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Research Paper

STUDENTS' PERCEPTIONS ABOUT CLIMATE CHANGE**Arnold D. Pitpitunge***Philippine Science High School – Central Luzon Campus, Philippines*

(Received: 16 February 2013; accepted: 17 September 2013)

This study determined the science high school students' perceptions on the aspects of climate change. It involved randomly selected 122 science high school students who took the researcher-made multiple choice climate change test. In each item, the students circled their choice, provided brief explanation about their answer, and determined the source of information about the concept. The answers were coded to determine the students' climate change perceptions. The results showed that the students hold more correct perceptions on the basic concepts and causes of climate change but they have more lack of perceptions on the effects, mitigations and adaptations. Furthermore, the students had alternative perceptions and they had poor knowledge and comprehension on the aspects of climate change. Significant differences were found on the correct perceptions of male and female students on climate change mitigations. Similarly, significant differences were observed in the correct and alternative perceptions of first and second year students on the basic concepts of climate change. Information from the media and from home/community was related to the lack of perception and alternative perceptions on climate change basic concepts, effects, and mitigations.

Keywords: adaptation, alternative perceptions, climate change, correct perceptions, mitigation, perceptions

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INTRODUCTION

Climate change encompasses environmental issues like flooding, storm surges, sea level rise, temperature rise, variability of precipitation, and extreme weather conditions. It is attributed to the rising concentration of greenhouse gases and increasing environmental degradation. It becomes a concern of international organizations and government institutions because of its impacts on different sectors such as agriculture, ecosystems and biodiversity (IPCC 2007).

Investigations of students' climate change perceptions reveal important insights about their way of thinking and understanding of environ-

mental issues and scientific concepts. Studies on climate change show that students have lack of perceptions on ozone layer depletion and global warming, on climate and weather (Lombardi and Sinatra 2012, Gowda *et al.* 1997), on the radiation involve in the greenhouse effect (Choi *et al.* 2010), and on the causes and consequence of climate change (Pruneau *et al.* 2001). These lack of perceptions persist even after receiving instruction about climate change and weather (Cordero *et al.* 2008). The perceptions are affected by sources of information like the media and schools (Ho 2009, Kisoglu *et al.* 2010).

This study aims to find out the science high

school students' perceptions on the aspects of climate change and to determine the extent of their knowledge and comprehension on climate change. Specifically, it seeks to determine if the students' (1) correct perceptions (extent of knowledge and comprehension), (2) lack of perceptions, and (3) alternative perceptions on the different aspects of climate change are significantly related to the variables such as gender, religious affiliation, academic year level, family's monthly income, leisure time activities, and sources of information.

METHODS

The descriptive-qualitative-correlation type of research was employed in this study. Through stratified-random sampling, 122 high school students whose age ranges from 12-14 were taken from the first and second year levels of two science schools of the 10-year basic education curriculum of the Philippines. For data gathering, two types of research instruments were used: (1) a questionnaire that requires personal information (personal data sheet) and (2) a multiple test items on climate change. Each multiple choice item had four options in which the students circled the answer they think is correct, wrote explanation about their answer, and identified the source of information.

The test contained concepts on the aspects of climate change that include the basic concepts, causes, effects, mitigations and adaptations.

The answer and explanation for each item were the bases in determining the perceptions of the students. The correct perceptions were derived from the correct answer and explanations on the concepts while the lack of perceptions was from incorrect answer and explanations. The alternative perceptions were determined from answers that are either correct or incorrect and explanations that are neither correct nor incorrect. The alternative perceptions referred to students' personal ideas, views, and beliefs which are not considered to be errors or incor-

rect even if they are not consistent with scientifically accepted views (Read 2004). The extent of knowledge and comprehension was determined by identifying the percentage of correct perceptions about the different aspects of climate change (Mangawil 2007).

Using the Kuder-Richardson reliability formula, the computed coefficient alpha was equivalent to 0.82 which shows that the test had high reliability. Data were entered into an SPSS 16.0 for Windows data file and the accuracy of data input, missing values, and outliers were checked. The percentage of correct perceptions, lack of perceptions, and alternative perceptions was computed and compared. Descriptive statistics was used to determine the profile of the students while t-test for independent sample and One-Way ANOVA determined the differences on the perceptions of students when grouped according to gender, religious affiliations, academic year level, family's monthly income, and leisure time activities. Spearman rho determined the relationship of students' perceptions and the sources of information.

