Development of Biodiversity Conservation Model
การพัฒนารูปแบบการอนุรักษ์ความหลากหลายทางชีวภาพ

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บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์ เพื่อศึกษาเปรียบเทียบคะแนนเฉลี่ยของความรู้เรื่องความหลากหลายทางชีวภาพ ความรู้สิ่งแวดล้อม
ศึกษา แรงบันดาลใจในการอนุรักษ์สิ่งแวดล้อม และพฤติกรรมการอนุรักษ์ความหลากหลายทางชีวภาพ ระหว่างก่อนและหลัง
อบรม และพัฒนานักเรียนระดับชั้นมัธยมศึกษาตอนปลายโรงเรียนเชียงยืนพิทยาคมให้สามารถเป็นวิทยากรที่จะนำความรู้ที่ได้รับ
จากการอบรมไปถ่ายทอดแก่นักเรียนและผู้อื่น การวิจัยครั้งนี้เป็นการวิจัยกึ่งทดลองโดยใช้ การประชุมเชิงปฏิบัติการอย่างมีส่วน
ร่วมแบบพาอิก ที่บูรณาการด้วยการวิจัยเชิงคุณภาพการอภิปรายกลุ่มย่อย การประเมิน 3 ด้าน และการประเมิน 4 ด้าน เพื่อ
ประเมินการแสดงบทบาทสมมุติการเป็นวิทยากร เครื่องมือเป็นแบบสอบถาม แบบประเมิน 3 ด้าน และการประเมิน 4 ด้าน กลุ่ม
ตัวอย่างเป็นนักเรียนมัธยมศึกษาตอนปลายโรงเรียนเชียงยืนพิทยาคม จำนวน 40 คน ได้จากการสุ่มตัวอย่างแบบเฉพาะเจาะจง
ตามเกณฑ์ที่กำหนดคือการมีจิตสาธารณะและให้คำมั่นว่าจะมีส่วนร่วมตลอดกระบวนการวิจัย สถิติที่ใช้ในการวิเคราะห์ข้อมูลคือ
Paired Sample t-test เพื่อเปรียบเทียบความรู้ก่อนและหลังการอบรม และ One Way ANOVA เพื่อเปรียบเทียบผลการประเมิน
3 ด้านและผลการประเมิน 4 ด้าน

ผลการวิจัยพบว่า คะแนนเฉลี่ยของความรู้ความหลากหลายทางชีวภาพ หลักการสิ่งแวดล้อมศึกษา แรงบันดาลใจในการมีจิต
สาธารณะเพื่อการอนุรักษ์แวดล้อมและพฤติกรรมการอนุรักษ์ความหลากหลายทางชีวภาพของนักเรียน และผลสัมฤทธิ์การอบรม
หลังการอบรม มีคะแนนเฉลี่ยสูงกว่าก่อนการอบรม ซึ่งแตกต่างกันอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.01, 0.01, 0.01, 0.01, และ
0.01 ตามลำดับ รวมทั้งได้นักเรียนที่สามารถเป็นวิทยากรที่จะถ่ายทอดความรู้เรื่องการอนุรักษ์ความหลากหลายทางชีวภาพให้แก่
เพื่อนนักเรียนด้วยกัน และบุคคลอื่นๆ นอกจากนี้ระหว่างการอบรมมีการประเมิน 3 ด้านเพื่อประเมินการมีส่วนร่วมของผู้รับการ
ฝึกอบรม พบว่า คะแนนเฉลี่ยการประเมินตนเอง การประเมินโดยเพื่อนและการประเมินโดยผู้อำนวยความสะดวก ในสถานการณ์
ปัจจุบันและอนาคต แตกต่างอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.01 และ 0.01   นอกจากนี้การประเมินคุณลักษณะการเป็น
วิทยากรด้วยการประเมิน 4   ด้าน พบว่า คะแนนเฉลี่ย การประเมินตนเอง การประเมินโดยเพื่อนวิทยากร การประเมินโดยผู้ฟัง
และการประเมินโดยวิทยากรผู้เชี่ยวชาญ แตกต่างอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.01

คำสำคัญ: การพัฒนา รูปแบบ การอนุรักษ์ ความหลากหลายทางชีวภาพ นักเรียน

Abstract

The objective was to compare the mean scores between pretest and posttest of biodiversity knowledge,
environmental education, environmental conservation inspiration, environmental conservation behavior and
to develop trainers who are able to transfer biodiversity knowledge to others. The quasi-experimental
research was employed in 40 high school students at Chiang-Yuen School, Chiang-Yuen District,
Mahasarakham Province. Participation-Appreciation-Influence-Control (PAIC) was conducted and it was
integrated with Three Dimensional Evaluations employed in examining the participation and Four

Dimensional Evaluations used for trainer role play evaluation. One-way ANOVA was used to examine the mean scores difference between three and four groups. They were collected by purposive sampling technique based on criteria of public mind and commitment to participate via the whole research process.

