

Model of Environmental Education with Integration of Life Cycle Assessment in term of Recycling Behavior

Sirikanya Donkonchum

*Department of Environmental Education
Faculty of Environment and Resource Studies
Mahasarakham University, Mahasarakham 44150, Thailand*

Nongnapas Thiengkamol

*Major Advisor, Department of Environmental Education
Faculty of Environment and Resource Studies
Mahasarakham University, Mahasarakham 44150, Thailand*

Chatchai Thiengkamol

*Co- Advisor, Director of Research In Motion Co., Ltd. 599/321
Baan Klang Krung, Jatujuk Sub-district, Jatujuk District
Bangkok 10900, Thailand*

Doi: 10.5901/mjss.2012.v3n11p497

Abstract: The objective of this research was to develop a model of environmental education with integration of Life Cycle Assessment (LCA) in term of recycling behavior. Moreover, understating on LCA in term of recycling behavior. Populations were 37,156 undergraduate students of academic year 2012 of Mahasarakham University. Simple random sampling was employed to select the sample. Questionnaire was used as instrument for data collecting. Pearson correlation and Path Analysis were used for data analysis. The results revealed that psychological traits in terms of goal of life (GL) showed directly affected to inspiration in aspects of role model (RM) with .554, It also showed directly affected to LCA in term of recycling behavior (RC) and energy consumption behavior (EB) with .604 and .598 while RM showed directly affected to RC and EB with .621 and .565. Moreover, psychological states in terms of religion belief (RB) showed directly affected to RM with .631 and it also directly affected to RC and EB with 622 and .601. Considering on environmental education integration with LCA in term of recycling behavior, in aspect of environmental attitude (AT) showed directly affected to RM with .611 and it showed also directly affected IE with .632 and directly affected to RC and EB with .629 and 605. EB showed directly affected to RC with .522.

Key Words: Development / Environmental Education Model / Integration / Life Cycle Assessment/ Recycling Behavior

1. Introduction

Presently, world community has recognized that recycling behavior is a mean to retard the waste accumulation and natural resources depletion. Recycling behavior is an effective way to cure the global environmental problems due to human activities. The environmental education principles include knowledge on ecological systems and environmental problems, preventing new problems from material production from natural resources. In addition, it includes the affective domain: the attitudes, values, and commitments necessary to build a sustainable society. Additionally, it also includes opportunities to build skills that enhance learners' problem-solving abilities, such as communication, public speaking, persuasive writing, researching, interviewing, and data analysis including group process of leadership, decision making, and cooperation. Additionally, understating on Life Cycle Assessment (LCA) in term of recycling behavior, will stimulate and inspire people to have public mind or public consciousness to raise their awareness and change attitude and behavior to realize the real value of material that covers to the environmental impact consequences (European Topic Centre on Waste and Material Flows, 2004 Thiengkamol, 2009a, Thiengkamol, 2009b, Thiengkamol, 2011e, Thiengkamol, 2011f, Thiengkamol, 2011i, Thiengkamol, 2011i, Jumrearnsan, & Thiengkamol, 2012, & Morgan, & Hughes, 2006).

In this research, LCA is covering the three paper cycle system areas of raw materials and forestry, paper production, and disposal/recovery. The raw materials are woods from cultivation for this specific purpose of paper production including considering on recycling behavior of paper. In order to inspire the undergraduate students to understand the importance of recycling behavior of paper based on LCA concept. Even though, they are not facing with shortage of paper and majority of them don't face the environmental impact of paper production process directly but some of them who live close to the paper production factory might understand better about the environmental impact, especially, wastewater discharge from the plants. This caused different harmful effect to water resources and the quality of life.

Additionally, recycling behavior based on LCA concept would be introduced the concept of energy consumption during production process, transportation, and distribution. From research findings, the overall results of the LCA studies indicate that recycling of waste paper has a lower environmental impact than the alternatives of land filling or incineration. The results is very clear in the comparison of recycling vs. land filling, and less pronounced but also clear in the comparison of recycling vs. incineration. Nevertheless, LCAs should be considered in terms of the environmental consequences occurring when choosing one alternative over the other recycling method based on energy consumption (European Topic Centre on Waste and Material Flows, 2004).