RESULTS AND DISCUSSION

The aspects of climate change include basic concepts, effects and causes of climate change, mitigation strategies to address the sources, and strategies to cope with the impacts of climate change. The concepts are related to different sectors such as coastal communities, human health, and ecosystem including agriculture, freshwater, forests, and biodiversity. Concepts, ideas and views related to greenhouse effects, greenhouse gases, global warming, and radiations are included in the identification of students' perceptions.

Figure 1 shows that the number of students who have correct perception on each of the aspects of climate change is below 50%. According to Mangawil (2007), the level of knowledge and comprehension is considered to be "poor" if the percentage of correct perceptions is between

30% and 49%. Therefore, based on the mean percentage of the correct perceptions, Figure 1 indicates students' poor level of knowledge and comprehension on all the aspects of climate change.

To improve the level of understanding of students and to eliminate their lack of percep-

tions, Cordero *et al.* (2008) suggested active learning methods. Students should be involved in the teaching and learning process. Climate change education should be scientifically and socially oriented to increase the knowledge and comprehension of students on the different aspects.

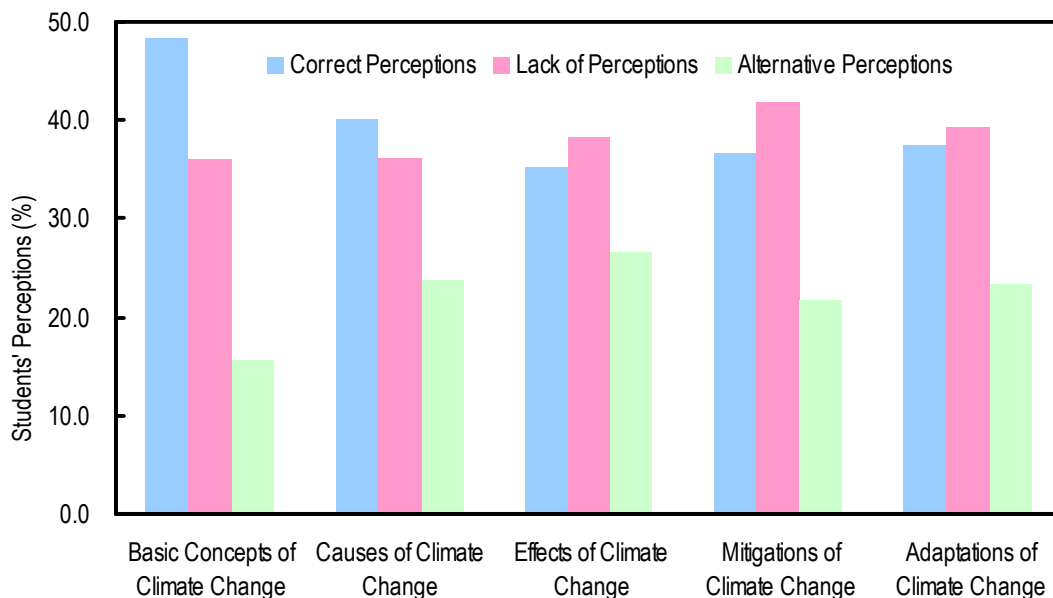


Figure 1 Students' perceptions on the aspects of climate change

The level of knowledge and comprehension based on correct perceptions: 30%-Below (Very poor); 30-49% (Poor); 50-69% (Moderate); 70-89% (High); 90% and above (Very high)

Correct perceptions

Table 1 shows the perceptions of students on the different aspects of climate change. The correct perceptions include the awareness of the students on the intensification of typhoons (IPCC 2007), the different aspects of climate change, and concepts of temperature rise, greenhouse effect and greenhouse gases (Choi *et al.* 2010)

The students identify human activities associated with climate change. Slash and burn farming system denudes forests that sequester atmospheric carbon dioxide. In addition, the conversion of forests into agricultural lands and land development decrease of carbon dioxide

sequestration and increase of greenhouse gas production (ADB 2009). Greenhouse gases are the main factor that contributes to the intensification of global warming and climate change (IPCC 2007). Methane from rice fields, wetlands and animal wastes also act as a greenhouse gas (Bogner *et al.* 2007).

