

Model of Knowledge of Life Cycle Assessment Plastic for Lower Secondary School Student รูปแบบความรู้การประเมินวัฏจักรชีวิตผลิตภัณฑ์พลาสติกสำหรับนักเรียนมัธยมศึกษาตอนต้น

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บทคัดย่อ

วัตถุประสงค์การวิจัยเพื่อพัฒนารูปแบบความสัมพันธ์เชิงโครงสร้างของความรู้การประเมินวัฏจักรชีวิตพลาสติกและสิ่งแวดล้อมศึกษาที่มีผลต่อพฤติกรรมการณ์อนุรักษ์เพื่อบรรเทาภาวะโลกร้อนผ่านแรงบันดาลใจในการมีจิตสาธารณะ ประชากรเป็นนักเรียนมัธยมศึกษาตอนต้นในสำนักงานเขตพื้นที่การศึกษามัธยมศึกษาเขต 26 ภาคตะวันออกเฉียงเหนือ ปีการศึกษา 2555 จำนวน 18,871 คน ใช้แบบสอบถามเป็นเครื่องมือในการเก็บรวบรวมข้อมูลตัวอย่างจำนวน 400 คน โดยใช้การสุ่มแบบแบ่งกลุ่มและนำรูปแบบสมการเชิงโครงสร้างใช้ในการพิสูจน์รูปแบบ คุณภาพของเครื่องมือมีค่า IOC>0.50 และค่าความเชื่อมั่นทั้งฉบับ 0.971

ผลการวิจัยพบว่าเมื่อพิจารณาแบบโครงสร้างของปัจจัยองค์ประกอบเชิงยืนยันของความรู้การประเมินวัฏจักรชีวิตพลาสติก (LCAP) และสิ่งแวดล้อมศึกษา (EE) สามารถอธิบายความแปรปรวนของตัวแปรแฝงภายในแรงบันดาลใจในการมีจิตสาธารณะ (IPM) ที่มีผลต่อพฤติกรรมการณ์อนุรักษ์สิ่งแวดล้อมเพื่อบรรเทาภาวะโลกร้อนได้ร้อยละ 78.00 และปัจจัยองค์ประกอบเชิงยืนยันของความรู้การประเมินวัฏจักรชีวิตพลาสติก (LCAP) และสิ่งแวดล้อมศึกษา (EE) สามารถอธิบายความแปรปรวนตัวแปรแฝงภายในแรงบันดาลใจในการมีจิตสาธารณะ (IPM) ได้ร้อยละ 68.00

คำสำคัญ: รูปแบบ ความรู้การประเมินวัฏจักรชีวิตพลาสติก สิ่งแวดล้อมศึกษา แรงบันดาลใจการอนุรักษ์สิ่งแวดล้อม พฤติกรรมการณ์อนุรักษ์สิ่งแวดล้อมบรรเทาภาวะโลกร้อน

Abstract

The objective of this research was to develop a structural relationship model of knowledge of LCA plastic, and environmental education affecting to environmental conservation behavior for global warming alleviation through inspiration of public mind. The population was 18,871 lower secondary school students from schools under Secondary Service Area Office 26 (Mahasarakham), Northeastern region of Thailand in academic year of 2013. The research instrument was the questionnaire. The samples were collected by Cluster random sampling technique to collect 400 lower secondary school students.

The questionnaire was used for data collection and it had IOC>0.50 with reliability of whole questionnaire of 0.971. Structural Equation model (SEM) was used for model verification. Results revealed that the structural model of confirmatory factors of Knowledge of Life Cycle Assessment Plastic (LCAP), and Environmental Education (EE) could be used to explain the variation of endogenous factors of Inspiration of Public Mind (PM) to cause Environmental Conservation Behavior for Global Warming Alleviation (BEH) with 78.00 percent. Moreover, confirmatory factors of LCAP and EE could be used to explain the variation of PM with 68.00 percent.

Keywords : Model, Knowledge of Life Cycle Assessment Plastic; Environmental education; Inspiration of Public Mind; Environmental Conservation Behavior for Global Warming Alleviation

1. INTRODUCTION

Presently, Life Cycle Assessment (LCA) is an important tool for determining the environmental impacts of products, processes or services, through production, usage, and disposal. LCA is a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and the associated environmental impacts directly attributable to the functioning of a product or service system throughout its life cycle. Therefore, LCA involves cradle-to-grave analyses of production systems and provide comprehensive evaluations of all upstream and downstream energy inputs and environmental emissions. LCA also enables a manufacturer to quantify the level of energy of the product's life. However, LCAs can be costly and time consuming, thus limiting their use as analysis techniques in both the public and private sectors. Streamlined techniques for conducting LCAs are needed to lower the cost and time involved with LCA and to encourage a broader audience to begin using LCA [1] [2] [3][4][5].

