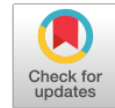


## Research Article

# Developing an integrated biology module for students' environmental attitude instruments



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### ABSTRACT

The development of modules based on environmental attitudes has been initiated but has not yet been integrated with instruments. This research aims to develop learning biology material and test the instruments' reliability in improving students' environmental attitudes. This development research uses the 4D model by Thiagarajan (1974). Field testing was conducted involving 150 students of Senior High School 1 of Caringin – West Java, Indonesia. The data collection instruments using an expert validation sheet and students' environmental attitudes sheet. Experts validation involved material, instructional design, and character education expert. Indicators for measuring environmental attitudes use the Environmental Attitude Scale (EAS), which consists of four subscales that refer to Ugulu (2013). According to EAS, the students' environmental attitudes are shown on the Eigen values of the four factors measured. The data analysis was performed using descriptive statistics. The results showed that the suitability aspects of material design and character education followed the average values of 90, 78, and 88 respectively. Meanwhile, Eigen values for environmental awareness factors (5,718); attitudes towards recovery (4,683); attitudes towards recycling (3,512); environmental consciousness and behavior (2,285). While Cronbach Alpha coefficients 0.81. Thus, the instruments integrated into module development carried out in this study are very capable of measuring student environmental attitudes. This study recommends the use of modules in developing students' environmental attitudes.



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## INTRODUCTION

The rate of ecosystem changes caused by human activities has tended to increase in the last ten years (Bellard, Bertelsmeier, Leadley, Thuiller, & Courchamp, 2012; Hanjra & Qureshi, 2010; Pramova et al., 2019; Seebacher & Franklin, 2012). This phenomenon is not only in Indonesia but also globally in almost all countries (Karataş, 2016; Sadhu, Garg, & Kumar, 2018; Thakur, 2016). Some of the massive changes that have occurred include land-use change, climate change (Gu et al., 2017; Yang et al., 2014), overexploitation of resources (Irfan & Alatawi, 2019; Mialhe et al., 2016), and the pollution index (Orlins & Guan, 2016; United Nations Environment Programme, 2017; Wiessner et al., 2014). These various environmental problems harm the

balance of the ecosystem and have the potential to threaten biodiversity (Rajalakshmi, 2016). Many researchers believe that these problems originate at the same point (Gifford, Steg, & Reser, 2012; Nelson & Ryan, 2015; Ntanos, Kyriakopoulos, Arabatzis, Palios, & Chalikias, 2018; Seebacher & Franklin, 2012). Human behavior that tends to be destructive and exploitative is strongly indicated as a source of environmental problems (Bellard et al., 2012; Kurz, Gardner, Verplanken, & Abraham, 2015; Thomas & Watters, 2015), so researchers believe that building morality and constructive attitudes is a one of the best solution (Karataş & Karataş, 2016).

Environmental morality is closely related to philosophical and biological considerations about the relationship between humans and their habitat and other organisms around them (Hossain & Ali, 2014; Nelson & Ryan, 2015). (Gifford et al., 2012; Nori, Signore, & Bonifacci, 2018) states that human thought patterns and behavior cannot be separated from the philosophical considerations that characterize his life. In a civilized society, moral considerations direct humans to re-analyze various right or wrong thoughts about their behavior towards the environment (Tuncay, Yilmaz-Tuzun, & Tuncer-Teksoz, 2011). It must be realized that the quality of individual and social life is very dependent on how their ethics is towards the environment (Keles, 2012). The expansion of ethics that includes the relationship between humans and the environment must be an integral part of human philosophy (Nelson & Ryan, 2015; Zalta, Nodelman, Allen, & Anderson, 2015).

The results show that there is a significant positive relationship between understanding ecocentric morality and environmental ethics, although statistically, there is no significant relationship between understanding moral and environmental ethics which is not anthropocentric (Nelson & Ryan, 2015; Palmer, Mcshane, & Sandler, 2014; Washington, Taylor, Kopnina, Cryer, & Piccolo, 2017). This study's findings support the argument that environmental ethics, which extends moral considerations beyond humans, is needed to address many environmental problems (Tuncay et al., 2011). Based on the various definitions above, it needs to be realized that environmental management carried out by humans currently is not following environmental attitudes (Rajalakshmi, 2016).

