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A Causal Model of Student Green Behavior with effect of Public Mind Inspiration and Plastic Life Cycle Assessment

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ABSTRACT

The research objectives was to verify causal model of Student Green Behavior (SGB) with effect of Public Mind Inspiration (PMI) and Plastic Life Cycle Assessment (PLCA) of undergraduates of Rajabhat Mahasarakham University. The results revealed that PLCA and PMI were able to explain the variation of SGB with 77.00 percent. PLCA had the most direct effect on SGB with an effect 0.47, subsequence was PMI with an effect 0.42. Moreover, PLCA had effect on PMI with an effect of 0.38 and be able to predict the variation of PMI with 79.00 percent. The causal model of SGB effect with PMI and PLCA was verified the anticipated model and it was tailored with all observed variables in line with criteria of Chi-Square/df value with less or equal to 2.021 and it was less than or equaled to 5.00 ($\chi^2/df \leq 5.00$). RMSEA (Root Mean Square Error Approximation) equaled to 0.044 (RMSEA < 0.05) and RMR (Root Mean Square Residual) equaled to 0.024 (RMR<0.05) including index level of model congruent value of Goodness of Fit Index (GFI) equaled to 0.95, and Adjust Goodness of Fit Index (AGFI) equaled to 0.94 which are between 0.90-1.00.

Key words: *Model, Student green behavior, Public mind inspiration, Lean knowledge*

Introduction

Construction student green behavior is a hard work for scientific and social academic people for several decades to alter their behavior. It is believed that the behavioral changes involve at least two main factor Genetics and environment (Sutthiphapa *et al.*, 2015; Breed and Sanchez, 2010). Genetic and environment factors play vital roles because genes occupy the evolutionary responses of previous people for behavioral selection. Environmental plasticity gives animals the occasion to regulate to variations throughout their own lifetime (Breed and Sanchez, 2010). However individual characters related to plentiful factors whether their diverse environment, knowledge, social, culture, lifestyles, belief, attitude, awareness, and intelligence (Thiengkamol, 2011e; Wikipedia, 2019). Lately, it is increasingly recognized in different fields of criminology, environment, health, education, and business, such as consumption pattern, energy aspect, and self- health care with the goal to reach sustainable development to meet the human life quality (Thiengkamol, 2016; Wikipedia, 2019). Thus, constructing student green behavior is needed to educate them with the various environmental knowledge whether in terms of life cycle assessment, environmental management system and lean principle in order to conserve the environment and ecosystem, therefore in this study Lean principle knowledge is introduced to undergradu-

ate to realize the important of environment conservation with public mind inspiration (Sutthiphapa *et al.,* 2015; Maporn *et al.,* 2015; Mukpradub *et al*., 2016).

The essential issue that is currently being recognized with LCA studies as an examination of the contribution of industrial systems. These activities make to climate change. Any gaseous emission is accepted to accelerate the global warming. It is assigned a value equal to the equivalent amount of CO_2 that it produces the same effect (Chaffee and Yaros, 2007).

It is due to the complex nature of plastic waste mixtures, mechanical recycling is often inefficient, leading to a majority of waste being incinerated. There is an alternative resolution to solve the waste problem, such as recovering valuable fuels from plastics via thermochemical methods. Life cycle assessment (LCA) was adopted to investigate plastic waste management options with recycling/recovery method is also taken into consideration (Khoo, 2019).

