

**INTERNATIONAL COLLABORATION
RESEARCH REPORT**

REPORT

**DEVELOPING OF CLIMATE CHANGE TEACHER MATERIAL TO FACILITATE
SHIFTING ATTITUDE OF SCIENCE PRE-SERVICE TEACHER**



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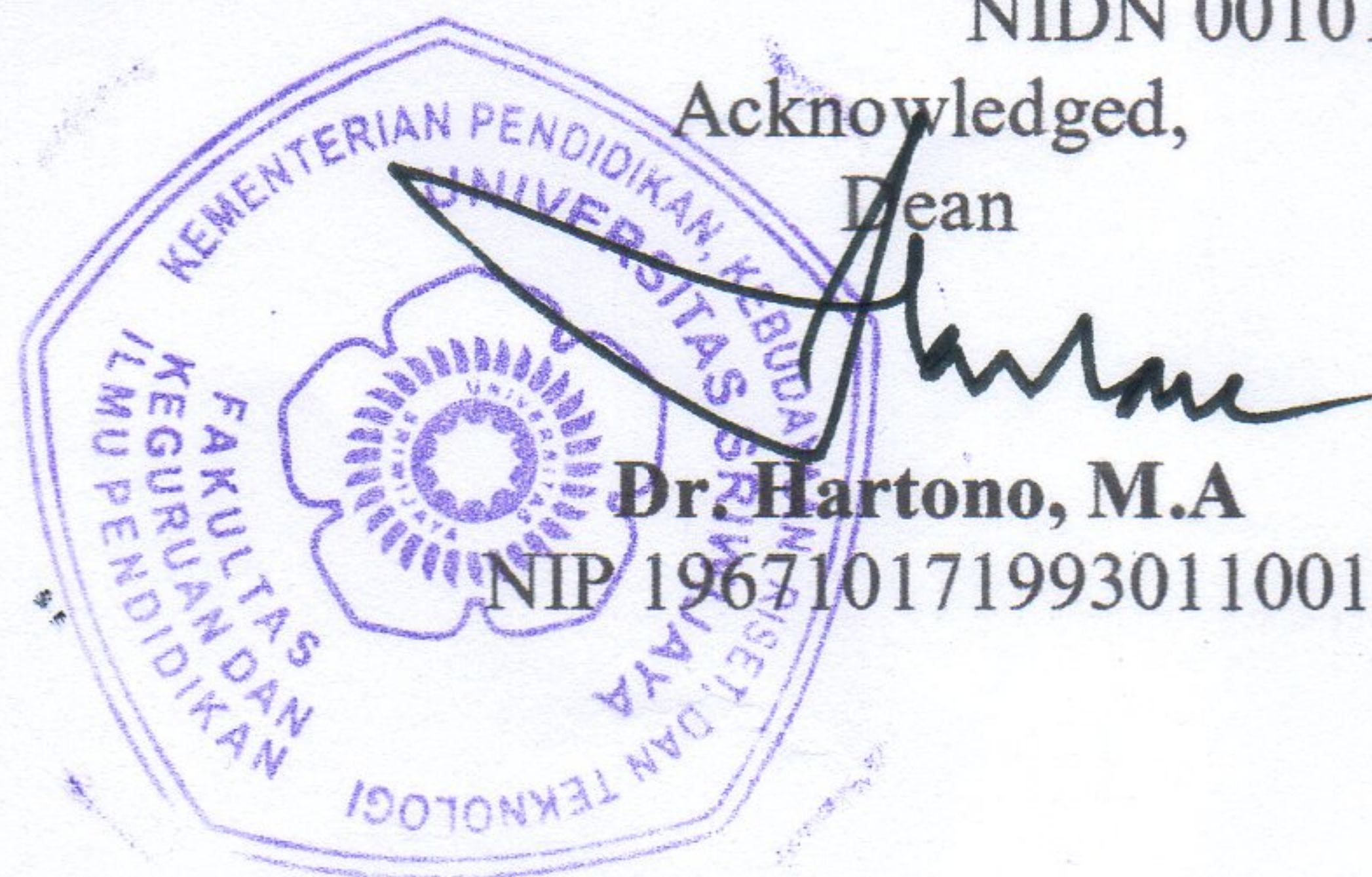


Table of Content

| | Page |
|-----------------------|------|
| Chapter I | 1 |
| Introduction | 1 |
| Chapter II | 4 |
| Literature Review | 4 |
| Chapter III | 7 |
| Research Method | 7 |
| Result and discussion | 9 |
| Anova test result | 14 |
| Reference | 20 |

CHAPTER I

INTRODUCTION

Nowadays climate change is considered as a huge global problem and a primary threat for planet earth in which the change itself has caused a global warming (Korir, 2019; Higde et al., 2017). The increase in global average surface temperature is now considered most likely due to an increase in greenhouse gas (GHG) emissions and an increase in the concentration of greenhouse gases at the same time in the atmosphere (Korir, 2019; Fortner et al., 2000), and scientific evidence showed that human activities have made a significant contribution to global warming in terms of the concentration of carbon dioxide, methane and nitrous oxide, and the anthropogenic accumulation of greenhouse gases in the atmosphere (Islam et al., 2013; Ogallo, 2010).