Mitigation strategies are promoted to reduce the production of greenhouse gases from the different sectors. Table 1 shows the activities (IPCC 2007), strategies, and practices (ADB 2009) that the students perceived as related to the reduction of greenhouse gas concentration in the atmosphere.

Table 1 Students' perceptions on the different aspects of climate change

Aspects of Climate Change	Correct Perception
Basic Concepts	<ul style="list-style-type: none"> • Typhoons have higher frequency, strength, wind speed and heavy precipitation • Climatic changes do not cause volcanic activities (weather and climate do not lead to eruption of volcanoes) • Global warming is an aspect of climate change • The greenhouse effect involves heat and greenhouse gases in the atmosphere • Greenhouse gases cause climate change
Causes	<ul style="list-style-type: none"> • Slash and burn or kaingin system of farming reduces carbon sequestration • Microorganisms in freshwater/rice fields and in animal wastes produce methane, a greenhouse gas • Greenhouse gases cause global warming and climate change • Land development and land use change produce greenhouse gases
Effects	<ul style="list-style-type: none"> • Sea level rise leads to salt water intrusion on coastal areas • Temperature rise makes coastal areas and ecosystem vulnerable • Higher temperature increases population of disease-causing vectors like mosquitoes • Precipitation variability, temperature rise, and drought affect water supply • Drought, flooding and stronger storms decrease agricultural yields
Mitigations	<ul style="list-style-type: none"> • Tree planting activities help carbon dioxide sequestration • The Philippine government promotes the use of biofuel like ethanol and other alternative source of energy (RA 9367) • Efficiency of new machines produces less greenhouse gases • Recycling practices help mitigate the impacts of climate change
Adaptations	<ul style="list-style-type: none"> • Improvement of building technology and sea wall constructions lessen the impact of climate change in coastal areas • Management of restricted areas and natural sanctuaries lessen the vulnerability of endangered species • Propagation of drought resistant species allows forest to cope with climate change • Adjustment of the dates of planting for farmers minimizes loss in agricultural yields
Aspects of Climate Change	Lack of Perceptions
Basic concepts	<ul style="list-style-type: none"> • Climate change is defined as the condition of an areas over long period of time or a result of bad weather condition • Climate change is the effect of global warming • Greenhouse gases produce heat
Causes	<ul style="list-style-type: none"> • Concentration of carbon dioxide in the atmosphere is a result of volcanic activities • Global warming and greenhouse effect cause climate change • Radiations increase the hole of the ozone layer • Wetlands/rice fields produce water vapor that causes climate change
Effects	<ul style="list-style-type: none"> • Climate change causes freshwater contamination and pollution • Carbon dioxide concentration in the atmosphere poisons forest plants • Increased number of stronger storms is the impact of climate change on coastal areas • Climate change has no effect on water supply • Climate change has no effect on endangered plants and animals • Adjustments in farming/cultivation decrease agricultural yields
Mitigations	<ul style="list-style-type: none"> • Waste segregation lessens the impact of climate change such as flooding • Paper products such as paper bags do not produce GHG even if they are burned • Usage of recycled materials in industrial productions lessens carbon dioxide • Recycled materials do not produces carbon dioxide • Waste management stops carbon dioxide production
Adaptations	<ul style="list-style-type: none"> • People in coastal areas should change their source of living from fishing to farming • Freshwater water supply in rural areas should be controlled • Endangered species should be collected and placed in sanctuaries • New species of trees should be introduced into the Philippine forests • More fisheries should be constructed in bodies of water

Table 1 (continued)