However, the Association of Plastics Manufacturers in Europe (APME) has been at the forefront in developing ecoprofiles for the plastics industry and users of plastic products. ISO has been active in generating new standards on environmental management, notably the ISO 14000 of standards is included for consideration of LCA plastic [2][3][4][5]. Currently, the principal uses of life cycle assessment are to improve environmental performance from the first stage of product development. There are many factors to consider for each environmental impact assessment, so a system has to be used to highlight the most significant factors for comparisons. One major advantage of plastic materials is their lightweight and strength, moreover a thin polymer film may perform the same job as a thick layer of natural material, thus resulting in reduced material use and

reduced energy costs in transport (O'Neill, 2003) [4]. Additionally, LCA is a crucial technique for the plastics industry in the 21st Century. Manufacturers and suppliers need to demonstrate that they are acting responsibly towards the environment in all aspects of production, from the design phase through consumer use and abuse, to disposal of end of life components. The ISO standards relating to environmental management are also involved for consideration [2][3][4][5]. Consequently, there are many different types of environmental impact. For example, plastics are generally produced from fossil fuels, which are gradually becoming depleted. The production process itself involves energy consumption and further resource depletion. During production, emissions may occur to water, air or soil. Emissions of concern include heavy metals, chlorofluorocarbons, polycyclic aromatic hydrocarbons, volatile organic compounds, sulfur oxides and dust. These emissions have effects such as ozone depletion, smog, acid rain, and carcinogen occurrences. Thus, production of a plastic product can have unfavorable effects on damage to environment both during its production and disposal. Non-biodegradable material composed of toxic chemicals. It pollutes not only ecosystems but human health including the physical environment [3][4][5][6]. Plastic affects human health for they may have chemical such as vinyl chloride and are benzene known that breathing the noxious fumes that hurt cells in the lung lining, increasing the risk of emphysema and cancer. If plastic get into the environment, it is a hazard to all life living in the water environment and land. Fish, birds, marine mammals, reptiles, and other animals can become disheveled in discarded plastics and sustain injuries from ingesting plastics. Lost nets go on to do what they were planned to do catch living animals but now they catch them accidentally. The resins in the plastic are flammable and have added considerably

to several accidents worldwide. Plastic does not undergo bacterial decomposition, disposing in landfills would preserve the chemicals forever. If plastic is burnt, it releases a poisonous chemical into the air, including a deadly toxin and the product effects in numerous dimensions [4][5][6][7][8].

Another significant factor associated to environmental behavior is Inspiration of public mind of environmental conservation. Thiengkamol advised (2011e) that inspiration is completely dissimilar from motivation because one who do or act or practice with the drive from inside with desire to do for public, especially, for environmental conservation. It may happen from the impression of good role model of person, event, environment and various media that inspire him/her to do for others without the requirement of rewards, money, honor or admiration as well but one feels happy to do for others [11][13][14][15][16][17][18][19][20][21][22][23][24].

On the other hand, the rate of plastic product consumption is elevated, therefore, it needs to raise people awareness and to change people attitude and behavior by applying with environmental education process since the environmental principle accentuated on the result of behavioral change in various issues on environmental conservation behavior anchored in the knowledge, understanding, awareness, attitude, skill, participation, and sensitivity [3][4][5][7][19][20][22][23][24].

2. OBJECTIVE

The objective was to develop a structural relationship model of knowledge of LCA plastic, and environmental education affecting to environmental conservation behavior for global warming alleviation through inspiration of public mind.

3. METHODOLOGY

The research design was implemented in steps by step as the followings:

3.1 The population was 18,871 lower secondary school students from schools under Secondary Service Area Office 26 (Mahasarakham), Northeastern region of Thailand in academic year of 2013. The Multi-stage random sampling was employed to collect 400 students from different schools under Secondary Service Area Office 26 (Mahasarakham) [25].

3.2 The research instrument was the questionnaire. It was used for data collection. The questionnaire composed of 180 questions with 5 rating scales. The content and structural validity were determined by Item Objective Congruent (IOC) with 5 experts in the aspects of LCA plastic, environmental education, social science and social research methodology. The reliability was done by collecting the sample group from 40 lower secondary school students from school under adjacent Secondary Service Area Office 26 (Mahasarakham). The reliability was determined by Cronbach's Alpha. The reliability of knowledge of LCA plastic, environmental education, inspiration of public mind, environmental conservation behavior for global warming alleviation and the whole questionnaire were 0.890, 0.871, 0.957, 0.965, and 0.971 respectively [6][7][8][11][21][22] [27].

