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Personal factors shaping pre-service math and science teachers' attitudes: An SEM study

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ABSTRACT

Climate change demands urgent attention from both teachers and students. As pivotal agents of change, preservice teachers play a crucial role in shaping a generation that values and conserves the environment. This study investigated how academic background (mathematics/science vs. non-mathematics/science) influences preservice teachers' attitudes toward climate change and their value orientations. The study included 287 mathematics/science and 182 non-mathematics/science preservice teachers who completed a 50-item questionnaire. Structural Equation Modeling (SEM) was employed to analyze the gathered data. The findings indicated that academic background did not significantly influence preservice teachers' value orientations or attitudes toward climate change. This suggests the presence of other influential factors not examined in this study. Given these results, adopting a comprehensive, interdisciplinary approach to environmental education is imperative. Such an approach can better equip preservice teachers with the knowledge and skills needed to effectively engage students in understanding and addressing climate change. Further research should focus on identifying these additional influencing factors. This will enable educators to refine environmental education strategies, fostering a future generation that values and actively contributes to environmental stewardship.

Keywords: attitude, background, climate change, pre-service teacher, value orientation

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INTRODUCTION

Climate change is a major threat to planet Earth today. These changes cause global warming (Korir, 2019; Higde et al, 2017), alter the earth's vegetation (Theurillat & Guisan, 2001), and affect soil fertility levels (Brevik, 2013). They also increase the risk of flooding, disease, and natural disasters (Ranger et al., 2011; Peterson, 2000; Banholzer et al., 2014). Scientific evidence shows that human activities have significantly contributed to the increase in greenhouse gas (GHG) emissions, which are the main cause of global warming and climate change (Islam et al, 2013; Ogallo, 2010; Boon, 2009). Climate experts attribute the rise in global average temperatures to increased atmospheric greenhouse gas concentrations, mostly from anthropogenic sources such as combustion engines and power plants (Herman et al., 2017). This paradigm-shifting condition addresses the root causes of the previously discussed environmental problems, transitioning from a scientific paradigm to one based on attitude, value orientation, and other factors shaping behavior (Gupta, 2010).

Attitude is a cognitive representation formed after evaluating actions, events, ideas, or other "attitude objects" (Arikan & Gunay, 2021). Meanwhile, value orientation is the value held by a

person that forms the background of their behavior. In other words, a person's perception, attitude, and behavior are strongly influenced by the values they adhere to and value, based on dominant factors such as religion, scientific principles, or personal preferences (Kempton et al., 2005).

On environmental issues, attitudes are more influenced by values and knowledge, as highlighted in research by Marshall et al. (2019) on the influence of value orientation on responses to coral reef cases. This study showed that only egoistic values affected responses to coral reef cases. Another study by Engel et al. (2020) demonstrated a close relationship between value orientation and human knowledge of oceanic environmental conditions.

Other studies examining the effect of value orientation on attitudes and behavior include Bruskotter & Fulton (2008) on fishers in tourist areas, Ajitha & Sivakumar (2017) on the use of luxury cosmetics in India, Choe et al. (2017) on the consumption of local food by tourists in Hong Kong, are Fornara et al. (2016) on household energy management, Chaihanchanchai & Anantachart (2023) on the purchase of environmentally sustainable products (green products), and Ranne (2021) on fashion collection consumption. These studies showed no link between preservice teachers' background, value orientation, and attitude towards climate change, especially when comparing mathematics and science preservice teachers who received specific science lessons with non-mathematics and science preservice teachers.

Research on the relationship between background, value orientation and attitude of preservice teachers in the context of climate change is important. Although several studies have shown a close relationship between a person's values, attitudes, and behavior, in-depth studies are still needed because different contexts reveal different relationships. Tikka et al. (2000) state that the contextual environment affects what a person thinks, does, or feels. Therefore, this study aims to determine the relationship between background, value orientation, and attitudes among mathematics and science and non-mathematics and science preservice teachers on the issue of climate change. The findings could have implications for the content of lecture materials for preservice teachers in each study program. Adjusting these materials according to value-oriented tendencies could impact preservice teachers' attitudes toward climate change issues.