This change has prompted the value and social paradigm to overcome the root causes of climate change by changing the peoples' perception and attitude toward the climate change. Understanding attitudes to climate change is an educational challenge today. Attitude is a cognitive representation of people's conclusions after evaluating actions, events, ideas or other things called "attitude objects". Attitude has the ability to predict behavior when the behavior being measured is specific behavior, for example behavior about renewable energy, install solar panel and so on (Arikan & Gunay, 2021). Several studies on attitudes to climate change have been conducted, one of which was a study by Borhstede et al., (2013). They compared the attitudes of respondents in 2005 and 2010. It showed that the number of respondents who liked new technology to reduce emissions was lower in 2010 than in 2005 due to changes in life style. A study by Wei et al., (2014) on respondent health professionals in China found that respondents believed climate change can occur at global and local levels (74.8%) and that greenhouse gas emissions are the causes of climate change. However, in terms of their specific knowledge about greenhouse gases and sources were still not enough. The majority of respondents stated that they were willing to change their attitude towards climate change, but the points were still limited, so it can be concluded that there is a gap between respondents' perceptions and actions towards climate change. Meanwhile, Dias et al., (2020) the obtained data from a study showed that respondents from Portugal believed in climate change and the education factor played a role in contributing to this level of belief about 11.8%. In the first year of study on attitudes, behavior, beliefs, and pre-service teacher students attitude towards climate change, it was found that the knowledge and attitudes of pre-service teacher students

towards climate change were not very qualified, pre-service teacher students tended to have low concern for climate change because they thought that the subject is not part of what they have to teach in class.

This study is also strengthened by the results of study on the perceptions and attitudes of teachers and pre-service teacher students on climate change which was still low in various countries such as the Philippines, Indonesia, Finland (Competente, 2019; Meilinda et al., 2017; Tolppanen et al., 2020). The results showed that by using various variables and different measuring instruments, the same attitude towards climate change was obtained for pre-service teachers in the three countries. Researchers conducted various studies to overcome the low perceptions and attitudes of teachers and pre-service teacher students on climate change, including through the development of modules or online teaching materials as done by Oliveira et al., (2021) for students in Jordan and Syria for distance learning, there is no description of the specific characteristics of the developed module because this module was developed to meet the need for distance learning only. Meanwhile Levrini et al., (2021) developed a learning module aimed at developing future scaffolding skills with a module design consisting of five stages, namely encountering the focal topic and futures thinking; engaging with scientific conceptual-epistemological and inquiry activities; bridge activities; future-oriented activities; and action competence activities. Another study by Baker et al., (2013), they developed a climate change module for 4th graders in the form of pictures. Patrick et al., (2020) had developed a module that explores the impact of climate change on the diversity of living things and ecological functions based on local people's perceptions. The results of the study showed that this module increases a good perception of climate change. Based on the results of the studies above, facilitating perceptions, behaviors, beliefs, and attitudes in the form of modules is very possible to improve the attitudes of students while the perceptions, behaviors, beliefs, and attitudes of each person with different socio-demographic areas would produce different things. Therefore, the formulation in this study is how to shape the climate change teaching material module based on perception, behavior, belief, and attitude that is developed for pre-service teachers in Indonesia.

Development of Teaching Materials Teaching materials are components in the curriculum that contain content that must be delivered to students. This component has various forms of messages in which some are in the form of facts, concepts, principles/rules, procedures, problems and so on. This component acts as the content or material to be delivered in the learning process. When learning will be delivered, education should understand the content of the message to be conveyed and the characteristics of the students who receive the

material. There are two forms of learning materials, namely: 1. The designed learning materials contain all components completely including the learning objectives and competencies to be achieved, learning activities that must be carried out by students, learning materials, learning activities, illustrations/media, exercises, and assignments 2. Incomplete designed learning materials arranged in the form of learning resources, learning media, teaching aids, maps and globes as well as 2D or 3D models of certain lessons. The order of how to present learning materials in teaching materials is to have an orderly sequence, gradual presentation, from simple to complex, from easy to difficult, mutually reinforcing in each part of the chapter, attracting students' interest and attention, challenging and stimulating students to read the teaching material.

CHAPTER II LITERATURE REVIEW

Attitude to the issue of change in the surrounding environment is one of the most important attitudes to map learning strategies in the classroom, particularly concerning the issue of climate change. Attitude towards the environment consists of beliefs, influences and behavioral impulses that describe activities or problems related to the environment (Christensen & Knezek, 2015). Attitude is also defined as a psychological tendency expressed by certain groups to see the degree of their perspective on certain issues. (Seroussi et al., 2019). Attitude can be defined as an expression of respect and care for environmental issues and subsequently to develop a personality to overcome these problems (Roberta, 2009). As a result, attitudes can be defined as feelings, perceptions and views of a group on the issue of environmental change and behavior to adapt to environmental changes and behavior to reduce the negative impacts of those changes. Climate change attitudes can stimulate environmentally friendly behavior (Ajzen, 1991; Kollmuss & Agyeman, 2002). Pessimistic attitudes or views on global environmental issues will hinder the desire to behave in an environmentally friendly manner (Sahin et al., 2021). The pessimistic attitude towards environmental issues is indicated by the perspective of the people who believe that there is no direct influence of climate change and the community believes that the quality of the environment will remain the same in the future (Roberta, 2009). Kollmuss & Agyeman (2002) explain the causes that encourage people to behave environmentally friendly as shown in Figure 1

