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Research Article

Development of Waste Pollution Module with 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. The module validity percentage according to the teaching subject expert validator was 93.26%, the matter expert was 100%, and the field practitioner was 95.12%. The percentage of practicality according to the students responses questionnaires were 80.53%.

Keywords: module; waste pollution; Argument Driven Inquiry (ADI) model

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INTRODUCTION

Science and technology that is always developing in the era of globalization has an impact on various aspects of life (Goodwin &; Martam, 2014; Bialik &; Fadel, 2015; Garba, et al., 2015), included in education (Eduviews, 2008; Reimers & Kanter, 2014). One of the impacts is that education should be able to produce human resources who have intact skills, known as 21st century skills (Trilling & Fadel, 2009). 21st century skills are important for students to be able to take part in real life (Hashim &; Hameed, 2012; Nasir, 2017).

Given the importance of 21st century skills, it is necessary to improve the learning process, one of which is in the Basic Environmental Science course. Improvement of the learning process can be done on waste pollution material. The material was chosen because waste pollution is a crucial thing that will continue to be around, but there are still many who do not realize (Villegas, 2018).

Waste pollution material is important to be used as contextual learning material. Contextual learning is learning by connecting the content learned by students with the real world (Davtyan, 2014). One contextual learning model is the Argument Driven Inquiry (ADI) model (Hudson & Whisler, 2008). The ADI model is a model designed to focus students on research and argumentation activities. This makes learning activities more contextual and educative (Sampson, et al., 2014).

The application of the ADI model trains students to think and act independently (Hasnunidah, et al., 2015). An alternative is to use modules for self-instructional learning (Muljono, 2001). Module development should be considered in such a way, so that it does not bore learners. An alternative that can be done is to develop research-based modules that are contextual (Fitriyati, et al., 2015).

Answering the above problems, the step that can be taken is to develop a waste pollution module with an ADI model based on waste pollution research. This module is equipped with a video of the condition of mountains of garbage and leachate water pollution at the Supit Urang landfill uploaded on Youtube and accessed via QR code, so it is expected to be contextual (Pantiwati, 2016). Learning activities in this module are presented according to the syntax of the ADI model, namely identifying tasks and compiling questions, designing methods and collecting data developing initial arguments, argumentation sessions, explicit and reflective discussions, writing investigative reports, reviewing the results of other groups without identity, and

correcting and sending reports (Sampson et al., 2014).

RESEARCH METHODS

The waste pollution module development model used is ADDIE, with steps to analyze, design, develop, implement, and evaluate (Branch, 2009). This model was chosen because the steps are systematic and allow revision at every stage, thus making the product more qualified.

In summary, after the product is prepared to the design stage, then the product is validated by teaching material experts, material experts, and field practitioners. After the module is validated, a formative evaluation is then carried out for students who have taken the Basic Environmental Science course. Formative revision activities are carried out to obtain data on the response of module users (students). Next is the module implementation stage in classes that take the Basic Environmental Science course. The subjects of the product trial were 20 students. This study was conducted online for 2 months. The data analysis technique used is a percentage to test the validity and practicality of the modules developed.

RESULT AND DISCUSSION

Validation Results of Teaching Material Experts

In summary, the validation results from teaching material experts can be seen in Table 1, which shows that the waste pollution module is very valid with a percentage of 93.26%. Comments and suggestions by teaching material experts can be seen in Table 2.

93,26

No.	Indikator	Rerata	Persentase (%)
1.	Kelayakan isi	4,63	92.50
2.	Komponen penyajian	4,66	93.10
3.	Komponen kebahasaan	4,69	93,85
4.	Komponen kelayakan kegrafikan	4,37	87,37
5.	Desain isi modul	4,86	97,14
6.	Kesesuaian dengan karakteristik modul	5	100

Rerata Presentase Hasil Validasi (%)	**93,26**

The accuracy of the bibliography in the manuscript has been checked

No.	Komentar dan Saran	Revisi
1.	Petunjuk penggunaan modul perlu diperbaiki pada bagian baris ke-4, yaitu bagian penomoran sintaks pembelajaran	Penomoran sintaks pembelajaran, sudah diperbaiki dengan menggunakan tanda kurung, seperti (1), (2), (3), dan seterusnya.
2.	Pada bagaian kegiatan pembelajaran 1, terdapat beberapa *typo* dan pemenggalan kalimat yang perlu diperbaiki	Beberapa *typo* dan kesalahan dalam pemenggalan kalimat sudah diperbaiki
3.	No.	Indicator
Average	Percentage (%)	1.
Fill credentials	4,63	92.50

Material Expert Validation Results

The validation results from material experts can be seen in Table 3 which shows that the waste pollution module is very valid with a percentage of 100%.