Value orientation refers to beliefs, attitudes, and principles guiding people in their behavior and decision-making. It is a fundamental aspect of a person's identity and outlook on life, influencing their attitudes toward social, political, and moral issues, including climate change and environmental issues. Value orientation is shaped by several factors, such as culture, religion, family upbringing, education, and life experiences.

Educational background is generally a strong predictor of belief in climate change. People with higher formal education tend to express higher levels of concern about climate change and the environment in general. Meanwhile, value is defined as a guide to living in the best way possible. Rokeach (1973) defines attitude as "an enduring belief concerning a desirable end-state of existence." From another perspective, value is seen as a marker of the standard of an act, a behavior guide, and a comparison between oneself and others, acting as a regulator of behavior patterns.

Values also form the basis of a person's cognitive structure, making them more enduring than attitudes (Kamakura & Novak, 1992). Value is an abstract principle that guides people in life and helps them adapt to their environment. Although some articles suggest that value is almost the same as attitude, the hierarchical relationship between values and environmental behavior is typically described as value → attitude → behavior (Homer & Kahle, 1988).

Several studies have found that value orientation determines attitude (Dietz et al., 1998; Schultz et al., 2000). Carman (1978) further states that value influences consumer behavior. Student attitudes toward science may be influenced by various factors, many of which likely reflect cultural differences and values (Smith et al., 2020). However, the relationship between values, attitudes, and behavior is very content-specific, meaning different contexts yield different relationships between values, attitudes, and behavior. Often, many other factors influence this relationship (Homer & Kahle, 1988). This research is important to conduct among teachers since teachers and parents are significant agents in shaping children's values and behavior (Bandura, 1986; Shaffer, 1994).

Climate change perceptions are critical to climate change mitigation because they increase

support for action and influence policy. Public engagement occurs when people believe climate change is a serious threat caused by human activities. Studies on attitudes toward climate change have focused on individual factors such as beliefs, knowledge, and attitudes. A recent study conducted in Australia in 2022 shows that climate change-induced extreme weather disasters and constant news cycles about global catastrophes have increased climate concerns among Australians. The vast majority (91%) of people aged 18-24 believe that climate change is occurring, and 75% are concerned about it (Ecker, 2022). A study conducted in France (Douenne & Fabre, 2020) focused on the connection between perceptions of climate change and attitudes toward policies, showing that respondents believe in anthropogenic climate change.

METHOD

Data on the background, attitude, and value orientation of pre-service teachers were collected through an online questionnaire. This questionnaire targeted pre-service teachers undergoing one year of professional education and residing in Sumatra and Java, the two most populated islands in Indonesia. The questionnaires were distributed via social media, email, and university contacts involved in teacher professional education. Supporting information such as demographic data, gender, and experience with climate change-related disasters (e.g., floods and droughts) was also collected. Similar methods were employed by Lange et al. (2014) in their research on consumer knowledge and behavior regarding food safety. In this study, Structural Equation Model (SEM) analysis was applied to the collected data, focusing on three factors: the teacher's educational background, attitude towards the environment, and value orientation related to the climate system. The selected questionnaire topics are detailed in Tables 1 and 2. The indicators of the constructed variables were structured according to the initial hypothesis, as depicted in Figure 1. The analysis was conducted on a dataset comprising 470 pre-service teachers, with a total of 40 items for attitude assessment and 10 items for evaluating value orientation. To ensure validity, 23 questions meeting the AVE limit of .633 and a loading factor of .5 were selected for further analysis.

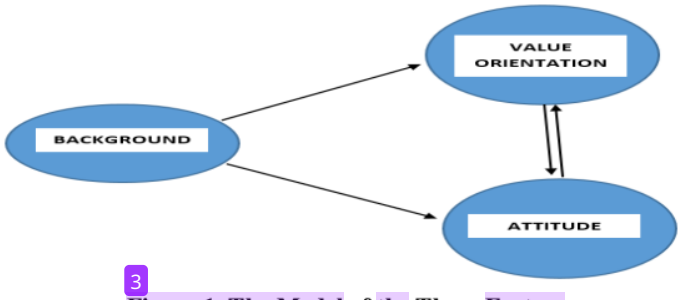

Figure 1. The Model of the Three Factors

The structure was built based on two initial questions: 1) Does background influence attitude and value orientation? and 2) Does value orientation affect pre-service teachers' attitudes? Although there were some modifications in this study, the model in Figure 1 has verified the good fit value and the suitability hypothesis in Table 1.

