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## **The Biological Literacy, Environmental Awareness and Integrated Science Process Skills in the SCiUS Students of Mahasarakham University Demonstration School (Secondary)**

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This research aims to compare the biology literacy, environmental awareness and Integrated science process skills in the Science Classrooms in University-Affiliated School Project (SCiUS) students of Mahasarakham University Demonstration school (Secondary) The sample consisted students of Science Classrooms in University-Affiliated School Project (SCiUS) Grade 11 and 12 the academic year 2015, by the purposive sampling. The research instruments were the biological knowledge test, the integrated science process skills test, created by Assoc. Prof. Dr. Paitoon Suksrivam is based on the concept of American Association for the Sciences Advancement of Science (AAAS) and awareness questionnaire of environmental conservation. The result found SCiUS students in Grade 11 and 12 their had a statistically significant difference in biological literacy at the .05 level and integrated science process skills difference was statistically significant at the .05 The Grade 11 student's had a biology literacy was at moderate level while the Grade 12 students had a high level of biology literacy. The environmental awareness SCiUS students Grade 11 and 12 are well aware of the environment as a whole in average level is the same. The integrated science process skills Grade 11 students are in the low to moderate level, while the Grade 12 are at moderate to high levels.

**Keywords :** Biological literacy , Environmental awareness, Integrated science process skills.

### **Introduction**

Currently, the global population is increasingly accelerated in certain regions of the world. Although some parts or countries with successful birth control, the increasing population, the lack of knowledge, understanding, and awareness to behave themselves properly have led to the issue of environmental quality and reduced natural resources (Nongnapas Kuvarunyu Thiengkamol, 2008). Environmental problems are common nowadays and they affect the

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quality of our lives. Environmental problems affect the society, ranging from local, national, to global communities.

To establish awareness, body of knowledge, and participation in preventing environmental problems and improving environmental quality, it requires environmental studies process. This is because environmental studies involve educating the public regardless of sex or age, and form of education. The body of knowledge in environmental studies consists of natural resources, physical environment, biological environment, human's creation, society, cultures, economy, politics, religions, beliefs, and values, all of which are closely related. In addition, environmental studies also address learning process and activities to enhance people to prevent and resolve environmental problems, as well as to ameliorate the environmental conditions (Vinai Veeravatnanond, 2012). In the meantime, teenagers' social characteristics and values are tied with media and modern technologies. They have swallowed consumerism from media. Therefore, their lives are well away from nature. Consumerist behavior reduces their awareness of natural resource and environmental conservation.

Currently, there environmental study-related activities and programs are widely offered in the USA, Europe, and other regions. Schools have also introduced some of these courses. In the United States, the American people have passed the National Environmental Education Act in 1990, giving rise to Department of Environmental Studies which put environmental studies in the national curriculum. Environmental studies is regarded as alternative subject in primary school to secondary school. Also, it is worth noting that environmental studies involves learning inside and outside of classroom (Vinai Veeravatnanond, 2012).

The Thai Ministry of Science and Technology (MOST) witnesses the importance of creating strong manpower in science and technology to develop the country. The Ministry starts with selecting highly potential high school students into the development process and enhance their mathematical, scientific, and technological potentials. MOST promotes establishment of science classrooms in schools under supervision of a university and fulfillment of science and technology proficiency in each university. Science Classrooms in University-Affiliated School Project (SCiUS) at Mahasarakham University Demonstration School (Secondary) does not only covers all the lessons according to the Basic Education Core Curriculum A.D. 2008 and its school-owned curriculum, but also coordinates with Faculty of Science, Mahasarakham University to offer broader knowledge in science, mathematics, and technology. In this collaboration, qualified professors at the university supervise the program and teaching in order to meet the objectives of SCiUS Program.

Education management in SCiUS Program requires development in knowledge, awareness, and science process skills among students. Biological literacy is an essential foundation for relating organisms with the environment. Therefore, in order to make students understand the importance of biology and environment, there are various mode of post-class educational techniques in order to follow up their learnability, environmental awareness, and development of science process skills. The author regards that it is important to evaluate biological literacy, environmental awareness, and integrated science process skills to develop students' capability.