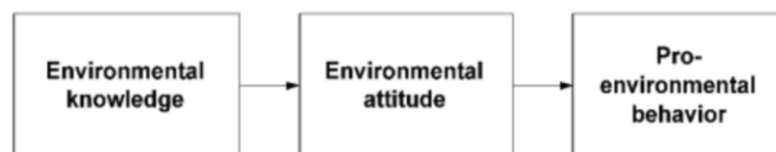


Figure 1. The causes that encourage people to behave environmentally-friendly

Based on Figure 1, the cause of people behaving environmentally friendly (proenvironmental behavior) is an attitude towards environmental issues (environmental attitude). People who care about environmental issues will intend to behave in an environmentally friendly manner. People, who are aware that the activity of burning garbage will have a bad impact on the environment, will carry out recycling activities as another alternative to reduce the bad impact. Figure 1. The causes that encourage people to behave environmentally-friendly Behavior The Definition of Behavior The government already has a strong infrastructure in the form of systems, rules, and policies in dealing with the threat of climate change. The problem that needs to be considered at this time is the existence of

individuals related to active roles that have a real impact through behavior. (Clayton et al., 2015) explain the relationship between solving the problem of climate change and human behavior.

Behavior will be the main source in understanding the extent to which a rule, technology or system can run effectively and well. The behavior of individuals who are not able to adapt to technology, systems or rules that have been built previously to deal with a threat of climate change, then the existence of the regulatory infrastructure becomes ineffective. Behavior is the result of a variety of experiences and human interactions with their surroundings, which appear as knowledge, attitudes, and behaviors. Behavior is an individual's response to an external or internal stimulus (Notoatmojo, 2010). Behavior is a function of individual and environmental characteristics. Individual characteristics include various variables such as motives, values, traits, personality, and attitudes that interact with each other and then interact with environmental factors in determining behavior. Environmental factors have great power in determining behavior, even greater power than individual characteristics (Azwar, 2010) A Framework Theory of Planned Behavior The theory of planned behavior is developed from the Theory of Reasoned Action (Fishbein and Ajzen, 1980; Fishbein and Ajzen, 1975). This development is deemed necessary because the original model had limitations in predicting behavior of persons having incomplete will or want (Ajzen, 1991). Ajzen (1998) added a construct, namely perceived behavioral control, that did not exist in the theory of reasoned action model. Intentions are assumed to capture the motivational factors that influence behavior, and indicate how hard people are willing to try and how much effort they plan to exert in order to perform the behavior (Fishbein and Ajzen, 1991). Intentions to engage in certain behaviors are influenced by (a) attitudes toward behavior, namely beliefs about certain behaviors and their consequences, (b) subjective norms, namely normative expectations (according to applicable norms or principles) from other people who are considered important by the doer of certain behaviors, (c) perceived behavioral control, an understanding of the ease or difficulty in displaying certain behaviors. The theoretical framework that is commonly used to predict and explain pro-environmental behavior is the Theory of planned behavior. Belief The definition of belief in climate change issues Efforts to understand individual behavior is a central topic in the field of psychology. One of the widely-used theories is the Theory of Reasoned Action (TRA) proposed by Fishbein and Ajzen (1975) (Ajzen & Driver, 1991).

The theory of planned behavior (Ajzen, 2001; Ajzen & Driver, 1991) is based on the assumption that humans are rational beings who use possible information to use for themselves systematically. Before taking an action, individuals will think about the implications or

intentions of their actions before deciding to perform the behavior or not (Ajzen, 1991: 184). This theory has emerged as one of the most influential and popular conceptual frameworks for studying human action (Ajzen, 2001). Briefly, according to the theory, human behavior is guided by three types of considerations: beliefs about possible consequences or other attributes of behavior (behavioral beliefs), beliefs about the normative expectations of others (normative beliefs), and beliefs about the existence of factors that may further or hinder behavioral performance (control beliefs) (Ajzen, 2001, 2002; Ajzen & Driver, 1991). To better understand the measurement of attitudes, subjective norms, and behavioral control, the concept or its forming factors in the Theory of Planned Behavior is first reviewed/

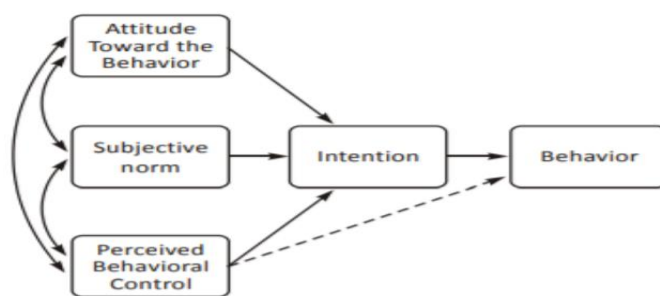


Figure 2. *Theory of Planned Behavior* (Source: Ajzen, 2005; p. 118)

Climate Change Literacy Framework The climate change framework used to define belief in climate change issues is based on the Climate Change Literacy Framework. Climate change literacy is part of Environmental Literacy which includes components of understanding, belief, and climate change behavior to mitigate climate change (Marzetta, 2017). It is critical for students and teachers to be Climate Change aware to take important decisions that stem from or impact on climate change and sustainability. The following figure 3 describes the components that make up the climate change literacy framework