Table 1. The goodness of fit hypothesis test is assessed from four sets of indicators.

Goodness of Fit Index		Cutt-off Value
SRMR	SRMR obs	< .08
D_ULS	D_ULS obs	< .10
D_G	D_G obs	< .10
Chi-square	Chi_square obs	< 520.49
NFI	NFI obs	> .90
Rms_Theta	Rms-Theta obs	< .12

The questionnaire

The instrument consists of two types: attitude and value instruments. The attitude question items can be seen in Table 2.

Table 2. Modified question items attitude pre-service teacher to climate change from Kaiser et al. (2007)

Indicator	Question Items
Conservation	I kill insects with chemical insecticides
	Contribute financially to environmental organizations
	I learn about environmental issues in the media (newspapers, magazines, and television)
	I am a member of an environmental organization
Energy	After one day of use, I immediately put my jacket or trousers in the laundry/washing machine
	As the last person to leave the room, I will turn off the light
	I leave powered equipment (TV, stereo, printer) on standby (its cord is always connected to the power source)
	During the dry season, I turn off the cooling (fan/ac) when leaving the room for more than 4 hours.
	In the hot, dry season, I just wear cool clothes in my room without having to turn on the fan or air conditioner
	If I stay at the hotel for more than 1 night, I change the towels every day
Transportation	I prefer to ride a bicycle or public transportation or walk to school or work
	I usually go everywhere using private car transportation
	For short distances (15 minutes distance), I prefer to walk or ride a bicycle rather than use a motorized vehicle
Avoid waste	I prefer to buy food in cans rather than plastic bottles
	Buy a bottled drink, and I return the bottle to the seller
	If I am offered a plastic bag from the store, I am more than happy to accept
	On excursions, I take drinks in disposable containers
	I chose to buy products in refill packs
	At parties/events/activities, we use plastic cutlery and paper cups
	I prefer markers over crayons for drawing
	After the picnic, I make sure the location is clean
Recycle	I love to reuse my shopping bags
	Refrain from using single-use battery-operated equipment
	I collect and recycle used paper personally or to used paper collectors
	I throw empty glass bottles into the recycling bin
	I separate waste by types
	I save wrapping paper for reuse
	To take notes, I write on the empty side of the used paper
	I throw an empty battery in the trash
Consumerism	I choose to buy certified organic food
	Eat fruits and vegetables that are in season at the time (seasonal)
	When shopping, I prefer products with eco-friendly labels
	I like to eat at fast-food restaurants
	I ordered fast food for takeaway

The attitude test instrument was created using a 5-point Likert scale ranging from strongly agree to strongly disagree. The construction of the questions in the attitude questionnaire was published by Kaiser et al. (2007), which has a correlation coefficient value of .58 and an attenuation error correction value of .72. It includes six question indicators covering conservation, energy, transportation, avoiding waste, recycling, and consumerism. All question items were rated on a five-point Likert scale (5 = strongly agree, 4 = agree, 3 = quite agree, 2 = disagree, 1 = strongly disagree).

Meanwhile, the value orientation instrument consists of 10 questions measuring the value

orientation of pre-service teachers in four types: biospheric, altruistic, egoistic, and hedonic. Biospherism involves biosphere-oriented values, such as respecting biodiversity and scientific values. Altruism is based on intrinsic values and the traditions of cultural heritage. Egoism focuses on lifestyle, economy, we e, and health. Hedonism is based on spiritual, artistic, and aesthetic values. This instrument is based on the framework developed by Marshall et al. (2019) and Hicks et al. (2015). They created the Human-Environmental Cultur alue Framework and clustered value orientations for cultural ecosystem services connected to components of the climate system: the sky (atmosphere), springs and rain (hydrosphere), plants (biosphere), the earth's surface covered in ice (cryosphere), and the earth's surface (geosphere). The instruments are detailed in Table 3.