In 1997 the academics in psychology, leading by Magnusson and Endler, proposed the textbook called "Personality at the crossroads" that compiled the theories of human behavior on integration of mind and states together (Magnusson, D., & Endler, N.S., 1997, Magnusson, 1999, Magnusson, 2001 & Punthumnavin, 2008). On the other hand, the Interactionism model is a popular theory that was universal recognize, even though in Thailand, since this model assists the academics to perceive a point of view on studying of causal behavior expression in different dimensions such as cause of trait, cause of state, cause of mind, and cause of co-influence or interaction between characteristics of trait and state of mind of actor. The holistic interactionist paradigm offers a prospect with individual characteristics variable factor affecting towards behavior (Cervone, 1991; Magnusson, 2001, Pervin, & John, 1990, & Cairns, 2001). The complexity of the processes at work implies that the operation of the organization cannot be explained by only one factor but there are the rest factors on a group of psychological and biological processes of a holistic nature (Susman, 2001).

However, with numerous literature reviews of behavioral science, it was found that there is no research was done on factors and causes that affecting towards behavior of conservation of natural resources and environment directly. In particular, the psychological traits, psychological states, and environmental education with integration of LCA influencing to environmental behavior change including recycling behavior based on LCA for energy conservation. Presently, 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 (Thiengkamol, 2011i, Thiengkamol, 2011j, & Jumrearnsan, & Thiengkamol, 2012).

Nonetheless, Inspiration of Public consciousness propositioned by Thiengkamol, should be paid notice for natural resources and environment conservation. She uttered that that public consciousness or public mind based on inspiration from insight and inspiration different from motivation because inspiration needs no rewards or admirations. Inspiration of public consciousness or public mind, especially, for natural resources and environment conservation, one doesn't receive any reward, admiration or complement for ones act for natural resources and environment conservation. Inspiration might be occurred due to appreciation in a person as role model or idle, events, situations, environment, media perceived such movies, book, magazine, and internet. (Thiengkamol, 2009a, Thiengkamol, 2009b, Thiengkamol, 2011a, Thiengkamol, 2011e, & Thiengkamol, 2011f).

Environmental education process aimed to change human behavior based on knowledge and understanding, awareness and consciousness raising, values, belief, attitude, and behavioral change. Therefore, it should be provided through every level of education in Thailand, particularly, in the university level since they are the young generations of the world hope to save the world, therefore they should take action and responsibility to protect biodiversity and ecological system through natural resources and environment conservation. Mahasarakham University is a leading university of Northeastern of Thailand that opens the faculty of Environment and Resources Studies. Therefore, it is its burden to carry out to produce young leaders and volunteers for the country to have better quality of life. This is pertinent to the sustainable development principle that aimed to develop the responsible global young generations to minimize the fossil energy consumption by practicing through daily living of recycling behavior building.

Recycling behavior is also beneficial to the environment because fewer natural resources are destroyed when paper recycled. Projects to increase recycling behavior can also raise public mind or public consciously and lead to increased environmental attitude and awareness to change their behavior. Several theoretical orientations can be identified for environmentally behavioral change on dealing with recycling behavior based on LCA and environmental education principle with integration of LCA concept. One strand of the literature is grounded in the belief that people are primarily maximization of inspiration of public mind or public consciousness. This research is paid the attempts to relate a variety of psychological factors in terms of psychological trait and psychological state to create recycling behavior based on LCA

concept (European Topic Centre on Waste and Material Flows, 2004 Thiengkamol, 2009a, Thiengkamol, 2009b, Thiengkamol, 2011e, Thiengkamol, 2011f, Thiengkamol, 2011i, Thiengkamol, 2011j, & 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 education with integration of Life Cycle Assessment concept to educate students to practice environmental behavior that happened from inspiration of public consciousness with affecting of psychological traits, psychological states, and environmental education principle.

2. Objective

The objective of this research was to develop a model of environmental education with integration of LCA in term of recycling behavior.

3. Methodology

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

1) The populations were 37,156 undergraduate students of academic year 2012 of Mahasarakham University. The 400 undergraduate students were collected by simple random sampling from different faculties of Mahasarakham University with the equal proportion.

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 fields 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. The reliability of environmental education, psychological trait, psychological state, inspiration of public consciousness, recycling behaviors, and the whole questionnaire were 0.971, 0.956, 0.972, 0.964, 0.889 and 0.978 respectively. The descriptive statistics used were frequency, percentage, mean and standard deviation. The inferential statistics used were t-test, One Way ANOVA, Pearson Correlation and Path Analysis for data analysis.