3.3 Primary assumption was set to analyze the Latent variables with Confirmatory Factor Analysis by considering from 1) Goodness of Fit Index (GFI) equal to 0.99 and Adjust Goodness of Fit Index (AGFI) equal to 0.98, 2) Root Mean Square Error of Approximation (RMSEA) equal to 0.026 (RMSEA < 0.05), and 3) Chi-Square value had no statistical significance at level of .01 and divided by degree of freedom was lesser than or equal to 5.

3.4 The inferential statistics used was Structural Equation Model (SEM) and analyzed with LISREL version 8.30 by considering on Chi-Square value differs from zero with no statistical significance at 0.05 level or Chi-Square/df value with less or equal to 5, RMSEA (Root Mean Square Error Approximation) value and RMR (Root Mean Square Residual) with less than 0.05 including index level

of model congruent value, GFI (Goodness of Fit Index) and critical number, and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.90-1.00 [25][26].

4. RESULTS

The results of this study were as the followings.

4.1 Results of Effects among Variables in Model in Terms of Direct Effect

4.1.1 Confirmatory factors of Knowledge of Life Cycle Assessment Plastic (LCAP) had direct effect to Inspiration of Public Mind (PM) with statistically significant at level of 0.01 with effect 0.39 and Environmental Conservation Behavior for Global Warming Alleviation (BEH) with statistical significance at level of 0.01 with effect 0.16. Moreover, confirmatory factors in aspect of Knowledge of Life Cycle Assessment Plastic (LCAP) had indirect and total effects to Environmental Conservation Behavior for Global Warming Alleviation (BEH) with statistical significance at level of 0.01 with effect of 0.30 and 0.46.

4.1.2 Confirmatory factors of Environmental Education (EE) had direct effect to Inspiration of Public Mind (PM) with statistical significance at level of 0.01 with effect of 0.55 and Environmental Conservation Behavior for Global Warming Alleviation (BEH) with no statistical significance at level of 0.05 with effect of 0.01. Moreover, confirmatory factors in aspect of Environmental Education (EE) had indirect and total effects to Environmental Conservation Behavior for Global Warming Alleviation (BEH) with statistical significance at level of 0.01 with effect of 0.42 and 0.43.

4.1.3 Confirmatory factors of Inspiration of Inspiration of Public Mind (PM) had direct effect to Environmental Conservation Behavior for Global Warming Alleviation (BEH) with statistical significance

at level of 0.01 with effect of 0.76.

4.1.4 The structural model of confirmatory factors of Knowledge of Life Cycle Assessment Plastic (LCAP), and Environmental Education (EE) could be used to explain the variation of endogenous factors of Inspiration of Public Mind (PM) to caused Environmental Conservation Behavior for Global Warming Alleviation (BEH) with 78.00 percent as following in equation (1).

$$BEH = 0.76*PM + 0.16*LCAP + 0.01*EE \dots\dots\dots(1)$$
$$(R^2 = 0.78)$$

Equation (1) factors that had the most effect to Environmental Conservation Behavior for Global Warming Alleviation (BEH) was Inspiration of Public Mind (PM) with effect of 0.76, and subsequences were Knowledge of Life Cycle Assessment Plastic (LCAP), and Environmental Education (EE) with effect of 0.016 and 0.01.

Additionally, confirmatory factors of Knowledge of Life Cycle Assessment Plastic (LCAP), and Environmental Education (EE) were used to explain the variation of confirmatory factors of Inspiration of Public Mind (PM) with 68.00 percent. Therefore, the equation can be written as following in equation (2).

$$PM = 0.39*LCAP + 0.55*EE \dots\dots\dots(2)$$
$$(R^2 = 0.68)$$

Equation (2) factors that had the most effect to Inspiration of Public Mind (PM) was Environmental Education (EE) with effect of 0.55, and subsequence was Knowledge of Life Cycle Assessment Plastic (LCAP) with effect of 0.39, these were able to explain the variation of Environmental Conservation Behavior for Global Warming Alleviation (BEH) with 68.00 percent.

The results of analysis of causal relationship model and analysis of path effect are presented in figure 1 and table 1.

