Development of a Waste Pollution Module using the Argument Driven Inquiry (ADI) Model for Students

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ABSTRACT

This research aims to develop a waste pollution module using the Argument Driven Inquiry (ADI) model. The module was developed using the ADDIE development model which consists of five stages, namely analysis, design, development, implementation, and evaluation. The validity of this development module refers to the results of validation by validators who are teaching materials experts, material experts and field practitioners. The practicality of this module refers to the results of assessments by users (students). The research results show that the module developed meets validity and practicality.

Pengembangan Modul Pencemaran Sampah dengan Model Argument Driven Inquiry (ADI) untuk Mahasiswa

ABSTRAK: *Penelitian ini bertujuan untuk mengembangkan modul pencemaran sampah dengan model Argument Driven Inquiry (ADI). Modul dikembangkan dengan model pengembangan ADDIE yang terdiri dari lima tahap, yaitu analysis, design, development, implementation, dan evaluation. Kevalidan modul hasil pengembangan ini mengacu pada hasil validasi oleh validator ahli bahan ajar, ahli materi, dan praktisi lapangan. Kepraktisan modul ini mengacu pada hasil penilaian oleh pengguna (mahasiswa). Hasil penelitian menunjukkan bahwa modul yang dikembangkan telah memenuhi kevalidan dan kepraktisan.*

INTRODUCTION

The development of science and technology in the era of globalization has an impact on various aspects of life including in education (Wulandari & Nofina, 2022);(Widodo et al., 2023). One of the impacts is that education should be able to produce human resources who have complete skills, known as 21st century skills (González-pérez & Ramírez-montoya, 2022);(Mutohhari et al., 2021). Bedir (2019) argue, it is important for students to have 21st century skills so they are able to take part in real life.

Considering the importance of 21st century skills, it is necessary to improve the learning process, one of which is the Basic Environmental Science course (González-salamanca et al., 2020);(Uralovich et al., 2023). Improving the learning process can be done in the material waste pollution. This material was chosen because waste pollution is a crucial thing that will continue to exist around us, but many people are still not aware of it (Raudhah et al., 2020).

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Waste pollution material is important to use as contextual learning material. Contextual learning is learning by connecting the content students' study with the real world (Asylah et al., 2023);(Suryawati et al., 2020). One of the contextual learning models is the model Argument Driven Inquiry (ADI). The ADI model is a model designed to focus students on investigative activities and provide opportunities for students to put forward scientific arguments. This makes learning activities more contextual and educational (Fadilah et al., 2020);(Riyanti et al., 2023).

The application of the ADI model trains students to think and act independently, so to support the learning process using the ADI model (Afifa et al., 2021), teaching materials are needed that students can use independently (Suprihatiningrum et al., 2022). Alternative teaching materials that can be used are modules. Haka et al. (2024) argue, modules are one of the teaching materials that emphasize independent learning (self-instructional). Module development must be considered in such a way that it does not bore students (Situmorang et al., 2020). An alternative that can be done is to develop contextual research-based modules. (Mulyadi et al., 2020)

In response to the problems above, the step that can be taken is to develop a waste pollution module using the ADI model based on research on waste pollution at the Supit Urang Landfill in Malang. The main content in this module is data on the amount of waste and the results of research on leachate pollution at the Supit Urang landfill. This module is equipped with a video of the condition of mountains of rubbish and leachate pollution at the Supit Urang landfill, so, it is hoped that it will be contextual. Learning activities in this module are presented according to the ADI model syntax, namely identifying the task and composing questions, designing a method and collecting data, developing an initial argument, argumentation sessions, explicit and reflective discussions, writing an investigation report, reviewing the results of other groups anonymously (double-blind group peer review), and revising and sending reports (Fakhriyah et al., 2021);(Divena et al., 2021);(S. S. Utami et al., 2022).

METHOD

The development of the waste pollution module with the ADI model uses the ADDIE model, which consists of the steps of analyzing, designing, developing, implementing, and evaluating. Branch (2009) argue, the ADDIE model was chosen because the steps are systematic and allow revisions to be made at each stage, thus making the product of higher quality. The research and development procedures carried out are in Table 1.

