

The role of environmental beliefs in determining the self-reported personal conservation behaviour of Indonesian preservice biology teachers

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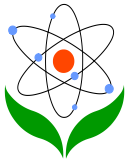
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Received 5 Nov., 2020

Revised 6 Jun., 2021

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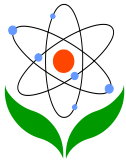
Abstract

The current study aimed to uncover the underlying psychological traits of the environmental behaviour of Indonesian preservice biology teachers. A hypothesized model based on theoretical background and previous studies was established and tested on a total of 216 Indonesian preservice biology teachers in West Java province. Gender and education effects were also considered in the testing of the environmental-related psychological traits of Indonesian preservice biology teachers. Ten scales of the Environmental Attitudes Inventory (EAI) were used as the main research instrument, and semi-structured interviews were also conducted to uncover more the perceptions of Indonesian preservice biology teachers of the environment. Independent sample t-test, analysis of variance, correlation tests, and structural equation modeling (SEM) were used to answer the proposed research questions. The results revealed significant gender and educational year differences in several environmental scales. Moreover, the accepted model results from SEM indicated an acceptable statistical model of Indonesian biology teachers' environmental beliefs and found that two paths influence the self-reported environmental behaviour of Indonesian preservice biology teachers. Based on the model, environmental beliefs and intention were found to have direct effects on the self-reported environmental behaviour. The current study highlights the importance of developing courses that can improve preservice teachers' environmental beliefs and intention.

Keywords: environmental beliefs; preservice teacher; behaviour theory; structural equation modelling; Indonesia

Introduction

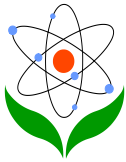
Indonesia is the most populated country in Southeast Asia, and the fourth most populous country in the world, after China, India, and the United States (Permadi et al., 2017; Streets et al., 2003). Indonesia is also known for its richness of diversity of plant and animal species, and often is referred to as a mega-biodiverse country, together with Brazil (Arifin & Nakagoshi, 2011; Margono et al., 2014). Many plants and animals are endemic species of the various Indonesian ecosystems. However, today, some of the native species, such as the Lesser One-horned rhinoceros (Brook et al., 2014), Sumatran tiger (Linkie et al., 2003), and bird-of-paradise (Riley, 2001),



are reported to be decreasing in number and population. These trends may change the status of some species to endangered species. Indonesian and international environmentalists and ecologists have argued that the decreasing numbers of native plant and animal species in Indonesia are caused by several environmental degradations that are apparent in Indonesia (Edinger et al., 1998; Permadi et al., 2017). These include high rates of air pollution, forest fires, inappropriate practices in agricultural sectors, and unstructured recycling systems (Margono et al., 2014; Permadi et al., 2017; Streets et al., 2003). These environmental problems threaten the existence of native plant and animal species, by slowly destroying their natural habitats. Based on the report from the Intergovernmental Panel on Climate Change – IPCC (2014), such eminent environmental degradations are mainly the results of human activity. Therefore, the Indonesian Ministry of Environment (Kantor Menteri Negara Lingkungan Hidup, 2004) acknowledge the need to educate Indonesian citizens to behave more friendly towards the environment.

Human activity or behaviour towards the environment has been one of the longstanding topics in the field of environmental education and psychology. Various theories have been proposed to explain the mechanism of human behaviours towards the environment, to better understand the components of human behaviour, so that appropriate intervention can be taken to obtain a more friendly human behaviour towards the environment. One of the well-known behavioural change theories, called the theory of reasoned action, was proposed by Ajzen and Fishbein (1980), and later revised into the theory of planned behaviour (TPB) (Ajzen, 1991). The theory explains that intention to behave is the only antecedent of expressed environmental behaviour. This intention to behave is derived from attitudes and beliefs. However, several recent studies have criticized TPB, and the critics have put forward another well-known behavioural change theory proposed by Stern (2000), called value-belief-norm (VBN) theory, which states that behaviour is derived from moral norms. A dichotomy is found from this theory, which also states that the individual's general beliefs towards the environment may also be considered as a key or most important predictor of one's environmental behaviour; the findings from several studies have supported this (e.g., Fonara et al., 2016; Corral-Verdugo et al., 2008; Hawcroft & Milfont, 2010).

Additionally, Dunlap et al. (2000) found that environmental attitudes explain more variance of the individual's environmental behaviour, and several other findings also support this finding (e.g., Barr, 2007; Kollmuss & Agyeman, 2002). These different theories and findings have resulted in confusion in explaining and predicting the individual's environmental behaviour. In response to this issue, Johnson, Bowker, and Cordell (2004) and Kollmuss and Agyeman (2002) argued that the variety of sample and population, such as culture, country, and level of education, used as the

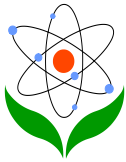


subject of the investigation, contribute to obtaining different results. Therefore, the current research aimed to examine what kind of psychological traits related to environmental behaviour significantly predict and influence the Indonesian population, so that policy or even specific educational programs can be taken into account, to tackle the less than environmental-friendly behaviour that Indonesian people have been demonstrating. To do so, the current research tested a model of Indonesian environmental-related psychological traits by performing structural equation modeling (SEM) on environmental beliefs, attitudes, intention, and behaviour. SEM is considered as one appropriate method to uncover the pathways and correlations of several psychological traits (Kaplan, 2009).

The current research focuses on revealing the environmental-related psychological traits of Indonesian preservice biology teachers, given that the population has only received limited attention in previous studies. Another reason is that the Indonesian science teachers, especially the biology teachers, play an important role in influencing the environmental behaviour of students or future citizens because they are given full authority to teach the environmental education subject in primary and secondary education. This full authority is given to them because there is no program at the university level to prepare environmental educators for primary, secondary, or even tertiary educational levels. This is also as a result of the impact of the comparatively recent embedding of Indonesian environmental education in the national curriculum, given that it was only in 2006 that the Indonesian government began implementation and the embedment of environmental education (EE), as well as environmental science education, in the national curriculum (Indonesian Ministry of Environment, 2012). Consequently, no university is ready and has a mature program to prepare the environmental educator.

