Assessing Students' Knowledge, Attitudes, and Environmental Behavior Related to Global Warming and Its Impact on The Marine and Coastal Environment: An Instrument-Making

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Abstract. Global warming has been a serious problem faced by the world for hundreds of years. The main cause is human activity. With the impact of global warming increasingly felt, especially in marine and coastal areas, environmental knowledge, attitudes, and behaviour need to be instilled in humans to overcome this problem. The success of education in instilling these things needs to be measured with a valid instrument. The purpose of this study was to develop an instrument to measure environmental knowledge, attitudes and behaviour related to global warming and its impact on the marine and coastal environment. This study consists of content validity involving 5 validators, then empirical validity testing and reliability testing involving 129 students. The results of the study showed that expert assessments stated that the developed instrument was valid. The results of the empirical validity test and reliability test also stated that the instrument was valid and reliable for use. This shows that the instrument can be used to measure environmental knowledge, attitudes and behaviour related to global warming and its impact on the marine and coastal environment.

1 Introduction

Global warming is a global problem that is faced by the world today. Global warming is the increase in the average temperature of the earth, both the atmosphere, oceans and even land, which is caused by the increasing concentration of greenhouse substances in the atmosphere [1]. Global warming causes various problems, especially climate change, which is being felt at the present time [2]. The Intergovernmental Panel on Climate Change (IPCC) stated that humans are the dominant cause of global warming observed since the mid-21st century [2,3].

As the party responsible for the increase in temperature on earth, humans should pay attention to every activity they do and how it impacts the environment. Among the human activities that cause the increasing temperature on earth is the excessive use of fossil fuels as an energy source [4]. Among the gases produced in the combustion of fossil fuels is carbon dioxide (CO2), which is said to be the main factor causing global warming [5,6]. Changes in CO2 concentration cause changes in the earth's temperature [4,7,8].

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The increase in temperature that occurs on Earth caused by global warming includes various elements, including the atmosphere, land, and even the ocean. As is known, the earth is mostly made up of oceans where 70% of the earth's surface is covered by ocean areas [9]. With its vast area and supported by its characteristics of having a large specific heat, the sea is able to absorb large amounts of heat so that it is able to support the world's climate [10,11]. Along with the increasing temperature on Earth due to the increasingly severe impact of global warming. Among the impacts of global warming on marine areas are the destruction of marine ecosystems [12], increased stratification [13], increase and expansion of tropical storm occurrences [14], and various other negative impacts, which are still being researched further by world researchers.

Indonesia is one of the largest maritime countries in the world [15] because Indonesia has a much larger ocean area than its land area [16]. Indonesia has 38 provinces [17], some of them are island provinces. One of the island provinces in Indonesia is the Riau Islands Province, whose territory consists of 96% ocean and 4% land [18]. As an archipelago, of course, the impact of global warming related to coastal areas and regions can be felt by the Riau Islands Province. Among them are the increase in sea surface temperatures, which causes sea levels to rise, and the reduction of chlorophyll-a levels [19]. Rising sea levels due to global warming also cause increased abrasion on the coastline [20,21].

Since humans are said to be the main actors responsible for the increase in temperature on earth in recent decades, one way to overcome the impact of global warming is to start from the formation of the human character itself. To overcome this, of course, an understanding of global warming or concepts related to global warming must be possessed from an early age, one of which is done through education at the junior high school level. This aims for junior high school students who have a mindset towards maturity and have a good conception of global warming, its causes, and its impacts on life. This is also done with the hope that students can form environmental attitudes and behaviours from themselves so that students can become agents of environmental change in the future.

To strengthen the concept of global warming itself, it should not be necessary to wait to be taught in a special chapter on global warming material, but can also be provided through materials related to the phenomenon of global warming such as those found in Science subjects. These materials include materials such as temperature and heat related to the increase in the earth's temperature and the increase in seawater volume, or materials on the interaction of living things and the environment related to the impact of global warming on the environment and living things. To what extent has learning in schools, especially science learning, provided an understanding of global warming and its impact on the environment? And to what extent has learned in schools, especially science learning, formed students' environmental attitudes and behaviour related to global warming? For this reason, measurements to determine how the knowledge of junior high school students in the island region is related to global warming and its impact on the marine and coastal environment and how students' environmental attitudes and behavior are related to global warming and its impact on the marine and coastal environment need to be carried out. To support these measurements, a valid and reliable instrument is needed, the results of which can provide a good picture of students' environmental knowledge, attitudes, and behavior related to global warming and its impact on the marine and coastal environment. Therefore, this study aims to develop a valid and reliable instrument to measure students' environmental knowledge, attitudes, and behavior related to global warming and its impact on the marine and coastal environment.