### **Objectives**

1. To assess biological literacy, environmental awareness, and integrated science process skills among SCiUS students
2. To compare biological literacy, environmental awareness, and integrated science process skills of grade 11 and grade 12 SCiUS students
3. To reflect biological literacy, environmental awareness, and integrated science process skills among SCiUS students

### **Hypotheses**

1. SCiUS students at DMSU (Secondary) have biological literacy.
2. SCiUS students know how to use biological literacy, establish environmental awareness, and develop integrated science process skills

### **Research methodology**

#### ***Population and sample***

##### **Population**

The population in this research included 89 students in SCiUS Program at Mahasarakham University Demonstration School (Secondary) in the academic year 2015.

##### **Sample**

The sample group in this research included students in SCiUS Program at Mahasarakham University Demonstration School (Secondary), selected based on purposive sampling (59 students).

#### ***Research instruments***

##### **2.1 Biological literacy examination form**

- 2.2 Environmental awareness questionnaire
- 2.3 Integrated science process skill questionnaire

***Research instrument development and validity testing***

Research instrument development and validity testing can be divided into different stages as follows:

**Development and validity testing of biological literacy examination form**

1. The biological literacy examination form was developed (50 items) based on the content as advised by experts to make the biology teaching manual and environmental biology workshop. The test blueprint was developed to distribute the measurement to cover all cognitive domain according to Bloom's Revised Taxonomy (Paitoon Suksringam, 2002).

2. Validity of the examination form is tested by experts. The Index of Item Objective Congruence (IOC) was analyzed. The item with IOC more than 0.50 was selected. The analysis revealed that the biological literacy examination has the validity at 0.90, which means that it is acceptable.

3. Congruence assessment of the examination form by expert was conducted using rating scales, with congruence level of very high, high, medium, low, and very low.

<b>Rating</b>	<b>Congruence Level</b>
5	Very high
4	High
3	Medium
2	Low
1	Very low

The average score of assessment by expert was weighted as follows: (Bunchom Sisa-at), 1992: 100)

4.51-5.0	Very high
3.51-4.50	High
2.51-3.50	Medium
1.51-2.50	Low
1.00-1.50	Very low

It was determined that if the average score by experts more than 3.51, the examination form is acceptable and congruent to use.

4. The examination form was tried out with non-sample students in order to test item difficulty and discrimination. Reliability of the examination

form was verified based on KR-20 formula. The examination form should have at least .08 level of reliability in order to be used for the actual test. According to the try-out, the biological literacy examination form has reliability level of .93, meaning that it is acceptable to use.

5. The scores for biological literacy are divided into 3 ranges as follows:

<b>Range</b>	<b>Interpretation</b>
1-15	Low literacy
16-30	Medium literacy
31-50	High literacy

#### **Development and validity testing of environmental awareness questionnaire**

Development and validity testing of the environmental awareness questionnaire have the following procedures.

1. The environmental awareness questionnaire was developed. It is then tested for checklist validity and questionnaire using IOC analysis performed by experts.

2. Content validity was analyzed using IOC. Only items with IOC more than 0.50 were selected. Item-total correlation was used to identify discrimination of the questionnaire. It was found that each questionnaire item had discrimination value more than the critical score of 0.361. Reliability was validated using  $\alpha$  – Cronbach Coefficient. It was found that the questionnaire had reliability score of 0.98 (higher than the standard of 0.80), meaning that it had high reliability and was accepted to use.

The average assessment scores of environmental awareness are interpreted as follows: (Bunchom Sisa-at, 1992)

4.51-5.0	Very high awareness
3.51-4.50	High awareness
2.51-3.50	Medium awareness
1.51-2.50	Low awareness
1.00-1.50	Very low awareness

#### **Development and validity testing of integrated science process skills questionnaire**

Development and validity testing of integrated science process skills questionnaire have the following procedures:

1. The integrated science process skills questionnaire was created by Dr. Paitoon Suksringam based on American Association for the Advancement of Science (AAAS). The questionnaire consisted of 30 items, which were categorized by 5 different skills (Nida Kitjinda-opas, 2009), which are

1. Process definitions (3 items)
2. Hypothesis development (6 items)
3. Determination and control of variables (4 items)
4. Experimentation (7 items)
5. Data interpretation and input (10 items)

The scoring criteria are as follows:

One point for each correct answer.

Zero point for incorrect or incomplete answer.

The skill assessment scores are divided into 3 ranges as follows:

<b>Range</b>	<b>Interpretation</b>
1-10	Low science process skills
11-20	Medium science process skills
21-30	High science process skills

2. Congruence of the integrated science process skills questionnaire was assessed by 5 experts. It was found that it has the congruence value of 4.62 (very high), and can be used for measuring integrated science process skills in this research.

