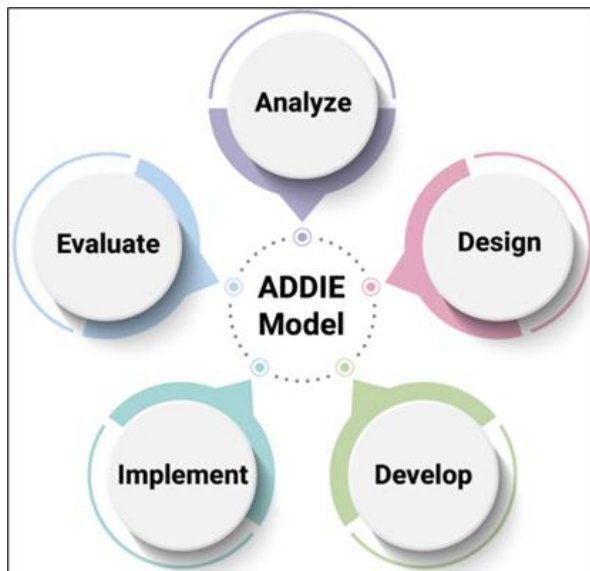


Figure 1 ADDIE development steps

The steps of this research follow the ADDIE stages. In the Analysis stage, the researcher examines and understands the curriculum in effect at the school. It continues with examining the learning outcomes to formulate learning objectives as considerations in developing the e-module. The process then moves to the Design stage by designing the e-module on the topic of global warming: concepts and solutions. The module design includes the module identity, usage instructions, learning outcomes, learning objectives, concept map, content material, summary, and exercises. Stage Development, the produced e-module is validated through focus group discussion activities. The aspects evaluated at this stage are the feasibility of the e-module, cover design, content design, cover page typography, display quality, and the overall validation conclusion. Development Stage, the questionnaire was developed by soliciting assessments, suggestions, and input from three validators. The 1-5 rating scores are analyzed using a Likert scale. The ratings from the validators are then summed and averaged to determine the validity category of the developed instrument. Suggestions and feedback from validators are used as material for refining the questionnaire. The scores obtained are then interpreted according to the validity criteria [6], as listed in Table 1.

Table 1 Validity score interpretation criteria

No.	Percentage (%)	information
1	0% - 20%	Invalid
2	21% - 40%	Not valid
3	41% - 60%	Fairly valid
4	61% - 80%	Valid
5	81% - 100%	Very valid

In the implementation, the developed e-module is subsequently tested. The trial of the e-module or product aims to determine whether the created product is suitable for use or not. Additionally, the trial of the model or product also examines the extent to which the created product can achieve its targets and objectives. [7]. The next stage is evaluation, where the developed e-module is evaluated using a formative test at the end of the class. The results of this evaluation are used to provide feedback on the developed e-module.

3. Results and discussion

3.1. Analysis Stage

The analysis stage is conducted to examine and understand the curriculum used at the school. This step is taken to align with the curriculum implemented in several high schools and madrasahs in the city of Palu. This activity is continued by reviewing learning outcomes to formulate learning objectives that will be used as considerations in developing the e-module. Based on the results of the Curriculum analysis, the researcher chose the material Global Warming: Concepts and Solutions. The table of learning outcomes (LO) and learning objectives (LO) from the material Global Warming: Concepts and Solutions.

3.2. Design Stage

The activity at this stage is to design an e-module on global warming: concepts and solutions. The resulting e-module will then be uploaded to a flip book. The web link will be provided to the students. The e-module design includes the module identity, module usage instructions, learning outcomes, learning objectives, concept map, content material, summary, and exercises.

3.3. Development Stage

3.3.1. Validation by experts

At this stage, the designed questionnaire will be validated by 3 expert validators. Using the questionnaire assessment table, the validators will give scores of 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). And also elaborating on suggestions and improvements in the provided comment section.

Table 2 Scores obtained from Validators

No.	Descriptor	Validator		
		1	2	3
1	Feasibility of e-module	3	3	3
2	Cover design e-module	3	3	3
3	Content design e-module	3	3	4
4	Typography cover page	3	4	3
5	Display quality	4	4	4
Percentage		80	85	85
Conclusion		Valid	Very valid	Very valid

The following are comments in the form of suggestions and improvements from validators.

Table 3 Comments from validators in validating the instrument of aspects of teacher perception

Validator	Comment	Decision
Validator 1	Completing ABCD in writing learning objectives	The questionnaire can be used with slight revisions
Validator 2	It is advisable to use HOTS operational verbs in learning objectives.	The questionnaire can be used with minor revisions.

Validator 3	The statement is made to measure all parts of the e-module.	The questionnaire can be used with slight revisions.
-------------	---	--

To test the practicality of the developed e-module, a questionnaire was given to 9 students to obtain student response information. The results of the student response questionnaire are presented in Table 4.

Table 4 Student response survey

Student response	Practicality score
Score count	290
Average	32,2
Percentage	80,6
Category	Practical

To obtain teacher responses regarding the use of e-modules in global warming education, a questionnaire was given to 3 chemistry teachers. The results of the teacher responses are presented in Table 5. The results of the teacher responses indicate that the developed e-module is practical for use in teaching.

Table 5 Teachers response survey

Teachers response	Practicality score
Teacher 1	85
Teacher 2	85
Teacher 3	80
Average	83,3
Category	Very practical

The final stage of model development is evaluation. Evaluation was given to 12 students who participated in the learning phase of the e-module trial. The evaluation results are displayed in the table. A limited trial phase was conducted.

Table 6 Pretest-posttest data on critical thinking skills

Description	Critical thinking skills	
	Pretest	Posttest
Average	35,85	73,75
Ideal score	100	100
N-gain score	0,59	
N-gain percentage	59%	
Criteria	Currently	
Interpretation category	Quite effective	

4. Conclusion

Based on the development results, it can be concluded that the developed e-module is declared very valid according to the assessment of three validators, with average percentages of 80%, 85%, and 85%. The e-module is also practical to use in 10th-grade chemistry learning, with a practicality percentage of 80.6% and very effective in improving students' thinking skills with an N-gain score of 0.59.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

- [1] Manalu, J. B., Sitohang, P., & Turnip, N. H. H. (2022). Development of Learning Devices For the Merdeka Curriculum. *Proceedings of Basic Education*, 80-86.
- [2] Herawati., & Muhtadi. (2020). Development of Interactive Electronic Modules (E-Modules) In The Subject of Chemistry For 11th Grade High School. *Journal of Educational Technology Innovation* 5(2), 180-191.
- [3] Astuti, N., Kaspul, K., & Riefani, M. K. (2022). The Validity of The Electronic Module "Cell Division" Based on Critical Thinking Skills. *Jurnal Eksakta Pendidikan*, 6(1), 94–102.
- [4] Hasanah, N., Sembiring, M., Afni, K., Dina, R., & Wirevenska, I. (2022). Socialization of The Independent Learning Curriculum to Enhance The Knowledge of Teachers at Muhammadiyah 04 Binjai Private Elementary School. *Ruang Cendekia: Journal of Community Service*, 1(3), 235.
- [5] Maydiantoro, A. (2021). esearch and Development Models (Research and Development). *Journal of Indonesian Educator Professional Development (JPPPI)*, 1(2), 29-35.
- [6] Riduwan. (2020). *Basics of Statistics*. Alfabeta. Bandung.
- [7] Puslitjaknov. (2008). *Development Research Methodology*. Jakarta: Center for Educational Policy and Innovation Research Research and Development Agency of the National Department of Education.