Table 3. Pre-service teacher orientation value questionnaire instrument on climate change

Climate Component	Value	Items
Atmosphere	H	The blue sky is captivating and rejuvenates the soul.
I appreciate the blue sky	E	The Blue Sky program, launched by the government, has a positive impact on public health.
	B	It serves as an early indicator of a pollution-free atmosphere.
	A	A pollution-free blue sky allows traditional communities to observe the sky clearly, gaining insights into seasonal changes and directional cues.
Biosphere	H	Certain ornamental plants enhance the beauty of gardens and homes around us.
I appreciate the diverse flora and fauna in nature because	E	Some plants possess medicinal properties.
	B	Certain plants, such as bamboo, are highly effective at absorbing carbon.
	A	Traditional communities can utilize some wild plants for various purposes.
Biosphere	H	The diversity of flora and fauna inspires the creation of many high-quality works of art.
I appreciate the diverse flora and fauna in nature because	B	Flora and fauna play a crucial role in absorbing carbon and forming the foundation of the food chain.
	E	Very high economic value for our society.
	A	The diversity of flora and fauna is a valuable legacy left by our ancestors.
Atmosphere	H	Clean, pollution-free air is essential for human well-being.
I appreciate clean and pollution-free air because	E	Clean, fresh air enhances our daily lives.
	B	Clean and fresh air will prevent acid rain from occurring, which endangers our lives.
	A	Clean and fresh air will improve the quality of human life as it was in the air when there was no industry in the days of our ancestors.
Hydrosphere	E	Clean springs will make us healthy.
I appreciate the existence of natural springs like rivers, lakes, or springs in specific locations because...	B	Water on Earth is abundant, yet the portion directly usable by humans is limited.
	H	Clean rivers and lakes are visually pleasing and serve as tourist relaxation spots.
	A	Certain springs, highly valued by Indigenous communities, are rigorously protected.
Hydrosphere	H	Rain is a gift sent down by the creator for living things on Earth.
I appreciate the rainwater that falls to the earth because….	E	Rainwater can be a natural water source beneficial to human life.
	B	Whatever the form and origin of water, a certain amount of water is always fixed, and the amount that can be utilized by humans is very limited, one of which is rainwater.
	A	Some communities rely solely on rainwater, particularly those with limited water resources.
Geosphere	H	Volcanic eruptions, though rare, are artistically captivating and can be captured in photographs or paintings.
Volcanic eruptions are very catastrophic natural disasters, but I appreciate the occurrence of these events because…	E	Economically, volcanic eruptions enrich the soil, making surrounding lands fertile again.
	B	Volcanic eruptions, whenever they are very large and reach the stratosphere, will cause the earth to cool down and even initiate global cooling.
	A	The occurrence of volcanic eruptions in certain traditional communities
Geosphere	B	the earth's surface has a role in maintaining temperature stability.
I appreciate the stable surface of the Earth, untouched by significant changes such as conversion from forest to	E	I disagree because, in my opinion, progressive changes in land use indicate an increasing economic level.
	A	Land use changes, particularly converting forests into housing, rice fields, or farms, threaten indigenous communities protecting these forests.

agricultural land or from agricultural land to housing, because...	H	Maintaining beautiful and well-kept landscapes is crucial for mental and physical health.
Cryosphere	H	The poles are a part of Earth's diversity created by God Almighty.
I maintain the existence of the polar regions and other areas that are covered with ice because	E	I did not appreciate it because the polar ice blocks the mining of the abundant minerals beneath.
	B	The polar ice caps are one of the places where water is stored, and the global temperature is balanced.
	A	When the ice melts in the Jayawijaya mountains of Papua due to global warming and pollution, we lose our ancestral heritage's unique and precious nature.
Cryosphere	H	There is the beautiful aurora which is formed from the interaction between the planet's magnetic field and solar light particles.
I appreciate that there are polar regions and other areas covered in perpetual ice because	E	I do not value the polar region because it is economically impractical for human habitation.
	B	The polar region is crucial for Earth's survival. Melting ice sheets reduce sunlight reflection into space, leading to global warming.
	A	If polar ice melts, the unique igloos at the North and South Poles will disappear.

