Model of Environmental Education and Psychological Factors Influencing to Global Warming Alleviation

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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 belief adjusting, skill and participation increasing including real practice in daily living.The populations were 35,010 undergraduate students of the first semester of academic year 2011 of Mahasarakham University. The simple random sampling was used to collect the sample for 450 undergraduate students with proportion according to fields of study. The questionnaire was employed as instrument for data collecting. LISREL was used for model verification. Results illustrated as Equation 1and 2 as followings. Considering on structural model confirmatory factors was able to explain the variation of endogenous factors of Environmental Education (EE) to caused Environmental Behaviors for Global Warming Alleviation (BEH) with 97.5 percents and the variation of endogenous factor of Environmental Education (EE) with 90.5 percents. Therefore, the equation 1 and 2 can be written as followings.*

$$BEH = 0.56 *PsT + 0.38*PsS + 0.52* EE \quad \text{(1)}$$
$$(R2 = 0.975)$$
$$EE = 0.45*PsT + 0.47*PsS \quad \text{(2)}$$
$$(R^2 = 0.905)$$

***Key Words:** Model / Environmental Education / Psychological Factors / Global Warming Alleviation.*

1. Introduction

Global warming is continuous rising in the average temperature of Earth's atmosphere and oceans. This finding is recognized by the national science academies of all the major industrialized countries and is not disputed by any scientific body of national or international standing. In particular, most scientists indicate that the warming in recent decades has been caused primarily by human activities that have increased the amount of greenhouse gases in the atmosphere such as deforestation and fossil fuel combustion (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).

Presently, 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, loss biodiversity, 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, & Thiengkamol, 2011f).

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, & Thiengkamol, 2011f). 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 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). However, Interactionist theory has grown in the latter half of the twentieth century and has become one of the principal sociological perspectives in the world today. Interationism is most popular at present in Thailand for psychological study, especially, psychological trait and psychological state are play essential roles to spire for public consciousness for environmental conservation. Generally, environmental issues were ignorant as non-important issue for people until the beginning of this year 2011, Thai peoples have faced with strange of weather in summer, they faced with cold weather. This stimulated their attention s for turning their awareness to global warming seriously (Punthumnavin, 2008, Thiengkamol, 2009b, Thiengkamol, 2009c, 2011e, Thiengkamol, 2011f, and Jumrearnsan, & Thiengkamol, 2012).

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 that are affected by environmental education and psychological traits.

2. Objective

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

3. Methodology

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

The populations were 35,010 undergraduate students of the first semester in academic year 2011 of Mahasarakham University. The 450 simple random sampling was employed to collect data from different faculties of Mahasarakham University with the equal proportion.

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 trait, psychological state, and inspiration of public consciousness, environmental behaviors, and the whole questionnaire were .937, .838, .897, .805, 929 and 978 respectively.

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 5, 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

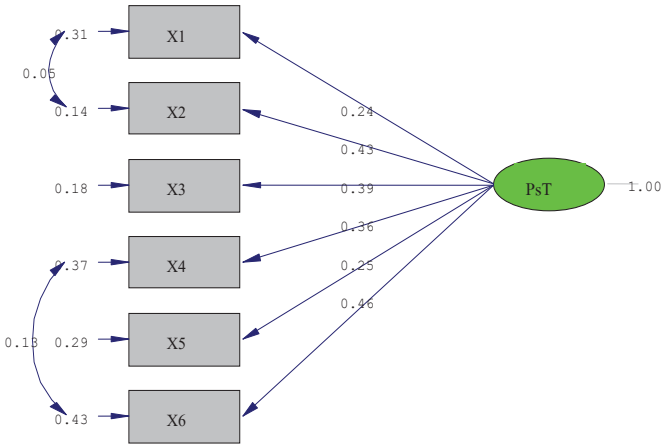
4.1 Confirmatory factors of Exogenous Variables

Results of Confirmatory Factor Analysis of Exogenous Variables of Psychological Trait, and Psychological State affecting to environmental behaviors for global warming alleviation, were revealed as followings.