4. Results

4.1 General Characteristics of Sample Group

The sample group of this study was 400 undergraduate students that were collected by random sampling technique from different faculties Mahasarakham University with the same proportion in the academic year of 2012. Most of them were female with 310 students (68.89%), most of them had Grade Point Average (GPA) between 2.50-2.99 with 175 students (38.89%) and most of them study in the field of social science with 170 students (37.78 %).

4.2 Comparison of Demographic Characteristics on Inspiration of Sample Group

The demographic characteristics of sample in terms of sex, Grade Point Accumulation (GPA), and field of study of sample group presented as follows:

4.2.1 Comparison of Inspiration between Different Sex of Sample Group

The demographic characteristics of sample in terms of sex, the comparison of inspiration between different sex of sample group was revealed that it was highly statistical significance ($p < .01$) as shown in table 1.

Table 1 Comparison of Inspiration between Different Sex of Sample Group

Sex	Number (n)	Mean	S.D.	t	Sig.
Male	143	3.411	.799	4.013	.000**
Female	307	3.672	.768		

** Statistically Significant at the .01 level

4.2.2 Comparison of Inspiration among Different GPA of Sample Group

The demographic characteristics of sample in terms of GPA, the comparison of inspiration among different GPA of sample group was revealed that it was no difference among different GPA of 1-<2.50, 2.50-<2.99 and 3.00->=3.00 with statistical significance ($p>.05$) as presented in table 2.

Table 2 Comparison of Inspiration among Different GPA of Sample Group

Source of Variation	Sum of squares	df	Mean Square	F	Sig.
Between Group	2.456	2	1.228	1.254	.325
Within Group	376.753	397	.949		
Total	379.209	399			

* Statistically Significant at the .05 level

4.2.3 Comparison of Inspiration among Different Fields of Study of Sample Group

The demographic characteristics of sample in terms of field of study included health science, science and technology, and social science, the comparison of inspiration among different fields of study of sample group was revealed that it was highly statistical significance ($p<.01$) as presented in table 3.

Table 3 Comparison of Inspiration among Different Fields of Study of Sample Group

Source of Variation	Sum of squares	df	Mean Square	F	Sig.
Between Group	60.650	2	30.325	30.235	.000**
Within Group	398.191	397	1.003		
Total	458.841	399			

** Statistically Significant at the .01 level

The LSD Multiple Comparison was used for analysis of each pair of inspiration among field of study of sample group. The differences of field of study included social science (Field 1), science and technology (Field 2), and health science (Field 3) to determine the mean score differences of their field of study, it showed that social science and science and technology were statistical difference ($p<.01$) while social science and health science were statistical difference ($p<.01$) but science and technology, and health science were no statistical difference ($p>.05$) as shown in table 4.

Table 4 LSD Multiple Comparison of Inspiration among Different Fields of Study of Sample Group

Variables	\bar{X}	Field 1	Field 2	Field 3
		3.012	3.567	3.879
Field 1	3.012	-	5.612** (.006)	8.045** (.000)
Field 2	3.567		-	-
Field 2	3.879			-

** Statistically Significant at the .01 level

4.3 Comparison of Characteristics and Recycling Behavior Based on LCA of Sample Group

4.3.1 Comparison of Recycling Behavior Based on LCA between Different Sex of Sample Group

The demographic characteristics of sample in terms of sex, the comparison of recycling behavior based on LCA between different sex of sample group was revealed that it was highly statistically significant ($p < .01$) as presented in table 5.

Table 5 Comparison of Recycling Behavior Based on LCA between Different Sex of Sample Group

Sex	Number (n)	Mean	S.D.	t	Sig.
Male	143	3.432	.701	4.365	.000**
Female	307	3.764	.689		

** Statistically Significant at the .01 level

4.3.2 Comparison of Recycling Behavior Based on LCA among Different GPA of Sample Group

The demographic characteristics of sample in terms of GPA, the comparison of recycling behavior based on LCA among different GPA of sample group was revealed that it was no difference among different GPA of 1-<2.50, 2.50-<2.99 and 3.00->=3.00 with statistical significance ($p > .05$) as presented in table 6.

Table 6 Comparison of Recycling Behavior Based on LCA among Different GPA of Sample Group

Source of Variation	Sum of squares	df	Mean Square	F	Sig.
Between Group	3.118	2	1.599	1.603	.212
Within Group	446.106	447	0.998		
Total	449.224	449			

* Statistically Significant at the .05 level

4.3.3 Comparison of Recycling Behavior Based on LCA among Different Fields of Study of Sample Group

The demographic characteristics of sample in terms of field of study included health science, science and technology, and social science, the comparison of recycling behavior based on LCA among different fields of study of sample group was revealed that it was highly statistically significant ($p < .01$) as presented in table 7.