Moreover, instead of opening a program at universities focused on preparing environmental educators, the content of environmental education curriculum has been integrated into the curricula of science teacher education, such as for biology, physics, and chemistry teacher education. To date, most biology teachers teach the environmental science subject, because assumptions about the environment are highly correlated with discussions in biology (Parker, 2016; Nomura, 2009). Therefore, preparing biology teachers with more pro-environmental beliefs, intentional attitudes, and behaviour towards the environment may be crucial to improving the Indonesian environment.

Prior to the methods, findings, and discussion of the current research, a literature review regarding environmental beliefs, attitudes, and behaviour is provided below. This literature review is used to build the hypotheses that are presented in the tested

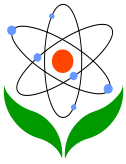


model. Descriptions of Indonesian environmental-related culture and education are also provided. Finally, the research questions are proposed.

Theoretical framework

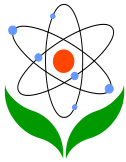
A rich literature in environmental education, psychology, and even policy has gained the conception that the emergence of environmental problems today is caused by how humans interact with, act with, and what they do to nature and the environment, called environmental behaviour (Gatersleben et al., 2002). There have been many studies uncovering human behaviour towards the environment, from specific behaviour, such as recycling behavior (e.g. Chan & Bishop, 2013; Lakhan, 2017), animal and plant conservation behaviour (Kruse & Card, 2004; Lloro-Bidart, 2018), or organic farming (e.g. Fairweather & Campbell, 2003), to general pro-environmental behaviour (e.g. Carfora et al., 2017). These studies have mainly been conducted in order to seek how people behave towards the environment in their daily life. Moreover, many of the previous studies have been done without directly observing people's behaviour, but by using survey questions of whether they engage in such particular pro-environmental related behaviours or not, called self-reported behaviour. Indeed, Gatersleben et al. (2002) argued that direct observation is considered as the accurate method to uncover the individual's environmental behaviour, but it requires more effort and time. Regardless of bias in the results, Gatersleben, Steg, and Vlek (2002) and Chao and Lam (2011) suggested the use of the self-reported method to gain a more efficient result, especially for the use of quantitative study. Therefore, the current study followed these previous studies to explore environmental behaviour through the use of self-reported behaviour.

Environmental behaviour is known as the expression or actualization of several psychological traits that people have in their mind. Gatersleben et al. (2002) stated that expressed behaviour is difficult to change. The underlying psychological traits are the key points to change an individual's behaviour towards the environment, and many have even argued that those traits are easier to change through particular interventions (Pooley & O'Conner, 2000). Several well-known underlying psychological traits of the individual's environmental behaviour include values, beliefs, attitudes, and intention. To date, many are still debating which of those traits have a direct effect on the expressed behaviour, even though they are parts of one mechanism (de Leeuw et al., 2015; Lakhan, 2017; Pooley & O'Conner, 2000). Hence, those still debated traits motivated the current study to investigate which mechanism work best in representing the environmental behaviour of Indonesian preservice biology teachers. Therefore, Indonesian higher education policymakers can consider which of the mechanisms can be more impactful to prepare more pro-environmentally behaved Indonesian teachers.



One well-known theory of behavioural change that many have used in explaining environmental behaviour is the theory of planned behaviour (TPB). The theory was proposed by Ajzen (1991) by extending the theory of reasoned action proposed by Fishbein and Ajzen (1980). According to TPB, the individual's environmental behaviour is derived from individual's intention to behave pro-environmentally, and one has control over his or her behaviour (perceived behavioural control). TPB also postulates that the individual's behavioural intention is derived from several psychological traits, including importantly attitudes towards that behaviour, which are also rooted from beliefs. This mechanism of behaviour has been tested in a wide range of samples and environmental issues. For example, de Leeuw et al. (2015) used the TPB to uncover high-school students' pro-environmental behaviour in more general issues, such as daily life activities. Yadav and Pathak (2017) used the theory to identify the green purchase behaviour of people in developing countries. In more specific issues, like the pro-environmental behaviour of hotel visitors conducted recently by Verma and Chandra (2018), the theory was evident in explaining environmental behaviour of hotel visitors. Similarly, Lakhan (2017) successfully used TPB to identify the pro-environmental behaviour of some ethnic minorities. This evidence motivated the current study to test and use the TPB in seeking whether it is well-fitted to the Indonesian preservice biology teacher sample. If so, the current study can later suggest some interventions, in order to influence the intention of Indonesian preservice biology teachers. The TPB was proposed as the hypothesis of the current study, and played the role of the backbone of the to-be-tested model that is visualized in Figure 1 (noted as H1).

Regardless of the many previous studies that have supported the TPB, some studies seeking the mechanism of environmental, health, or other behavioural traits have gained different findings that point to beliefs as one factor directly influencing behaviour (e.g. Corraliza & Berenguer, 2000; Cambell-Arvai, 2015; Sniehotta, Presseau, & Araújo-Soares; 2014). Even Sniehotta et al. (2014) criticized the TPB by raising some concerns about its validity and utility, due to the many different findings that do not align with the theory. Regarding the findings of a direct correlation between environmental beliefs and behaviour, Pickett-Baker and Ozaki (2008) identified consumer's behavioural decisions to purchase pro-environmental products and found that people's purchase of green products is highly correlated to their pro-environmental beliefs. Fairwether and Campbell (2003), who studied New Zealand farmers' farming practices, found that conventional and modern farmers were different, based on their beliefs on the use of genetic engineering. Pooley and O'Conner (2000) found that in order to change people's behaviour to be more pro-environmental through intervention, such as environmental education programs, strengthening their environmental beliefs is suggested as the most effective way.



The aforementioned findings have forwarded another theory that is often used in explaining the individual's environmental behaviour, the value-belief-norm (VBN) theory proposed by Stern (2000). The VBN theory states that behaviour is directly derived from moral norms and general environmental beliefs. Corral-Verdugo et al. (2008), Fonara et al. (2016), and Hawcroft and Milfont (2010) have supported the use of this theory that environmental beliefs have a direct effect on, and are key predictors of environmental behaviour. Therefore, based on previous studies, the current study proposed the hypothesis that there is a significant direct effect from environmental beliefs to environmental behaviour, as it is noted as H2 in Figure 1.

