Causal Relationship Model of Environmental Education

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Abstract *Environmental education has been accepted and applied for encouraging the global citizens to take a responsible practice through their behavior changing in daily life activity. This might be an effective and rapid change to decrease the greenhouse gases via the awareness raising, attitude and value adjusting, skill and participation increasing including real practice in daily living. The populations will be undergraduate students of academic year 2011 of Mahasarakham University. The Multi-stage random sampling was used to collect the sample for 450 undergraduate students from different faculties. The questionnaire was employed as instrument for data collecting. LISREL was used for model verification. Results illustrated that considering on structural model confirmatory factors of Environmental Education (EE) was able to explain the variation of endogenous factors of Psychological Trait (Trait) caused endogenous factor of Environmental Behaviors for Global Warming Alleviation (BEH) with 82.0 percents.*

$$BEH = 0.29 \ TRAIT + 0.75 \ EE \ \dots\dots\dots\dots\dots\dots(1)$$
$$(R^2 = 0.82)$$

1. Introduction

Global warming is recognized as seriously environmental issues because the rising in the average temperature of Earth's atmosphere and oceans is still rapidly incessant. This finding is realized by the national science academies of all the major industrialized countries and is not disputed by any scientific body of national or international standing. Particularly, the majority of scientists specify that the warming in current decades has been caused first and foremost by human being activities that have enlarged the amount of greenhouse gases in the atmosphere such as deforestation, fossil fuel combustion and destroyed biodiversity of ocean by over harvesting fishery (United States National Academy of Sciences., 2008, National Research Council of USA., 2010, & Thiengkamol, 2011e).

The main international mitigation effort is the Kyoto Protocol, which seeks to stabilize greenhouse gas concentration to prevent a "dangerous anthropogenic interference" (UNFCCC, 2005). At international level as of May 2010, 192 states members of the UNFCCC had ratified the protocol. The only members of the UNFCCC that were asked to sign the treaty but have not yet ratified it are the USA and Afghanistan (UNFCCC, 2011).

Currently, environmental information on climate change with global warming has become hot issue for general people who are directly impacted by the earth quake, flood, and drought, furthermore it also affected to natural system, ecological system, biodiversity loss, new vector of disease born, species migration, and so on. However, the environmental problem can't absolutely separate from individual level. The main of cause is revealed that the people have not enough knowledge and understanding, and lack of consciousness, awareness, and attitude to practice proper behavior including realizing that they take very important parts to take responsibility for conservation of natural resources and environment (Thiengkamol, 2011e).

The Tenth National Economic and Social Development Plan of Thailand (B.E. 2550-2554), it included the principle of participation of every sectors in Thai society and aimed to set Thai citizen as center of development in order to accomplish a sustainable economic and society based on the moral and ethics for living and conservation of natural resources and environment in order to develop the quality of life of Thai people in numerous aspects that was consistent to principle of sustainable development in accordance to concept of conference of environment and development of United Nation since 1992. In Agenda 21 of global action plan mentioned that "Sustainable development is development which meets the needs of the presented without compromising the ability of future generations to meet their own needs." (Office of National Economic and Social Development Plan, 2010, WCED, 1987, Volker, 2007, Watkinson, 2009,

&Thiengkamol, 2011e). In order to meet sustainable development, it can be done through the environmental education process by via all channels whether informal, formal, non-formal, lifelong education systems, moreover the mass media and internet are also included but it needs to stress in the way of attitude changing and continuous implementation to develop permanently environmental behavior of natural resources and environmental conservation (Thiengkamol, 2011e).

The intention of psychologists tried to understand on human behavior, and then they had developed a large number of theories and models but they had the main focus on explanation how individual perceived and evaluated the stimulant before making decision to express his behavior. Nevertheless, study on human behavior, it can't be neglected the psychological trait. Trait theorists are primarily interested in the measurement of traits, which can be defined as habitual patterns of behavior, thought, and emotion including psychological health and physical health which are inherited trait from parents. There is much debate over how much of who we are is by nature (genetic) or nurture (environment), and both contribute significantly to our complete expression (Kassin, 2003, & Pearson, 2006).