Table 7 Comparison of Recycling Behavior Based on LCA among Different Fields of Study of Sample Group

Source of Variation	Sum of squares	df	Mean Square	F	Sig.
Between Group	56.646	2	28.323	29.782	.000**
Within Group	425.000	447	.951		
Total	481.646	449			

** Statistically Significant at the .01 level

The LSD Multiple Comparison was used for analysis of each pair of recycling behavior based on LCA among field of study of sample group. The differences of field of study included social science (Field 1), science and technology (Field 2), and health science (Field 3) to determine the mean score differences of their field of study, it showed that social science and science and technology were statistical significance ($p < .01$) while social science and health science were statistical significance ($p < .01$) including science and technology, and health science were no statistical significance ($p > .05$) as presented in table 8.

Table 8 LSD Multiple Comparisons of Recycling Behavior Based on LCA among Different Fields of Study

Variables	\bar{X}	Field 1	Field 2	Field 3
		3.113	3.621	3.908
Field 1	3.113	-	6.012** (.006)	7.534** (.000)
Field 2	3.621		-	-
Field 2	3.908			-

** Statistically Significant at the .01 level

4.4 Environmental Education Model with Integration of Life Cycle Assessment in term of Recycling Behavior

The results revealed that psychological traits in terms of goal of life (GL) showed directly affected to inspiration in aspects of role model (RM) with .554, It also showed directly affected to LCA in term of Recycling Behavior (RC) and energy consumption behavior (EB) with .604 and .598 while role model (RM) showed directly affected to LCA in term of Recycling Behavior (RC) and energy consumption behavior (EB) with .621 and .565. Moreover, psychological states in terms of religion belief (RB) showed directly affected to inspiration in aspects of role model (RM) with .631 and it also directly affected to LCA in term of Recycling Behavior (RC) and energy consumption behavior (EB) with .622 and .601. Additionally, psychological traits in terms of goal of life (GL) illustrated directly affected to inspiration in aspects of impressive environment (IE) with .533 and psychological states in terms of religion belief (RB) illustrated directly affected to inspiration in aspects of impressive environment (IE) with .628 while impressive environment (IE) showed directly affected to LCA in term of Recycling Behavior (RC) and energy consumption behavior (EB) with .633 and .608.

Considering on environmental education integration with LCA in term of Recycling Behavior in aspect of environmental attitude (AT) showed directly affected to inspiration in aspects of role model (RM) with .611 and it showed also directly affected to inspiration in aspects of impressive environment (IE) with .632 and directly affected to LCA in term of Recycling Behavior (RC) and energy consumption behavior (EB) with .629 and .522. Energy consumption behavior (EB) showed directly affected to RC (RC) with .522.

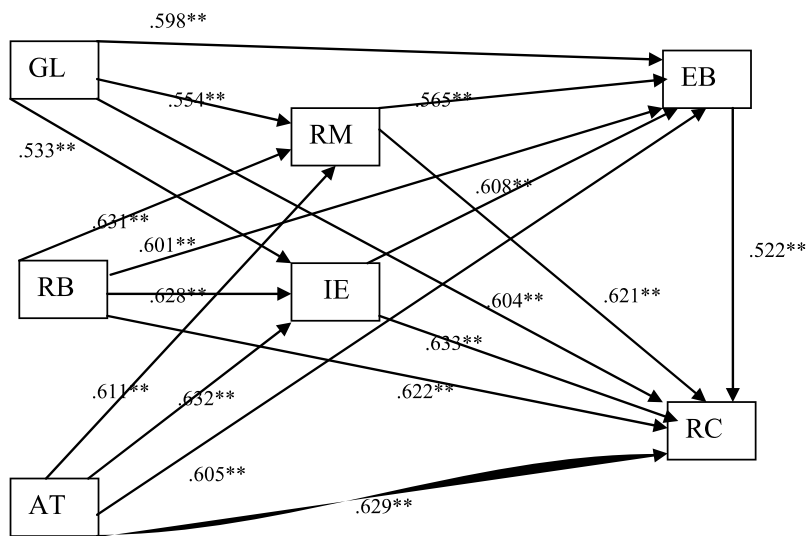


Diagram 1: Model of Environmental Education with Integration of LCA in term of Recycling Behavior
 ** Statistically Significant at the .01 level