Table 1. Research and Development Procedures

No.	ADDIE stage	General Procedures
1.	Analyze	a. Validate the performance gap
		b. Determine instructional goals
		c. Confirm the intended audience
		d. Identify required resources
		e. Determine potential delivery systems
		f. Compose a project management plan
2.	Designing	g. Make a task list
		h. Develop performance objectives
		i. Develop testing strategies
3.	Develop	j. Generate content
		k. Select or develop supporting media
		l. Develop guidance for students
		m. Develop guidance for lecturers
		n. Conduct formative revisions
4.	Implement	o. Prepare the lecturer
		p. Prepare the student
5.	Evaluate	q. Determine evaluation criteria
		r. Select evaluation tools
		s. Conduct evaluations

Source: (Branch, 2009)

More concisely, after the product has been prepared to the design stage, the

product is then validated. The results of the module cover design can be seen in Figure 1.

Figure 1. Cover of the Waste Pollution Module with the Argument Driven Inquiry Model

Product validation is carried out by teaching materials experts, material experts and field practitioners (Yulia et al., 2023). Validation is carried out according to the indicators in Table 2 as follows.

Table 2. Module Validation Indicators

No	Validation	Indicator
1.	Teaching materials expert	Eligibility of content
		Serving components
		Linguistic component
		Components of graphic feasibility
		Module content design
		Compliance with module characteristics
2.	Material expert	Suitability of material to learning objectives
		Material accuracy
		Depth of material
		Up-to-date material
3.	Field practitioners	Presentation of learning
		Module attractiveness
		Ease of use of the module
		Ease of understanding the module

After the module is validated, a formative evaluation is then carried out on students who have taken the Basic Environmental Science course. Formative evaluation was carried out in 3 stages, namely individual trials (one-to-one trials) with 3 students, small group trials with 8 students, and field trials with 15 students. Formative revision activities were carried out to obtain response data from module users (students) (Kalaitzopoulou et al., 2023). The indicators used to assess student responses arepresentation of learning, attractiveness of the module, ease of the module to use, and ease of the module to understand (Murdikah et al., 2021);(Widya & Isnaeni, 2023). The product is revised based on user response at this stage.

The next step is the implementation stage of the module in classes taking the Basic Environmental Science course. The product trial subjects were 20 students. This research was carried out in the O5 UM Biology building during April 2020. The practical data collection technique used a student response questionnaire which was carried out at the end of the learning process.

The data analysis technique used is a percentage to test the validity and practicality of the module being developed. If the analysis results show valid and practical results then the module is suitable for use, whereas if the results are invalid then further revisions need to be made (Triwahyuningtyas et al., 2020).

Module improvement based on suggestions that will be given by experts based on the aspects assessed on the product to be developed (Sari et al., 2023). In this case, it aims to create a product that is effective in its use later in the learning process. The module validation results are calculated and compared with the module validity criteria as in Table 3.

Table 3. Module Validity Criteria*)

Percentage (%)	Validity Criteria
90.01–100.00	Very valid
85.01–90.00	Valid
70.01–85.00	Fairly valid
50.01–70.00	Not valid
01.00 – 50.00	Invalid

Source: (Sugiyono, 2015)
*) Especially for material, the validity level must be 100%

The practicality criteria for the module can be seen in Table 4.

Table 4. Module Practicality Criteria

Percentage (%)	Practicality Criteria
80.01–100.00	Very practical
60.01–80.00	Practical
40.01–60.00	Quite practical
20.01–40.00	Not practical
00.00–20.00	Not practical

RESULTS AND DISCUSSION

The research results include validity and practicality test results. Validity test results include product validation results by teaching material expert validators, material experts and field practitioners as follows (Suhaini et al., 2021). Practical test results include the results of filling out user response questionnaires from formative and implementation revisions.

Results of Expert Validation of Teaching Materials

Aspects assessed for module validation by teaching materials experts include appropriateness of content, presentation components, linguistic components, graphic appropriateness components, module content design, and conformity with module characteristics. Expert validation of teaching materials was carried out by an expert validator of teaching materials, namely Dra. Sunarmi, M.Pd. In summary, the validation results from teaching materials experts can be seen in Table 4.8, which shows that the waste pollution module is very valid with a percentage of 93.26%.

In line with Pakaya et al. (2023), that getting positive results in the validation test, the module can be used in the learning process. Alexopoulos et al. (2020) argue, if the product developed is valid, then it can be said that the product has provided a correct description and is in accordance with the actual situation.