Note: (B) Biosphereism is in the form of respecting biodiversity and scientific values; (A) Altruistic is a value orientation based on intrinsic values and traditional societies of the cultural heritage; (E) Egoistic is a value orientation based on respecting lifestyle, economy, welfare, and health); (H) Hedonic is values based on spiritual, art, and aesthetic values

Structural equation model

The Structural Equation Model (SEM) is a tool for analyzing the relationships between latent variables measured using multiple correlation indicators. In this study, SEM was applied to datasets in two steps. In the first step, an analysis of the indicators for each variable was conducted to determine whether they could be used in the subsequent hypothesis testing stage. The background variable is a qualitative variable with two categories: MIPA (Maths and Natural Sciences) and non-MIPA (non-Maths and Natural Sciences). Thus, the number of indicators used is k-1, which is 1 for the MIPA indicator. Each respondent's answer was coded as 1 for Yes and 0 for No. The same coding applied to the four categories of the value variable (Hedonic, Egoistic, Biospheric, and Altruistic), resulting in three indicators with the same coding. For the attitude variable, the data used were quantitative, with each indicator measured through questions tested on all respondents. The test was conducted using CFA analysis to measure the factor loading value of each question.

Based on the results of the analysis of the attitude indicator at a limit of .2, there were 30 valid statements and 10 invalid statements. At a limit of .3, there were 26 valid statements and 14 invalid statements. At a limit of .5, there were 13 valid statements and 27 invalid statements. Each of the results from these three limits (.2, .3, and .5) was tested for comparison in the full model analysis by dropping invalid statements based on the conclusion recap table. The result in the full model showed that if the loading factor limit was .2, then the Attitude variable had an AVE value of .490. If the loading factor limit was .3, the Attitude variable had an AVE value of .499. If the loading factor limit was .5, the Attitude variable had an AVE value of .633. Since the AVE limit for a variable to be considered valid must be above .5, the loading factor limit used was .5. Factor loading testing was conducted at both the variable and dimension levels, meaning that indicators at these levels had to meet the criteria above .5, as shown in Table 4.

Based on Table 4, all statements had a factor loading value greater than .5, leading to the conclusion that all these statements were valid and could be used in further analysis.

Data analysis

The structural equation model (SEM) in Figure 1 was based on the initial questionnaire data. For the attitude variable (Table 2), the Likert scale ranged from 1 to 5, with 1 meaning very inappropriate and 5 meaning very appropriate. The value orientation variable was assessed based on the suitability of the choice with the value orientation, which was then converted to an interval scale as shown in Table 5.

Table 4. The results of the factor loading test at variable and dimension levels

Variable	Dimension	Statement	Factor Loading Value		
			Variable	Dimension	Conclusion
Attitude	Indicator 3 (Avoiding littering)	P16	.591	1.000	Valid
	Indicator 4 (Recycle)	P18	.575	.706	Valid
		P20	.674	.797	Valid
		P21	.654	.774	Valid
	Indicator 5 (Consumerism)	P24	.589	.744	Valid
		P26	.659	.769	Valid
		P29	.629	.730	Valid
	Indicator 6 (Conservation Behavior)	P34	.613	.694	Valid
		P36	.730	.811	Valid
		P37	.676	.779	Valid
		P38	.550	.603	Valid
		P39	.650	.702	Valid
		P40	.555	.544	Valid

Table 5. The value orientation categorization formula for each respondent

No	Score Interval	Interval	Category
	X<Mi-1,5 Sdi	0-18.91	Hedonism
	Mi-(1,5 SDi) ≤ X < SDi	18,92-25,22	Egoism
	Mi ≤ X Mi + (1,5 SDi)	25,23-31,52	Bioferism
4	Mi + (1,5 SDi) ≤ X	31,53-40	Altruism