After PAIC was implemented, the results revealed that the mean scores of posttest of biodiversity knowledge, environmental education, environmental conservation inspiration, environmental conservation behavior and training achievement were higher than pretest with statistical significance ($p < 0.01$ for all aspects). Additionally, it also obtained the trainers who are able to transfer biodiversity knowledge to others. In present and future situations it was illustrated that mean scores were different with statistical significance ($p < 0.01$ and $p < 0.01$). Additionally with Four Dimensional Evaluation, the mean scores were different with statistical significance ($p < 0.01$).

Keywords: Development, Model, Biodiversity, Conservation, Student

1. INTRODUCTION

Biodiversity is the degree of variety and variability of living organisms and their ecosystem including genetic variation, species variation, and ecosystem variation within an area, a biome, or a planet. Terrestrial biodiversity tends to be highest at low latitudes near the equator which seems to be the result of the warm climate and high primary productivity. Marine biodiversity tends to be highest along the coasts in the Western Pacific, where sea surface temperature is highest, and in mid-latitudinal band in all oceans. Biodiversity normally tends to collect in hotspots, and has been increasing through time [1] [2] [3] [4] [5].

Ecosystem diversity, particularly in Thailand, is situated in a hot and humid climatic zone that sustains a range of tropical ecosystems. The tropical ecosystems supply broader niches for organism's survival and are able to support a much larger variety of plants, animals and microbe species. Thailand has approximately 15,000 species of plants which account for 8% of estimated total number of plant species found globally [5] [6] [7]. These numbers visibly surpass the numbers of plant species in temperate countries such as Norway and Sweden that have approximately 1,800 plant species each. Thailand also has approximately 1,721 species of terrestrial vertebrates including mammals, birds, reptiles and amphibians in comparison to 299 and 328 species found in Norway and Sweden, respectively [4] [5].

Therefore, implementation with environmental education process into school is a critical thinking to meet sustainable development. This was introduced in conference of environment and development of United Nation since 1992 and defined in Agenda 21 of global action plan which 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" [8]. This is simply to explain that people at present generation should have knowledge and understand the important of environmental problems. Thus, in any of their activities for living, they need to consume the natural resources and their action affect the environmental quality. Then, they must take responsibility for any activity that they execute with public mind to conserve the environment and natural resources actively. Moreover, they must have appropriate behavior for pro-environment based on proper awareness and positive attitude to participate in environmental projects and activities including having sensitivity to realize the essentialness of environmental quality and practice to protect environment until it becomes a permanent habit and becomes their behavior to take responsibility to maintain the environmental quality without any requirement of rewards, money or admiration [8] [9] [10].

Inspiration of public mind of environmental conservation was proposed by Thiengkamol (2011e). It was reported that inspiration is absolutely different from motivation because one having inspiration does, acts or practices with the drive from inside and with their desire to do something for public, especially for environmental conservation, and it may occur by the impression of good role model of person, event, environment and various media that inspire him/her to do for other without the requirement of rewards, money, honor or admiration, but one feels happy to do for others [9] [11] [12].

Nevertheless, the rate of biodiversity loss is still high. Therefore, it is necessary to raise awareness and change attitude and behavior of young generation such as high school students by implementing with effective training process of Participation-Appreciation-Influence-Control (PAIC) process. PAIC process emphasized on the result of behavioral change in various issues on environmental conservation behavior based on the knowledge, understanding, awareness, attitude, skill, participation, and sensitivity for people to alter their actual behavior to achieve the pro-environmental conservation for sustainable development. However, Chiang-Yuen School is a high school in Mahasarakham Province which is located in the Northeastern region of Thailand, and covers the area of pristine forest with high biodiversity. Therefore, it is a good opportunity to train high school students to become trainers. This young generation is our hope for environmental conservation and sustainable development if they appreciate and concern with the importance of biodiversity with public mind. PAIC process can be used for this purpose [13] [14].

2. OBJECTIVE

The objective was to compare the mean scores between pretest and posttest of biodiversity knowledge, environmental education, environmental conservation inspiration, and environmental conservation behavior.

3. METHODOLOGY

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

3.1 The handbook of biodiversity conservation was constructed for high school students at Chiang-Yuen School, Chiang-Yuen District, Mahasarakham Province in the Northeastern region of Thailand. Its content included knowledge of biodiversity, environmental education, inspiration of environmental conservation, and environmental conservation behavior [11] [14] [15].

3.2 The research tools comprised of questionnaire and evaluation forms comprising Three Dimensions and Four Dimensions. The questionnaire was used for determining the participants about knowledge of biodiversity, environmental education, inspiration of environmental conservation, and environmental conservation behavior.