The results of the validation of the Waste Pollution Module Teaching Materials product can be seen in the following table 5.

Table 5. Expert Validation Results for Waste Pollution Module Teaching Materials

No.	Indicator	Average	Percentage (%)	Category
1.	Eligibility of content	4.63	92.50	Very valid
2.	Serving components	4.66	93.10	Very valid
3.	Linguistic component	4.69	93.85	Very valid
4.	Components of graphic feasibility	4.37	87.37	Valid
5.	Module content design	4.86	97.14	Very valid
6.	Compliance with module characteristics	5	100	Very valid
Average Percentage of Validation Results (%)			**93.26**	**Very valid**

Comments and suggestions provided by teaching materials experts as well as revisions to the waste pollution module can be seen in Table 6.

Table 6. Comments and Suggestions from Expert Validators for Waste Pollution Module Teaching Materials

No.	Comments and Suggestions	Revision
1.	In the instructions for using the module, it is necessary to correct the 4th line, namely the learning syntax numbering section, which should use brackets, such as (1), (2), (3), and so on.	The learning syntax numbering has been corrected using brackets, such as (1), (2), (3), and so on.
2.	In learning activity section 1, there are several typos and sentence fragments that need to be corrected	Several typos and errors in sentence fragmentation have been corrected
3.	In each learning activity, the number of groups should be even	Instructions for forming even numbered groups
4.	Need to improve the command sentences for the explicit and reflective discussion sections	The command sentences in the explicit and reflective discussion sections were corrected
5.	Check the accuracy of the bibliography in the manuscript	The strength of the bibliography in the manuscript has been checked

Material Expert Validation Results

Aspects assessed for module validation by material experts include the suitability of

the material with the Course Learning Outcomes, the accuracy of the material, the depth of the material, and the up-to-date ness of the material. Material expert validation is carried out by material expert validators, namely Prof. Dr. Ir. Suhadi, M.Sc. In summary, the validation results from experts can be seen in Table 7, which shows that the waste pollution module is very valid with a percentage of 100%.

Table 7. Expert Validation Results for Waste Pollution Module Material

No.	Indicator	Average	Percentage (%)	Category
1.	Suitability of material to learning objectives	5	100	Very valid
2.	Material accuracy	5	100	Very valid
3.	Depth of material	5	100	Very valid
4.	Up-to-date material	5	100	Very valid
Average Percentage of Validation Results (%)		**100**		**Very valid**

Comments and suggestions provided by material experts as well as revisions to the sample pollution module can be seen in Table 8. According to Oktarina et al. (2023), comments and suggestions are important in the validation process with the aim of creating a better product.

Table 8. Comments and Suggestions from Expert Validators on Waste Pollution Module Material

No.	Comments and Suggestions	Revision
1.	In a module, there must be a scope of behavior for behavior within a certain time period	The module has added the scope of behavior to be achieved, namely changes in behavior during learning
2.	Lecturers must test students in implementing the module. For example, the teacher creates a	In the module, examples of explicit activities are added when the lecturer throws rubbish in

No.	Comments and Suggestions	Revision
	scenario of throwing away wrappers in front of the class to find out students' reactions.	front of the class and students are instructed to provide comments
3.	Source is listed by year	Reference list source has been added year

Field Practitioner Validation Results

Aspects assessed for module validation by field practitioner validators include indicator and objective components, learning process/activity components, presentation components, linguistic components, and presentation completeness components. Validation of field practitioners was carried out by a lecturer in the Basic Environmental Science course, namely Dr.Sueb, M.Kes. In summary, the validation results from field practitioners can be seen in Table 9, which shows that the waste pollution module is very valid with a percentage of 95.12%.

Table 9. Field Practitioner Validation Results of the Waste Pollution Module

No.	Indicator	Average	Percentage (%)	Category
1.	Presentation of learning	5	100	Very practical
2.	Module attractiveness	4.33	86.67	Very practical
3.	Ease of use of the module	4.86	97.14	Very practical
4.	Ease of understanding the module	4.83	96.67	Very practical
Average Percentage of Validation Results (%)		**95.12**		**Very practical**

Formative Revision Results

After validation of the module by experts, formative revisions were then carried out through 3 stages, namely individual trials (one-to-one trials), small group trials and field trials. This trial was carried out to determine student responses to the learning presentation, the attractiveness of the module, the ease of the

module to use, and the ease of the module to understand. Trials were carried out on students who had taken Basic Environmental Science courses, especially material on Waste Pollution.