2 Methods

This research is a descriptive study with a quantitative approach. The study was conducted with the aim of measuring the validity and reliability of the measurement instrument for junior high school student's knowledge, attitudes, and environmental behaviour related to global warming and its impact on the marine and coastal environment. Validity and reliability tests were conducted on two types of questions, namely multiple-choice questions to measure aspects of knowledge and questionnaires to measure environmental attitudes and behavior. Before conducting validity and reliability tests, the instrument was first developed by conducting a literature review to determine the main indicators and then developing them into questions. The main indicators of the instrument developed [22,23,32–41,24,42–46,25–31] are as follows.

Table 1. Instrument indicators for aspects of knowledge, attitudes and environmental behavior of junior high school students related to global warming and its impact on the marine and coastal environment.

No.	Aspects	Indicators
1	Knowledge	1. Understanding the concept of global warming
		2. Knowledge of the Impact of Global Warming on the Marine Environment
		3. Knowledge of the Impact of Global Warming on the Coastal Environment
		4. Ability to analyze and evaluate problems related to global warming in the marine and coastal environment
		5. Awareness and action to overcome the impact of global warming
2	Attitude	1. Participation in environmental conservation activities
		2. Participation in Reducing carbon footprints
		3. Use of renewable energy
		4. Advocacy and Education
		5. Participation in environmental policies
		6. Environmental research and monitoring
		7. Attitudes towards Marine Resource Conservation
3	Environmental Behavior	1. Participation in environmental conservation activities
		2. Participation in Reducing carbon footprints
		3. Use of renewable energy
		4. Advocacy and Education
		5. Participation in environmental policies
		6. Environmental research and monitoring

This research was conducted through 3 research stages, namely:

2.1. Content validity test

A content validity test is a validity test that involves validators finding out how valid the instrument developed is before being tested in the field. This content validity test was conducted by involving 5 validators with scientific backgrounds in Physics Education and Biology Education. The validity test was conducted using a validity assessment instrument with the main assessment indicators covering 3 main aspects [47] as shown in Table 2.

Table 2. Main indicators of content validity test

No.	Indicators
1	Relevance and presentation
2	Language accuracy
3	Conformity with conceptual and operational definitions

Each indicator of the content validity test instrument shown in Table 2 above, is developed in several questions. Each question is presented with 4 answer choices as shown in Table 3.

Table 3. Rating scale for content validity items

Rating scale	Description
4	Very good
3	Good
2	Poor
1	Very poor

The data from the content validity test were analyzed using the Aiken Formula [48]. For validity tests involving 5 validations and validity test instruments that have 4 answer choices, the instrument is said to be valid if the V value ≥ 0.87.

2.2. Empirical validity and reliability test

Validity and reliability are two criteria that indicate how good an instrument is for use in research [49]. What makes measuring validity and reliability so important in developing an instrument is that validity and reliability show how appropriate an instrument is for measuring a particular variable and how consistent an instrument is so that the results of the measurements taken tend to be the same when carried out at different times, so that the results obtained can be generalized to other conditions [50]. Empirical validity and reliability tests were conducted involving 129 junior high school students. Data analysis was conducted using SPSS.

3. Results and Discussions

The results of this study will be presented for each test according to the research stages presented in the methods section.

3.1 Content Validity Test Results

As explained in the method section, the content validity test was conducted by involving 5 validators who were in accordance with the instrument being developed. The questions on the instrument were developed through the main indicators that had been determined. The distribution of the question items whose validity was tested is as follows.