Aspects of Climate change	Alternative perceptions (Perceptions that are neither correct nor incorrect)
Basic concepts	<ul style="list-style-type: none"> • Flooding is associated with garbage and poor drainage system • Ozone hole causes climate change • Greenhouse gases pollute the environment
Causes	<ul style="list-style-type: none"> • Radiation from the sun causes climate change • Ozone layer depletion is the factor that changes the Earth's climate change • Increasing human population increases carbon dioxide concentration in the environment
Effects	<ul style="list-style-type: none"> • Day and night temperature variability in coastal areas is an effect of climate change • Increasing concentration of greenhouse gases and rising temperature increase cases of skin cancer and skin diseases • Changes in farming practices increase crop yields
Mitigations	<ul style="list-style-type: none"> • Recycling of materials lessen harmful gases • Biodegradable materials are safe to use • Efficient machines are safe and eco-friendly
Adaptations	<ul style="list-style-type: none"> • Water distribution is based on the need of the community • Natural sanctuaries are converted into eco-tourist parks • Birth control and family planning lessen production of wastes and greenhouse gases

The students recognize the climate change impacts on human health conditions (Akerlof *et al.* 2010), coastal communities (ADB 2009), and ecosystems that include agriculture, freshwater, forest (Hawkins *et al.* 2008), and biodiversity (IPCC 2007).

Adaptation strategies are necessary to cope with the consequences or potential damages of climate change. Table 1 shows that students focused on adaptation strategies to cope with the impacts of climate change on coastal areas, agriculture (Lansigan 2005) and ecosystems that include biodiversity and forests (IPCC, 2007).

Lack of perception

Similar with the findings of Cordero *et al.* (2008), the students are unable to differentiate the following terms, climate change, global warming, climate, and weather. Table 1 indicates that understanding of the mechanism of greenhouse effect and global warming is problematic (Choi *et al.* 2010).

Without considering the impacts of precipitation variability and temperature rise (IPCC 2007), the students wrote that climate change does not alter water supply in many parts of the country and it has no impact on agricultural activities, biodiversity, and ecosystem.

The students inaccurately associate waste clean-up as more related strategy to climate change mitigation than tree planting activities. They focus on environmental-friendly activities such as recycling and waste management. In addition, many of them admit lack of knowledge and awareness on the different mitigation strategies to lessen the production of carbon dioxide from the different sectors.

Changes in livelihood of fishermen, collection of endangered species, introduction of tree species, and construction of fisheries are proposed to cope with the impacts of climate change. These suggestions are made without consideration of the effects on temperature rise and variability, intensification of typhoons, vulnerability of organisms (IPCC 2007), and invasion of introduced species.

Alternative perceptions

The students identify garbage and poor drainage system as the observable indicator of climate change, climate change and the hole of the ozone layer as related concepts and greenhouse gases as pollutant. Solar radiation and ozone layer depletion cause changes in the atmosphere. Temperature rise and variability is associated with skin cancer and diseases.

The increasing human population is a factor that increases the carbon dioxide concentration in the atmosphere. The students recommend birth control and family planning program as tools to control the population. They believe that biodegradable materials release less greenhouse gases and efficient machines decrease the energy consumption. In addition, they propose proper distribution of freshwater supply and conversion of natural sanctuaries into eco-tourist parks as adaptation strategies.

Students' perceptions and their socio-demographic characteristics

The perceptions of the students on the different aspects of climate change are not related to their religious affiliation, family's monthly income, and leisure time activities. However,

Table 2 shows that the students' correct perceptions and lack of perceptions on the mitigation of climate change are related to gender. It indicates that male and female differ on their perceptions on strategies to stop the production of greenhouse gases from the different sectors.

Table 3 shows that perceptions of students on the basic concepts and causes of climate change are related to their academic year level. Second year students have more correct perception on basic concepts than the first year students who have more lack of perceptions on the causes. First year students have more alternative perceptions on basic concepts. This could be associated with the exposure of second year students to different environmental issues integrated in their science subjects.