According to this perspective, traits are relatively stable over time, differ across individuals, and influence behavior. However, in studying of human geography, it revealed that both physical and biological features are the stimulants to make people convey their behavior in different approaches of place, surrounding people, and experience. These are unable to ignore since the human and environment are deeply and tightly related to each other, while environment play a role as stimulant to make human to perform different activities. Therefore, the human behavior was expressed by psychological trait and also caused to make a change of environment (Suwan, 2006). The ability of understanding about behavioral occurrence or expression of human, it leads to predict and control the undesirable behavior or promote and build the desirable behaviors.

It was obviously seen that there was no research done on environmental behavior for global warming alleviation affecting by environmental education based on psychological trait covering physical health, psychological health, self-confidence, mercy and kindness, achievement motivation, and goal of life. Currently, it is very rarely and there is no research is holistically integrative done about environmental education when it compared with other aspects of relating factors affecting to environmental behaviors.

Therefore, this research was designed to study by covering all factors relating as mentioned above, it would be able to develop a model of environmental behaviors for global warming alleviation that are affected by environmental education and psychological traits.

2. Objective

The objective was to propose the structural model of environmental education and psychological trait affecting to environmental behavior for global warming alleviation.

3. Methodology

The research design was implemented in steps by step as follows:

3.1 The populations were 35,010 undergraduate students of the first semester in academic year 2011 of Mahasarakham University. The Multi-stage random sampling was employed to collect 450 students from different faculties of Mahasarakham University.

3.2 The research instrument was the questionnaire and it was used for data collecting. The content and structural validity were determined by Item Objective Congruent (IOC) with 5 experts in the aspects of environmental education, psychology, social science and social research methodology. The reliability was done by collecting the sample group from 50 undergraduate students of Rajabhat Mahasarakham University which is nearby Mahasarakham University. The reliability was determined by Cronbach's Alpha. The reliability of environmental education, psychological traits, and the whole questionnaire were 0.937, 0.838 and0.956 respectively.

3.3 The descriptive statistics used were frequency, percentage, mean and standard deviation. The inferential statistics used was LISREL by considering on Chi-Square value differs from zero with no statistical significant at .05 level or Chi-Square/df value with lesser or equal to 2, P-value with no statistical significant at .05 level and RMSEA (Root Mean Square Error Approximation) value with lesser than 0.05 including index level of model congruent value, GFI (Goodness of Fit Index) and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.90-1.00.
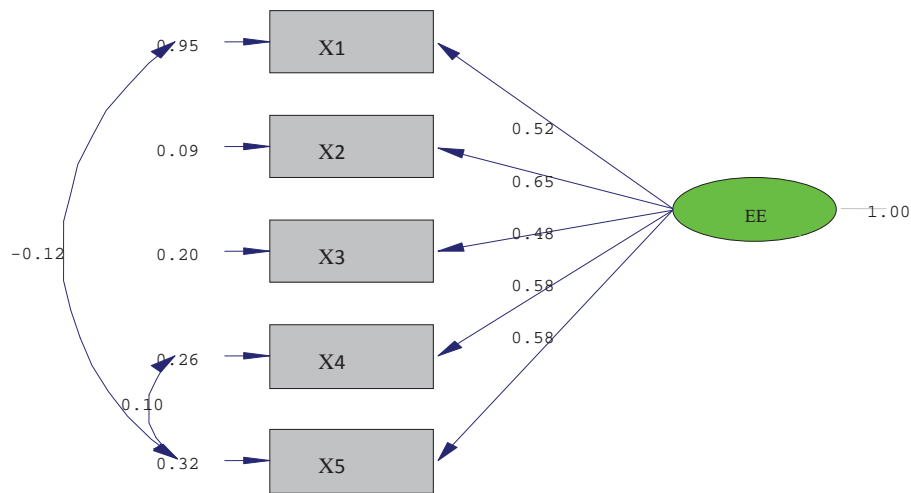
4. Results

4.1 Results of Confirmatory factors of Exogenous Variables

Results of Confirmatory Factor Analysis of Exogenous Variables of Environmental Education (EE) and Psychological Trait (TRAIT) affecting to environmental behaviors for global warming alleviation (BEH), were revealed as followings.