Table 4. Grid of research instruments developed

No.	Aspects	Indicators	Item Numbers
1	Knowledge	1. Understanding the concept of global warming	1, 2, 3
		2. Knowledgee of the impact of global warming on the marine environment	4, 5, 6, 7
		3. Knowledge of the Impact of global warming on the Coastal Environment	8, 9, 10
		4. Ability to analyze and evaluate problems related to global warming in the marine and coastal environment	11, 12, 13
		5. awarenesss and action to overcome the impact of global warming	14, 15
2	Attitude	1. participationn in environmental conservation activities	1, 2, 3, 4
		2. participationn in reducing carbon footprints	5, 6, 7, 8
		3. Use of renewable energy	9, 10, 11
		4. Advocacy and Education	12, 13, 14
		5. Participation in environmental policies	15, 16, 17, 18
		6. Environmental research and monitoring	19, 20, 21, 22
		7. Attitudes towards Marine Resource Conservation	23, 24, 25
3	Environmental Behavior	1. Participation in environmental conservation activities	1, 2, 3
		2. Participation in reducing carbon footprints	4, 5, 6, 7, 8, 9, 10
		3. Use of renewable energy	11, 12, 13
		4. Advocacy and Education	14, 15, 16, 17, 18
		5. Participation in environmental policies	19, 20, 21, 22
		6. Eenvironmental research and monitoring	23, 24, 25

Based on the results of the content validity test that has been carried out, the instrument is declared valid for the three aspects of content validity assessment with the details of the results shown in Table 5 below.

Table 5. Results of content validity test

No.	**Indicators**	**V-Aiken**	**Category**
1	Relevance and presentation	0.98	**V**
2	Language accuracy	0.94	**V**
3	Conformity with conceptual and operational definitions	0.95	**V**

Description: **V** = Valid

The results above show that based on the results of the validator's assessment of the developed instrument, it is declared valid. This stage is an important stage to ensure that the developed instrument is in accordance with the purpose of using the instrument and the concept underlying the aspects to be measured through the instrument [51–53]. Content validity carried out by experts is a priority step in instrument development before the instrument is tested in the field [54,55]. Content validity can also provide insight into the preferences of experts regarding the instruments developed [56].

3.2 Results of empirical validity and reliability tests

Based on the validity and reliability tests carried out using SPSS, the following results were obtained.

3.2.1. Results of validity and reliability tests of knowledge aspect measurement instruments

For the knowledge aspect, the questions are presented in the form of multiple choices with a total of 15 questions. Based on the results of the validity and reliability tests conducted using SPSS, the following results were obtained.

Table 6. Results of the validity test of the knowledge aspect measurement instrument

No.	r calculated	r critical	significance	Description
1	0.365	0.1729	0.000	**V**
2	0.527	0.1729	0.000	**V**
3	0.344	0.1729	0.000	**V**
4	0.517	0.1729	0.000	**V**
5	0.556	0.1729	0.000	**V**
6	0.320	0.1729	0.000	**V**
7	0.461	0.1729	0.000	**V**
8	0.413	0.1729	0.000	**V**
9	0.399	0.1729	0.000	**V**
10	0.638	0.1729	0.000	**V**
11	0.498	0.1729	0.000	**V**
12	0.496	0.1729	0.000	**V**
13	0.309	0.1729	0.000	**V**
14	0.464	0.1729	0.000	**V**
15	0.335	0.1729	0.000	**V**

A question item is said to be valid if r calculated > r critical or if significance < 0.05 [57]. Based on the results shown in Table 6, it can be said that all question items are declared valid so that all question items can be tested for reliability. Based on the reliability test carried out, the following results were obtained (Figure 1).

Reliability Statistics

Cronbach's Alpha	N of Items
.707	15

Figure 1. Screenshots of the results of the reliability test of the knowledge aspect measurement instrument.

A research instrument is said to be reliable if the reliability coefficient obtained is greater than 0.7 [58]. In Figure 1, it can be concluded that the knowledge aspect measurement instrument, apart from being valid, is also reliable for use because the reliability coefficient is 0.707.

3.2.2. Results of validity and reliability tests of attitude aspect measurement instruments

For the attitude aspect, the instrument is presented in a questionnaire with closed questions with a total of 25 questions. Based on the results of the validity and reliability tests conducted using SPSS, the following results were obtained.

Table 7. Results of the validity test of the attitude aspect measurement instrument

No.	r calculated	r critical	significance	Description
1	0.186	0.1729	0.034	**V**
2	0.307	0.1729	0.000	**V**
3	0.181	0.1729	0.040	**V**
4	0.413	0.1729	0.000	**V**
5	0.353	0.1729	0.000	**V**
6	0.428	0.1729	0.000	**V**
7	0.377	0.1729	0.000	**V**
8	0.549	0.1729	0.000	**V**
9	0.510	0.1729	0.000	**V**
10	0.433	0.1729	0.000	**V**
11	0.430	0.1729	0.000	**V**
12	0.416	0.1729	0.000	**V**
13	0.479	0.1729	0.000	**V**
14	0.472	0.1729	0.000	**V**
15	0.460	0.1729	0.000	**V**
16	0.658	0.1729	0.000	**V**
17	0.596	0.1729	0.000	**V**
18	0.523	0.1729	0.000	**V**
19	0.438	0.1729	0.000	**V**
20	0.563	0.1729	0.000	**V**
21	0.458	0.1729	0.000	**V**
22	0.545	0.1729	0.000	**V**
23	0.418	0.1729	0.000	**V**
24	0.575	0.1729	0.000	**V**
25	0.327	0.1729	0.000	**V**