Table 2 Science High School students' perceptions on the different aspects of climate change when grouped according to gender

Perceptions	Aspect of Climate Change	Gender	N	Mean	SD	Mean Difference	t	Sig. (2-tailed)
Correct Perception	Mitigations	Male	51	45	22.0	14	3.9	0.0001
		Female	71	31	18.2			
Lack of Perception	Mitigations	Male	51	36	24.4	-10	-2.2	0.03
		Female	71	46	24.4			

Table 3 Science High School Students' Perceptions on the Different Aspects of Climate Change when grouped according to Academic Year Level

Perceptions	Aspects of Climate Change		Academic Year Level	N	Mean	SD	Mean Difference	t	Sig. (2-tailed)
Correct Perception	Basic concepts	Con-	First Year High School	59	43	22.6	-9	-2.3	0.026
			Second Year High School	63	52	22.4			
Lack of Perception	Causes		First Year High School	59	40	17.2	8	2.2	0.03
			Second Year High School	63	32	20.5			
Alternative Perception	Basic concepts	Con-	First Year High School	59	20	14.0	8	3.1	0.002
			Second Year High School	63	12	12.8			

Relationship of Students' perceptions and the sources of information

The correct perceptions of the students on the aspects of climate change are not influenced

by the different sources of information such as the media, home and community, and academic institutions. However, Table 4 shows that the lack of perceptions and alternative perceptions

are related to the sources of information.

The media that include television programs, documentary films, newspapers, and other printed media remain to be one of the important sources of information about climate change for the students (Filho 2010), although the media sometimes provide vague and incomplete information on climate change (Fortner 2001).

Table 4 indicates that information from home/community lessened the lack of perceptions of the students on the basic concepts. It further implies that family and community members are providing information that could remove or correct lack of perceptions of students about climate change.

Information from schools increased the lack of perception of students about climate change mitigations. The development of lack of perceptions might be due to association of environmental-friendly activities with climate change

mitigations and adaptations (Fortner 2001). The activities might include community clean-up, wastes segregation scheme and recycling. The association contributes to the lack of perceptions of the students. Such lack of perceptions will continue to persist if the correct relationship is not established.

Information from the media decreased the alternative perceptions of the students on effects and adaptations. Information from schools removed the alternative perceptions of students on the basic concepts.

The complexity of climate system and the broadness of climate change concepts produce students' lack of perceptions and alternative perceptions. The diversity of information from the media, home/community, and school could deepen or eliminate incomplete understanding on climate change (Fortner 2001).

Table 4 Correlation of Students' Perceptions on the Aspects of Climate Change and the sources of information (n=122)

Aspects of Climate Change			Lack of perceptions			Alternative Perceptions		
			MEDIA	HOME	SCHOOL	MEDIA	HOME	SCHOOL
Basic Concepts	Correlation	Coeffi-	-0.098	-0.199*	0.086	-0.084	-0.028	-0.260**
		cient						
	Sig. (2-tailed)		0.281	0.028	0.344	0.358	0.756	0.004
Effects	Correlation	Coeffi-	0.227*	-0.069	0.008	-0.232*	0.163	-0.013
		cient						
	Sig. (2-tailed)		0.012	0.448	0.929	0.010	0.073	0.887
Mitigations	Correlation	Coeffi-	0.051	-0.005	0.214*	-0.123	-0.084	-0.164
		cient						
	Sig. (2-tailed)		0.579	0.958	0.018	0.178	0.356	0.070
Adaptations	Correlation	Coeffi-	0.128	-0.002	0.048	-0.186*	-0.098	-0.058
		cient						
	Sig. (2-tailed)		0.161	0.982	0.602	0.040	0.284	0.529

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Conclusions

The students hold correct perception, lack of perceptions, and alternative perceptions on the different aspects of climate change. They have more correct perceptions on the basic con-

cepts of climate change. However, they hold more lack of perceptions on both the effects and mitigations of climate change.

The students have poor extent knowledge and comprehension on climate change. It indi-

cates that the students need deeper understanding about the different concepts in each aspect of climate change. They must evaluate the climate change basic concepts, causes, effects, mitigations and adaptations. They need more activities to explore and investigate climate change phenomena.

The difference in the perceptions of first and second year students on the basic concepts and causes of climate change provide insights on providing them activities to increase their awareness, involvements, and perceptions. In mitigating the impacts of climate change, male and female are given equal chances but women should be empowered to increase their perceptions and participations. Because the sources of information are not related to the correct perceptions but are related to the lack of perceptions and alternative perceptions of the students, identification of students' pre-conceptions and selection of correct materials are necessary in climate change education.