1) Confirmatory factors of EE had Bartlett's test of Sphericity of 995.457 statistically significant level (p< .01) and Kaiser–Mayer–Olkin Measure of Sampling Adequacy/MSA) of 0.809. This indicated that components of EE aspect had proper relationship at good level and it can be used for analysis of confirmatory factors as shown in picture 1 and table 1.

Picture 1. Model of Confirmatory factors of Environmental Education

Chi-Square=3.30, df=3, P-value=0.34705, RMSEA=0.015

Table 1. Results of Analysis of Confirmatory factors of Environmental Education

Components of Environmental Education	Weight	SE	t	R^2
X1 Knowledge and Understanding on Environment	0.52	0.052	9.93**	0.22
X2 Attitude toward Environment	0.65	0.029	22.84**	0.82
X3 Value for Environment	0.48	0.028	17.03**	0.53
X4 Skill for Environmental Practice	0.58	0.033	17.43**	0.56
X5 Participation to Environmental Activities	0.58	0.036	16.24**	0.51
Chi-square = 3.30 df = 3 P = 0.34705				
GFI = 1.00 AGFI = 0.99 RMSEA = 0.015 RMR =0.010				

** Statistically significant level of .01

From picture 1 and table 1, results of analysis of confirmatory factors of EE from 6 observe variables were revealed that the model was congruent to empirical data by considering from 1) Goodness of Fit Index (GFI) equaled to 1.00 and Adjust Goodness of Fit Index (AGFI) equaled to 0.99 2) Root Mean Square Error of Approximation (RMSEA) equaled to 0.015 (RMSEA < 0.05) and 3) Chi- Square value had no statistically significant at level of .01 and degree of freedom was lesser than or equaled to .05 ($x^2 / df \leq 5.00$).

Considering on loading weight of observe variables in model, it was revealed that observe variables had loading weight with 0.48 to 0.65 and had covariate to model of Environmental Education with 22.00 to 82.00 percents.

4.2   Results of Confirmatory Factor Analysis of Endogenous Variables

1. Confirmatory Factor Analysis of Endogenous Variables of Psychological Trait (TRAIT) affecting to environmental behaviors for global warming alleviation (BEH) was revealed as followings.
Confirmatory factors of TRAIT had Bartlett's test of Sphericity of 591.807 statistically significant level (p< .01) and Kaiser–Mayer–Olkin Measure of Sampling Adequacy/MSA) of 0.782. This indicated that components of TRAIT aspect had proper relationship at good level and it can be used for analysis of confirmatory factors as shown in picture 2 and table 2.

Picture 2. Model of Confirmatory factors of Psychological Trait
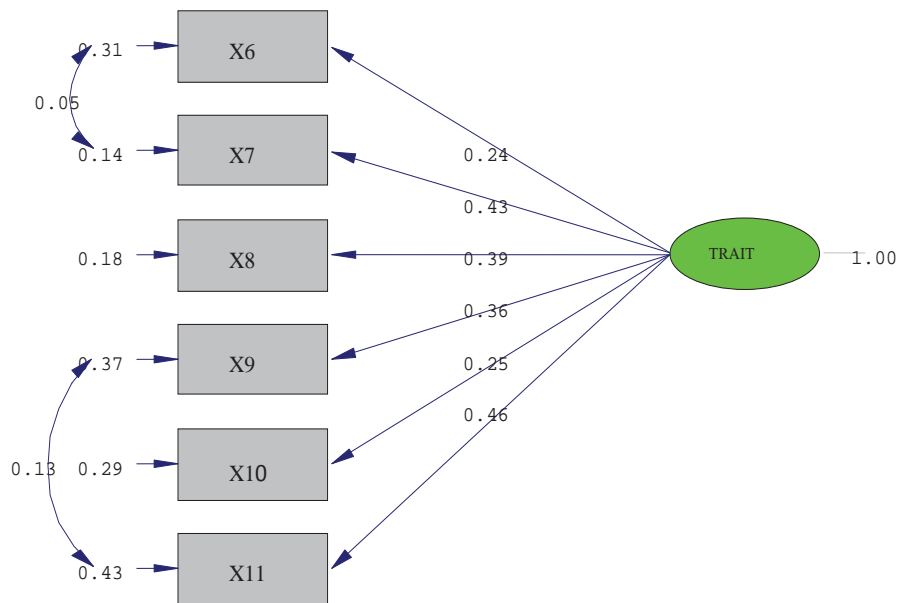
Chi-Square=10.20, df=7, P-value=0.17745, RMSEA=0.032