The Life Cycle Assessment (LCA) is also known as life-cycle analysis, ecobalance, and cradle-to-grave analysis technique to assess environmental impacts associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use (Wikipedia, 2019). Plastic Life Cycle Assessment (PLCA), is an environmental accounting and management approach that considers all the aspects of resource use and environmental releases of plastic related with an industrial system from cradle to grave to conserve environment and ecosystem (Maporn *et al*., 2015; Science Direct, 2019). As holistic view of environmental interactions, it covers a variety of activities, from the extraction of raw materials from the Earth and the production and distribution of energy, through the use, and reuse, and final disposal of a product. PLCA is a virtual tool intended to compare and not absolute evaluate. Thus it helps the decision makers to compare all major environmental impacts that alternative courses of action is chosen when conducting a PLCA. It defines the goal and scope to make a more informed decision. Key issues related with data collection, impact assessment modeling, and interpretation of the results are also delineated. The caution of LCA usage is an environmental management tool that informs decision makers including decision criteria with cost and performance. These should also be considered in order to make a well-balanced decision (Maporn *et al*., 2015). Generally, LCA composes of four phases including phase 1, goal and scope aims to define how large a part of product life cycle will be taken in assessment and to what end will assessment be serving. The criteria serving to system comparison and specific times are described in this step, phase 2, the inventory analysis provides a description of material and energy flows within the product system and specifically its interaction with environment, consumed raw materials, and emissions to the environment. All important processes and subsidiary energy and material flows are described later; phase 3, details from inventory analysis serve for impact assessment. The indicator results of all impact sorts are complete in this step; the significance of every impact sort is assessed by normalization and eventually also by weighting; and phase 4, interpretation of a life cycle involves critical review, determination of data sensitivity, and result presentation (Maporn *et al*., 2015).

Public Mind Inspiration (PMI) verified by Thiengkamol and her colleagues research works by covering numerous topics of research including, education, environment and natural resources, life cycle assessment, and health. These associated to environmental conservation behavior (Thiengkamol, 2016). PMI consists of a crucial person to act as a role model, an impressive environment, an impressive event and inspiration from media receiving. Per se, she and her colleagues observed authoritative approaches to create the inspiration of public mind or a public consciousness of environmental conservation. It is obviously seen that general people do not realize environmental problems daily living because of their facing with other key needs to consume for daily living (Thiengkamol, 2012e; Sutthiphapa *et al*., 2015; Maporn *et al.,* 205; Thiengkamol, 2016). Hence, they will not be aware of an environmental crisis until it comes to their backyards and affects their quality of life. However, if people face to vigorous pollution, such as air pollution or water pollution and so on, they will be enforced to pay attention for those environmental problems (Mongkonsin *et al,* 2013b; Kotchakote *et al.,* 2013a; Rivera-Rentas *et al*., 2007; Schmidt, 2007). In this context inspiration is completely different from motivation as a person who supports, acts and practices environmental conservation with the drive gained from an inspired desire will be pleased to do so in support of the local com-

munity and national population without the need for further rewards such as money, honor or admiration. The inspiration for such an act may have been acquired from a leading role model, an impressive environment, an impressive event and / or inspiration from participation of the media (Thiengkamol, 2011e; Saisunantharom *et al.,* 2013a; Suensing *et al*., 2013b; Hoerisch, 2002).

The purpose of this research is to introduce EF knowledge for the undergraduate students to understand importance of EF and PMI pro-environmental behavior behaviors including consumption, energy conservation, waste management, recycling, traveling and environmental knowledge transferring. Finally, they should take parts to take responsibility for global warming alleviation (Thiengkamol, 2012e; Saisunantharom *et al*., 2013a; Suensing *et al.,* 2013b; Thiengkamol, 2016; Schaefer *et al*., 2006; WWF, 2019; Wackernagel *et al.,* 2005; Mukpradub *et al*., 2016).

Research Objective

The research objectives was to identify causal model of Student Green Behavior (SGB) with effect of Public Mind Inspiration (PMI) and PlasticLife Cycle Assessment (PLCA).

Methodology

The research was conducted step by step as followings:

Population and Sample

The populations were 10,757 undergraduates in first semester of academic year of 2021 of Rajabhat Mahasarakham University in the Northeastern of Thailand.