Educators should also involve students in identifying adaptation strategies to cope with the impacts of climate change. They should provide opportunities for the students to evaluate impacts of climate change and create models on how to adapt to the change. Educators should not limit their presentations, instructions and teachings on daily temperature or daily weather conditions but on global data. In addition, there is a need to uncover the lack of perception and incomplete understanding or alternative perceptions of the students to be able to create teaching strategies and techniques. The poor level of knowledge and pre-perceptions of student are best bases for the design of educational strategies to teach climate change. Knowledge gap and lack of perceptions are identified for the selection of information and activities for students.

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Research Paper

A Lab Guiding Tool for a Life Science Experiment that Possibly Provides Teachers' Tacit Knowledge: Evaluation of Its Efficacy for Auto-tutorial Support in Upper Secondary Schools

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A lab guiding tool that provides teachers' tacit knowledge was developed to outline the procedure of a life science experiment, and its effectiveness was examined. At first, some lab instructions and teaching plans that had been already published were collected for an analysis of the actual state of teaching practices. It was founded that (1) these lab instructions focused on experimental procedures and did not contain the knack that teachers accumulate from their experiences (tacit knowledge) and (2) an environment supporting students in reconfirming teacher's instructions had not been established. The author thus analyzed teachers' tacit knowledge required for students' practice on "Making preparations for microscopic observation." The author made said knowledge into a transmittable form by using numeric representation and images, assembled it into a new instructional tool (a lab guiding tool), and developed a learning environment in which students can reconfirm the instructions. The new lab guiding tool improved the success rate and reduced the number of discarded specimens. The high success rate could be attributed to good ideas generated by the information that students had obtained from the new lab guiding tool. The reduction in the number of discarded specimens was due to less wasted motion and students' failure in performance.

Key words: lab instructions, lab guiding tool, life science experiment, teachers' tacit knowledge

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INTRODUCTION

The new Courses of Study notified by Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT) claimed the enrichment of observations, experiments, and scientific experiences (MEXT 2011a, 2011b). However, some investigations of science education in upper secondary schools revealed that many Japanese teachers had performed teacher-led experiments, not student-led ones; that is, "The students only follow the prescribed experimental procedures"

(MEXT 1999, Central Council for Education 2004, Japan Science and Technology Agency 2010).

Therefore, students, being inexperienced, might obtain unsatisfactory results in the experiments if they followed only the prescribed experimental procedures. For instance, "Observation of mitosis in onion root tip cells" is considered an important experiment in Japan because it has been described in all science and biology

textbooks for a long time (Hatogai 2011, Tokyo Metropolitan School Personnel In-service Training Center 2005). However, teachers and researchers have pointed out some difficulties in performing this experiment and have tried to make it easier by developing methods with fewer steps. Even when the students used these easier methods, 10% – 15% of them failed in the preparation. The causes included “a cover glass slips out of place in the squashing step” and “squashing pressure is insufficient” (Kawakami and Kato 2004, Tokyo Metropolitan School Personnel In-service Training Center 2005, Nakatake and Nakayama 2006, Yonezawa *et al.* 2006).

This is partly because the squashing step requires a knack for applying an appropriate degree of pressure on the specimen with one’s thumb, which depends on each specimen. At present, the author thinks that students have little chance to obtain their teachers’ tacit knowledge¹⁾ since teachers have accumulated the tacit knowledge, such as the knack which is hard to be described, from their experiences.

It has been reported that even when teachers perform demonstrations involving the knack, students will fail to learn from an event when exposed to it only once (Sweller 1988, Taylor 1988, Chandler and Sweller 1991, Majerich and Schmuckler 2008).

Therefore, a success or failure of a life science experiment depends on various factors, such as differences in the individual experimental specimen and certain steps in the experiment that need tacit knowledge. According to some reports on Asian higher education reported that tacit knowledge played a vital role in scientific research and education (e.g., Zhang and Han 2008, Hara *et al.* 2010). Furthermore, some Japanese reports have indicated that tacit knowledge is important to promote the understanding and use of scientific knowledge (Central Council for Education 2006, 2008). However, the role

of tacit knowledge in science experiments in Japanese secondary education has not been sufficiently researched. Therefore, this study focused on transmitting the teachers’ tacit knowledge to students by improving conventional lab instructions that described the experimental procedures. If students were provided with the teachers’ tacit knowledge in the lab instruction, their experiment results (e.g., success rate and the length of operation time) would be improved.