100

2.	**Serving components**	**4,66**	**93.10**
3.	Linguistic component	4,69	93,85
4.	Graphic feasibility component	4,37	87,37
5.	Module content design	4,86	97,14
6.	Compliance with module characteristics	5	100
Average Percentage of Validation Results (%)			**93,26**

Comments and suggestions provided by material experts as well as revisions to

the waste pollution module can be seen in Table 4.

The reference list source has been added years

No.	Komentar dan Saran	No.
Comments and Suggestions	Revision	1.
Instructions for using the module need to be fixed in the 4th line section, which is the numbering section of the learning syntax	Learning syntax numbering, has been fixed by using parentheses, such as (1), (2), (3), and so on.	2.
In part of learning activity 1, there are several	Some	3.

Field Practitioner Validation Results

In summary, the validation results of field practitioners can be seen in Table 5, which shows that the waste pollution module is very valid with a percentage of 95.12%.

95,12

In each learning activity, the number	**Instructions for the formation of even-numbered groups**	**4.**	**Need to fix command sentence section for explicit**

of groups should be even			**and reflective discussion section**
Command sentences in the explicit and reflective discussion sections were corrected	5.	Check the accuracy of the bibliography in the manuscript	The accuracy of the bibliography in the manuscript has been checked
2.	Kemenarikan modul	4,33	86,67
No.	Indicator	Average	Percentage (%)
1.	Suitability of the material to the learning objectives	5	100
	2.		**Accuracy of the material**

Formative Revision Results

After module validation by experts, formative revisions were then carried out through 3 stages, namely *one-to-one trial, small group trial,* and *field trial.* This trial aims to determine student responses to the presentation of learning, 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 for students who had taken Basic Environmental Science courses, especially Waste Pollution material.

Uji Coba Perorangan (*One-To-One Trial)*

Conducted on 3 students, consisting of students with high, medium, and low academic abilities. The results of individual trials obtained an average value of 96.84%

(very practical) (Table 6).

96,84*One-To-One Trial Results Summary*

5	**100**	**3.**
Depth of material	5	100
4. 100	Material up-to-date Average Percentage of Validation Results (%)	5 100
	Rerata Nilai (%)	**96,84**

Small Group Trial

This trial was conducted on 8 students who had covered the Basic Environmental Science course. The results of this trial obtained an average value of 92.5 (very practical) (Table 7).

92,50*Group Trial Results*

No.	**No.**	**Comments and Suggestions**
Revision	1.	In modules, the scope must be there for behavior for behavior within a certain period of time
In the module, the scope of behavior to be achieved has been added,	2.	Lecturers must test students in implementing modules. For example, a teacher creates a scenario of throwing wrappers in front of the class

namely behavior change during learning		to find out the reaction of students.
In the module added examples of explicit activities when lecturers throw garbage in front of the class and students are instructed to leave comments	3.	Source listed year
The reference list source has been added years	Mahasiswa ke-4	96,84
5.	Mahasiswa ke-5	No.
Indicator	Average	Percentage (%)
1.	Presentation of learning	5
100	2.	Module highlights

4,33	86,67

c. *Field Trial*

Field trials were conducted on 15 students. The results of this trial obtained an average value of 92.5 (very practical) (Table 8).

	92,14	
3.	**Convenience of modules for use**	**4,86**
97,14	4.	Ease of modules to understand
4,83	96,67	Average Percentage of Validation Results (%)
95,12	Mahasiswa ke-3	98,95
4.	Mahasiswa ke-4	90,53
5.	No.	Student
Average Value (%)	1.	1st Student
95,29	2.	2nd Student
98,95	3.	3rd Student
95,79	Average Value (%)	96,84
10.	Mahasiswa ke-10	100
11.	No.	Student
Average Value (%)	1.	1st Student
86,32	2.	2nd Student
96,84	3.	3rd Student
100	4.	4th Student
	96,84	5.

Next is the practicality test result of the class used for implementation. The

results of user responses by 20 students are very practical. More details can be seen in Table 9.