Sample was 400 undergraduates of Rajabhat Mahasarakham University in second semester of academic year of 2021 that gathered with the Multi-Stage sampling technique (Schonlau *et al.,* 2002)

Research tool

The content and structural validity of questionnaire were proved by Item Objective Congruent (IOC) from 5 experts in the fields of LCA, social science and social research methodology. The reliability was tried out by conducting with the sample group from 40 undergraduate of Mahasarakham University that is neighboring area. The reliability was determined by Cronbach's Alpha formula. The ecological footprint contained 42 items, public mind inspiration contained 35 items, and student green behavior contained 42 items, and whole questionnaire consisted 161 items. Their reliabilities were 0.864, 0.870, 0.925, 0.924 and 0.935 respectively.

Data Collection

The research instrument was the questionnaire and it was used for data gathering.

The survey research used questionnaire to collect 400 undergraduates with the Multi-Stage sampling (Schonlau *et al.,* 2002) from 10,757 undergraduates in second semester of academic year of 2021 of Rajabhat Mahasarakham University of Northeastern region of Thailand.

Data Analysis

The descriptive statistics were frequency, percentage, mean and standard deviation. Structural Equation Model (SEM) was used for model confirmation with LISREL version 8.30 by considering on Chi-Square value had no statistically significant at level of 0.01 or Chi-Square/df value with less or equal to 5, RMSEA (Root Mean Square Error Approximation) and RMR (Root Mean Square Residual) values with less 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 0.9-1.00.

Results

General Characteristics of Sample Group

The sample group was 400 undergraduate students that were selected by Multi-stage random sampling technique. The sample group was collected from different faculties of 10,757 undergraduates of Rajabhat Mahasarakham University in first semester of academic year of 2021. Northeastern region of Thailand. Majority of sample group was female 228 (57.00%), most of them paid respect for Buddhist with 390 (98.00%), and had resident Inside Municipality 244 (61.00%). Majority had nuclear family with 240 (60.00%). They traveled by Motor-bicycle 292 (73.00%), and had mean age 19.75 years. Moreover, majority had income per month with mean 6,565.42 thai baht as shown in Table 1.

Confirmatory factors Analysis of Exogenous Variables

2.1 Confirmatory factors analysis of variables of the

PLCA affecting SGB was illustrated as the followings.

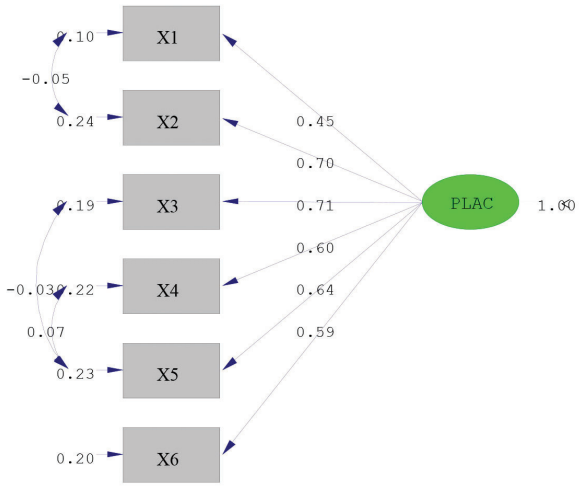
Confirmatory factors of EF had Bartlett's test of Sphericity of 633.245 at statistically significant level (p< 0.01) and Kaiser–Mayer–Olkin Measure of Sampling Adequacy (MSA) of 0.801. This identified that components of LACP had correlation at good level and it can be used for confirmatory factor analysis as showed in picture 1 and Table 1.

Table 1. General Characteristics of Sample Group of Undergraduate

Gender	Number	Percent
1. Male	1728	43.00
2. Female	228	57.00
Total	400	100.00
Religion	Number	Percent
1. Buddhist	392	98.00
2. Christian 3. Islamic	44	1.001.00
Total	400	100.00
Resident	Number	Percent
1. Inside Municipality	244	61.00
2. Outside Municipality	156	39.00
Total	400	100.00
Characteristic Family	Number	Percent
1. Nuclear Family	240	60.00
2. Extended Family	160	40.00
Total	400	100.00
Travel by	Number	Percent
1. Motor-bicycle	292	73.00
2. Bicycle	28	7.00
3. Car	25	6.25
4. Public Transport5. Walk	2530	6.257.50
Total	400	100.00
Age (years) Minimum =18, Maximum=25, Mean=19.75, S.D.=1.20		
Income (baht) Minimum =1,000 Maximum=20,000, Mean=6,565.42, S.D.=2,041.77		