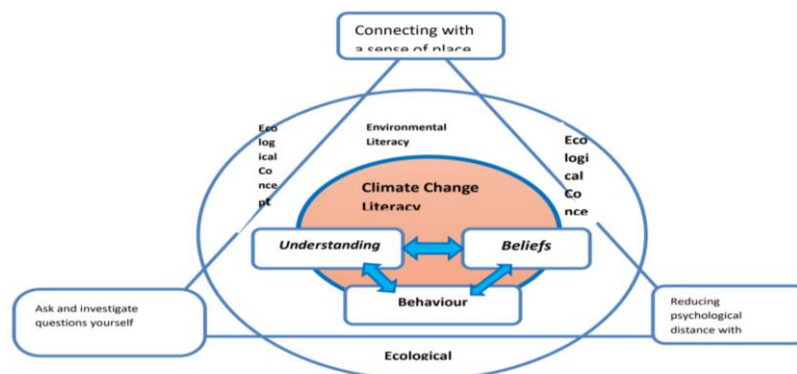


Figure 3. Learning Design Elements for Climate Change Literacy

CHAPTER III RESEARCH METHOD

This study is a multi-year research. In the first year the research method used was descriptive method, namely a method that describes the attitude, behavior, belief, and attitude of pre-service science teachers on the issue of climate change. The study was conducted in Indonesia from August-November 2021 with a total of 1,780 pre-service teachers from FORKOM (Communication Forum) members of the LPTK (Institute of Teacher's Education) in Indonesia from various study programs and majors. The instrument used in measuring attitudes, general views and behavior was a questionnaire containing statements with five choices of answers on a Likert scale. The instrument used to measure attitudes towards climate change issues was adapted from Sahin et al., (2021); Sharples (2010); Tuncer Teksoz et al., (2014). The instrument was in the form of a questionnaire consisting of a favorable statement and an unfavorable statement containing 5 answer choices on a Likert scale as shown in Table 1.

Table 1. Likert scale favorable and unfavorable statements based on DeVellis, (2017)

| <i>Answer Choices</i> | <i>Favourable statement</i> | <i>Unfavourable statement</i> |
|-----------------------|-----------------------------|-------------------------------|
| Strongly Agree | 5 | 1 |
| Agree | 4 | 2 |
| Neutral | 3 | 3 |
| Disagree | 2 | 4 |
| Strongly Disagree | 1 | 5 |

Behavioral measurement aimed to see how often pre-service science teachers engage in behaviors that reduce the impact of climate change. The instrument used to measure behavior was using a questionnaire containing 5 answer choices, namely always, often, sometimes, seldom and never as in Table 2.

Tabel 2. The instrument used to measure behavior was using a questionnaire

| Statements | Answer Choices | Favourable statement | Unfavorable statement |
|------------|----------------|----------------------|-----------------------|
| True | Very Sure | 10 | 1 |
| | Sure | 9 | 2 |
| | Neutral | 8 | 3 |
| | Unsure | 7 | 4 |
| | Very Unsure | 6 | 5 |
| False | Very Sure | 5 | 6 |
| | Sure | 4 | 7 |
| | Neutral | 3 | 8 |
| | Unsure | 2 | 9 |
| | Very Unsure | 1 | 10 |

The data collection was carried out by distributing online questionnaires via the following link https://uncp.co1.qualtrics.com/jfe/form/SV_b26mjdz4Jh6gRku. The data was then analyzed descriptively to see how much attitude, general view, behavior and beliefs of pre-service science teachers were to the issue of climate change. The results of the data were then categorized into five groups, namely very low, low, average, high and very high. The basis for grouping the data results used the guidelines from Azwar (2019) in Table 3.

Table 3. Data result categorization guidelines based on Azhar (2019)

| Categories | Criteria |
|------------|---------------------------------|
| Very Low | $X \leq M - 1,5SD$ |
| Low | $M - 1,5SD < X \leq M - 0,5SD$ |
| Average | $M - 0,5 SD < X \leq M + 0,5SD$ |
| High | $M + 0,5SD < X \leq M + 1,5SD$ |
| Very High | $X > M + 1,5SD$ |

In the second year, the research method used is material development study using ADDIE mode. ADDIE is one of the most frequently used models in instructional design because it is more efficient and more effective (Aldoobie, 2015). ADDIE stands for Analysed, Design, Develop, Implemented and Evaluated (Moradmand, 2014). The stages of the ADDIE learning model design are shown in Figure 4. The analyzed phase or the analysis phase is a phase to analyze the needs of students, analyze material and other things needed (Moradmand et al., 2014). The design phase is a phase that determines the form of teaching materials to be developed, the content to be included and the curriculum to be referred. The development phase is the phase of making and building the entire contents of the textbook in accordance with a predetermined design that includes attitude behavior, belief, and student teacher behavior towards climate change. Evaluated phase is the stage of evaluating the effectiveness of teaching materials by testing them on a group of prospective teacher students and seeing the impact on their learning (Moradmand et al., 2014; Ahmadigol, 2015).