## **Research methodology**

### ***Research designs***

For this research, the researcher conducted quasi-experimental research and two-group posttest design.

This is a qualitative research using description, observation, and learning activities.

#### **Stage 1**

1. Invitation letters were sent to 5 experts who are biology and environmental lecturers at Mahasarakham University.

2. Research instruments were designed and created.

#### **Stage 2**

1. Data collection tools were developed and submitted to experts for assessment.

2. Data collection tools were tried out and tested for their validity.

#### **Stage 3**

1. Students learned biology according their normal curriculum in normal class schedule.

2. At the end of the semester, the biological literacy examination form, environmental awareness questionnaire, and integrated science skills questionnaire were taken by students as posttests. Results were recorded.

3. The data were analyzed using the computer program.

### ***Data analysis***

1. Average scores after learning were analyzed using t-test.

2. Data were analyzed and explained based on the observation during learning activities.

### ***Statistical tools used for data analysis***

1. Basic statistics such as

1.1 Frequency and percentage

1.2 Average

1.3 Standard deviation

2. Statistics testing validity of the instruments such as

2.1 Item objective congruence

2.2 Item difficulty of the environmental awareness questionnaire

2.3 Discrimination of the questionnaire items using item-total correlation

2.4 Reliability based on Kuder - Richardson (KR-20) of the environmental awareness questionnaire

2.5 Reliability of the checklist and questionnaire based on the  $\alpha$  – Cronbach Coefficient

3. Result and hypothesis testing statistics such as *t*-test (independent)

### **Results**

This research aims 1) to assess biological literacy and environmental awareness by relating to the environment, 2) to assess integrated science process skill of SCiUS to compare biological literacy and environmental awareness, and 3) to assess environmental awareness in relation to environmental among grade 11 and 12 SCiUS students to reflect biological literacy, environmental awareness, and integrated science process skills among SCiUS students. The findings of the research are as below.

Biological literacy of grade 11 SCiUS students was at medium level in 4 attributes, which are organisms and environment, reproduction and growth of



According to Table 2, by using integrated science process skills questionnaire created by Dr. Paitoon Suksringam based on American Association for the Advancement of Science (AAAS) to assess integrated science process skills of grade 11 and grade 12 SCiUS students, it was found that they had statistical significance level of .05.

**Table 3** Average and standard deviation for environmental awareness of students in the overall and sorted by attributes.

Environmental awareness	$\bar{X}$	S.D.	Level
1) Ecosystem	2.90	1.29	Medium
2) Natural resources	2.84	1.30	Medium
3) Environmental conditions	2.99	1.30	Medium
Overall	2.91	1.30	Medium

According to Table 3, grade 11 and grade 12 SCiUS students had environmental awareness, both in the overall and in each attribute, at medium level.

The next section discusses the analysis of relationship between biological literacy, environmental awareness, and integrated science process skills among SCiUS students.

**Table 4:** The correlation coefficient between biological literacy, environmental awareness, and integrated science process skills among SCiUS students.

Variables	Literacy	Integrated science process skills	Awareness
Literacy	1	0.63*	0.39*
Integrated science process skills		1	0.51*
Awareness			1

\*Statistical significance < .05

According to Table 4, biological literacy, environmental awareness, and integrated science process skills had positive relationship with statistical significance level of .01. The correlation coefficient (r) between literacy and integrated science process skills was 0.63, between literacy and awareness 0.39, and between integrated science process skills and awareness 0.51.

## Conclusion

This research aims 1) to assess biological literacy and environmental awareness by relating to the environment, 2) to assess integrated science

process skill of SCiUS to compare biological literacy and environmental awareness, and 3) to assess environmental awareness in relation to environmental among grade 11 and 12 SCiUS students to reflect biological literacy, environmental awareness, and integrated science process skills among SCiUS students. The research can be concluded as below.

Biological literacy of grade 11 SCiUS students was at medium level in 4 attributes, which are organisms and environment, reproduction and growth of organisms, environment and genetics, and ecosystem and biodiversity. The overall literacy is also at medium level.

Biological literacy of grade 12 SCiUS students was at medium level in organisms and environment, environment and genetics, and at high level in reproduction and growth of organisms, and ecosystem and biodiversity. The overall literacy was at high level.