Table 2. Results of Analysis of Confirmatory factors of Psychological Trait

Confirmatory factors of Psychological Trait		Weight	SE	t	R^2
X6	Physical Health	0.24	0.035	6.94**	0.16
X7	Psychological Health	0.43	0.028	15.14**	0.57
X8	Self-Confidence	0.39	0.029	13.71**	0.46
X9	Mercy and Kindness	0.36	0.037	9.71**	0.25
X10	Achievement Motivation	0.25	0.031	8.02**	0.17
X11	Goal of Life	0.46	0.040	11.45**	0.34

Chi-square = 10.20 df = 7 P = .17745
 GFI = 0.99 AGFI = 0.98 RMSEA = 0.032 RMR = .0093

   ** Statistically significant level of .01

From picture 2 and table 2, results of analysis of confirmatory factors of TRAIT from 6 observe variables were revealed that the model was congruent to empirical data by considering from 1) Goodness of Fit Index (GFI) equaled to 0.99 and Adjust Goodness of Fit Index (AGFI) equaled to 0.98 2) Root Mean Square Error of Approximation (RMSEA) equaled to 0.015 (RMSEA < 0.05) and 3) Chi- Square value had no statistically significant at level of .01 and degree of freedom was lesser than or equaled to .05 ($x^2 \, / \, df \, \leq 5.00$).

Considering on loading weight of observe variables in model, it was revealed that observe variables had loading weight with 0.24 to 0.46 and had covariate to model of Psychological Trait with 16.00 to 57.00 percents.

2. Confirmatory Factor Analysis of Endogenous Variables of Environmental Behaviors for Global Warming Alleviation (BEH)

Confirmatory Factor of Environmental Behaviors for Global Warming Alleviation (BEH) had Bartlett's test of Sphericity of 834.218 statistically significant level (p< .01) and Kaiser–Mayer–Olkin Measure of Sampling Adequacy/MSA) of 0.832. This indicated that components of BEH aspect had proper relationship at good level and it can be used for analysis of confirmatory factors as shown in picture 4 and table 4.

Picture 3. Model of Confirmatory factors of Environmental Behaviors for Global Warming Alleviation (BEH)
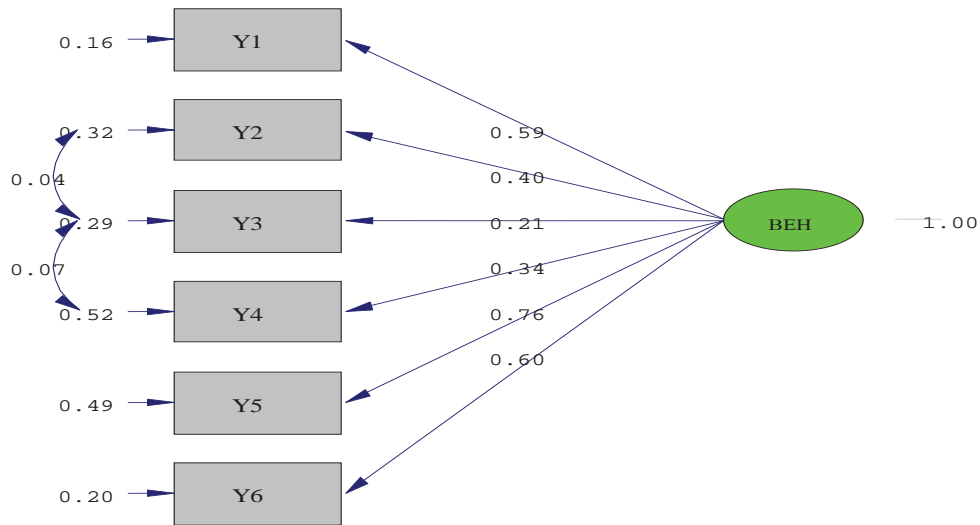
Chi-Square=11.08, df=7, P-value=0.13517, RMSEA=0.036