Based on the results shown in Table 7, it can be seen that all questions are declared valid because r calculated > r critical or sig. < 0.05. Therefore, all question items can be included in the reliability test, the results of which are shown in Figure 2.

Reliability Statistics

Cronbach's Alpha	N of Items
.834	25

Figure 2. Screenshots of the results of the reliability test of the attitude aspect measurement instrument.

Based on the results shown in Figure 2, it can be concluded that the instrument is not only valid but also reliable for use in measuring students' attitudes regarding global warming and its impact on the marine and coastal environment because the reliability coefficient is 0.834, which is greater than 0.7.

3.2.3. Results of validity and reliability tests of environmental behavioral measurement instruments

Similar to the attitude aspect, the measurement instrument for the environmental behavior aspect is also presented in the form of a questionnaire with closed questions with a total of 25 questions. Based on the results of the validity and reliability tests carried out using SPSS, the following results were obtained.

Table 8. Results of the validity test of the attitude aspect measurement instrument

No.	r calculated	r critical	significance	Description
1	0.736	0.1729	0.000	**V**
2	0.669	0.1729	0.000	**V**
3	0.692	0.1729	0.000	**V**
4	0.516	0.1729	0.000	**V**
5	0.284	0.1729	0.000	**V**
6	0.188	0.1729	0.000	**V**
7	0.589	0.1729	0.000	**V**
8	0.514	0.1729	0.000	**V**
9	0.331	0.1729	0.000	**V**
10	0.441	0.1729	0.000	**V**
11	0.514	0.1729	0.000	**V**
12	0.652	0.1729	0.000	**V**
13	0.541	0.1729	0.000	**V**
14	0.668	0.1729	0.000	**V**
15	0.719	0.1729	0.000	**V**
16	0.679	0.1729	0.000	**V**
17	0.742	0.1729	0.000	**V**
18	0.658	0.1729	0.000	**V**
19	0.436	0.1729	0.000	**V**
20	0.507	0.1729	0.000	**V**
21	0.726	0.1729	0.000	**V**
22	0.773	0.1729	0.000	**V**
23	0.633	0.1729	0.000	**V**
24	0.565	0.1729	0.000	**V**
25	0.613	0.1729	0.000	**V**

Table 8 shows that all questions are valid because r calculated > r critical or sig. < 0.05. Based on these results, all question items can be tested for reliability. The results of the instrument reliability test are as follows.

Reliability Statistics

Cronbach's Alpha	N of Items
.919	25

Figure 3. Screenshots of the results of the reliability test of the attitude aspect measurement instrument.

The results shown in Figure 3 state that the instrument is reliable. This is because the reliability coefficient is 0.919, greater than 0.7. This shows that the instrument is valid and reliable and used to measure students' environmental behaviour related to global warming and its impact on the marine and coastal environment.

If content validity is an important initial step in developing an instrument, then empirical validity and reliability are also important steps that must be taken before the instrument is used. In a study, a variable cannot be measured or determined empirically without a valid and reliable instrument [59]. This process also ensures that the instrument is developed in accordance with the theoretical standards of a measurement instrument [60]. In other words, a good instrument is a valid and reliable instrument that is developed based on established criteria [61]. A valid instrument can measure research variables with accurate results without bias and a reliable instrument will produce consistent results in the same situation [62]. The

results shown by the study indicate that the instrument was developed in accordance with the theory and meets the standards of an instrument to measure students' environmental knowledge, attitudes, and behavior related to global warming and its impact on the marine and coastal environment.

4. Conclusion

Based on the research conducted, it can be concluded that based on the content validity test conducted with 5 validators, the instrument is declared valid for all indicators, both relevance and presentation, language accuracy, and conformity with conceptual and operational definitions. The results of the empirical validity test and reliability test also show that the instrument is valid and reliable for use in measuring aspects of knowledge, attitudes, and environmental behavior of junior high school students related to global warming and its impact on the marine and coastal environment.

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