In *Study I*, an experiment, “Observation of mitosis in onion root tip cells” was chosen to analyze the instructions of experiments in school textbooks and teaching plans. In *Study II*, a new lab instructional tool that could provide the teachers’ tacit knowledge was developed and examined its effect on students’ lab practice.

[STUDY I]

ANALYSIS OF THE ACTUAL STATE OF INSTRUCTIONS OF EXPERIMENTS

Study purpose

The lab instructions on “Observation of mitosis in onion root tip cells” in Japanese science and biology textbooks and the teaching plans for this experiment were collected to analyze the descriptions of experimental procedures to identify problems in carrying out the experiment.

Methods

Analysis of descriptions in lab instructions

Lab instructions on “Observation of mitosis in onion root tip cells” in six Japanese science textbooks for lower secondary school students and four biology textbooks for upper secondary school students were assessed regarding explicit knowledge²⁾ in the descriptions of five steps of the experiment: fixation, maceration, washing, staining and squashing, and teachers’ tacit knowledge particularly knacks about the step of squashing of tissue.

Analysis of teaching plans

Eight teaching plans for “Observation of

mitosis in onion root tip cells” were obtained from the websites of following municipal education centers until August 15, 2012: Tokyo, Niigata, Tochigi, Gifu (two plans), Ishikawa (two plans), and Kagoshima. Descriptions of the “Methods of Explanation” and “Guidance to Individuals,” which instructed the teacher to visit each lab bench and to give guidance to individuals if necessary, in the eight teaching plans were analyzed.

Results

Analysis of lab instructions

Table 1 shows the explicit knowledge regarding five steps of the experiment, “Observation of mitosis in onion root tip cells.” Table 2 shows the status of the descriptions of explicit knowledge required for each step mentioned in Table 1 and the indication of the method for squashing of tissue in the lab instructions in the ten textbooks. No lab instructions described most of the explicit knowledge, such as the aim of each operation and the action of the chemicals;

only operation procedures were described.

Three lab instructions provided concrete descriptions of the direction of squashing, that is, vertical, by using simple illustrations. However, there were differences among these descriptions. The degree of pressure was indicated in some instructions as “gently,” “slowly,” or “strongly,” but any reason for carrying out such action was not included though adjusting the pressure according to the conditions of specimens was required for spreading them well. Adequate instructions on how to squash and on the degree of pressure in the final preparatory step were not provided. Only three lab instructions mentioned the actions of chemicals briefly.

In short, all lab instructions examined did not sufficiently cover explicit knowledge; the details of the procedures were unclear and differed among the publishers. Furthermore, there was almost no description of the teachers’ tacit knowledge that is the specific knack required for a particular step.

Table 1 Explicit knowledge of five steps in the experiment, “Observation of mitosis in onion root tip cells”

step	Explicit knowledge of five steps
Fixation	Fixatives (acetic acid, ethanol, etc.) can preserve biological structures such as cells and tissues as close to their natural state as possible.
Maceration	The maceration solution (dilute hydrochloric acid) can separate cells from one another easily. Excessive maceration can break cells and inhibit staining. Insufficient maceration leaves cells intact, that is, hard; therefore, cells cannot be spread into a layer even if squashed.
Washing	The washing solution (water) can remove the fixatives and maceration solution, both of which may inhibit staining. Excessive washing hardens a sample. Insufficient washing causes insufficient removal and staining.
Staining	The staining solution (acetocarmine, etc.) can stain nuclei and chromosomes reddish purple. Excessive staining hardens a sample. Insufficient staining makes observation difficult because of the poor contrast.
Squashing	By squashing, cells are spread into a layer and can be easily observed under a microscope. Excessive squashing can break cells. Insufficient squashing makes observation difficult because the overlap of the cells is maintained. Non-vertical squashing causes a shearing deformation of tissues and the resultant cell destruction and chromosome breakage.