5. Discussions

The findings illustrated that the demographic characteristics of sex, GPA, and field of study, the female had better inspiration for LCA in term of Recycling Behavior with mean score of 3.672 and male with mean score of 3.411. This

might indicate that the female might be easily to stimulate to have inspiration of public consciousness for changing the recycling behavior easier than male. The result of comparison of the inspiration of LCA in term of Recycling Behavior among different GPA of sample group was revealed that it was no statistical significance ($p > .05$). This might explain that there are no differences of the inspiration of LCA in term of Recycling Behavior among different GPA of students, therefore whether they got low, moderate or high, the similar inspiration of LCA in term of Recycling Behavior. Moreover, the comparison of inspiration of public consciousness among different fields of study of sample group was revealed that it was highly statistical significance ($p < .01$). The mean score differences of their field of study, it showed that social science and science and technology were statistical difference ($p < .01$) while social science and health science were statistical difference ($p < .01$) but science and technology, and health science were no statistical difference ($p > .05$). It implied that science and technology, and health science had better inspiration of public consciousness than social science.

Moreover, the comparison of LCA in term of Recycling Behavior between sex of sample group was revealed that it was highly statistical significance ($p < .01$), it might be concluded that female had better LCA in term of Recycling Behavior than male. Besides the comparison of LCA in term of Recycling Behavior among different GPA of sample group was revealed that it was no statistical significance ($p > .05$) but comparison of LCA in term of Recycling Behavior among different fields of study of sample group, was revealed that it was highly statistical significance ($p < .01$), then the LSD Multiple Comparison was used for analysis of each pair of LCA in term of Recycling Behavior among field of study of sample group. It illustrated that science and technology, and health science had LCA in term of Recycling Behavior than social science. It indicated that they female had better inspiration of public consciousness of LCA in term of Recycling Behavior better than male. However, their different GPA did not effect to inspiration of public consciousness of LCA in term of Recycling Behavior. These results are also pertinent to researches of Thiengkamol, 2011i, Thiengkamol, 2011j, & Jumrearnsan, & Thiengkamol, N., 2012.

Environmental education model with integration of LCA in term of Recycling Behavior as presented in diagram 1, the results illustrated that if we want to develop undergraduate students to have LCA in term of Recycling Behavior and energy conservation behavior for undergraduate students, Mahasarakham University, we might use the religion belief, especially, most of them are Buddhist to understand the important of LCA in term of Recycling Behavior and energy conservation behavior that will decrease natural resource such as forest wood and decrease fossil fuel use for paper product transportation. Moreover, decrement of paper use with LCA in term of Recycling Behavior, it leads to decrease of energy consumption and increase carbon dioxide sink as forest protection and also increase oxygen for human being. Moreover, parents and teacher should perform role model for their children and students. Nevertheless, environmental education in term of attitude also illustrated highly affected to LCA in term of Recycling Behavior and energy conservation behavior so we might use environmental education process to educate them in the university by integrated through every subjects. These findings were also congruent to studies of Thiengkamol, N., (2005a, 2005b, 2010b, 2011b, 2011c, 2011f, 2011g, 2011i, 2011j, 2012a & 2012b).

References

- Cairns, R. B. (1979). *Social Development. The origins and plasticity of interchanges*. San Francisco : W.H. Freeman and Company.
- Cervone, D. (1991). *The two disciplines of personality psychology*. Review of Handbook of personality; Theory and research. Psychological Science, 2, 371-377.
- Jumrearnsan, W. and Thiengkamol, N. (2012). Development of an Environmental Education Model for Global Warming Alleviation. *Journal of the Social Sciences*, 7 (1):67-70.
- Magnusson, D., and Endler, N.S. (1997). *Interactional psychology and Personality*. New York: John Whitey & Sons.
- Magnusson, D. (1999). *Holistic interactionism : A perspective for research on personality development*. In L.A. Pervin & O.P. John (Eds.), *Handbook of personality : Theory and research*, 219-247, New York : Guilford.
- Magnusson D. (2001). The holistic-Interactionistic Paradigm : Some Directions for Empirical Developmental Research. *European Psychologist*, 6 (3), 153-162.
- Morgan, F. W., & Hughes, M. V. (2006). Understanding Recycling Behavior in Kentucky: Who Recycles and Why. *JOM*, 58 (8), 32 -35
- Pervin L. A., and John, O. P. (1990). *Handbook of Personality: Theory and research*. New York : The Guilford Press.
- Pervin, L. A. (1999). Epilogue: Constancy and change in personality theory and research. In L.A. Pervin & O.P. John (Eds.), *Handbook of personality: Theory and research* (pp. 689-704). New York : Guilford.
- Pervin, L. A. (2001). A dynamic Systems Approach to Personality. *European Psychologist*, 6 (3), 172-176.
- Punthumnavin, D. (2008). *Feature of Hypothesis and Data Analysis Providing for Utilization of Results of Development Research*. Bangkok: National Research Council of Thailand (NRCT).
- Susman E. J. (2001). Mind-Body interaction and development: Biology, Behavior and Context. *European Psychologist*, 6 (3), 63-171.
- Thiengkamol, N. (2004). *Development of A Learning Network Model for Energy Conservation*. Doctoral Dissertation of Education (Environmental Education) Faculty of Graduate Studies, Mahidol University, Thailand.