Table 3 Results of Analysis of Confirmatory factors of Environmental Behaviors for Global Warming Alleviation

Confirmatory factors of Environmental Behaviors for Global Warming Alleviation		Weight	SE	t	R^2
Y1	Consumption Behavior	0.59	0.029	19.95**	0.69
Y2	Energy Conservation	0.40	0.032	12.67**	0.34
Y3	Waste Management	0.21	0.028	7.41**	0.13
Y4	Travelling Behavior	0.34	0.039	8.81**	0.18
Y5	Recycling Behavior	0.76	0.044	17.01**	0.54
Y6	Knowledge Transferring and Supporting for Environmental Conservation	0.60	0.031	18.96**	0.64
Chi-square = 11.08 df = 7 P = 0.13517					
GFI = 0.99 AGFI = 0.98 RMSEA = 0.000 RMR = 0.036					

** Statistically significant level of .01

From picture 3 and table 3, results of analysis of confirmatory factors of BEH from 6 observe variables were revealed that the model was congruent to empirical data by considering from 1) Goodness of Fit Index (GFI) equaled to 0.99 and Adjust Goodness of Fit Index (AGFI) equaled to 0.98 2) Root Mean Square Error of Approximation (RMSEA) equaled to 0.000 (RMSEA < 0.05) and 3) Chi- Square value had no statistically significant at level of .01 and degree of freedom was lesser than or equaled to .05. $x^2 / df \leq 5.00$.

Considering on loading weight of observe variables in model, it was revealed that observe variables had loading weight with 0.21 to 0.76 and had covariate to model of Environmental Behaviors for Global Warming Alleviation with 13.00 to 69.00 percents.

4.3 Results of Effect among Variables in Model in Terms of Direct Effect

1) Confirmatory factors of Environmental Education (EE) had direct effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of .01 with effect of 0.75. Moreover, confirmatory factors in aspect of Environmental Education (EE) had indirect effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of .01 with effect of 0.093.

2) Confirmatory factors of Environmental Education (EE had direct effect to Psychological Trait (TRAIT) with statistically significant at level of .01 with effect of 0.32.

3) Considering on structural model confirmatory factors of Environmental Education (EE) was able to explain the variation of endogenous factors of Psychological Trait (Trait) to caused Environmental Behaviors for Global Warming Alleviation (BEH) with 82.0 percents as following.

$$BEH = 0.29 \text{ TRAIT} + 0.75 \text{ EE} \dots\dots\dots\dots\dots\dots(1)$$
$$(R^2 = 0.82)$$

Equation (1) factors that had the most effect to Environmental Behaviors for Global Warming Alleviation (BEH) was Environmental Education (EE), subsequences was Psychological Trait (TRAIT) and these were able to explained the variation of Environmental Behaviors for Global Warming Alleviation (BEH) with 82.0 percents.