3.3 The evaluation forms of Three Dimensions and Four Dimensions were constructed to evaluate the participants' practice during PAIC implementation.

3.4 The participants were 40 high school students at Chiang-Yuen School. They would be recruited according to the setting criteria (willingness, time, devotion, commitment, and public mind).

3.5 The participants, 40 high school students at Chiang-Yuen School, were used to investigate the training achievement. The PAIC was used to train the participants systematic operation. The focus group discussion integrated with brainstorming and Training of Trainer (TOT) was implemented [9] [11] [16]. The Three Dimensional Evaluation (TDE) was used to determine the congruence of three aspects' evaluation regarding Self-evaluation, Friends' evaluation, and Facilitators' evaluation for training participation. The Four Dimensional Evaluation (FDE)

was used for trainers' role play evaluation [9] [11] [16].

4. RESULTS

The results of this study were as follows**.**

4.1 General Characteristics of Sample Group

The sample group of this study was 40 high school students at Chiang-Yuen School, Chiang-Yuen District, Mahasarakham Province in Northeastern region of Thailand in the academic year of 2013. The sample was high school students selected to be trained in knowledge of biodiversity, environmental education, inspiration of environmental conservation, and environmental conservation behavior. Most of them gave opinions by participating in answering, asking questions, discussing, doing activities in small groups, and evaluating at high levels.

4.2 Results of Pretest and Posttest with PAIC technique

PAIC technique was trained for 40 high school students about knowledge of biodiversity, environmental education, inspiration of environmental conservation, and environmental conservation behavior by Paired Sample t-test Analysis in order to investigate the mean scores difference of pretest and posttest. The research results revealed that before and after PAIC training process was implemented, the mean scores of posttest of training achievement on knowledge of biodiversity, environmental education, inspiration of environmental conservation, environmental conservation behavior and training achievement were higher than those of pretest with statistical significance (p< 0.01 for all aspects), as shown in table 1.

Table 1. Pretest and Posttest of Sample Group of High School Students

Training Issues	Posttest		Pretest		t	p
	$\overline{X}$	S.D.	$\overline{X}$	S.D.		
Knowledge of Biodiversity	41.53	3.38	39.98	3.58	3.14	0.00**
Environmental Education	87.23	5.05	83.53	5.94	5.13	0.00**
Inspiration of Environmental Conservation	41.50	3.64	40.30	4.21	2.74	0.00**
Environmental Conservation Behavior	42.50	4.43	40.95	4.22	2.54	0.00**
Training Achievement	52.50	2.77	51.73	3.04	2.08	0.00**

** Significant Level at 0.01

4.3 Results of Three Dimensional Evaluations for Participation in Present Situation

Three Dimensional Evaluation was employed for determining the participation of 40 high school students in three aspects evaluation in present situation including Self-evaluation, Friends' evaluation, and Facilitators' evaluation by using One-way ANOVA Analysis in order to investigate the mean score differences of three groups. The results of One-way ANOVA showed that there were different mean scores among Self-Evaluation, Friends' Evaluation, and Facilitators' Evaluation about participation in training process with statistical significance (p<0.01) as shown in table 2.

Table 2. Three Dimension Evaluation of Sample Group for Participation in Present Situation

Source of Variation	Sum of squares	df	Mean Square	F	Sig.
Between Groups	3.62	2	1.81	20.07	0.00**
Within Groups	10.53	117	0.09		
Total	14.15	119			

** Significant Level at 0.01

The Scheffe's method was used for analyzing each pair in comparison to Three Dimensional Evaluation (TDE) to determine the mean score differences of their participation in the training

process of PAIC. It showed that Self-Evaluation and Friends' Evaluation, Self-Evaluation and Facilitators' Evaluation, and Friends' Evaluation and Facilitators' Evaluation were statistically significant at level of 0.01, 0.01 and 0.01.

4.4 Results of Three Dimensional Evaluations for Participation in Future Situation

Three Dimensional Evaluations were employed for determining the perceptions of 40 high school students in three aspects evaluation in future situation including Self-evaluation, Friends' evaluation, and Facilitators' evaluation by using One-way ANOVA Analysis in order to investigate the mean score differences of three groups. The results of One-way ANOVA showed that there were different mean scores about participation in training process with statistical significance ($p<0.01$) as shown in table 3.

Table 3. Three Dimension Evaluation of Sample Group for Participation in Future Situation

Source of Variation	Sum of squares	df	Mean Square	F	Sig.
Between Groups	1.04	2	0.52	6.80	0.00**
Within Groups	9.36	117	0.08		
Total	10.40	119			

** Significant Level at 0.01

The Scheffe's method was used for analyzing each pair in comparison to Three Dimensional Evaluation (TDE) to determine the mean score differences of their participation in the PAIC training process. It showed that Self-Evaluation and Friends' Evaluation had no statistically significant at level of 0.05. Self-Evaluation and Facilitators' Evaluation and Friends' Evaluation and Facilitators' Evaluation were statistically significant at level of 0.01 and 0.01.