- Thiengkamol, N. (2005a). Strengthening Community Capability through The Learning Network Model for Energy Conservation. *Journal of Population and Social Studies*, 14 (1), 27-46.
- Thiengkamol, N. (2005b). Development of Health Cities Network for Mekong Region. In *Proceedings of the International Conference "Transborder Issues in the Grate Mekong Sub-Region" Ubon Ratchathani, Thailand, 30 June-2 July 2005* (pp.111-119). Ubon Ratchathani: Nevada Grand Hotel.
- Thiengkamol, N. (2009a). *The Great Philosopher: the Scientist only know but Intuitioner is Lord Buddha*. Bangkok: Prachya Publication.
- Thiengkamol, N. (2009b). *The Happiness and the Genius can be Created before Born*. Bangkok: Prachya Publication.
- Thiengkamol, N. (2010b). Urban Community Development with Food Security Management: A Case of Bang Sue District in Bangkok. *Journal of the Association of Researcher*, 15 (2), 109-117.
- Thiengkamol, N. (2011a). *Holistically Integrative Research* (2nd ed.). Bangkok: Chulalongkorn University Press.
- Thiengkamol, N. (2011b). Development of Energy Security Management Model for Rural Community through Environmental Education Process. In *Proceedings of the 1st EnvironmentAsia International Conference on "Environmental Supporting in Food and Energy Security: Crisis and Opportunity" Bangkok, Thailand, 22-25 March 2011* (pp.11). Bangkok: Rama Garden Hotel.
- Thiengkamol, N. (2011c). Development of Food Security Management Model for Undergraduate Student Mahasarakham University through Environmental Education Process. In *Proceedings of the 1st EnvironmentAsia International Conference on "Environmental Supporting in Food and Energy Security: Crisis and Opportunity" Bangkok, Thailand, 22-25 March 2011* (pp.12). Bangkok: Rama Garden Hotel.
- Thiengkamol, N. (2011e). *Environment and Development Book*. (4th ed.). Bangkok: Chulalongkorn University Press.
- Thiengkamol, N. (2011f). *Nurture Children to be Doctors*. Bangkok: INTELLUALS.
- Thiengkamol, N. (2011g). Development of Energy Security Management for Rural Community. *Canadian Social Science*, 5 (5), October 31, 2011.
- Thiengkamol, N. (2011h). Development of a Food Security Management Model for Agricultural Community. *Canadian Social Science*, 7 (5), October 31, 2011.
- Thiengkamol, N. (2011i). Development of Model of Environmental Education and Inspiration of Public Consciousness Influencing to Global Warming Alleviation. *European Journal of Social Sciences*, 25 (4):506-514.
- Thiengkamol, N. (2011j). Model of Psychological State Affecting to Global Warming Alleviation. *Canadian Social Science*, 7 (6):89-95, December 31, 2011
- Thiengkamol, N. (2012a). Development of A Prototype of Environmental Education Volunteer. *Journal of the Social Sciences*, 7 (1):77-81.
- Thiengkamol, N. (2012b). Development of Food Security Management for Undergraduate Student Mahasarakham University. *European Journal of Social Sciences*, 27 (2):246-252.
- European Topic Centre on Waste and Material Flows. (2004). *Review of existing LCA studies on the recycling and disposal of paper and cardboard*. Retrieve from http://eea.eionet.europa.eu/Public/irc/eionet-circle/etc_waste/library?l=/working_papers/lcapdf/_EN_1.0_&a=d