Integrated science process skills of grade 11 SCiUS students were found at low level in process definition, and determination and control of variables whereas they were at medium level in hypothesis development, experimentation, and data interpretation and conclusion. The overall integrated science process skills of grade 11 SCiUS students were found at medium level.

Integrated science process skills of grade 12 SCiUS students were found at medium level in process definition, and determination and control of variables, and experimentation whereas they were at high level in hypothesis development and data interpretation and conclusion. The overall integrated science process skills of grade 12 SCiUS students were found at high level. In general, integrated science process skills of grade 12 SCiUS students were medium and their average scores of all attributes were higher than those of grade 11 SCiUS students.

According to environmental awareness assessment, both grade 11 and grade 12 SCiUS students had medium level of environmental awareness, both in the overall and in specific attributes. Comparison result of biological literacy between grade 11 and grade 12 SCiUS students revealed that their biological literacy had statistical significance of .05. By using integrated science process skills questionnaire created by Dr. Paitoon Suksringam based on American Association for the Advancement of Science (AAAS) to assess integrated science process skills of grade 11 and grade 12 SCiUS students, it was found that they had statistical significance level of .05.

## **Discussion**

Ministry of Science and Technology of Thailand understands the importance of creating able manpower in science and technology for national

development. The Ministry started with choosing high school students with strong potentials into the development process that enhance their knowledge and skills in mathematics, science, and technology. For this matter, Ministry of Science and Technology supports the establishment of science classrooms in university-affiliated schools to highlight the specialties in science and technology of each university. Mahasarakham University has the potentials and is prepared in many aspects to establish “science classrooms in school”. Mahasarakham has the Faculty of Science and Mahasarakham University Demonstration School (Secondary) as the supporting factors. The Faculty has reputation in science, biodiversity and technology know-hows, scientific learning sources, and supporting organizations. Some of the learning sources include Mushroom Research Center, Paleontology Research Center, Faculty of Science Research Center, Walairukhavej Botanical Research Institute, Silk Innovation Center, Scientific Tools Academic Unit, Alternative Energy Information Technology and Energy Conservation Center, Computer Center, and Academic Resource Center. In addition, Mahasarakham University has assigned relevant faculties to participate in science teaching and organize learning activities for SCiUS students (SCiUS Administration Committee; 2013). The students in this program are treated as special curriculum taught by lecturers from Faculty of Science. Knowledge and skill development in science are crucial for students’ development. Based on this research, biological literacy of grade 11 students was at medium level while grade 12 high level. This results from the different experience and learning duration. According to the environmental awareness assessment, the level of environmental awareness, both in the overall and in specific attributes, was found at medium level for both grades. This means that high school education still does not place highlighted importance on relating biological literacy with environmental and natural resource conservation. However, the trend among the majority students indicated toward the positive side. This is consistent with the research by Adisak Singseevo *et al.* (2011). Singseevo examined environmental awareness among secondary school students in Kalasin province of Thailand. He discovered that students had medium level about environment, interpretation and environmental problem solving skills. They had good attitude toward the environment and their behavior toward the environment satisfactory. Also, the above research pointed out that students’ gender had positive relationship with interpretation and environmental problem solving skills among students in Kalasin province, with the statistical significance level of .05, and their environmental literacy had positive relationship with environmental attitude and interpretation and environmental problem solving skills with the statistical significance level of .05. The research also agreed with Hye-Eun Chu *et al.*

(2007) who discovered that environmental awareness had positive relationship with environmental attitude, skills and responsible behavior toward the environment. On the other hand, according to Hye-Eun Chu (2007), good skills had no impact on behavior toward the environment while gender difference, education level of parents, and environmental knowledge source have positive relationship with knowledge, attitude, skill, and behavior toward the environment.

Integrated science process skills of grade 11 SCiUS students were found at low level in process definition, and determination and control of variables whereas they were at medium level in hypothesis development, experimentation, and data interpretation and conclusion. Integrated science process skills of grade 12 SCiUS students were found at medium-high level. The findings in this research are consistent with those of Sombat Appamaraka (2009). Appamaraka explored how 5-level cycle based on students' thinking and teacher's manual affects academic achievement, integrated science process skills, and critical thinking among grade 9 students. All these indicated that science process skills need to be further improved and added into learning activities for SCiUS students in order to achieve the objectives and goals of establishing science classrooms in university-affiliated schools.

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