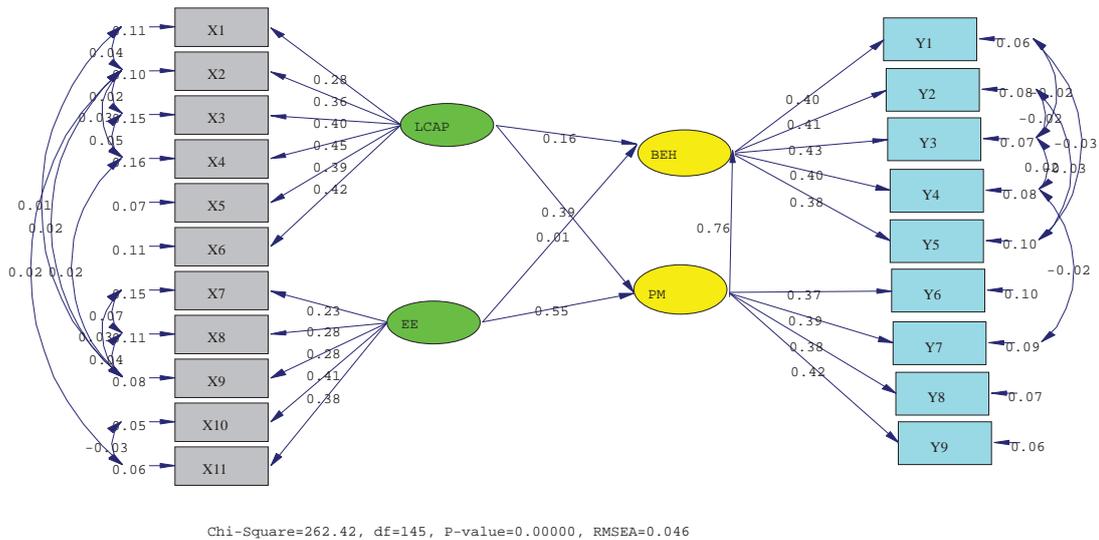


Figure 1 Causal Relationship Model of Knowledge of LCAP and EE Affecting BEH through PM

Table 1 Direct, Indirect and Total Effects of LCAP and EE Affecting BEH through PM

Causal variable	Result variables					
	PM			BEH		
	TE	IE	DE	TE	IE	DE
LCAP	0.39** (0.084)	-	0.39** (0.085)	0.46** (0.065)	0.30** (0.065)	0.16** (0.051)
EE	0.55** (0.091)	-	0.55** (0.091)	0.43** (0.059)	0.42** (0.068)	0.01 (0.054)
PM	-	-	-	0.76** (0.061)	-	0.76** (0.061)
$\chi^2 = 262.42; df = 145$		CN = 269.414		$\chi^2 / df = 1.810$		
GFI = 0.95		AGFI = 0.92		RMSEA = 0.046		RMR = 0.014

TE: Total Effect, IE: Indirect Effect, DE: Direct Effect

From table 1, it showed that the LCAP and EE had direct, indirect and total effect to BEH and it also had direct effect to PM. And PM had direct effect to BEH.

5. DISCUSSIONS

The results showed that the exogenous latent variable of Knowledge of Life Cycle Assessment Plastic (LCAP) had direct effect to Environmental Conservation Behavior for Global Warming Alleviation (BEH) with highly statistical significance at level of 0.01 with effect of 0.16 and Environmental Education (EE) had direct effect to Environmental Conservation Behavior for Global

Warming Alleviation (BEH) with no statistical significance at level of 0.05 with effect of 0.01. These results are in line with Thiengkamol concept, especially environmental education and inspiration of environmental conservation [10][12][13][14][15][16][18][20][21] [22][23] that the results illustrated that Environmental Education (EE) influencing through inspiration of public mind to act better environmental behaviors whether consumption behavior, energy conservation behavior, waste management behavior, traveling behavior and knowledge transferring and supporting for environmental conservation when they had real practice through environmental

conservation with inspiration of environmental conservation with public mind. However, understand LCAP knowledge is a critical issue to lead student to conserve the environment sustainably [2][3][4][5].

Therefore, the research results should be introduced to apply into lower secondary school in every region of Thailand, particularly, Northern region by challenging the students to take responsibility to conserve environment based on knowledge of LCA plastic by reducing use the plastic product use, especially, the plastic bag by changing their behavior of plastic use to use other natural materials such as banana leave, bioplastic, or cloth bag or rattan basket or bamboo basket with public mind because they are key change agent for our hope to lead our world to sustainable development.

Concurrently, environmental education principle is relevant to sustainable development principles; therefore, if this principle can be contained in the curriculum in all schools, it will assist and support the young global population to perform daily life activities with highest maximized utilization for natural materials to conserve environment.

Nevertheless, it might be concluded that LCAP, EE, and PM latent variables are essential components to influence the lower secondary school students to alter their environmental behaviors of environmental conservation behavior regarding to consumption behavior, energy conservation, recycling behavior, waste management, and knowledge transferring and supporting for environmental conservation through PM. Therefore, the model of LCAP, and EE influencing through PM to BEH was verified the proposed model that fitted with all observed variables according to criteria of Chi-Square value differs from zero with no statistical significance at 0.01 level or Chi-Square/df value with less or equal to 5, RMSEA (Root Mean Square Error Approximation) value 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 0.90-1.00 [26][27].

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