From Picture 1 and Table 2, results of analysis of the confirmatory factors of the PLCA from the 6 observed variables was showed that the model was fitted 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 0.001 (RMSEA < 0.05) and 3) Chi- Square value had no statistically significant at level of 0.01 and divided by degree of freedom was less than or equaled to 5.00 (χ^2/df≤5.00).

Considering on loading weight of 6 observed variables in model, it was showed that observed



Chi-Square=6.06, df=6, P-value=0.45623, RMSEA=0.001

Picture 1. Model of confirmatory Factors of PLAC

variables had loading weight with 0.45 to 0.71 and had covariate to model of PLCA with 50.00 to 79.00 percent.

Confirmatory Factors Analysis of Endogenous Variables

Results of the confirmatory factors analysis of the endogenous variables of the PMI affect the SGB, was showed as the followings.

Confirmatory factors analysis of endogenous variables of the PMI had Bartlett's

test of Sphericity of 912.678 with a statistically significant level (p< 0.01) and Kaiser–Mayer–Olkin Measure of Sampling Adequacy (MSA) of 0.680. This signified that components of PMI had correlation at good level and it can be used for confirmatory factor analysis as showed in Picture 2 and Table 3.

From Picture 2 and Table 3, results of analysis of confirmatory factors of PMI from 5 observed variables was determined that the model was fitted 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 0.004 (RMSEA < 0.05) and 3) Chi-Square value had no statistically significant at level of 0.01 and divided by degree of freedom was less than or equaled to 5.00 (χ^2/df≤5.00).

Considering on loading weight of 5 observed variables in model, it was determined that observed

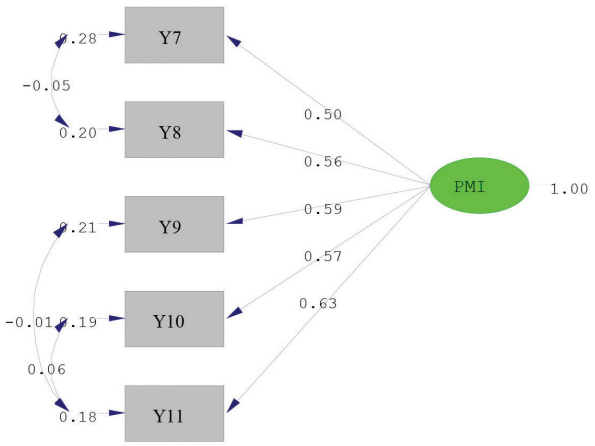
variables had loading weight with 0.50 to 0.63 and had covariate to model of PMI with 58.00 to 75.00 percent.

Confirmatory Factors Analysis of Endogenous Variables of SGB was showed as the followings.

Confirmatory Factors of SGB had Bartlett's test of Sphericity of 1023.211 with a statistically significant level ($p < 0.01$) and Kaiser–Mayer–Olkin Measure of Sampling Adequacy (MSA) of 0.781. This identified that components of SGB had correlation at good level, thus it can be used for confirmatory factor analysis as demonstrated in Picture 2 and Table 3.

From Picture 3 and Table 4, results of analysis of confirmatory factors of SGB from 6 observed variables was confirmed that the model was fitted 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 0.01 and divided by degree of freedom was less than or equaled to 5.00 ($\chi^2/df \leq 5.00$).

Considering on loading weight of observed variables in model, it was showed that observed variables had loading weight with 0.50 to 0.64 and had covariate to model of SGB with 59.00 to 76.00 percent.



Chi-Square=2.45, df=2, P-value=0.87123, RMSEA=0.004

Picture 2. Model of Confirmatory Factor of PMI

Results of Effect among Variables in Model in Terms of Direct and Indirect Effect

The Plastic Life Cycle Assessment (PLCA) and Public Mind Inspiration (PMI) had effects on the Student Green Behavior (SGB) as the followings.