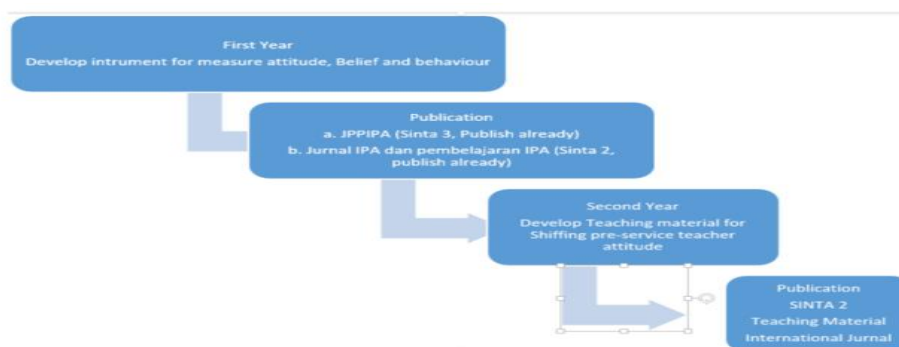


Figure 4. Research Roadmap

RESULT AND DISCUSSION

In this second year, a study was conducted on the value orientation of prospective mathematics and non-mathematics teacher students. Several studies divide values into three groups related to environmental issues and climate change, namely 1) egoistic results; 2) social or societal outcomes and; 3) Biospheric outcomes (Kempton, 2005), but recent research on values shows that values can be divided into four groups based on ESVS (Hicks et al., 2015; Marshall et al., 2018), namely: 1) biosphere values are values based on processing biological and scientific values; 2) Altruistic, namely values that are based on intrinsic values and traditional community owners of cultural heritage); 3) Egoistic, namely values based on respecting lifestyle, economy, welfare and health); 4) Hedonic, namely a value orientation based on spiritual, artistic and aesthetic values.

The research results that have been achieved for the second year are textbooks with attached textbook drafts. Meanwhile, other data that was processed in the second year of research was the development of a value orientation to climate (climate change) and then connected the value orientation held with attitudes towards climate change. The data is categorized based on the categorization formula as shown in Table 4.

Table 4. Respondent categorization formula

| No | Interval nilai | Kategori |
|----|------------------------------|-------------------|
| 1 | $X < Mi - 1,5 SDi$ | H (0 – 18,910) |
| 2 | $Mi - (1,5 SDi) \leq X < Mi$ | E (18,92 -25,22) |
| 3 | $Mi \leq X < Mi + (1,5 SDi)$ | B (25,23 – 31,52) |
| 4 | $Mi + (1,5 SDi) \leq X$ | A (31,53 – 40) |

Description:

- (1) Hedonic (appreciation of spiritual, artistic, and esthetic opportunities)
- (2) Egoistic (appreciation of health benefits, wisdom and way of life, economic values, wellbeing, and lifestyle)
- (3) Biospheric (appreciation of biodiversity, and scientific heritage benefits)
- (4) Altruistic (appreciation of intrinsic values, and Traditional Owner heritage),

Based on the data obtained, the teachers were grouped into 2 large groups, namely mathematics and non-mathematics teachers, non-mathematics teachers were grouped into 4 scientific fields, namely classroom teachers, social studies teachers, science teachers and language teachers with the number of each teacher being 55, 177, 85, 55, 97 people. Based on Table 1, the grouping of teachers can be seen in Table 5.

Table 5. Teacher value orientation grouping

| Teacher Grouping | Score | Categorization |
|-------------------|--------|----------------|
| Mathematics | 25,56 | Biospheric |
| Language | 24,31 | Egoistic |
| Science | 26,,46 | Biospheric |
| Social | 24,67 | Egoistic |
| Classroom Teacher | 25,47 | Biospheric |

Examples of questions from the climate change value orientation can be seen in Table 6

Tabel 6. Example question of value orientation

| No | Task | Choice |
|----|--|--|
| 1 | Saya menghargai langit biru karena | Langit yang berwarna biru terlihat menarik dan menyegarkan saat di pandang Langit biru merupakan program yang dicanangkan pemerintah dan berdampak baik bagi kesehatan manusia Dengan langit biru yang bebas polusi masyarakat Langit biru merupakan indikator atmosfer yang bebas polusi |
| 2 | Saya menghargai beberapa jenis tanaman karena... | Beberapa tanaman dapat menjadi penghias dan memperindah taman-taman Beberapa tanaman tertentu mengandung khasiat obat yang berkhasiat menyehatkan badan kita Beberapa tanaman tertentu paling efektif dalam menyerap karbon di atmosfer Beberapa tanaman liar tertentu dimanfaatkan masyarakat tradisional untuk konsumsi dan keperluan lainnya walaupun belum terbukti secara ilmiah |

Several examples of questions related to attitude were developed in the form of a 5-scale Likert scale in the form of 1) to strongly agree; 2) to agree; 3) to quite agree; 4) to disagree and 5) to disagree is as shown in Table 7.