Individual Trial (One-To-One Trial)

This trial was carried out on 3 students, namely one student with high academic ability, one student with medium academic ability, and one student with low academic ability. The results of individual trials obtained an average score of 96.84% (very practical) and can be seen in Table 10.

Table 10. Summary of Individual Trial Results (One-To-One Trial)

No.	Student	Average Value (%)	Category
1.	1st student	95.29	Very practical
2.	2nd student	98.95	Very practical
3.	3rd student	95.79	Very practical
Average Value (%)		**96.84**	**Very practical**

Based on comments and suggestions from individual trials, formative revisions were carried out which can be seen in Table 11.

Table 11. Results of Formative Revision of Individual Trial of Waste Pollution Module

No.	Comments and Suggestions	Revision
1.	The important notes section should not appear too often	Important notes on several pages have been removed, especially on pages containing questions.
2.	Try checking again whether the module contains reference names or not in the material description.	The reference list is in accordance with the content quotation
3.	The glossary section can be supplemented further because there are still many meanings that students need to know.	Additions to the glossary, namely the definition of B3 waste and clay liner.

Small Group Trial

Small group trials were carried out on 8 students who had taken the Basic

Environmental Science course. The results of the small group trial obtained an average value of 92.5 (very practical) and can be seen in Table 12.

Table 12. Summary of Small Group Trial Results

No.	Student	Average Value (%)	Category
1.	1st student	86.32	Very practical
2.	2nd student	96.84	Very practical
3.	3rd student	100	Very practical
4.	4th student	96.84	Very practical
5.	5th student	90.53	Very practical
6.	6th student	75.79	Practical
7.	7th student	95.79	Very practical
8.	8th student	97.90	Very practical
Average Value (%)		92.50	Very practical

Based on comments and suggestions from small group trials, formative revisions were carried out which can be seen in Table 13.

Table 13. Formative Revision Results of Small Group Trials of the Waste Pollution Module

No.	Comments and Suggestions	Revision
1.	Fonts can be varied	The font type is fixed, namely Microsoft PhagsPa, but the font size is varied. For the title section the font size is 16, the subtitle section is 14, and the content section is 11.
2.	The use of foreign words and formulas used to assess formative test results need to be improved.	The writing of foreign words uses italics and the formula for assessing the results of formative revision has been improved.
3.	The module design is made even more attractive.	The module design has been improved.

Field Trial

Field trials were carried out on 15 students who had taken the Basic

Environmental Science course. The results of the small group trial obtained an average value of 92.5 (very practical) and can be seen in Table 14.

Table 14. Summary of Small Group Trial Results

No.	Student	Average Value (%)	Category
1.	1st student	100	Very practical
2.	2nd student	88.42	Very practical
3.	3rd student	98.95	Very practical
4.	4th student	90.53	Very practical
5.	5th student	81.05	Very practical
6.	6th student	95.79	Very practical
7.	7th student	91.58	Very practical
8.	8th student	87.37	Very practical
9.	9th student	89.47	Very practical
10.	10th student	100	Very practical
11.	11th student	78.95	Practical
12.	11th student	95.79	Very practical
13.	13th student	94.74	Very practical
14.	14th student	97.89	Very practical
15.	15th student	91.58	Very practical
Average Value (%)		92.14	**Very practical**

Based on comments and suggestions from small group trials, formative revisions were carried out which can be seen in Table 15.

Table 15. Formative Revision Results of Field Trial of the Waste Pollution Module

No.	Comments and Suggestions	Revision
1.	On the front page of each chapter the title has a margin that is not wide enough	Margins have been fixed
2.	Images taken by yourself do not need to be sourced from personal documentation	Image source sentences from personal documentation removed
3.	The definition of waste can be added according to Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management	Added the definition of waste according to Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management

Next are the results of the practicality test of the class used for implementation. The results of user responses by 20 students can be seen in Table 16.