Table 2. Results of Confirmatory Factor Analysis of PLAC

Components of PLAC	Weight	SE	t	R^2
X1 Raw Material	0.45	0.027	19.55**	0.50
X2 Production Process	0.70	0.026	23.56**	0.79
X3 Transportation and Distribution	0.71	0.027	21.11**	0.78
X4 Utilization	0.60	0.028	18.54**	0.65
X5 Recycle	0.64	0.029	19.23*	0.70
X6 Waste Disposal	0.59	0.027	18.44**	0.64

Chi-square = 6.06 df = 6 P = 0.45623
GFI = 1.00 AGFI = 0.99 RMSEA = 0.001 RMR =0.0049
** Statistically significant level of 0.01

Table 3. Results of Confirmatory Factor Analysis of PMI

Components of PMI	Weight	SE	t	R^2
Y7 Self-Public Mind	0.50	0.027	220.23**	0.58
Y8 Role Model Impression	0.56	0.026	21.23**	0.62
Y9 Event Impression	0.59	0.028	21.26**	0.65
Y10 Environment Impression	0.57	0.027	20.89**	0.62
Y11 Media Reception	0.63	0.026	21.18**	0.75

Chi-square = 2.45 df = 2 P = 0.87123
GFI = 1.00 AGFI = 1.00 RMSEA = 0.004 RMR = 0.0032
** Statistically significant level of 0.01

Confirmatory factors of the PLCA directly affected on PMI with a statistically significant level of 0.01 with an effect 0.38 and PLCA directly affected on the SGB with a statistically significant level of 0.01 with an effect 0.47 and indirectly affected on the SGB with a statistically significant level of 0.05 with effect of 0.16.

Confirmatory factors of the PMI directly affected on the SGB with a statistically significant level of 0.01 with effect of 0.42.

Considering on structural model confirmatory factors of component analysis of the SGB and the PMI had effects on the PB with variation of 77.00 %. The structural equation can be written as showed in following equation (1).

$$SGB = 0.47*PLCA+0.42*PMI \quad .. (1)$$
$$R^2 = 0.77$$

Equation (1) factors that had the most effect to the SGB was the with 0.47, subsequence was PMI with an effect 0.42, it was able to explicate the variation of the with 77.00 percent.

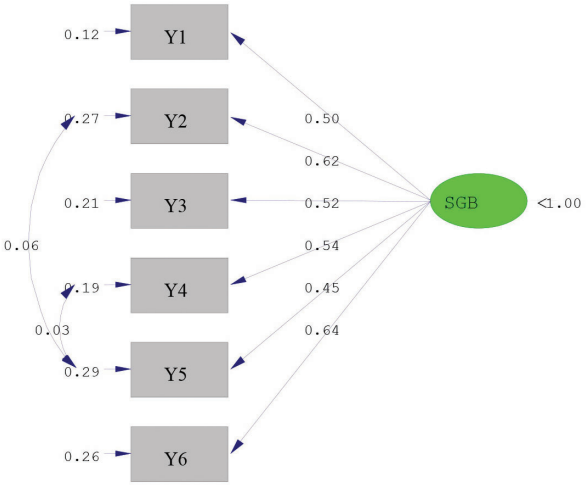
Considering on confirmatory factor the PMI of undergraduates, it demonstrated that the PLCA had an effect on the PMI with 0.38. It is able to explicate the variation of the PMI with 79.00%. The structural equation can be written as the following.

$$PMI = 0.38*PLCA + \quad .. (2)$$
$$R^2 = 0.79$$

Equation (2) factors that had the most effect to the PMI was EF and it is able to explain the variation of PMI with 79.00 percent.

The results of the exogenous variable had effect on the endogenous variables with direct and indirect effects were established in Picture 4 and Table 4.