An excellent environmental attitude is essential in balancing nature. Someone with a right attitude is indicated to protect the environment around him (Hudha, Husamah, & Rahardjanto, 2019; Septian, Ruhimat, & Somantri, 2016). One effort that can be applied to improve students' environmental attitudes is developing student character integrated into all activities at school. For example, the teacher can make some rules that must be obeyed by students and will punish those who break the rules. Other examples include being a good role model for students; providing the right motivation related to how to protect the environment; and provide enlightenment to students with the meaning of morals and all matters relating to morals are activities that can be applied to build character (Fatimah, 2014; Maunah, 2016).

However, the efforts made by many researchers are still partially explored. Some of what has been done include exploring students' environmental care, integrating environmental values, and several other things related to the curriculum, such as applying a learning model based on environment and conservation. Meanwhile, the development of media integrated with the measurement of environmental awareness has not been done much. This study aims to develop a character-based biology module and measure its effectiveness in improving students' environmental attitudes. This development module can be a breakthrough in implementing environmental education that is more dynamic and contextual with everyday life realities.

## METHOD

This development research was conducted at State Senior High School 1 of Caringin, Bogor - West Java, Indonesia, with 150 students as subjects. The research was conducted from May to August 2019. This study's development model was 4D by Thiagarajan, Semmel, and Semmel (1974). Product development includes an expert assessment stage and development testing. The material developed in the module is biodiversity, which is integrated with character-based assessment instruments. The character-based assessment referred to refers to students' attitudes towards the environment. The module validity test includes the assessment of material experts, learning design experts, and character education experts. The percentage conversion of the assessment refers to Arikunto (2010) (Table 1).

Table 1. Validation criteria toward biology material development based character education

Range score	Criteria
76 – 100	Very high
51 – 75	High
25 – 50	Moderate
0 – 25	Low

The analysis stage is carried out by working on the data collected using the instrument. The product's effectiveness is seen based on the students' environmental attitudes after using the module in the learning process. The environmental attitude measurement instrument refers to the environmental attitude scale (EAS) (Ugulu, Sahin, & Baslar, 2013). The attitude rating scale includes four subscales: (1) environmental awareness; (2) attitude towards recovery; (3) attitudes towards recycling; (4) environmental awareness and behavior.

## RESULTS AND DISCUSSION

The defined stage reveals the fact that character integration has not been patterned in the learning process. Moreover, students' character and attitudes towards the environment are still not planned and measured in an integrated module. Miharja, Kusumawardana, and Setiawan (2020) and Suryawati, Suzanti, Suwondo, and Yustina (2018) state that strengthening the character and attitude of caring for the environment needs to be initiated and designed with the right pattern. Adjustment of content and criteria in competency standards and basic competencies also needs to be done in formulating the integration of character and environmental care attitudes (Moreira et al., 2020; Utami, Amalia, Prayitno, Prihandini, & Pradana, 2019). The results of these preliminary observations recommend a competency analysis (core and basic competence) to performance indicators. In this case, the analysis was carried out on the material of biodiversity.

The results of need analysis at the define stage are used as the basis for developing and designing integrated module products. The module design is tailored to meet and answer predetermined needs. The design stage is carried out by determining the topic, sharpening teaching indicators and objectives, designing student learning activities, and developing independent learning evaluation instruments. Learning materials are made and designed according to the characteristics to be developed. According to Binkley et al (2012); de Bie, Wilhelm, and van der Meij (2015), and Dwyer, Hogan, and Stewart (2014), creativity is used to determine the right idea in determining the appropriate concept for the product to be made.

Module development is carried out through a series of expert validation tests. The validity test is intended to determine the module's reliability and feasibility if used in the learning process. Several components that focus on the material expert validator's assessment include the material suitability, clarity of objectives and indicators, coverage and depth of material, the accuracy of concepts, examples, and references (Table 2).