	80,53	
5th Student	**90,53**	**6.**
6th Student	75,79	7.
7th Student	95,79	8.
8th Student	97,90	Average Value (%)
92,50	Mahasiswa ke-4	65,33
5.	Mahasiswa ke-5	No.
Student	Average Value (%)	1.
1st Student	100,00	2.
2nd Student	88,42	3.
3rd Student	98,95	4.
4th Student	90,53	5.
5th Student	81.05	6.
6th Student	95,79	7.
7th Student	91,58	8.
8th Student	87,37	9.
9th Student	89,47	10.

10th	100	
Student		11.
11th	78,95	
student		12.
11th	95,79	
student		13.
13th	94,74	
Student		14.
14th	97,89	
Student		15.
	15th Student	**91,58**

Module Validity Test by Teaching Material Experts

Before the module is tested, it is important to test the validity of the module by a teaching material expert (Seplus, et al., 2017). The percentage of validation results from teaching material experts is 93.26%, which shows that the module is classified as very valid (Akbar, 2013) in terms of content feasibility, presentation components, language, graphic feasibility, module content design, and in accordance with module characteristics.

The waste pollution module with the ADI model gets a percentage of 92.50% in terms of the feasibility of the contents of the module, which means it is very valid. This module meets the material coverage criteria because of the completeness, breadth, and depth of material in accordance with CPMK, sub CPMK, and learning objectives. The existence of learning materials that are specifically packaged according to learning objectives will make it easier for students to learn thoroughly (Riyadhi et al., 2009). This module also meets the latest and contextual criteria because this module was developed in accordance with the development of science, especially the development of the latest issues regarding waste pollution in 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 Malang landfill; and the examples given come from the surrounding environment. This contextual learning module is important to develop because it can improve students' conceptual understanding (Uslima, dkk., 2018; Dewi &; Primayana, 2019).

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 module also meets the supporting criteria for material presentation including images, videos, and QR codes; phenomena for apperception at the beginning of the chapter; practice questions; answer key; reference; *numbering;* and naming tables and figures. This module also fulfills the completeness of presentation, starting from the beginning, the core part (learning activities with ADI learning syntax), and the end. This presentation component is important in a module because it can make the module easier to understand and interesting for students (Ghirardini, 2011).

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. This language component is important to be adjusted to the conditions of students because language will affect student understanding of learning material (Finegan, 2008).

The graphic feasibility component includes module size, *Cover* Module and Content Design Modules (Layout, Typography, and Illustration) (BSNP, 2014). This module has met the graphic eligibility criteria of 87.37%, which means it is valid. This is because the graphic aspect of the module is adjusted to BSNP (2014). This module is supported by attractive colors and cover design illustrations. This can clarify the concept. The attractiveness of illustrations will support the harmony of the modules written, so that it will attract students in learning (Nadarrini, 2016).

Compliance with module characteristics. This module meets the criteria of independent learning (*self instructional*). In this module there is a competency map, which explains CPMK, sub CPMK, and objectives explained at the beginning of each chapter, learning materials presented according to the context of the task and student environment, illustrations that support the clarity of learning materials, practice questions and instruments to evaluate the level of mastery of one's own material. In accordance with Sepjal (2013) that feasible modules can be used for independent learning, i.e. have clear objectives, pay attention to individual differences, enable systematically organized learning, utilize various media, allow active participation by students, and have a good evaluation strategy. Modules that meet these criteria can provide remedial instruction for students who have not yet achieved their learning objectives. Students can also be given time to complete learning as they wish, so that learning materials can be enjoyed and students get a satisfying learning experience

(Salandanan, 2009).

This module also meets the criteria of complete unity (*self contained*) to achieve three CPMKs contained in one module, so that students can learn the learning material thoroughly. Modules that have complete unitary criteria are prepared for the achievement of learning objectives. Modules cover a wide range of relevant materials and sources (Lim, 2016). This module can also be stand-alone (*stand alone*). The module is independent of other media. All additional material is integrated through the module through coding *QR* and web addresses written in modules and accessible to students. Modules that meet these characteristics will facilitate learning for students because students have received complete information from this module, even without accessing other teaching materials, such as textbooks (Guido, 2014).

This module also has customizing characteristics (*adaptive*), compiled based on the latest research data at the Supit Urang Malang landfill that is actual and in accordance with current circumstances. Adaptive learning modules are important to be developed to achieve an effective learning system (Yang, et al., 2013) and also have a positive impact on student engagement in learning (Malach, dkk., 2016). Easy to use modules (*user friendly*) because it uses simple and easy to understand language, according to opinion Simui dkk. (2017) that the easy-to-use module has presentation content and *Layout* a good, interactive language, and structured based on real situations.