4.1.2 Confirmatory Factor Analysis of Psychological Trait (PsT)

Confirmatory factors of PsT 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 PsT 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 Psychological Trait (PsT)



Chi-Square=10.20, df=7, P-value=0.17745, RMSEA=0.032

Table 1 Results of Analysis of Confirmatory factors of Psychological Trait (PsT)

Confirmatory factors of Psychological Trait		Weight	SE	t	R^2
X1	Physical Health	0.24	0.035	6.94**	0.16
X2	Psychological Health	0.43	0.028	15.14**	0.57
X3	Self-Confidence	0.39	0.029	13.71**	0.46
X4	Mercy and Kindness	0.36	0.037	9.71**	0.25
X5	Achievement Motivation	0.25	0.031	8.02**	0.17
X6	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					

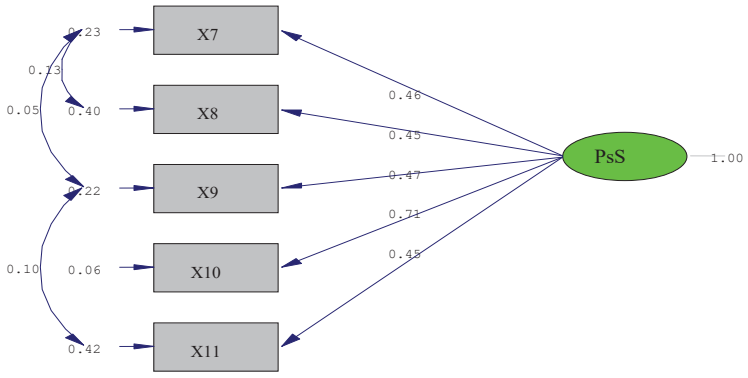
** Statistically significant level of .01

From picture 1 and table 1, results of analysis of confirmatory factors of PsT 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 ($\chi^2 / df \leq 5.00$).

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 16.0 to 57.0 percents.

4.1.2 Confirmatory Factor Analysis of Psychological State (PsS)

Confirmatory factors of Psychological State had Bartlett's test of Sphericity of 751.823 statistically significant level (p< .01) and Kaiser–Mayer–Olkin Measure of Sampling Adequacy/MSA) of 0.769. This indicated that components of PsS aspect had proper relationship at good level and it can be used for analysis of confirmatory factors as presented in picture 2 and table 2.



Chi-Square=0.236, df=2, P-value=0.75428, RMSEA=0.001

Picture 2: Model of Confirmatory factors of Psychological State (PsS)

Table 2 Results of Analysis of Confirmatory factors of Psychological State (PsS)

Confirmatory factors of Psychological State		Weight	SE	t	R^2
X7	Value of Self-Living	0.46	0.028	12.02**	0.39
X8	Value of Family Living	0.45	0.035	11.56**	0.47
X9	Attitude of Sufficiency	0.47	0.037	15.58**	0.49
X10	Religion Belief	0.71	0.038	17.96**	0.88
X11	Environmental Physical	0.45	0.039	11.01**	0.46
Chi-Square=0.236, df=2, P-value=0.75428					
GFI = 1.00 AGFI = 1.00 RMSEA = 0.001 RMR = .012					

** Statistically significant level of .01

From picture 2 and table 2, results of analysis of confirmatory factors of PsS from 5 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 1.00 2) Root Mean Square Error of Approximation (RMSEA) equaled to 0.001 (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 5. ($\chi^2 / df \leq 5.00$).

Considering on loading weight of observe variables in model, it was revealed that observe variables had loading weight with 0.45 to 0.71 and had covariate to model of Psychological State with 39.0 to 88.0 percents.

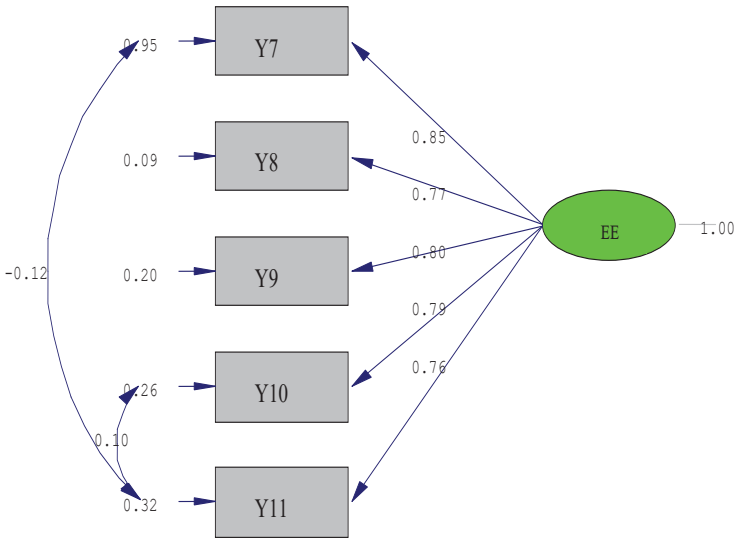
4.2 Confirmatory Factor Analysis of Endogenous Variables

Results of Confirmatory Factor Analysis of Endogenous Variables of Environmental Education influencing to environmental behaviors for global warming alleviation, was revealed as followings.