Besides having a direct effect on the behaviour, previous studies also found that environmental beliefs are indirectly correlated to the behaviour mediated by environmental attitudes (e.g., Barr, 2007; Dunlap et al., 2000; Kollmuss & Agyeman, 2002; Milfont & Duckitt, 2010). These findings recall many older findings and theories (e.g., Scott & Willits, 1994; Vining & Ebreo, 1992) that assume the direct effect of the individual's environmental attitudes and behaviour. Thus, this assumption motivated the current study to advance one of the hypotheses in the model of the environmental behaviour of Indonesian preservice biology teachers. It can be seen in Figure 1 that this hypothesis is noted as H2.

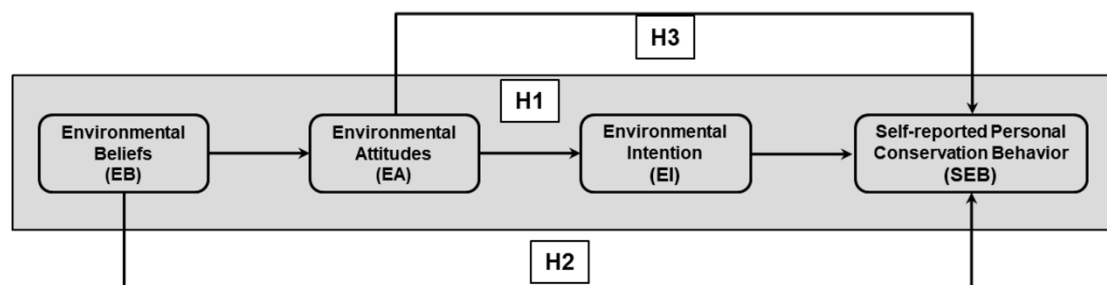
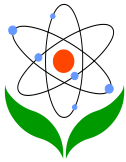


Figure.1 Hypothesized model

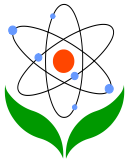
Johnson et al. (2004) and Kollmuss and Agyeman (2002) noted that different findings of the environmental behaviour mechanism are obtained because previous studies have been carried out by using different samples with different socio-cultural backgrounds. Ethnicity (e.g. Lakhan, 2017; Johnson et al., 2004; Rachmatullah et al., 2020), gender (e.g. Johnson et al., 2004; Chan, 2001), and level of education (e.g. Johnson et al., 2004; de Leeuw et al., 2015) are found in most studies that explore environmental beliefs, attitudes, intention, and behaviour to be the determinants, and contribute to differences in the individual's psychological traits related to the nature and environment. Therefore, reviews on Indonesian culture that are related to pro-environmental behaviour and the structure of environmental education are provided below, in order to gain more insight into these socio-cultural backgrounds that can help in discussing the findings.



Environmental-related cultures and environmental education in Indonesia

Not only is Indonesia known to be one of the mega-biodiverse countries, but it is also known to be one of the most linguistic, ethnic, and culturally diverse countries (Parker, 2016). Within this cultural diversity issue, Indonesian traditional culture has valued nature and the environment in more pro-environmental ways than what are demonstrated today, with the emergence of many critical environmental problems. For example, the Sundanese culture, one of the largest ethnic populations in Indonesia, considers nature and the environment should be respected as a protected entity (Koentjaraningrat, 1987). A traditional proverb that still exists in Sundanese society includes “Gunung talingakeun, leuweung kanyahokeun, kebon garaaeun, gawir awieun, lebak balongan, sampalan sawahan, walungan rempekan”, which means ‘protect the mountains, learn from the forests, cultivate the farms, plant bamboo in the cliffs, make ponds in the valley basins, use the lowland as rice fields, and plant the riverside with trees’. This proverb reflects, teaches, and nurtures pro-environmental beliefs or sustainable education to the Sundanese people (Koentjaraningrat, 1987; Indrawardana, 2012). Not only Sundanese ethnic, but other Indonesian ethnic populations, such as the Tobelo Dalam (Tamalane et al., 2014) and Balinese (Roth, 2014; Surata & Vipriyanti, 2018) also have the local wisdom of living in harmony with nature and the surrounding environment. Consequently, because of similarities in mostly ethnic local wisdom related to preservation and living in harmony with nature, the meaning of the Indonesia national motto, which is “Bhinneka Tunggal Ika,” has been extended from the original meaning of unity in diversity, by adding another point with regard to preserving and living harmoniously and in balance with nature and the environment (Tamalane et al., 2014).

Environmental education in Indonesia has been included in the national curriculum, and officially became a separate subject at primary and secondary school level from 2006 (Indonesian Ministry of Environment, 2012). Previously, as Nomura (2009) and Parker (2016) reviewed about environmental education in Indonesia, or usually called pendidikan lingkungan hidup (PLH), it has been embedded in science subjects, especially biology. In the new and revised version of the Indonesian curriculum of 2013, the environmental education subject still exists as a separate subject (Indonesian Ministry of Education and Culture – Kementrian Pendidikan dan Kebudayaan, 2016a, 2016b, 2016c), and in science subjects, science teachers are also encouraged to emphasize the connection between scientific knowledge and environmental issues, as well as religious issues. One of the reasons for this emphasis in science subjects is the close relation between scientific knowledge and environmental issues so that by attempting to connect it with environmental issues, students are expected to have a more applicable mindset that can increase their pro-environmental awareness, beliefs, concerns, or even behaviour.



Additionally, religious teachings are also eminent in the Indonesian science and environmental education, especially in the new curriculum of 2013 and its revised version in 2015. Parker (2016) stated that Indonesia is known as a religious country, and religious teachings are a crucial part of Indonesian education and culture. Environmental and science education in Indonesia is delivered mostly by giving understanding to students that God creates nature and environment, and thus protecting it is part of obeying God. Parker (2016) commented that this religious environmental education in Indonesia is the best effort to increase Indonesians' beliefs, awareness, concerns, and behaviour towards the environment because it fits with the Indonesian system of social and cultural life.