Notes: Mi: average overall score; SDi: standard deviation of the overall score; X: The score achieved by the respondent

The collected data was then processed and analyzed using structural equation modeling (SEM) by examining the three-match sets presented in Table 1. This included a comparative fit index (CFI), which compares the observed model and the null model, and the Absolute Root Mean Square Error Index of Approximation (RMSEA). The analysis also included the Chi-Square and Chi-Square normed ($\chi 2$ & $\chi 2$-norm). While the Chi-Square test is typically used to test for significant differences between observed and estimated data, SEM aims not to see differences between data. After conducting the Chi-Square test, it is recommended to use normalized $\chi 2$ and RMSEA, as both are accurate for measuring Chi-Square inflation, which, along with CFI, is the most widely used index. For the Goodness of Fit Index, it is recommended to meet six good fit criteria as in Table 1. However, based on further results shown in Table 6, five points fell into the fit category, while one category, RMs Theta, did not fall into that category, so the whole model can be accepted.

Table 6. Goodness of fit index model

Goodness of fit index	Model
SRMR obs	.047
D_ULS obs .063	.063
D-G obbs	.039
Chi-square obs	117,342
NFI obs	.837
Rms-Theta obs	.301

FINDING AND DISCUSSION

Finding

Based on the analysis of data from 469 pre-service teachers, both from mathematics and science backgrounds and non-mathematics and science backgrounds, focusing on the variables of attitude and value orientation as shown in Figure 1, the background influencing the attitude and value orientations of pre-service teachers is the background of mathematics and science pre-

service teachers. Figure 1 also indicates that Attitude is a variable with a reflective indicator, while Background and Value are variables with formative indicators.

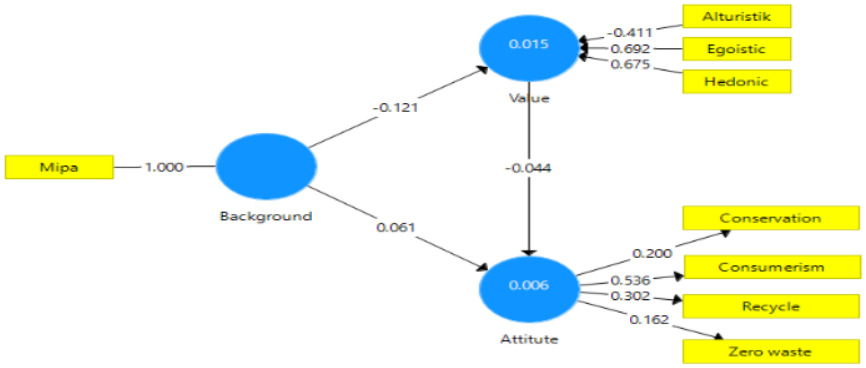

Figure 2. SEM Analysis Results: Standardized Regression Coefficients between Background, Value, and Attitude Factors (Scale: -1 to 1)

A value of -1 or 1 indicates a strong positive or negative influence from one factor to another. The small arrows indicate the standard factors of the construct variables, while the different variables in value orientation and attitude are described in Tables 2 and 3.

Factor Landing

Based on Figure 2, the background variable, specifically the subject matter taught by the pre-service teacher, positively affects attitude, particularly among mathematics and science pre-service teachers. According to Table 2, of the six question indicators—conservation, energy, transportation, avoiding waste, recycling, and consumerism—valid indicators with adequate loading factor values and AVE values are avoiding waste disposal (.598), recycling (.831), consumerism (.917), and conservation behavior (.802). In contrast, the energy and transportation indicators were found to be low.

The Egoistic and Hedonic value orientation indicators have p-values of .044 and .045 and outer weights of .692 and .675, respectively. However, the Altruistic indicator has a p-value of .182 and an outer weight of -.411, indicating that it does not meet the outer weight criteria, as its p-value is lower than 1.64, leading to the exclusion of this indicator. According to Table 5, mathematics and science pre-service teachers have a value orientation in the biosphere category, meaning they act towards the environment based on biodiversity and scientific values. In contrast, language and social studies teachers have a value orientation in the Egoistic category, focusing on values that respect lifestyle, economy, welfare, and health. Several previous studies have shown that biospheric value orientation is the most influential predictor of a person's attitude towards the environment (Dietz et al., 1998; Schultz et al., 2000). In other words, individuals with a biospheric value orientation tend to have a positive attitude towards the environment (Kempton et al., 1996).