However, it might be indicated PLCA latent variable is an important variable to alter undergraduate green behavior. Thus, the causal Model of SGB with Effect of PMI and PLCA was proved the proposed model and it was tailored with all observed variables with criteria measures of Chi-Square/df value



Chi-Square=7.34, df=7, P-value=0.40032, RMSEA=0.015

Picture 3. Model of confirmatory factors of SGB

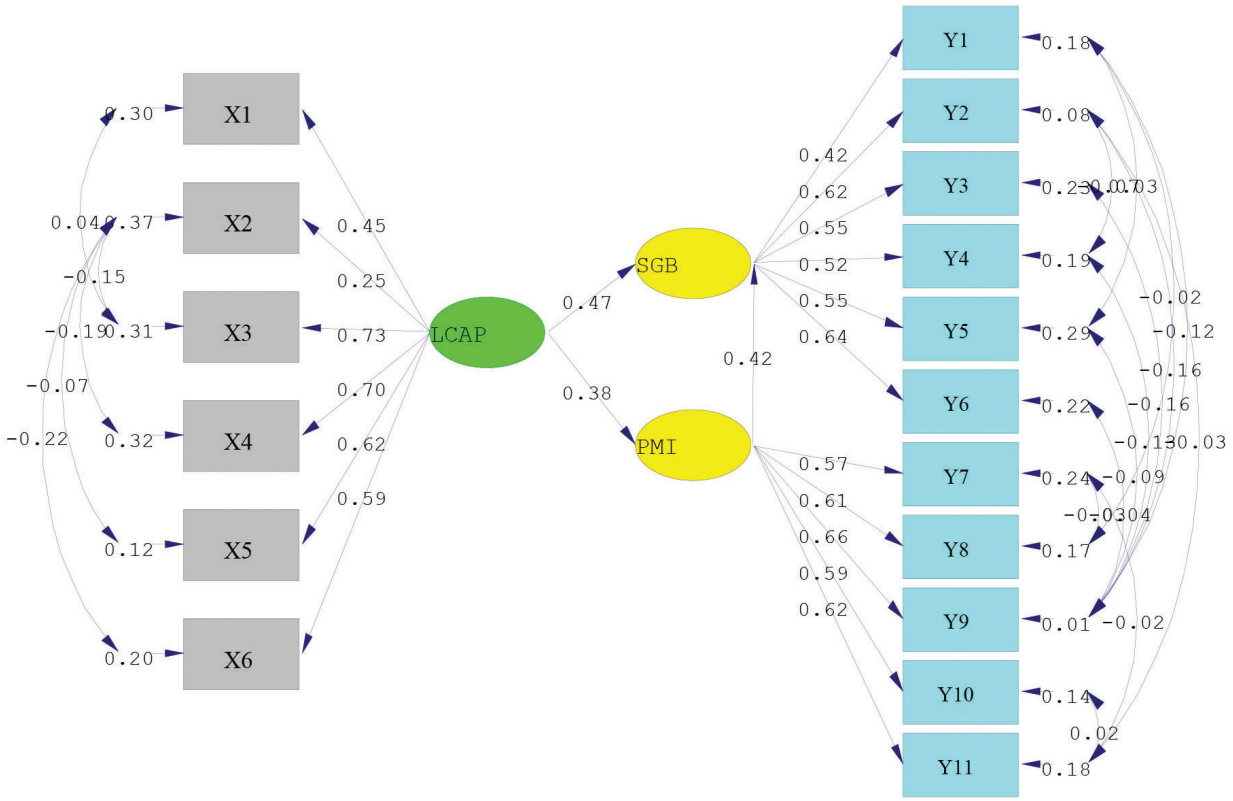
Table 4. Results of confirmatory factor analysis of SGB

Components of SGB	Weight	SE	t	R^2
Y1 Consumption Behavior	0.50	0.026	21.76**	0.59
Y2 Energy Conservation Behavior	0.62	0.027	20.97**	0.69
Y3 Waste Management Behavior	0.52	0.028	21.23**	0.62
Y4 Recycling Behavior	0.54	0.027	20.54**	0.70
Y5 Traveling Behavior	0.45	0.026	21.97**	0.61
Y6 Environmental Knowledge Transferring Behavior	0.64	0.027	21.32**	0.76