Tabel 7. Examples of questions related to attitude towards the issue of climate change

| No | Item Pertanyaan | SS | S | CS | KS | TS |
|----|--|----|---|----|----|----|
| 1 | Setelah satu hari digunakan, jaket yang saya pakai akan segera saya masukan ke binatu/ mesin cuci | | | | | |
| 2 | Sebagai orang yang terakhir meninggalkan ruangan, saya akan mematikan lampu | | | | | |
| 3 | Saya membiarkan peralatan bertenaga listrik (TV, Printer, stereo) dalam keadaan siaga (kabelnya selalu tersambung ke sumber listrik) | | | | | |
| 4 | Ketika meninggalkan ruangan lebih dari empat jam saya akan mematikan pendingin ruangan (kipas angin/AC) | | | | | |

- 5 Untuk jaran yang dekat (ditempuh dalam waktu 15 menit berjalan kaki) daya lebih suka berjalan kaki atau naik sepeda daripada naik kendaraan bermotor
-

The results of the comparison of the values and attitudes of the two groups of mathematics and non-mathematics teachers can be seen in the following processed data

4.2.1 Normality Test

This research collects data which is secondary data so that before testing the hypothesis using the ANOVA test, a normality test must be carried out first. The purpose of carrying out the normality test is to see whether the data is normally distributed or not. The results of the normality test of the research data are presented as follows.

4.2.2 Hasil Uji Homogeneity of Variances

The homogeneity test aims to determine the existence of the same variance in the samples used. If the samples used do not have the same variance, then the ANOVA test cannot be carried out. The decision criteria are taken based on the probability value, where if the probability (sig.) $> \alpha$, then it is accepted and rejected, and vice versa if the probability (sig.) $< \alpha$ is rejected and accepted. If accepted, it shows that there is no difference in the variance value of value and attitude or the sample has the same variance, whereas if accepted it shows that there is a difference in the variance value of value and attitude or the sample has a different variance. The results of the Homogeneity of Variances test are as follows.

Tabel 8 Uji Homogeneity of Variances language Teacher group

| B1 | N | Subset for alpha = 0.05 | | | |
|------|----|-------------------------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 |
| 1 | 10 | 15.70 | | | |
| 2 | 45 | | 22.53 | | |
| 3 | 41 | | | 27.98 | |
| 4 | 2 | | | | 32.50 |
| Sig. | | 1.000 | 1.000 | 1.000 | 1.000 |

Means for groups in homogeneous subsets are displayed.

- a. Uses Harmonic Mean Sample Size = 6.186.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Tabel 9 Uji Homogeneity of Variances Kelompok Guru Mata Pelajaran IPA

| B2 | N | Subset for alpha = 0.05 | | | |
|------|----|-------------------------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 |
| 1 | 3 | 15.33 | | | |
| 2 | 13 | | 22.85 | | |
| 3 | 39 | | | 28.23 | |
| 4 | 2 | | | | 32.00 |
| Sig. | | 1.000 | 1.000 | 1.000 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.274.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Tabel 10 Uji Homogeneity of Variances Kelompok Guru Mata Pelajaran Guru Kelas

| B4 | N | Subset for alpha = 0.05 | | | |
|------|----|-------------------------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 |
| 1 | 10 | 16.80 | | | |
| 2 | 75 | | 23.12 | | |
| 3 | 85 | | | 27.89 | |
| 4 | 7 | | | | 33.71 |
| Sig. | | 1.000 | 1.000 | 1.000 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 14.928.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Tabel 11. Uji Homogeneity of Variances Kelompok Guru Mata Pelajaran Matematika

| B5 | N | Subset for alpha = 0.05 | | | |
|------|----|-------------------------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 |
| 1 | 4 | 15.00 | | | |
| 2 | 23 | | 23.17 | | |
| 3 | 25 | | | 28.48 | |
| 4 | 3 | | | | 33.67 |
| Sig. | | 1.000 | 1.000 | 1.000 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 5.999.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Based on the test table of homogeneity of variances, the sig value is > 0.05 so it can be concluded that the five sample groups have the same variance. This result is shown by the test results that the probability (sig.) $>$ than 0.05 so that it is accepted, which means that there is no difference in the value of the variance of the five groups of teachers or the sample has the same variance

4.2.3 Hasil Uji ANOVA

Hypothesis testing was proposed to test the effect of value on attitude for each group of language, science, social studies, classroom teachers and mathematics teachers. The hypothesis testing carried out in this study used the ANOVA test where the ANOVA model was used to determine whether there was an effect of value on attitude for each group of teachers. Testing using the ANOVA test uses the help of SPSS software. The results of the ANOVA test are as follows.

Tabel 12 ANOVA test language Teacher group

| | Sum of Squares | Df | Mean Square | F | Sig. |
|----------------|----------------|----|-------------|---------|------|
| Between Groups | 1568.418 | 3 | 522.806 | 151.316 | .000 |
| Within Groups | 324.776 | 94 | 3.455 | | |
| Total | 1893.194 | 97 | | | |

Tabel 13 Uji ANOVA Kelompok Guru Mata Pelajaran IPA

| | Sum of Squares | df | Mean Square | F | Sig. |
|----------------|----------------|----|-------------|--------|------|
| Between Groups | 724.858 | 3 | 241.619 | 99.053 | .000 |
| Within Groups | 129.282 | 53 | 2.439 | | |
| Total | 854.140 | 56 | | | |