Table 16. Summary of Practicality Test Results

No.	Student	Average Value (%)	Category
1.	1st student	81.33	Very practical
2.	2nd student	89.33	Very practical
3.	3rd student	93.33	Very practical
4.	4th student	65.33	Practical
5.	5th student	76.00	Practical
6.	6th student	86.67	Very practical
7.	7th student	80.00	Practical
8.	8th student	77.33	Practical
9.	9th student	82.67	Very practical
10.	10th student	92.00	Very practical
11.	11th student	73.33	Practical
12.	11th student	60.00	Quite practical
13.	13th student	78.67	Practical
14.	14th student	81.33	Very practical
15.	15th student	72.00	Practical
16.	16th student	80.00	Practical
17.	17th student	97.33	Very practical
18.	18th student	76.00	Practical
19.	19th student	98.67	Very practical
20	20th student	69.33	Practical
Average Value (%)		**80.53**	**Very practical**

Apart from that, to find out the practicality of the module, student response data was also taken. A summary of the results of student responses to the module obtained a percentage of 80.53% with very practical criteria. A good response from students in using the product because the product can attract learning interest with materials related to life.

Module Validity Test by Teaching Materials Experts

Before the module is tested, it is important to test the validity of the module

by a teaching materials expert (Hasairin et al., 2023);(Saragih & Tanjung, 2023). Aspects assessed for module validation by teaching material expert validators include content suitability, presentation components, linguistic components, graphic suitability components, module content design, and conformity with module characteristics (Puspita et al., 2024);(Handoko et al., 2024). The percentage of validation results from teaching materials experts was 93.26%, which shows that the module is classified as very valid.

The appropriateness of the module content includes material coverage, up-to-date and contextual, as well as compliance with laws and regulations. The waste pollution module using the ADI model obtained a percentage of 92.50% in terms of the appropriateness of the module content, which means it is very valid. This module meets the material coverage criteria because the completeness, breadth and depth of the material are in accordance with CPMK, sub-CPMK and learning objectives. Having learning materials packaged specifically according to learning objectives will make it easier for students to learn thoroughly. Hainora et al. (2022) argue, this module also meets the latest and contextual criteria because this module with developments in science, especially developments in the latest issues regarding waste pollution at one of the landfills, namely at the Supit Urang Malang landfill; equipped with the latest examples, including examples of waste management at the Supit Urang Landfill in Malang; and the examples provided come from the surrounding environment. This contextual learning module is important to develop because it can improve students' conceptual understanding. This module also complies with laws and regulations because it complies with IPR and is free from SARA (Coates et al., 2022).

The presentation components of the module include presentation techniques, presentation support, and presentation completeness. The waste pollution module with the ADI model developed has met the presentation technique criteria with a percentage of 93.10%, which means it is very valid. This is proven by the systematic consistency of the presentation in the chapters, the logic of the presentation, the consistency of the presentation, coherence, and the balance of substance between chapters and sub-chapters.

Module also meets the criteria for supporting the presentation of material because of the suitability and accuracy of illustrations (images/videos) with the material, advance organizer (motivation generator for learning) at the beginning of the chapter, practice questions at the end of each chapter, answer key to practice questions at the end of the module, references/ reference sources, as well as the accuracy of numbering and naming tables/figures (Komikesari et al., 2020). This module also fulfills the complete presentation, namely includes a cover page, foreword, table of contents, list of images, list of tables, competency map, instructions for using the module, learning activities with ADI learning syntax which is equipped with material descriptions, formative critical thinking tests, formative awareness tests environment, environmental behavior formative tests, feedback, assignments, and reflection, as well as a reference list, glossary, and formative test answer key (Imbia & Diartika, 2024). This presentation component is important in a module because it can make the module easier to understand and interesting for students.

Linguistic components include suitability for student development, readability, ability to motivate, straightforwardness, coherence and coherent flow of thought, conformity with Indonesian language rules, and use of terms (Noor & Rahman, 2022). The waste pollution module that has been developed has fulfilled the linguistic component by getting a percentage of 93.85%, which shows it is very valid. It is important for this language

component to be adjusted to the students' conditions because language will influence students' understanding of the learning material.