Table 2. Recapitulation of material suitability by expert lecturers

Aspect	Validator 1		Validator 2	
	Average Score	Criteria	Average score	Criteria
The suitability between material and basic competency	83	Very high	100	Very high
The clarity of objectives and indicators of the learning material	100	Very high	83	Very high
Depth and width of the material (the scope of material)	83	Very high	100	Very high
The accuracy of concepts, definitions, and facts	100	Very high	83	Very high
The accuracy of examples, cases, and facts	83	Very high	83	Very high
The accuracy of reference	100	Very high	83	Very high

The results of the material suitability analysis, as in Table 2, show that the suitability of the material with an average value of 90 (very good). The validation results note that the content presented and the learning materials developed are in-depth and in line with curriculum needs. On the other hand, the module's material is presented communicatively and straightforwardly to help students understand the concept. Some researchers stated that the material presented communicatively could help students to avoid misconceptions. Moreover, students' motivation was also reported to have increased significantly.

Design suitability and module feasibility were reviewed based on color selection, layout determination, and attractiveness (Table 3). The analysis results show that the suitability aspect of the experts' design components is at an average score of 78 (good). These results reveal that the choice of images, illustrations, fonts, layouts, and consistency is correct and appropriate. Moreover, the module display is also considered very attractive. Quality and attractive designs can attract students to study the material (Ardan, 2016). Some suggestions for improvement or improvement of learning material before being tested have been made based on experts' validation.

Table 3. Recapitulation of suitability design taken from expert lecturers

Aspect	Average	Criteria
Colour composition	83	Very high
Layout	67	High
Attractiveness	83	Very high

Strengthening character values is an advantage that is integrated into the development of this module. The five elements of character included in the module include religious, honesty, responsibility, communicative, and environmental concerns. The analysis of the suitability of the character education aspects, as described in Table 4, shows an average score of 88 (very good). These results are indicated to strengthen the character of students. According to some experts, character education that is integrated into teaching materials will positively impact building student behavior so that the teaching and learning process becomes more effective (Lee, 2009; Smith, 2013).

Table 4. Recapitulation suitability scores on character education given by experts

Aspect	Average	Criteria
Religious	87	Very good
Honest	80	Very good
Responsible	100	Very good
Communicative	87	Very good
Environmental concerns	87	Very good

The module's dissemination is limited to students of State Senior High School 1 of Caringin, Bogor, West Java. The module's effectiveness in strengthening the character of environmental care is measured using the EAS instrument, which consists of four factors (Ugulu et al., 2013). The results of the measurement of the four factors are presented in Table 5.

Table 5. Results about factor structures and loadings of the EAS

Items	F1	F2	F3	F4
<i>Factor I (Environmental Awareness)</i>				
The primary purpose of tree planting is to beautify the environment in terms of aesthetics	0.665			
Since the environment can clean itself, human waste does not cause a problem.	0.661			
Instead of spending money on historical places, it is more advantageous for us to build luxurious roads.	0.587			
Some species are unnecessary for the environment.	0.565			
The government should give permission for building, on touristic purpose, in national parks and forests.	0.563			
The media news about polluted seas, rivers and lakes are exaggerated.	0.557			
The extinction of the insects such as flies is useful for environment.	0.541			
Nature renews itself with substance cycle. Therefore, recycling helps economy only in terms of time.	0.537			
The best way to build houses is to dry up the wetlands and build there.	0.535			
I do not think that recycling works as much as it is said.	0.530			
It is meaningless to buy paper bags instead of nylon bags given for free in the markets.	0.527			
People have the right to make changes in nature for meeting their needs.	0.521			
A land does not have desertification problem if it is surrounded on three sides by sea.	0.517			
Money can be saved by buying drinks in plastic bottles since drinks in glass bottles are expensive.	0.495			
I am curious about how the natural events occur.	0.475			
<i>Factor II (Attitudes Towards Recovery)</i>				
Using rechargeable batteries instead of disposable batteries supports recycling.		0.685		
Giving old clothes to the people in need supports recycling.		0.653		
We should throw the used batteries and bottles into the appropriate trash bins.		0.631		
Using old newspapers for packing supports recycling.		0.615		
Shopping only as much as needed is an important step in recycling.		0.588		
I believe that we should be economical for environment.		0.575		
We should use both sides of white papers to support recycling.		0.543		
For saving energy, I turn off the lights in my house when they are not used.		0.540		
<i>Factor III (Attitudes Towards Recycling)</i>				