Result from SEM

The SEM results presented in Figure 2 indicate that the model fits well with a significance level of <.005. Referring to Figure 1, several conclusions can be drawn: 1) R2 Value was .012, indicating that the Value variable was influenced by the Background variable by 1.2%, while the remaining 98.8% was influenced by unexamined factors; 2) The path coefficient for Background was -.109, indicating a negative direction, suggesting a non-unidirectional relationship. An increase of 1 unit in Background results in a decrease of .109 in Value; 3) R2 Attitude was .007, suggesting that Attitude was influenced by Background and Value variables by .7%, while 99.3% was influenced by other unexamined factors; 4) The path coefficient for Background was .063, indicating a positive direction, suggesting a unidirectional relationship. An increase of 1 unit in

Background leads to an increase of .063 in Attitude; and 5) The path coefficient for Value was -.047, indicating a negative direction, suggesting a non-unidirectional relationship. An increase of 1 unit in Value results in a decrease of .047 in Attitude.

Discussion

The online form was utilized to gather data from 469 mathematics and science pre-service teachers, comprising 329 and 140 individuals, respectively. From the collected data, it was determined that the Value variable was influenced by the Background variable by 1.2%, while the remaining 98.8% was attributed to other unexamined factors. The path coefficient for Background was -.109, indicating a negative direction, implying a non-unidirectional relationship. Additionally, Attitude was influenced by both Background and Value variables by .7%, with the remaining 99.3% influenced by unexamined factors. The path coefficient for Background was .063, indicating a positive direction, suggesting a unidirectional relationship between Background and Attitude, while the path coefficient for Value was -.047, indicating a negative direction and a non-unidirectional relationship.

Figure 2 illustrates that the background significantly impacts the attitude and value orientation of pre-service teachers, aligning with findings from research by Sjöblom & Wolff (2017), which noted that background correlates with knowledge, attitude, and value orientation, with the latter being more stable and resistant to change compared to attitude. According to the theory of behavior change, behavior is easily influenced by cognition or individual knowledge (Prochaska, 2008). While cognition can be altered through continual exposure to information about resources and the environment, changes in attitude and behavior vary depending on differences in value orientation and motivation for behavior. This perspective resonates with Indraratna & Locke (2000) and Courbalay et al. (2015), who posit that behavior and attitude are jointly influenced by cognition and values, as evidenced in their studies on behavioral interventions concerning packaging waste recycling behavior. Individuals with diverse value orientations exhibit varied behaviors because information forms the basis for developing environmental attitudes. Consequently, attitudes toward the environment represent reasoned decisions based on received information—where information can alter one's cognition, attitude, intentions, and ultimately, behavior toward the environment (Bamberg et al., 2003).

There are two modes of disseminating information as interventions for changing attitudes and behaviors: the first involves popular media communications such as the internet, television, and newspapers (Winett, 2013; Völlink & Meertens, 2010), while the second entails focused and organized methods like brochures, symposiums, and interviews (Geller, 1981). Despite substantial evidence supporting the efficacy of the latter mode in influencing targeted behaviors, some researchers argue that information and cognitive interventions are pivotal in shaping individual attitudes, particularly in environmental contexts. Staats & Hartig (2004) conducted a longitudinal study over three years involving 150 participants, revealing that only 38 individuals changed their attitudes toward resource use based on various sources of information. Similarly, McMakin et al. (2002) found no significant difference in behavior change between an experimental group receiving information interventions and a control group concerning household utility usage. Conversely, Miranda et al. (2016) observed behavior changes, such as reduced food waste, among participants exposed to social media and e-newsletter interventions compared to those in the control group. Wang et al. (2018) argued that direct influences of information interventions on students' attitudes toward recycling electronic waste were inconclusive. Despite conflicting findings, researchers believe that sustained information interventions can foster gradual attitude changes on a smaller scale.