Picture 5. Model of Direct and Indirect Effect of EE through TRAIT Affecting to BEH
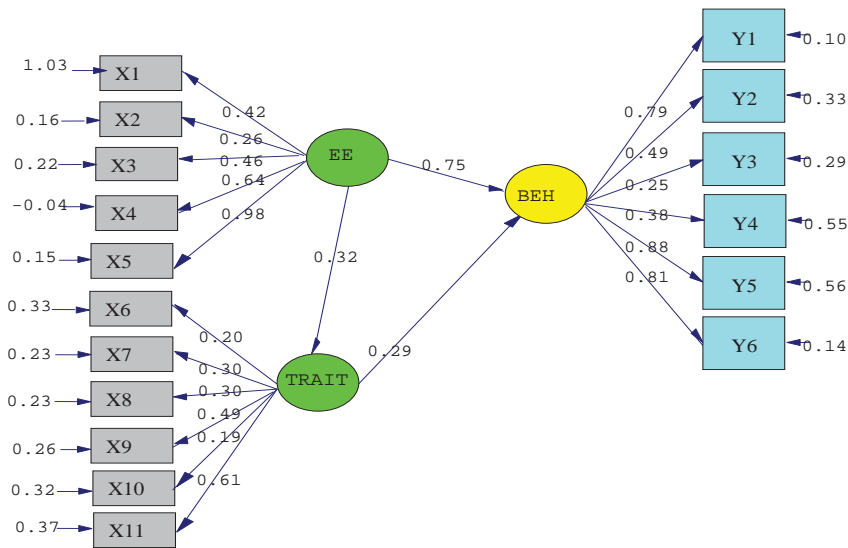
Chi-Square=251.23, df=143, P-value=0.165, RMSEA=0.035

5. Discussion

The findings indicated that environmental education had direct affecting to psychological trait and environmental behavior for global warming alleviation with highly with statistically significant at level of .01 with effect of 0.32 and 0.75. Additionally, Moreover, when considering on weight of loading of observe variables of Skill for Environmental Practice (X4), and Participation to Environmental Activities (X5) was able to predicted the variation of EE that was congruent to different studies of Thiengkamol, N. (2004, 2005a, 2005b, 2010b, 2011a, 2011b, & 2011c) that the results illustrated that the participants of Participatory Appreciation Influence Control (PAIC) training process with the integration of focus group discussion and brain storming would perform better environmental behaviors whether consumption behavior, energy consumption, recycling behavior, travelling behavior and knowledge transferring and supporting for environmental conservation after they had real practice via different activity participation for environmental conservation. Nevertheless, confirmatory factors of Psychological Trait (TRAIT) had direct effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of .01 with effect of 0.29. This result is congruent to the concept of psychologists about psychological trait also an important factor that affected to behavior of people and research of Thiengkamol, that studied on the affecting of psychological trait to environmental behavior (Thiengkamol, 2012c).

It might be concluded that environmental education determined by observe variables of Knowledge and Understanding on Environment (X1), Attitude toward Environment (X2), Value for Environment (X3), Skill for Environmental practice (X4), and Participation to Environmental Activity (X5) and Psychological Trait (TRAIT) composing of Physical Health (X6), Psychological Health (X7), Self-Confidence (X8), Mercy and Kindness (X9), Achievement Motivation (X10), and Goal of Life (X11) affecting to Behavior for Global Warming Alleviation (BEH) covering of Consumption behavior (Y1), Energy conservation (Y2), Waste disposal (Y3), Travelling behavior (Y4), Recycling behavior (Y5), and Knowledge transferring and supporting for environmental conservation (Y6).

The exogenous factors of Environmental Education (EE) was able to explain the variation of endogenous factors of Psychological Trait (TRAIT) to caused Environmental Behaviors for Global Warming Alleviation (BEH) with 82.0 percents. The model of EE affecting to BEH through TRAIT was verified the proposed model was fitted with all observe variables according to criteria of Chi-Square value differs from zero with no statistical significant at .05 level or Chi-Square/df value with lesser or equal to 2, P-value with no statistical significant at .05 level and RMSEA (Root Mean Square Error Approximation) value with lesser than 0.05 including index level of model congruent value, GFI (Goodness of Fit Index) and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.90-1.00.

Therefore, it might be concluded that environmental education and psychological trait play very important roles to create the environmental behavior of consumption behavior, energy conservation, waste management, travelling behavior, recycling behavior , and knowledge transferring and supporting for environmental conservation, therefore environmental education should introduced by integration in every subjects in the school. These results were congruent to concepts proposed by Thiengkamol (2009b, 2009c, & 2011e) and researches of Thiengkamol, (2012c) and Jumrearnsan, & Thiengkamol, (2012).

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