In all pre-university formal education – at the primary and secondary education level – it is compulsory to teach environmental education. The Indonesian environmental education mostly has the purpose of increasing students' affective aspects towards the environment, such as their beliefs, attitudes, and concerns. However, like Frick, Kaiser and Wilson (2004) noted, affective aspects themselves are still not sufficient to make people behave more pro-environmentally; they also need to increase their knowledge. Thus, the environmental education in Indonesia is integrated into science education as well, with the main purpose of increasing students' environmental knowledge (Sukarjita et al., 2014). This integration between science education and environmental education is also clearly shown in the framework of Indonesian science education visualized in Figure 2.

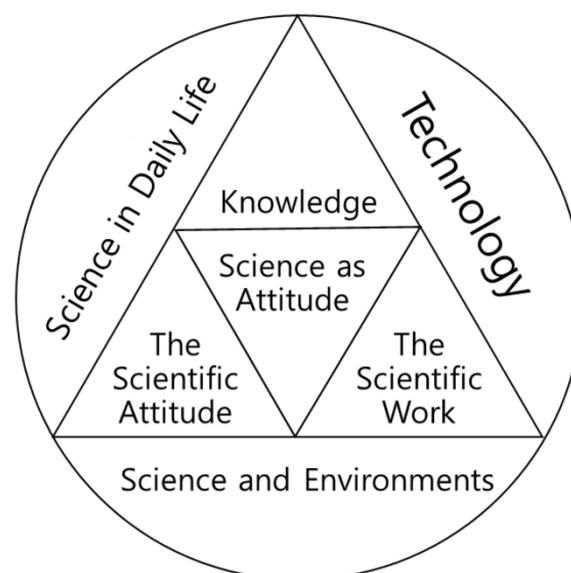
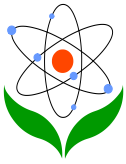


Figure 2. Framework of Indonesian science education (adopted from the Indonesian Ministry of Education and Culture, 2016a, 2016b, 2016c).



As previously mentioned, most science teachers, especially biology teachers, teach environmental education to primary and secondary school students. The current study also reviews in advance the biology education program in one central-public educational studies-based University located in western Java Island. Based on the review, environmental concepts are taught in several distinct courses, such as the 2nd semester Environmental Science course that emphasizes the integration between increasing preservice teachers' environmental knowledge and policies; the 4th semester Introductory of Environmental Impact Assessment course, which focuses on honing preservice teachers' understanding of environmental problems, policies, and behaviour; and the 6th semester General Ecology course. Also, most other courses, like Botany and Zoology, frequently ask students to go into Nature to observe Nature, and conduct some field trips to understand the interdependence of natural components better. These methods also have the purpose of increasing their feeling of connectedness with nature and the environment.

Research questions

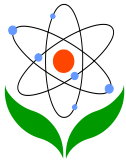
Based on the above background and theoretical framework, the research questions of this study are as follows:

1. Are there any gender and educational year differences in the environmental beliefs, attitudes, intention, and self-reported behaviour of Indonesian preservice biology teachers?
2. What is the most influential environmental psychological trait in the environmental behaviour of the Indonesian preservice biology teacher?
3. What do Indonesian preservice biology teachers think about behaving towards the environment?

Methods

Participants

The participants in the current research were 216 Indonesian preservice biology teachers from one public educational studies-based university located on the western Java Island. The university itself is known as the central university for preparing future Indonesian teachers, and also contributes to the establishment of the curriculum for Indonesian primary and secondary school levels. The participants joining the current research were in their second (30%), third (38%) and fourth (32%) year, and were affiliated to the biology education program. One of the issues in most biology education programs in Indonesian universities is the limited number of male



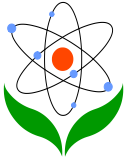
students; and so in the current research, only 15% of the total participants were males. We are aware of limited number of male participants, which might impact the findings of the current research, especially regarding the findings of gender differences. Thus we acknowledge this issue as one of the limitations of the current research. Regardless of this limitation issue, we still believe that the current research can be considered as the starting point, or maybe as the first research regarding the exploration of environmental beliefs, attitudes, intention, and self-reported behaviour of preservice teachers in Indonesia, given that exploration of the general population is still found to be limited.

Research instruments

Sample of research was chosen based on the objectives of the study: validity, reliability and perception. Four content experts were assigned to evaluate the content validity of the e-content module (three experts) and the e-assessment module (three experts). Since the Chemistry MOOC was developed for the undergraduate chemistry topics, a group of 23 undergraduate students was involved in the pilot study to answer the reliability questionnaire. A total of 129 undergraduate students from the Faculty of Science and Mathematics enrolled in Chemistry courses were randomly chosen as the respondents for perception study. The demographic information of the respondents is shown in Table I.

Survey

As mentioned above in the introduction, to examine the environmental beliefs, attitudes, and self-reported behaviour of Indonesian preservice biology teachers, the Environmental Attitudes Inventory (EAI) developed by Milfont and Duckitt (2010) was used as the main research instrument. The main reason that the EAI was used in the current research instrument is that it was developed by considering the multidimensionality of environmental attitudes and instrument may appropriate to exploring behaviour change theories. Many other instruments do not consider this dimensionality issue (see Milfont & Duckitt, 2010 for more detail), which can lead to misinterpretation of the results. The instrument embraces environmental beliefs, attitudes (affects), intention, and self-reported environmental behaviour. It, therefore, consists of a total of 12 environmental scales, with ten items in every scale. However, only 10 out of the 12 environmental scales were used to answer the research questions. The other two scales were excluded from the current research, because of the low psychometrical properties that the two scales had. After the evaluation to the ten scales through the item response theory (IRT) Rasch model and classical test theory (CTT), and only 97 out of the 100 items from the ten scales met the psychometrical requirements performed through Rasch analysis based on Boone et al. (2014). All the items were on Likert-scales with five choices, of 1 = strongly



disagree to 5 = strongly agree. Table 1 shows the psychometrical properties of the ten scales. The Table shows that the ten scales were also categorized into four environmental domains, based on every scale's construct definition, as provided in the original Milfont and Duckitt (2010) paper. Those four domains are environmental beliefs (EB), environmental attitudes (EA), environmental intention (EI), and self-reported environmental behaviour (SEB).