Tabel 14 Uji ANOVA Kelompok Guru Mata Pelajaran IPS

| | Sum Squares | of df | Mean Square | F | Sig. |
|----------------|-------------|-------|-------------|---------|------|
| Between Groups | 1271.924 | 3 | 423.975 | 151.086 | .000 |
| Within Groups | 216.076 | 77 | 2.806 | | |
| Total | 1488.000 | 80 | | | |

Tabel 15 Uji ANOVA Kelompok Guru Mata Pelajaran Guru Kelas

| | Sum Squares | of df | Mean Square | F | Sig. |
|----------------|-------------|-------|-------------|---------|------|
| Between Groups | 2141.140 | 3 | 713.713 | 233.409 | .000 |
| Within Groups | 528.996 | 173 | 3.058 | | |
| Total | 2670.136 | 176 | | | |

Tabel 16 Uji ANOVA Kelompok Guru Mata Pelajaran Matematika

| | Sum Squares | of df | Mean Square | F | Sig. |
|----------------|-------------|-------|-------------|---------|------|
| Between Groups | 987.316 | 3 | 329.105 | 111.739 | .000 |
| Within Groups | 150.211 | 51 | 2.945 | | |
| Total | 1137.527 | 54 | | | |

Based on the ANOVA table it can be concluded that the results of testing the hypothesis there is no significant difference in performance between each group of teachers in attitude and value. This result is indicated by the calculated F value of each teacher group and the probability value (sig.) which means that H_0 is accepted, where $<$ and the probability (sig.) > 0.00 . The value from the ANOVA table and the value is 2.32 so that $2.245 < 2.32$ and the probability value (sig.) in the ANOVA table of 0.108 while the significant level is $\alpha = 0.10$ so that $0.108 > 0.10$, then H_0 is accepted and H_a is rejected. Thus this study rejects the hypothesis H_a . This fact shows that there is no difference in attitude between teachers and orientation values.

4.2.4 Uji Tukey HSD

Tukey's test is also called the honest significant difference test (BNJ) or honestly significant difference (HSD), introduced by Tukey (1953). Tukey's test was used to compare

all pairs of treatment means after the Analysis of Variance test was carried out. The criteria for testing the hypothesis are as follows. If the probability (sig) < 0.05 then it is rejected, it means that there is a difference between the values and attitudes of the teacher group. If the probability (sig) > 0.0 then accepted rejected, meaning that there is no difference between the value and attitude of the teacher group.

Tabel 17 Uji Tukey HSD language teacher group

| (I) B1 | (J) B1 | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|--------|--------|-----------------------|------------|------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | -6.833* | .650 | .000 | -8.53 | -5.13 |
| | 3 | -12.276* | .656 | .000 | -13.99 | -10.56 |
| | 4 | -16.800* | 1.440 | .000 | -20.57 | -13.03 |
| 2 | 1 | 6.833* | .650 | .000 | 5.13 | 8.53 |
| | 3 | -5.442* | .401 | .000 | -6.49 | -4.39 |
| | 4 | -9.967* | 1.343 | .000 | -13.48 | -6.45 |
| 3 | 1 | 12.276* | .656 | .000 | 10.56 | 13.99 |
| | 2 | 5.442* | .401 | .000 | 4.39 | 6.49 |
| | 4 | -4.524* | 1.346 | .006 | -8.05 | -1.00 |
| 4 | 1 | 16.800* | 1.440 | .000 | 13.03 | 20.57 |
| | 2 | 9.967* | 1.343 | .000 | 6.45 | 13.48 |
| | 3 | 4.524* | 1.346 | .006 | 1.00 | 8.05 |

*. The mean difference is significant at the 0.05 level.

Tabel 18 Tukey HSD test for science Kelompok Guru Mata Pelajaran IPA

| (I) B2 | (J) B2 | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|--------|--------|-----------------------|------------|------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | -7.513* | 1.000 | .000 | -10.17 | -4.86 |
| | 3 | -12.897* | .936 | .000 | -15.38 | -10.42 |
| | 4 | -16.667* | 1.426 | .000 | -20.45 | -12.88 |
| 2 | 1 | 7.513* | 1.000 | .000 | 4.86 | 10.17 |

| | | | | | | |
|---|---|---------|-------|------|--------|-------|
| | 3 | -5.385* | .500 | .000 | -6.71 | -4.06 |
| | 4 | -9.154* | 1.186 | .000 | -12.30 | -6.01 |
| 3 | 1 | 12.897* | .936 | .000 | 10.42 | 15.38 |
| | 2 | 5.385* | .500 | .000 | 4.06 | 6.71 |
| | 4 | -3.769* | 1.132 | .008 | -6.77 | -.77 |
| 4 | 1 | 16.667* | 1.426 | .000 | 12.88 | 20.45 |
| | 2 | 9.154* | 1.186 | .000 | 6.01 | 12.30 |
| | 3 | 3.769* | 1.132 | .008 | .77 | 6.77 |

*. The mean difference is significant at the 0.05 level.