Module Validity Test by Material Experts

The material validation test aims to obtain approval from material expert validators on the suitability of the content of the module material to the needs (Riyadhi, 2009). The material on a good module is usually sorted by topic, chronological, place, cause and effect, logical structure, problem-centered, or following a spiral sequence (Depdiknas, 2008). The module material validation sheet consists of several assessment indicators, namely material coverage, material accuracy, as well as up-to-date and contextual (BSNP, 2014). The results of the module validity test by expert validators of 100%, show that the waste pollution module with the ADI model is very valid (Akbar, 2013).

This module that has been developed meets the criteria for material coverage. The material is arranged in accordance with the learning objectives, meeting the completeness, breadth, and depth of the material. The subject matter in this module is

material on the concept of waste, the impact of waste pollution, and handling environmental problems due to waste. In addition, there are also special materials to empower critical thinking, environmental awareness, and environmental behavior. This material is important considering that environmental learning should not only be a concept, but also implemented in community life to foster an attitude of caring for the environment (Sueb, et al., 2019), environmental awareness (Sueb, et al., 2020), and environmental cleanliness (Sueb, et al., 2019). This module also meets the accuracy of the material as well as the up-to-date and contextual aspects. The module meets the aspects of the recency of examples, especially from the results of research at the Supit Urang Malang landfill.

Module Validity Test by Field Practitioners

The module validation sheet by field practitioners consists of several assessment indicators, namely the presentation of learning, the attractiveness of the module, the ease of the module to use, and the ease of the module to understand (BSNP, 2014). The results of the module validity test by field practitioner validators amounted to 95.12%, showing that the waste pollution module with the ADI model was very practical (Akbar, 2017).

The waste pollution module with the ADI module fulfills the elements of learning presentation with a percentage of 100%, which is very practical. Modules assessed *student centered* and can be used in an integrated manner in learning. Active learning can improve performance, help in gaining knowledge, and achieve student understanding (Sasikumar, 2014).

This module meets the criteria for module attractiveness with a percentage of 86.67%, which is very practical because the module display design is able to display student interest in learning, the module content can motivate and arouse student interest in learning, and the images presented are clear with appropriate captions. The display on the module plays a role in reducing student boredom in the module (Kurniawati, 2012).

This module meets the criteria for ease of module to use 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; *Font* and spaces; there is a sub CPMK clearly written in the module; modules use sentences that do not cause double meanings; learning activities and illustrations in the module facilitate learning; module content

can be linked to daily activities; and can be learned well. Thus, this module helps students. This is the main characteristic of the module (Depdiknas, 2008).

The module meets the criteria of ease to understand with a percentage of 96.67%, which is very practical because the module uses language that is easy to understand, learning activities in the module help students find concepts, questions are provided in accordance with the concepts studied, concepts are clarified with appropriate illustrations or pictures, evaluation of activities is clearly written, and the module content is useful for students. Good modules provide communicative, unambiguous language, correct grammar, and clear questions (Daryato, 2014).

Practical Test of Waste Pollution Module with ADI Model

Practicality is related to the ease of use of teaching materials in the learning process (Son, et al., 2018). Teaching materials are said to be practical if they can be used to implement learning logically, continuously, and not much problem (Sukardi, 2011). Modules are said to be practical if users, namely field practitioners (lecturers) and students, assess that modules can and are easy to use (Plomp, dkk., 2013).

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 is done to determine student responses to the presentation of learning, the attractiveness of modules, the ease of modules to use, and the ease of modules to understand (BSNP, 2014). This phase consists of *one-to-one trial, small group trial,* and *field trial.* The results of the module practicality test at the three stages are very practical, so that the module can be used for the implementation stage.

After the implementation stage, the modules developed were also reassessed for their practicality 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 showed a percentage of 80.53%, which is very practical (Akbar, 2017). This is because the module has fulfilled the components of learning presentation, module attractiveness, ease of module to use, and ease of module to understand. 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 (Depdiknas, 2008).

CONCLUSION

The waste pollution module with the ADI model developed has met the validity aspect based on validation by expert validators of teaching materials, materials, and field practitioners. This module has also fulfilled the practical elements of the results of formative revision trials and the results of user (student) response questionnaires.

The suggestion given is that the waste pollution module can be added to the results of research in various landfills and also polling stations; garbage pollution modules can be developed in the form of interactive media connected to Android to make users more attractive; and modules can be developed in digital form such as e-modules so that the use of modules is more practical.

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