The *EB domain* consisted of four EAI scales, namely *environmental fragility* (EVF), which measures participants' belief in the fragile and easily-damaged characteristic of the environment through human activities; *confidence in science and technology* (CST), which measures participants' belief in human intellectuality in solving environmental problems, such as through science and technology; and *anti-human utilization of and dominance over nature* (aHUD) which measures beliefs on the equity between human and nature, and so protecting the environment should be first, rather than prioritizing economic development. aHUD originally was consisted of two different scales, human dominance over nature and human utilization of nature, but in the current research, both have been combined into one-joint construct, given that both scales have similarity in the construct definition that connects the relationship between human rights over nature. Additionally, we took the negative statements side, and thus we put 'anti' on the scale's name. The *EA domain* was also composed of four EAI scales, without any joint-construct. The four scales are *enjoyment of nature* (EJN), which measures participants' perception of spending time in nature and open-green areas; *support for interventionist conservation policies* (SIC), which measures participants' perceptions of support for policies related to conservation and regulation of the use of raw materials; *ecocentric concern* (ECO), which measures participants' emotional states towards environmental degradation and loss; and *support for population growth policies* (SPG), which measures participants' perceptions and concerns of support for policies related to overpopulation. The *EI* and *SEB* domains consisted of one EAI scale for each. The *EI* consisted of *environmental movement activism* (MOV), which measures participants' readiness and intention to be involved in the action of protecting nature and the environment. Moreover, the *SEB* consisted of *personal conservation behaviour*, which measures participants' self-reported conservation behaviour.

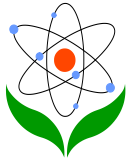
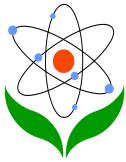


Table I. Psychometric properties of the used Environmental Attitudes Inventory (EAI) scales

Domain	EAI Scale		Total Item	Measure	Infit MNSQ	Outfit MNSQ	Item Reliability	Person Reliability	α if item deleted	Cronbach's α
Environmental Beliefs (EB)	Environmental fragility	EVF	10	-1.02 ~ 0.66	0.73 ~ 1.22	0.81 ~ 1.27	0.97	0.77	.685 ~ .746	.734
	Anti-Human utilization of and domination over nature	aHUD	20	-0.97 ~ 1.32	0.69 ~ 1.69	0.68 ~ 1.69	0.99	0.77	.748 ~ .798	.777
	Confidence in science and technology	CST	9	-1.19 ~ 2.41	0.50 ~ 1.40	0.50 ~ 1.40	0.99	0.69	.632 ~ .697	.690
Environmental Attitudes (EA)	Enjoyment of nature	EJN	10	-1.33 ~ 1.22	0.74 ~ 1.35	0.77 ~ 1.31	0.98	0.80	.798 ~ .818	.825
	Support for interventionist conservation policies	SIC	10	-0.86 ~ 0.88	0.71 ~ 1.39	0.73 ~ 1.33	0.98	0.74	.712 ~ .745	.750
	Ecocentric concern	ECO	9	-0.73 ~ 0.64	0.80 ~ 1.48	0.81 ~ 1.25	0.97	0.74	.737 ~ .766	.773
	Support for population growth policies	SPG	10	-0.89 ~ 1.00	0.67 ~ 1.37	0.64 ~ 1.28	0.98	0.75	.715 ~ .767	.758
Environmental Intention (EI)	Environmental movement activism	MOV	10	-0.38 ~ 0.61	0.77 ~ 1.39	0.74 ~ 1.37	0.86	0.82	.797 ~ .816	.821
Self-reported Environmental Behavior (SEB)	Personal conservation behavior	PCB	9	-0.94 ~ 0.49	0.63 ~ 1.26	0.58 ~ 1.24	0.97	0.64	.598 ~ .679	.675



As mentioned above, only three out of the 100 items from the 10 EAI scales were excluded from the analysis, because these did not meet the IRT-Rasch cut-off. These excluded items were CST_3, ECO_3, and PCB_1. However, as is shown in Table 1, we still included some items that did not meet the cut-off (the Linacre (2012) and Boone et al. (2014) cut-off MNSQ is from (0.50 – 1.50). Those items were aHUD_1 (outfit MNSQ = 1.69) and aHUD_10 (outfit MNSQ = 1.53). We believe that because those items were included in the joint-construct, the items became misfitting items, and the MNSQ values were still considered not too high from the cut-off. Therefore, we still kept the items in the further analysis.

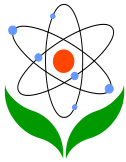
Semi-structured interview

Following the survey, a semi-structured interview was conducted. A total of six participants, two (one for each gender) from every academic year (second, third, and fourth years), participated in the interviews. These participants were randomly selected based on their academic year and gender. The interview process was conducted to gather more in-depth data on what participants think about engaging in the pro-environmentally behaviour. Thus several questions, such as “how do you react to the phenomena of environmental damage?”, “how do you explain and connect your own self to the emergent phenomena of environmental damage?”, and “how do you explain the intention to behave and the behaviour itself in the context of the environment?” were used as prompting questions to uncover their ideas about pro-environmental behaviour. The interview took between about fifteen and twenty-five minutes for each respondent.

Data analyses

To respond to the research questions, independent sample t-test was used to determine gender differences, and one-way analysis of variance (ANOVA) test was used to uncover educational year differences. Following the analyses, the Pearson's correlation and partial correlation were performed, to find out how one domain correlates with other domains without and with any control variables. Addressing the main research question, evaluating the hypothesized model was done through structural equation modeling and was performed with AMOS software. The indexes suggested by Schumacker and Lomax (1996) and Yu (2002) were used to evaluate the model. Based on these indexes, a model with a p-value of chi-square (χ^2) > .01, AGFI > .90, NFI > .90, CFI > .95, TLI > .95, and RMSEA < .06 or .08 is considered a good model. The interview data were analysed thematically.