4.2.1 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 presented in picture 3 and table 3.

Picture 3: Model of Confirmatory factors of Environmental Education



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

Table 3 Results of Analysis of Confirmatory factors of Environmental Education

Components of Environmental Education		Weight	SE	t	R^2
Y7	Knowledge and Understanding on Environment	0.85	0.042	19.02**	0.86
Y8	Attitude toward Environment	0.77	0.039	12.47**	0.78
Y9	Value for Environment	0.80	0.038	18.32**	0.83
Y10	Skill for Environmental Practice	0.79	0.034	17.36**	0.80
Y11	Participation to Environmental Activities	0.76	0.035	17.02**	0.77
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 ($\chi^2 / df \leq 5.00$).

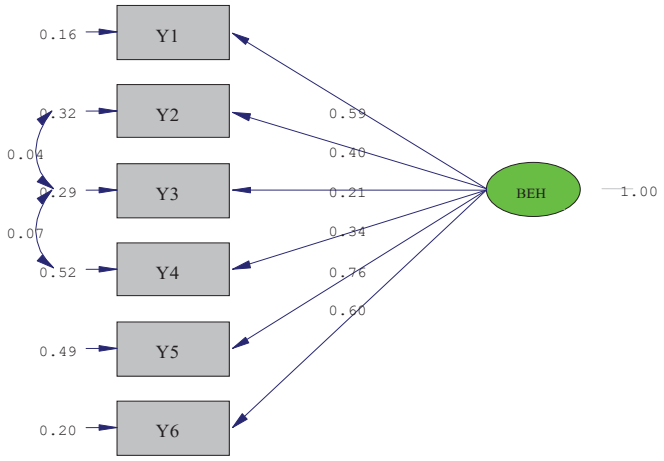
Considering on loading weight of observe variables in model, it was revealed that observe variables had loading weight with 0.76 to 0.85 and had covariate to model of Environmental Education with 77.0 to 86.0 percents.

4.2.2 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 4: 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 4 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 4 and table 4, 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. $\chi^2 / df \leq 5.00$.

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 13.0 to 69.0 percents.

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

4.3.1 Confirmatory factors of Psychological Trait (PsT) had direct effect to Environmental Education (EE) and Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of .01 with effect of 0.45 and 0.56. Additionally, confirmatory factors of Psychological Trait (PsT) had indirect effect to Environmental

Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of .01 with 0.234.

4.3.2 Confirmatory factors of Psychological State (PsS) had direct effect to Environmental Education (EE) and Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of .01 with effect of 0.47 and 0.38. Additionally, confirmatory factors of Psychological State (PsS) had indirect effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of .01 with 0.2444.

4.3.3 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 0.52.

Considering on structural model confirmatory factors was able to explain the variation of endogenous factors of Environmental Education (EE) to caused Environmental Behaviors for Global Warming Alleviation (BEH) with 97.5 percents and the variation of endogenous factor of Environmental Education (EE) with 90.5 percents. Therefore, the equation 1 and 2 can be written as followings.