4.5 Results of Four Dimensional Evaluations for Trainer Role Play

Four Dimensional Evaluations were employed for determining the trainer role play in four aspects evaluation of Trainers' self-evaluation, Trainers' friends' evaluation, Audiences' evaluation and Trainers' expert's evaluation by using One-way

ANOVA Analysis in order to investigate the mean score differences of four groups. The results of One-way ANOVA showed that there were different mean scores about trainer role play during PAIC with statistical significance ($p<0.01$) as shown in table 4.

Table 4. Results of Four Dimensional Evaluations for Trainer Role Play

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.90	3	2.30	20.49	0.00**
Within Groups	19.31	172	0.11		
Total	26.21	175			

** Significant Level at 0.01

The Scheffe's method was used for analyzing each pair in comparison to Four Dimensional Evaluation (TDE) to determine the mean score differences of their trainer role play in the training process of PAIC. It showed that Trainers' Self-valuation and Trainers' Friends' Evaluation, Trainers' Self-evaluation and Audiences' Evaluation, and Trainers' Self-evaluation and Trainers' expert's Evaluation were statistically significant at level of 0.01, 0.01 and 0.01.

For the duration of the PAIC training implemented, focus groups discussion and brain storming were integrated. Consequently, it is obviously seen that they had a very good participation, and they were able to convey their idea and elucidate to their friends in the small group. Furthermore, they were able to play their role being trainers effectively. Principally, in small group discussion they joyfully participated and were able to use their own imagination to draw their own ideas and express their thoughts to propose their project to implement after PAIC training finished. Additionally, they planned to share their knowledge and understanding got from PAIC process to other students in the same school and act as trainers for other schools' students in the same district and the same province with public mind on biodiversity conservation to meet sustainable development.

5. DISCUSSIONS

The results pointed out that the high school student participants had knowledge of biodiversity, environmental education, inspiration of environmental conservation, and environmental conservation behavior after participating in the PAIC training process. These were congruent to a variety of studies [11] [17] [18]. It might be explicated that the high school student of Chiang-Yuen School after accomplishing PAIC training technique are capable to raise knowledge of biodiversity, environmental education, and inspiration of environmental conservation, and they change environmental conservation behavior after participating in the PAIC training via actual practicing behavior in their daily life activities in their school forest on knowledge of biodiversity, environmental education, inspiration of environmental conservation, and environmental conservation behavior. The findings are also congruent to the results of different studies [32] showing that the participation affected practice for environmental conservation with public mind to accomplish the genuine sustainable development via environmental education process regarding knowledge of biodiversity, environmental education, inspiration of environmental conservation, and environmental conservation behavior after participating.

The results of TDE of 40 participants were employed for determining the congruence of three aspects evaluation including Self-evaluation, Friends' evaluation, and Facilitators' evaluation. The mean scores were different among three aspects in present and future situations (p<0.01 and p<0.01). This might be explicated that high school student participants live in the rural area, so they realize the importance of biodiversity conservation as they learn and stay at Chiang-Yuen School bordering on the school forest with pristine biodiversity. These students stay far away from Bangkok. Most of them are generally modest persons, so their mean score both in self-evaluation and friends' evaluation are

lower than facilitators'. In addition, FDE was used to evaluate the trainer role play of high school student participants; it was revealed that the mean scores of Trainers' self evaluation, Trainers' friend evaluation, Audiences' evaluation, and Trainers' experts' evaluation were statistically significant at level of 0.01. However, Trainers' self-evaluation, and Trainers' friends' evaluation are conducted on high school students who are modest persons. Therefore, their mean scores are lower than that of Trainers' expert's evaluation. However, the result of training was relevant to several studies of Thiengkamol, (2010b, 2012a, 2012b) and researches of Thiengkamol's colleagues such as Chomputawat, 2013; Ngarmsang, et al., 2012a; Sangsan-anan, et al., 2012b; Petchang, 2013.

In addition, it was discovered that PAIC training is successful for training in combination of brain storming process to develop a shared vision, action plan and projects in different issues of training such as urban community food security management, environment and natural resource conservation, conservation of disability student, and environment. It can be applied to use in other contexts with different target groups by replicating its implementation to build the biodiversity conservation model through trainer development for environmental knowledge and transfer to school and community in other province in this region.

6. CONCLUSION

PAIC technique can be used to enhance biodiversity knowledge, environmental education, environmental conservation inspiration, and environmental conservation behavior and to develop trainers who are able to transfer biodiversity knowledge to others as the following diagram.

PAIC → TDEs → FDEs → Prototype

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