Components of graphic feasibility include module size, module cover (layout, typography and illustrations), and module content design (layout, typography and illustrations). This module has met the graphic eligibility criteria of 87.37%, which means this module is valid. This is because the graphic aspects of the module are adapted to Prasetyo et al. (2021). This module is supported by attractive colours and cover design illustrations. This can clarify the concept and message of the material to be presented. The attractiveness of the illustrations in the module will support the harmony of the written module, so that it will attract students in learning.

Conformity with the characteristics of the module includes that the module can be used for independent learning, has a complete unity, can stand alone, adapts to current developments and is easy to use This module meets these criteria with a percentage of 100%, which means it is very valid.

This module meets the criteria for independent learning (self-instructional). In this module there is a competency map, which explains the learning outcomes of the course (CPMK), sub-CPMK, and learning objectives which are explained at the beginning of each chapter, learning material is presented according to the context of the assignment and student environment, examples and illustrations are provided that support clarity of explanation learning materials, practice questions and instruments to measure or evaluate one's own level of mastery of the material, feedback on student assessments, and there are also references. This is in line with Pribadi & Susilana (2021) opinion, that a suitable module is a module that can be used for independent learning, that is, has clear objectives, pays attention to individual differences, allows systematically organized

learning, utilizes various media, allows active participation by students, and has a good evaluation strategy. Modules that meet these criteria can provide remedial instruction for students who have not yet achieved their learning goals (Ambayon, 2020). Students can also be given time to complete learning according to their wishes, so that the learning material can be enjoyed and students get a satisfying learning experience (Utami et al., 2020) .

This module also meets the criteria for a complete unit because in this module there is learning material to achieve three CPMKs contained in one complete module, thus giving students the opportunity to study complete learning material. Modules that have complete unified criteria are prepared to achieve learning objectives (Hegerius et al., 2020). Modules cover a wide range of relevant materials and resources. This module can also stand alone. The module developed does not depend on other media or does not have to be used together with other media, so students do not depend on other media. All additional material is integrated through the module by providing a QR code and web address which is written in the module and can be accessed by students (Anggraeni et al., 2022). Modules that meet these characteristics will make learning easier for students because students have received complete information from this module, even without accessing other teaching materials, such as textbooks (Syahrial et al., 2021).

This module also has adaptive characteristics. This module has a high adaptive capacity towards developments in science and technology, prepared based on the latest research data at the Supit Urang Landfill in Malang which is actual and in accordance with current conditions. Adaptive learning modules are important to develop to achieve an effective learning system and also has a positive impact on student engagement in learning. This module also meets the criteria for being easy to use because it uses simple language, is

easy to understand, and uses commonly used terms. This is in accordance with Setiyani et al. (2020) research, that the criteria for a module that is easy to use is a module that has good content presentation and layout, uses interactive language, and is appropriate to real situations.

Module Validity Test by Material Experts

The material validation test aims to obtain approval or validation from the material expert validator regarding the suitability of the module material content to needs. Material in a good module is usually ordered by topic, chronological, place, cause and effect, logical structure, problem-center, or follows a spiral sequence. The module material validation sheet consists of several assessment indicators, namely material coverage, material accuracy, as well as up-to-date and contextual (Yulis & Oktariani, 2024). The results of the module validity test by expert validators were 100%, indicating that the waste pollution module using the ADI model was very valid.

The module that has been developed meets the material coverage criteria because the material is prepared in accordance with learning objectives, meets the completeness, breadth and depth of the material in accordance with CPMK and sub-CPMK. The breadth of material in this module reflects the substance of the material contained in CPMK and sub-CPMK. The depth of the material includes starting from the introduction of concepts to interactions between concepts with attention to the learning objectives (Pettersson, 2021). The main material in this module is material regarding the concept of waste, the impact of waste pollution, and handling environmental problems caused by waste. Apart from Ravista et al. (2021), there is also special material to empower critical thinking, environmental awareness and environmental behavior.

This module also meets material accuracy, namely meeting aspects of fact accuracy, concept accuracy, and procedure/methodaccuracy.Miftakhurrohmah et al. (2023) argue, this means that the facts presented are in accordance with reality and are effective in increasing students' understanding, the concepts/laws/theories presented do not give rise to many interpretations and are in accordance with the definitions applicable in the field of biology correctly (accurately), and the procedures/methods presented can be applied coherently and correctly.