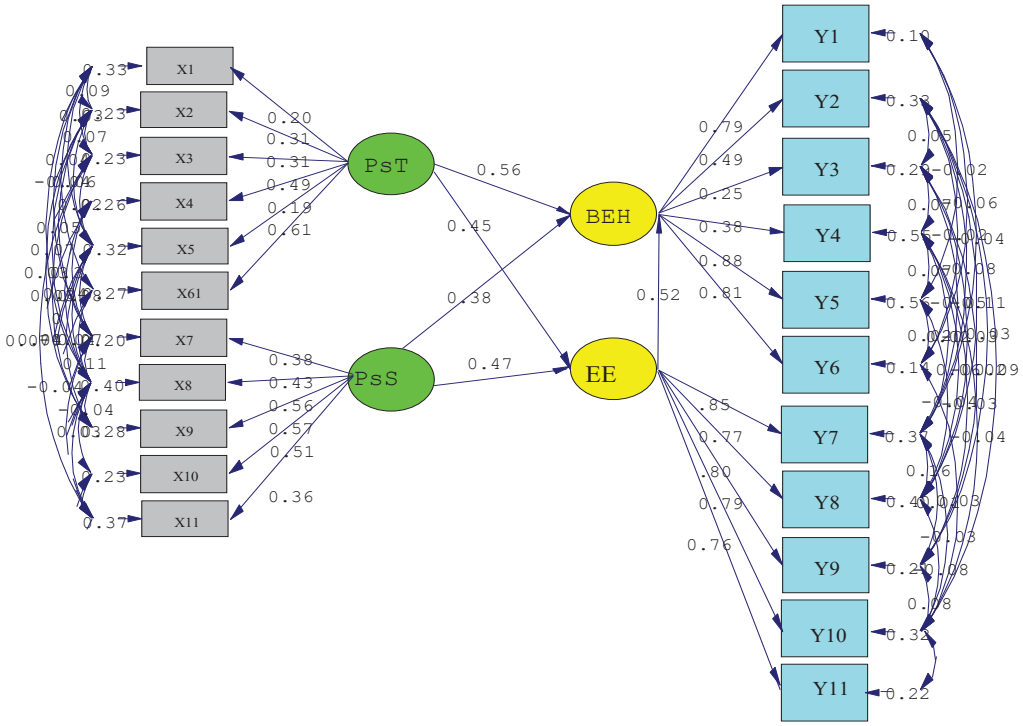
$$BEH = 0.56 *PsT + 0.38*PsS + 0.52* EE \quad \text{.....(1)}$$
$$(R2 = 0.975)$$

Equation (1) factors that had the most effect to Environmental Behaviors for Global Warming Alleviation (BEH) was Environmental Education (EE), subsequences were Psychological Trait (PsT) and Psychological State (PsS). These were able to explain the variation of Environmental Behaviors for Global Warming Alleviation (BEH) with 90.5 percents.

$$EE = 0.45*PsT + 0.47*PsS \quad \text{.....(2)}$$
$$(R^2 = 0.905)$$

Equation (2) factors that had the most effect to Environmental Education (EE) was Psychological Trait (PsT), subsequences was Psychological State (PsS). These were able to explain the variation of Environmental Inspiration of Public Consciousness with 90.5 percents.

Picture 5: Model of Direct and Indirect Effect of PsT and PsS through EE Influencing to BEH



Chi-Square=201.73, df=186, P-value=0.14321, RMSEA=0.031

5. Discussion

The findings indicated that Psychological Trait (PsT) composing of Physical Health (X1), Psychological Health (X2), Self-Confidence (X3), Mercy and Kindness (X4), Achievement Motivation (X5), and Goal of Life (X6), and Psychological State (PsS) composing of Value of Self-Living (X7), Value of Family Living (X8), Attitude of Sufficiency (X9), Religion Belief (X10), and Environmental Physical (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 endogenous factors of Environmental Education (EE) was determined by observed variables of Knowledge and Understanding on Environment (Y7), Attitude toward Environment (Y8), Value for Environment (Y9), Skill for Environmental practice (Y10), and Participation to Environmental Activity (Y11),

The exogenous factors of Psychological Trait and Psychological State were able to explain the variation of endogenous factors of Environmental Education (EE) to caused Environmental Behaviors for Global Warming Alleviation (BEH) with 97.5 percents and the variation of endogenous factor of Environmental Education (EE) with 90.5 percents. The model of PsT and PsS affecting to BEH through EE 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 5, 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, psychological trait and Psychological state play very important parts to create the environmental behavior of consumption behavior, energy conservation, waste management, travelling behavior, recycling behavior , and knowledge transferring and supporting for environmental conservation based on environmental education, therefore environmental education should introduced by integration in every subjects in the school. Moreover, in aspect of environment, especially in formal education, Ministry of Education should introduce school curriculum in all level of education since kinder garden level to university level across the country to make student to gain more knowledge and understanding about environment and to raise their awareness, attitude adjust, to challenge their participation to cause behavioral changing for environmental conservation. The results of this study were congruent to various studies of Thiengkamol, N., (2004, 2005a, 2005b, 2010b, 2011b, 2011c, 2011e, 2011i, 2011j, & 2012c Jumrearnsan, & Thiengkamol, 2012, and Dornkornchum, & Thiengkamol, 2012).

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