Tabel 19 Uji Tukey HSD Kelompok Guru Mata Pelajaran Guru Kelas

| (I) B4 | (J) B4 | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|--------|--------|-----------------------|------------|------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | -6.320* | .589 | .000 | -7.85 | -4.79 |
| | 3 | -11.094* | .585 | .000 | -12.61 | -9.58 |
| | 4 | -16.914* | .862 | .000 | -19.15 | -14.68 |
| 2 | 1 | 6.320* | .589 | .000 | 4.79 | 7.85 |
| | 3 | -4.774* | .277 | .000 | -5.49 | -4.06 |
| | 4 | -10.594* | .691 | .000 | -12.39 | -8.80 |
| 3 | 1 | 11.094* | .585 | .000 | 9.58 | 12.61 |
| | 2 | 4.774* | .277 | .000 | 4.06 | 5.49 |
| | 4 | -5.820* | .688 | .000 | -7.60 | -4.04 |
| 4 | 1 | 16.914* | .862 | .000 | 14.68 | 19.15 |
| | 2 | 10.594* | .691 | .000 | 8.80 | 12.39 |
| | 3 | 5.820* | .688 | .000 | 4.04 | 7.60 |

*. The mean difference is significant at the 0.05 level.

Tabel 20 Uji Tukey HSD Kelompok Guru Mata Pelajaran Matematika

| (I) B5 | (J) B5 | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|--------|--------|-----------------------|------------|------|-------------------------|-------------|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | -8.174* | .930 | .000 | -10.64 | -5.70 |
| | 3 | -13.480* | .924 | .000 | -15.93 | -11.03 |
| | 4 | -18.667* | 1.311 | .000 | -22.15 | -15.19 |
| 2 | 1 | 8.174* | .930 | .000 | 5.70 | 10.64 |
| | 3 | -5.306* | .496 | .000 | -6.62 | -3.99 |
| | 4 | -10.493* | 1.053 | .000 | -13.29 | -7.69 |
| 3 | 1 | 13.480* | .924 | .000 | 11.03 | 15.93 |
| | 2 | 5.306* | .496 | .000 | 3.99 | 6.62 |
| | 4 | -5.187* | 1.049 | .000 | -7.97 | -2.40 |
| 4 | 1 | 18.667* | 1.311 | .000 | 15.19 | 22.15 |
| | 2 | 10.493* | 1.053 | .000 | 7.69 | 13.29 |
| | 3 | 5.187* | 1.049 | .000 | 2.40 | 7.97 |

*. The mean difference is significant at the 0.05 level.

Meanwhile the results of the textbook development are divided into 5 chapters, namely: Planet Earth and the atmosphere; Weather, climate and seasons; Greenhouse effect, greenhouse gases and global warming; Climate change; Climate change and the earth system; as well as mathematical modeling in the context of climate change. The sequence and content of the teaching materials developed can be seen in Figure 5

| DAFTAR ISI | |
|--|-----|
| DAFTAR ISI | ii |
| KATA PENGANTAR | iii |
| BAB 1 PLANET BUMI DAN ATMOSFER | 1 |
| 1.1 Matahari | 2 |
| 1.2 Planet Bumi | 6 |
| 1.3 Atmosfer | 8 |
| 1.4 Troposfer | 9 |
| 1.5 Stratosfer | 11 |
| 1.6 Mesosfer | 13 |
| 1.7 Termosfer | 14 |
| BAB 2 CUACA, IKLIM DAN MUSIM | 16 |
| 2.1 Cuaca | 17 |
| 2.1.1 Suhu atau Temperatur Udara | 19 |
| 2.1.2 Tekanan Udara | 22 |
| 2.1.3 Angin | 23 |
| 2.1.4 Kelembaban Udara | 27 |
| 2.1.5 Curah Hujan | 27 |
| 2.2 Musim | 29 |
| 2.3 Iklim | 30 |
| 2.3.1 Iklim Matahari | 30 |
| 2.3.2 Iklim Fisis | 33 |
| BAB 3 EFEK RUMAH KACA, GAS RUMAH KACA DAN PEMANASAN GLOBAL | 35 |
| 3.1 Efek Rumah Kaca | 36 |
| 3.2 Gas Rumah Kaca | 39 |
| 3.3 Pemanasan Global | 41 |

| DAFTAR ISI | |
|--|-----|
| DAFTAR ISI | ii |
| KATA PENGANTAR | iii |
| BAB 1 PLANET BUMI DAN ATMOSFER | 1 |
| 1.1 Matahari | 2 |
| 1.2 Planet Bumi | 6 |
| 1.3 Atmosfer | 8 |
| 1.4 Troposfer | 9 |
| 1.5 Stratosfer | 11 |
| 1.6 Mesosfer | 13 |
| 1.7 Termosfer | 14 |
| BAB 2 CUACA, IKLIM DAN MUSIM | 16 |
| 2.1 Cuaca | 17 |
| 2.1.1 Suhu atau Temperatur Udara | 19 |
| 2.1.2 Tekanan Udara | 22 |
| 2.1.3 Angin | 23 |
| 2.1.4 Kelembaban Udara | 27 |
| 2.1.5 Curah Hujan | 27 |
| 2.2 Musim | 29 |
| 2.3 Iklim | 30 |
| 2.3.1 Iklim Matahari | 30 |
| 2.3.2 Iklim Fisis | 33 |
| BAB 3 EFEK RUMAH KACA, GAS RUMAH KACA DAN PEMANASAN GLOBAL | 35 |
| 3.1 Efek Rumah Kaca | 36 |
| 3.2 Gas Rumah Kaca | 39 |
| 3.3 Pemanasan Global | 41 |

Figure 5. Content of teaching materials

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