This module also fulfills the up-to-date and contextual aspects because it is in accordance with scientific developments and fulfills the up-to-date aspects of examples, especially from research results at the Supit Urang Landfill in Malang. This shows that the material presented is up to date (in accordance with the latest developments in biological science) and descriptions, examples and exercises encourage students to obtain information from various sources, presented as relevant and interesting, and reflect current events, happenings or conditions (Joyce et al., 2021).

Practicality Test of the Waste Pollution Module with the ADI Model

Practicality is related to the ease of using teaching materials in the learning process. Teaching materials are said to be practical if they can be used to implement learning logically, continuously, and without many problems. A module is said to be practical if users, namely field practitioners (lecturers) and students, assess that the module can be used and is easy to use.

Module Practicality Test by Field Practitioners

The module validation sheet by field practitioners consists of several assessment indicators, namely presentation of learning, attractiveness of the module, ease of the module to use, and ease of the module to understand. The results of the module practicality test by field practitioner validators were 95.12%, indicating that the waste pollution module using the ADI model

is very practical. This waste pollution module with the ADI module fulfills the learning presentation elements with a percentage of 100%, which is very practical. This is in line with Dewi & Primayana 92019) and Saragih & Tanjung (2023) the fact products that are considered valid and practical to use because the product has useful value in its use. The novelty of this product is the use of the ADI model which makes considered to encourage active student involvement and is student-centered and can be used integrated in learning. Active learning can improve performance, help in gaining knowledge, and achieve student understanding.

This module meets the module attractiveness criteria with a percentage of 86.67%, which is very practical because the module display design is able to show students' interest in learning, the module content can motivate and arouse students' interest in learning, and the images presented are clear with appropriate information. The appearance of the module plays a role in increasing student motivation in studying the material and avoiding boredom with the modules presented (Mitra et al., 2024).

This module meets the criteria for ease of use of the module with a percentage of 97.14%, which is very practical because there are clear instructions for using the module, making it easier to carry out activities; choosing the type of font, size and spacing used makes it easier to read the module; there is a sub-CPMK written clearly in the module; the module uses sentences that do not create double meanings; learning activities and illustrations in the module make learning easier; module content can be linked to daily activities; and can be studied well. Thus, this module helps students to study independently without completely depending on other people. This is the main characteristic of the module (Nurhasnah et al., 2020).

The module meets the criteria for ease of understanding with a percentage of 96.67%, which is very practical because the module uses language that is easy to understand, the learning activities in the module help students discover concepts, the questions provided are in accordance with the concepts being studied, the concepts are explained with illustrations or pictures appropriate, activity evaluations are written clearly, and the module content is useful for students. A good module provides communicative, unambiguous language, correct grammar, and clear questions (Antonioli & Schneider, 2023).

Module Practicality Test by Students

Modules that have met the valid criteria by expert validators of teaching materials, materials and field practitioners are then tested on students who have taken the Basic Environmental Science course. This trial was carried out to determine student responses to the learning presentation, the attractiveness of the module, the ease of the module to use, and the ease of the module to understand. The trial was carried out in three stages, namely individual trials (one-to-one trials), small group trials and field trials. The results of the module practicality test at the three stages are very practical, so the module can be used for the implementation stage.

After the implementation stage, the level of practicality developed was also re-assessed by experimental class students, namely students who used the waste pollution module with the ADI model accompanied by guidance. The results of the module practicality test show a percentage of 80.53%, which is very practical. This is because the module has fulfilled the components of learning presentation, the attractiveness of the module, the ease of the module to use, and the ease of the module to understand (Delita et al., 2022). The use of modules can overcome the limitations of students and lecturers. Modules can increase students' motivation, develop their previous abilities, and encourage them to

learn independently (Rizki et al., 2022);(Ndoa & Jumadi, 2022).

CONCLUSIONS AND SUGGESTIONS

The waste pollution module with the ADI model developed has fulfilled the validity aspect based on validation by expert validators of teaching materials, materials and field practitioners. This module also meets the practical elements from the results of formative revision trials and the results of user (student) response questionnaires. Suggestions that can be given for further module development are as follows. 1)The waste pollution module can be added to research results at various landfills and TPS, 2)The waste pollution module can be developed in the form of interactive media connected to Android to make it more attractive to users, and 3) Modules can be developed in digital form such as e-modules so that module use is more practical.

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