The SEM analysis determined that value orientation exerts a stronger influence on attitude (0.897) compared to background knowledge (regression coefficient of 0.07). These findings corroborate the assertions of Kamakura & Novak (1992), who posited that "values form the fundamental cognitive structure of individuals and are thus more enduring than attitudes." Additionally, Kaltenborn & Bjerke (2002) underscore that values constitute the foundation of human attitudes and significantly influence decision-making processes, including those pertaining to the environment (Sjöblom & Wolff, 2017). In the environmental context, a specific link

between value orientation and attitude is observed, particularly in the biospheric values domain. Despite the intrinsic relationship between value orientation and attitude, Pešić (2006) noted from studies conducted between 1989 and 2004 that changes in value orientation tend to be relatively slower, and rapid shifts are usually confined to normative contexts.

Based on the data presented in Figure 2, pre-service teachers' backgrounds were categorized into two groups: Mathematics and Natural Sciences (MIPA), and Non-Mathematics and Natural Sciences (Non-MIPA). Among these backgrounds, only pre-service teachers with MIPA backgrounds showed factor loadings suitable for inclusion in SEM modeling. Additionally, out of the four value orientation categories examined, only two measured indicators: egoism and hedonism. Egoistic orientations encompass values that emphasize environmental respect based on lifestyle, economic needs, welfare, and health, while hedonistic orientations prioritize spiritual, artistic, and aesthetic values.

Numerous studies have established a positive correlation between biospheric and altruistic value orientations and pro-environmental attitudes and, conversely, a negative correlation between egoistic and hedonistic value orientations (Gärling et al., 2003; Nordlund & Garvill, 2002; Stern & Dietz, 1994). These findings align with the SEM model depicted in Figure 2, which predominantly focuses on egoism and hedonism value orientations. In contrast, Groot & Steg's (2008) study concluded that biospheric and egoistic value orientations influenced positive environmental attitudes. Such discrepancies can arise because the relationship between value orientations and attitudes is highly context-specific, varying across different domains and often involving other influential factors (Kahle & Chiagouris, 2014), as evidenced in Groot & Steg's (2008) research.

Initially, support for environmental issues was underpinned by two primary value orientations: ecocentric and anthropocentric (Thompson & Barton, 1994). Ecocentric views emphasize the interdependence and reciprocal relationship between all living organisms, including humans, and nature. In contrast, anthropocentric views prioritize human centrality and perceive nature as primarily serving human needs, often favoring economic growth over environmental conservation (Alagoz & Akman, 2016). Over time, ecocentric perspectives evolved into biospheric and altruistic orientations, whereas anthropocentric perspectives evolved into egoistic and hedonistic orientations (Thompson & Barton, 1994). Despite these differing orientations, both ecocentric and anthropocentric perspectives can foster positive attitudes toward environmental conservation. Ecocentric individuals may advocate for conservation on moral grounds, believing in nature's intrinsic value, whereas anthropocentric individuals may support conservation for its perceived benefits to human well-being and quality of life (Thompson & Barton, 1994).

The findings of this study offer valuable insights for curriculum developers in tertiary institutions, lecturers, and textbook authors aiming to enhance environmental education in teacher professional programs. It underscores the importance of integrating biospheric and egoistic value orientations into curricula and learning materials to ensure that pre-service teachers, regardless of their value orientation, develop positive influences on the environment, particularly in the context of climate change.

CONCLUSION

Attitude shapes an individual's behavior, including their stance on environmental issues like climate change, and is influenced by various factors. This study reveals that the educational background of pre-service teachers significantly impacts their attitude and value orientation. While value orientation tends to be stable, educating pre-service teachers about environmental issues can influence their value orientation, and the alignment of educational background and value orientation can impact attitudes towards the environment. Further research is needed to explore the intricate influences of a pre-service teacher's background, including teaching experience duration, exposure to natural disasters, demographic characteristics, and the complexity of value orientation on their attitudes towards environmental issues.

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