Findings



Gender and educational year effects

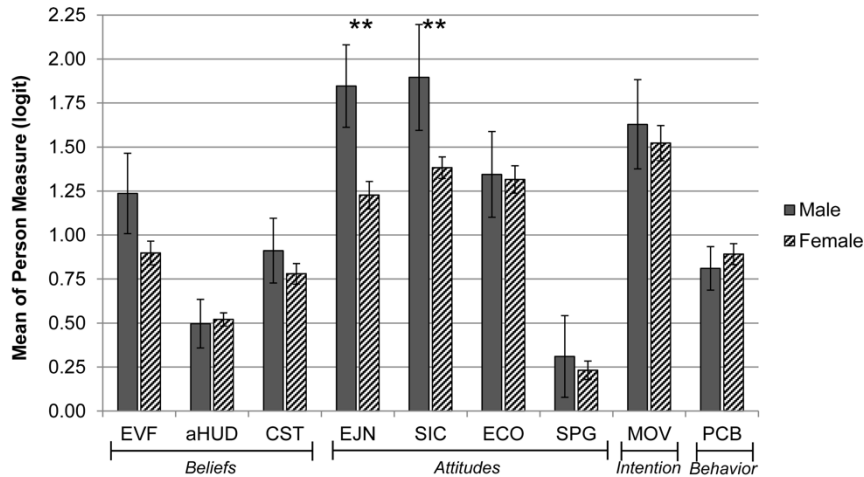


Figure 3. Independent sample t-test results of the used EAI scales based on gender. (Note: ** $p < .01$, * $p < .05$, no mark $p > .05$).

Figure 3 visualizes the results of gender differences. Based on the independent sample t-test analyses, among the 10 environmental scales used in the current study, only two scales were found to exhibit significant gender differences with medium effect size. Those two scales were enjoyment of nature (EJV, $t = 2.94$, p -value = .004, $d = 0.57$), and support for interventionist conservation policies (SIC, $t = 2.67$, p -value = .008, $d = 0.51$). Interestingly, male ($M = 1.85$, $SD = 1.33$; $M = 1.90$, $SD = 1.70$, respectively) had higher averages than female ($M = 1.23$, $SD = 1.06$; $M = 1.38$, $SD = 0.83$, respectively) in both scales.

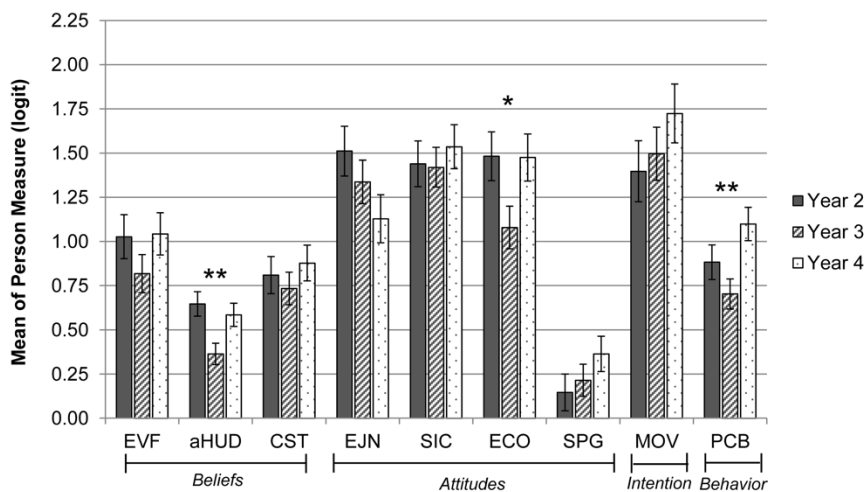
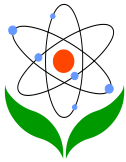


Figure 4. Analysis of variance (ANOVA) results of the used EAI scales based on years. (Note: ** $p < .01$, * $p < .05$, no mark $p > .05$).



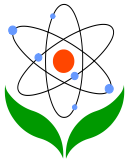
The ANOVA results for educational years found that only three scales exhibited significant differences. Those scales were anti-human utilization of and dominance over nature (aHUD, $F [2,211] = 5.59, p = 0.004, \eta^2 = 0.050$), ecocentric concern (ECO, $F [2,211] = 3.40, p = .035, \eta^2 = 0.031$) and personal conservation behaviour (PCB, $F [2,211] = 4.87, p = .009, \eta^2 = 0.044$). Following the ANOVA test, Tukey multiple comparison test was performed as the post hoc test. Based on the finding from the post-hoc test, the current study found that the aHUD scale third year students ($M = 0.36, SD = 0.50$) had significantly ($p\text{-value} < 0.01$) lower average than the second ($M = 0.65, SD = 0.69$) and fourth year students ($M = 0.59, SD = 0.42$). An intriguing finding was found in the ECO scale, as the ANOVA test found that educational years significantly impact the ECO; however, even though the second ($M = 1.48, SD = 1.37$) and fourth ($M = 1.48, SD = 0.91$) year students had higher average than the third year students ($M = 1.08, SD = 0.99$), as visualized in Fig. 4, based on the post-hoc test, no statistically significant result was found. It may be the reason why the p -value from the ANOVA result was quite high ($p = 0.035$). Lastly, the post hoc test for PCB showed that fourth year students ($M = 1.10, SD = 0.81$) had significantly ($p = .006$) higher average than third year students. Meanwhile, no significant differences were found between fourth year and second year ($M = 0.88, SD = 0.83, p = .497$), or between second year and third year students ($M = 0.70, SD = 0.71, p = .339$).

Correlations among variables and testing the hypothesized model through structural equation modeling

Before testing the hypothesized model, both Pearson's correlation and partial correlation tests were performed on the four environmental dimensions to find out the inter-correlation between the domains, and the mediator between one domain and another domain. Table 2 shows the results of the correlation tests.

Table 2. Pearson's correlation and partial correlation results of the four environmental domains (** $p < .01, * p < .05, \text{no mark } p > .05$).