Chi-square = 7.34 df = 7 P = 0.40032
GFI = 1.00 AGFI = 0.99 RMSEA = 0.015 RMR = 0.0049
** Statistically significant level of 0.01

Table 5. Direct and Indirect Effect of PLCA Affecting PB through PMI

Causal variable	Result variables					
	PMI			PB		
	TE	IE	DE	TE	IE	DE
PLCA	0.38**(0.015)	-	0.38**(0.015)	0.63**(0.003)	0.16*(0.007)	0.47**(0.002)



Chi-Square=192.04, df=95, P-value=0.00000, RMSEA=0.044

Picture 4. A Causal Model of SGB with Effect of PMI and PLCA

with less or equal to 2.021 and it was less than or equaled to 5.00 (). RMSEA (Root Mean Square Error Approximation) equaled to 0.044 (RMSEA < 0.05) and RMR (Root Mean Square Residual) equaled to 0.024 (RMR < 0.05) including index level of model congruent value of Goodness of Fit Index (GFI) equaled to 0.95, and Adjust Goodness of Fit Index (AGFI) equaled to 0.94 which are between 0.90-1.00.

Discussion

The results indicated that understanding the concept of Plastic Life Cycle Assessment (PLCA) was measured by 6 observed variables of Transportation and Distribution (X3), Production Process (X2), Recycle (X5), Utilization (X4), Waste Disposal (X6) and Raw Material (X1), with predicting power of 0.71, 0.70. 0.64, 0.60, 0.59, and 0.45 respectively. Moreover, PLCA also directly affected on the Student Green Behavior with effect of 0.47 with moderately effect. Consequently it is obviously seen that PLCA is a critical factor to make undergraduate to alter their environmental conservation behavior. SGB is forecasted by Environmental Knowledge Transferring Behavior (Y6), Energy Conservation Behavior (Y2), Recycling Behavior (Y4), Waste Management Behavior (Y3), Consumption Behavior (Y1) and Traveling Behavior (Y5) with prediction power of 0.64, 0.62, 0.54, 0.52, 0.50, and 0.45 respectively. It is indicated that PLCA is an essential exogenous variable to incorporate for increasing green behavior of undergraduates to perform a better behavior as a good role model to handover their environmental knowledge of Plastic Life Cycle Assessment to their close people whether close friends, their family members, and others university persons and their society. This goes along with Thiengkamol and her colleagues (Thiengkamol, 2012e; 2012a; Donkonchum and Thiengkamol, 2012; Kotchachote *et al.*, 2013a; Saisunantharom *et al.*, 2013a; Suebsing *et al.*, 2013b; Mongkonsin *et al*., 2013b; Sutthiphapa *et al*., 2015).

Additionally, the Public Mind Inspiration (PMI) had direct effect on the SGB with effect of 0.42 even as concerning to predict the relationship of the observed variables of the Self-Public Mind (Y7), Role

Model Impression (Y8), Event Impression (Y9), Environment Impression (Y10), and Media Reception (Y11). These are consistent with different researches of Thiengkamol and her colleagues (Kotchachote *et al.*, 2013a; Saisunantharom *et al.*, 2013a; Deerada *et al.*, 2014; Sutthiphapa *et al.*, 2015; Mukpradub *et al.*, 2016). This indicated that Inspiration of Public Mind affecting student green behavior including consumption behavior, energy conservation, waste management behavior, recycling behavior, traveling behavior and knowledge transferring and supporting for environmental conservation.

However, the research results showed that university administrators and academic team can use PLCA integrated in teaching-leaning process and use it to encourage and inspire the undergraduate to pay devotion and play a role as a good role model via environmental knowledge and understanding of PLCA to transfer with the public mind concept to achieve the real sustainable development and good quality of life.

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