Items	F1	F2	F3	F4
I can go from door to door to teach people recycling.			0.658	
I separate waste materials in my house for recycling.			0.641	
I feel sad when I see people throwing away objects that can be recycled.			0.618	
When I buy a product I pay attention whether its case is recyclable.			0.576	
It makes me happy when people recycle used bottles, cans and paper.			0.531	
<i>Factor IV (Environmental Consciousness and Behavior)</i>				
For a livable environment, I can work voluntarily for a long time if needed.				0.641
I do not waste water while I am brushing my teeth.				0.626
I prefer environmentally harmless products even if they are more expensive.				0.610
I participate in environmental projects.				0.586
My friends know me as a sensible person towards environment.				0.543
I talk with people around me on environmental matters.				0.502
I can reutilize the back sides of used papers if possible.				0.487

Table 6. Factor names, Eigen values and variance of factors

Factor Names	Eigen values	Variance of factors
Environmental awareness	5.718	14.521
Attitudes towards recovery	4.683	12.275
Attitudes towards recycling	3.512	8.588
Environmental consciousness and behavior	2.285	7.972

More specifically, the four environmental care factors (Table 6) have Eigenvalues of 5.718 (environmental awareness) and 4.683, 3.512, and 2.285, respectively, for attitude towards recovery, attitude towards recycling, and environmental consciousness and behavior. The first factor consists of fifteen indicators that refer to students' environmental awareness, such as tree planting, environmental cleanliness, the importance of species present in an environment, protection of forests and national parks, and cultural and economic aspects of an environment. Meanwhile, the second factor tends to lead to students' efforts in supporting the restoration of the surrounding environment, such as the use of rechargeable batteries, the use of used clothes and newspapers, to the use of two sides of the paper as an effort to reduce paper waste and efficiency. The third factor consists of indicators that measure students' attitudes towards the issue of recycling used goods. Indicators that fall into this third factor include active participation in recycling, such as sorting out waste that can be recycled and not. Moreover, the fourth factor is specified as behavior towards the environment, characterized by several essential indicators such as voluntary work and active participation in environmental campaigns.

In this study, for determining whether the EAS items are consistent with each other or not, frequently used Cronbach's alpha internal consistency coefficient was calculated. For this purpose, a series of reliability analyses were performed for each factor. Table 8 summarizes factor, number of items, and reliability value of each factor (Ugulu et al., 2013). Cronbach's alpha coefficient of the EAS was found as 0.81. Following related literature, the EAS can be regarded as a reliable and valid instrument to measure students' environmental attitudes.

Table 7. Factor names, Eigen values and variance of factors

Factor Names	Cronbach's Alpha
Environmental awareness	0.80
Attitudes towards recovery	0.75
Attitudes towards recycling	0.72
Environmental consciousness and behavior	0.70
The whole instrument	0.81

According to some views, students-as individuals- always try their best in every activity and have a strong commitment and willingness to protect their environment (Nurtian & Aminatun, 2019). Aliman, Budijanto, Sumarni, and Astina (2019) and Jack (2013) states that attitude is an important aspect that can affect various aspects of life. These impact the formation of an accepting attitude that allows individuals to understand the consequences of their behavior. In the long term, students can build confidence, increase self-confidence, trust in others, and have the courage to make independent decisions (Dada, Eames, & Calder, 2017).

On the other hand, some researchers also consider that attitudes have the same position as morality. Attitude is said to be a series of actions rooted in thinking to produce a specific action. Based on this definition, it can be seen that in the context of morality, there is a habitual desire. As a result, he can take actions with ease, without much deliberation or forethought. So important is the role of morality in student life so that students' actions or behavior towards the environment can be based on environmental attitudes (Nurtian &



Aminatun, 2019). Goodman (2018) stated that moral logic could influence a person's perspective, in this case, on how he treats the environment around him. Those statements are in line with (Tuncay et al., 2011), which states that moral thinking on the environment determines a process that determines good or bad actions in protecting the environment.

## CONCLUSION

The results showed that the Integrated Biology module was effective in improving students' environmental attitudes. Thus, this teaching material can be categorized as feasible, practical, and useful for the Biology learning process in Senior High Schools. This study recommends the use of an integrated module of character values in developing students' environmental attitudes. This study also recommends that teachers innovate in developing learning modules that are more attractive, effective, and efficient in developing environmental attitudes.

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