Variable I	Variable II	Pearson's Correlation	Partial Correlation			
			Control variable			
			EB	EA	EI	SEB
Beliefs (EB)	EA	0.578**	-	-	.555**	.491**
	EI	0.209**	-	-.085	-	.072
	Behavior (SEB)	0.492**	-	.369**	.460**	-



Attitudes (EA)	EI	0.468**	.435**	-	-	.402**
	SEB	0.367**	.116	-	.267**	-
Intention (EI)	SEB	0.304**	.236**	.161*	-	-

It can be seen from Table 2 that the four domains were significantly ($p < .01$) correlated with one another. The highest correlation coefficient was found between EB and EA ($r = .578$), while the lowest was between EB and EI ($r = .209$). Additionally, based on the results from partial correlation test, three correlations were found to become non-significant when controlled by other domains. These were the correlations between EA and SEB when controlled by EB ($r = 0.116$, $p = .090$), EB and EI when controlled by EA ($r = -0.085$, $p = .217$), and EB and EI when controlled by SEB ($r = 0.072$, $p = .292$). Structural equation modeling (SEM) was used as the follow-up of the correlation test, to evaluate the hypotheses, and the hypothesized model of the structure of environmental beliefs, attitudes, intention, and behaviour of Indonesian preservice biology teachers. Figure 5 shows the SEM result. It can be seen from Figure 4 that two out of the three hypotheses, which are H1 and H2, were accepted, while H3, hypothesizing there is a significant path from environmental attitudes to SEB, was rejected.

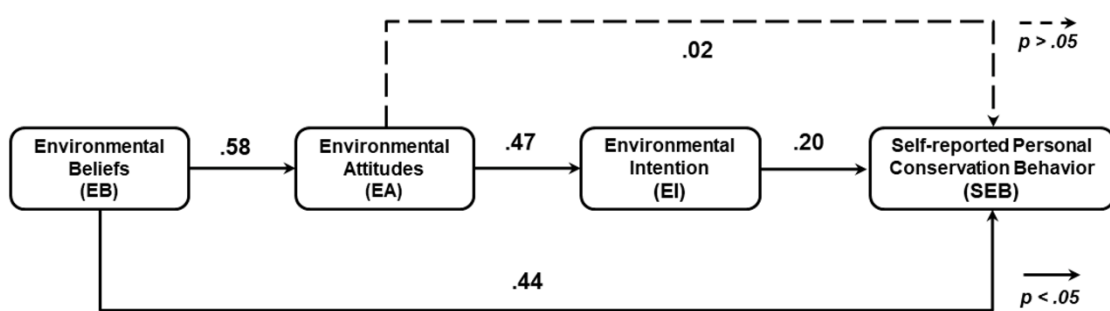
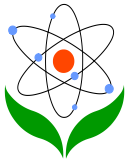


Figure 5. The accepted model ($\chi^2/df = 1.55$, p -value = .214, SRMR = .021, GFI = .996, AGFI = .964, NFI = .993, IFI = .997, TLI = .984, CFI = .997, RMSEA = .050)

Interview results

The results from interviewing six Indonesian preservice biology teachers supported the accepted model. Most of them (88%) believed that human activities, including their activities, caused the environmental problems that have been emerging in



Indonesia; and this belief has stimulated them to behave more pro-environmentally in their own life. These are quotes from their responses (“...” corresponds to the truncated response):

[translated from the Bahasa/Indonesian language] “... *I believe that all the environmental problems are caused by citizens, because they tend to do not think much when doing something harmful to the environment... because it is caused by them, including myself, I also believe that only us can reduce the problems; thus, I am frequently involved in the protecting environment-related activities in my neighbourhood*” (FNKE16).

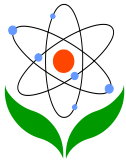
[translated from the Bahasa/Indonesian language] “... *I have been believing all the emergent environmental problem is caused by people surrounding me and myself as well... specifically driven by their and my own needs and desires... I have tried to control my own desires by so far not throwing trash in the inappropriate places and saving water usage...*” (MSTY14).

[translated from the Bahasa/Indonesian language] “... *The high economic demands that Indonesian people have make them doing what they want to the environment, including harmful actions... even in a very small action... because I believe if many people do the very small harmful action it will eventually cause the bigger thing... thus in order to prevent it, I have tried small things to preserve the environment by doing small actions, such as throwing trash in appropriate places and studying environmental science*” (FTTN14).

Moreover, we also captured that they all acknowledged that their major in the university contributed to making them see and observe nature and the environment. It led them to understand better the balance and beauty of nature and the environment, which made them feel more connectedness with it, and with more intention to protect nature. Such statements are:

[translated from the Bahasa/Indonesian language] “... *My biology education department provides several courses related to the environmental and the problems within it...also, many professors provide many activities that do work in nature, such as direct observation and field trips. These efforts have made me more aware of the environmental problems... also, increase the level of comfortableness being in nature... because of this sometimes I think to join environmental-related activist club*” (MSTY14).

[translated from the Bahasa/Indonesian language] “... *I feel my major now (biology education) really helps me in increasing my environmental awareness... by learning the interdependency between humans, plants, animals and nature...*”



protecting nature is similar to protecting my own self and other humans...” (FRNI15).

Regarding the issue of intention, all of them noted that even though they had the intention to behave more pro-environmentally to reduce the environmental problems, sometimes they could not realize this in their everyday life. They stated the reason was that their surroundings, like rules, other people, or social media, do not support their intention, leading them to fail to realize their pro-environment behavioural intention. These are some statements of the Indonesian preservice biology teachers regarding this issue:

[translated from the Bahasa/Indonesian language] “... *Indeed everyone has the intention to behave more friendly to the environment. But, the realization of it is not that easy and apparent. Government with their rules needs to support intention to be realized...*” (MRFI16).

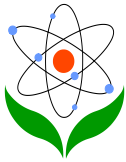
[translated from the Bahasa/Indonesian language] “... *I do always have the intention to behave pro-environmentally, but when I see my friends do not behave friendly to the environment, suddenly my intention is gone... thus I believe surrounding people have an impact in making someone behaving more pro-environmental*” (MSTY14)

Discussion and Implication

Gender and educational year effects

Responding to the first research question, we found that gender and educational year significantly influenced several variables. Males were found to enjoy more spending time in nature and to have more positive attitudes towards conservation policy. However, from the interview, we did not find that males enjoy spending time in nature more; instead, we found that both males and females said that they enjoy spending time in nature. Not selectively drawing the interviewees might have been causing this qualitative result, or discrepancy might be caused by the sample size issue, which we also acknowledge as a limitation of the current research.

Regarding the findings from the effect of the educational year, the current study found several variables interacted with educational year; however, the patterns were not clear. From the quantitative results, the third year students showed lower than the second and fourth year students in the variables that were found to be significantly influenced by educational year. When we tried to uncover more through interviews, we also did not find any difference between the representative students. Thus, we



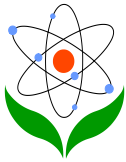
believe the more qualitative study is needed to better explain these unclear patterns and the discrepancy between quantitative results and interview in the gender issue.

Model of environmental related psychological traits of the Indonesian preservice biology teacher

The current study has successfully generated an acceptable statistical model of the environment-related psychological traits from the Indonesian preservice biology teacher sample. The model indicates two significant paths to the environmental behaviour; one directly departs from their environmental beliefs, while the other one is from their environmental intention. Both paths were derived from two well-known theories of behavioural change, namely the theory of planned behaviour (Ajzen, 1991) and value-belief-norm (Stern, 2001), meaning that the current study has supported these theories. Regarding TPB, several studies (e.g., Sniehotta et al., 2014) have found that intention is fairly suggested to have a direct impact on behaviour, which later suggests the TPB is no longer an appropriate theory to use to explain particular behaviour. However, in part, the current study found that the hypothesis generated from the TPB was significant. Thus, the finding of the current study adds more evidence for the TPB to still exist and to be used in explaining particular behaviour.

The acceptable model indicates the environmental beliefs as the crucial factor in influencing the environmental behaviour from the Indonesian preservice biology teachers' sample. The finding suggests that increasing the degree of environmental beliefs may be one of the most effective ways to tackle the other-than-friendly behaviour towards the environment that Indonesians have so far demonstrated. Because biology teachers in most Indonesian schools teach the environmental education subject, they can directly interact with the students and contribute to influencing students' underlying psychological traits related to the environment. Thus, establishing a learning environment in biology teacher preparation programs in Indonesia that focus on increasing their environmental beliefs can be considered an influential effort for higher education policymakers and teachers.

There are many efforts suggested by several studies that can be used to increase the individual's environmental beliefs. One effort that considers the impactful effort to environmental beliefs is field trip or fieldwork (e.g., Alon & Tal, 2017; Ballantyne & Packer, 2002; Dillon, 2012). Dillon (2012) argued that in fieldwork, people can be encouraged to see the real phenomena of nature and the environment, as well as the problems within it. White (2004) added that experiencing nature directly enables the development of sensory experience that contributes to the increase of environmental beliefs and awareness. Moreover, Manzanal, Barreiro, and Jiménez (1999) argued that fieldwork activity not only stimulates positive feelings, beliefs, and awareness towards the environment but can also help people think in more

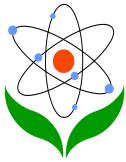


complex frameworks of the environment, such as emphasizing the more interdependent issues of the environment. However, Manzanal et al. (1999), together with Alon and Tal (2017), suggested that several cautions need to be considered by the teachers, to better implement fieldwork activity. The authors argued that the wrong direction of fieldwork activity may result in the opposite effects of what should be obtained. The wrong implementation of fieldwork can also increase the individual's dominance perception over nature, which means the decrease of environmental beliefs. Such wrong direction of fieldwork activity that is closely related to the biology major is sampling activity. When biology students go outside to do fieldwork activity, the activity of sampling plant and even animals is an inevitable activity for them. Because sampling from the real world can be considered like their object of study, this can increase their understanding of biological matters. Therefore, clear instruction emphasizing this kind of issue needs to be considered, before conducting fieldwork activity.

When preservice biology teachers experience many fieldwork activities and offer more education about fieldwork activity, they would get used to it, and consider it as a primary or important teaching method. It is our contention based on what we have explained above regarding fieldwork activity. Therefore, when they have this kind of perception, they would use fieldwork activity often when they start teaching in school. They are expected to do more fieldwork activity with their students while studying the environment and biology. The impact of fieldwork activity explained above may also apply to their students. The students may have more feeling of connectedness towards the environment, and see more environmental problems in real life that can increase their environmental beliefs. If students also have similar paths to those of preservice biology teachers, increase in environmental beliefs can also positively influence student's environmental attitudes, intentions, then environmental behaviour, respectively, or the other path that directly influences environmental behaviour. More evidence from the study exploring Indonesian primary and secondary students needs to be gathered. Lastly, based on Alon and Tal (2017), adding environmental action in fieldwork activity is considered as having multiple impacts not only on environmental beliefs but also on attitudes and behaviour that will be exerted, as an increase in environmental behaviour. Thus, we urge higher education not only in Indonesia to maximize the use of fieldwork activity in biology teacher preparation programs or even other programs.

Conclusion

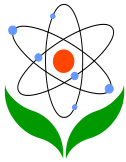
The current study aimed to uncover the underlying psychological traits of the environmental behaviour from the sample of Indonesian preservice biology teachers



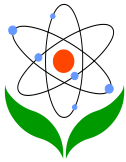
through generating a statistical model together with interviews. Based on the results, the current study found that two paths influence the personal conservation behaviour of Indonesian preservice biology teachers. The first path was the path that follows the theory of planned behaviour, which indicates the environmental intention as the predictor of personal conservation behaviour. The second path is the path indicated direct effect from environmental beliefs to the personal conservation behaviour, and this path was found to have more impact than the first path. The accepted hypothesis in this study generated from TPB adds more evidence that this theory can be used in explaining particular behaviour. The interviews of the representative samples confirmed these findings. Therefore, the current study concludes that increasing the environmental belief through environmental (science) education is considered the most influential effort to make Indonesian preservice biology teachers behave more friendly towards the environment.

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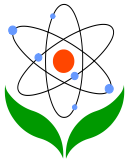
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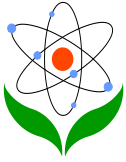
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