Table 2 Descriptions of explicit knowledge required for five steps and indication of squashing in the lab instructions in 10 textbooks

Lab instruction*	Descriptions of explicit knowledge required for five steps **					Indication of squashing
	FX	MA	WA	ST	SQ	
1 KR (JHS)	○	△	×	△	×	Concrete indication of “vertical” for the direction of squashing
2 GA (JHS)	×	△	×	×	×	
3 DG (HS)	×	×	×	×	×	
4 JS (HS)	×	×	×	×	×	
5 KR (HS)	○	△	×	×	△	Not indicated concretely
6 TS (HS)	×	×	×	×	△	
7 KS (JHS)						
8 DN (JHS)	×	△	×	×	×	
9 TS (JHS)						
10 SS (HS)						

*** Japanese school textbook publishers (Abbreviation)**

KR: Shinko Shuppansha Keirinkan Co., Ltd.; GA: Gakko Tosho Co., Ltd.; DG: Daiichi Gakushusha Corporation; JS: Jikkyo Shuppan Co., Ltd.; TS: Tokyo Shoseki Co., Ltd.; KS: Kyoiku-shuppan. Co., Ltd.; DN: Dainippon Tosho Publishing Co., Ltd.; SS: Suken Shuppan Co., Ltd.

**** Experimental steps**

Abbreviations FX: fixation; MA: maceration; WA: washing; ST: staining; SQ: squashing

Marks ○: Described; △: Described a part; ×: Not described

Analysis of teaching plans

Four plans described the “Methods of Explanation” as a combination of oral explanation with showing slides and demonstrations before students’ experiments. Three teaching plans mentioned “Guidance to Individuals” by the teacher during the experiment. From these teaching plans, it appears that students are expected to follow the procedure according to the teacher’s instructions and cannot have enough opportunity to ask the teacher about his instructions after he has finished them, even if the instructions included the teachers’ tacit knowledge.

[STUDY II]**DEVELOPMENT OF A LAB INSTRUCTION AND VERIFICATION OF ITS EFFICACY FOR AUTO-TUTORIAL SUPPORT****Study purpose**

On the basis of the results of *Study I*, a plan was formulated to develop a new lab instruction,

in which the following ideas were reflected: (1) to make the teachers’ tacit knowledge, which is difficult to verbalize, a transmittable form by using illustrations and images (still pictures and movies); and (2) to develop a learning environment in which students can reconfirm the teacher’s instructions. Then the usefulness of the new lab instruction on performing the students’ laboratory was verified in an upper secondary school.

Methods**Setting of a task**

As “Observation of mitosis in onion root tip cells” is widely practiced in lower secondary schools, “Making a preparation of salivary gland of a Chironomidae larva for the observation of giant chromosomes” was selected, because that is only described in upper secondary school textbooks. The other reasons for the selection are (1) the practice has been described for a long time in Japanese upper secondary school text-

books; (2) individual differences exist among living insects; (3) it seems difficult for students to achieve this task by only following written experimental procedures, so the teachers' tacit knowledge may be required; and (4) the time required to complete this task is relatively short.

The experimental procedures of this task were as follows: introduction (explanation of the specimen, apparatus, and chemicals), operation step 1 (OP1: setting a specimen on a slide glass), operation step 2 (OP2: separation of the larva's head from its body), operation step 3-1 (OP3-1: removing entrails, including salivary gland, from the body), operation step 3-2 (OP3-2: separation of salivary gland from entrails), and operation step 4 (OP4: staining the salivary gland).

Development of a lab instructional tool

In order to develop the lab instructional tool, the author (1) performed a preliminary implementation of the task to identify particular steps for which teachers' tacit knowledge is useful and (2) made such teachers' tacit knowledge into transmittable forms and packed them into the lab instructional tool.

The author conducted the preliminary implementation for 11 first-year students of an upper secondary school who were divided into the control and experimental groups. A print that contained the experimental procedures and some still pictures was made as the preliminary lab instructional tool. In addition to the print, movies that showed mainly the operation procedures were provided to the students in the experimental group; they could watch the movies by a notebook PC. The students of the both groups were asked to perform all the operations of this task by themselves and to submit three complete preparations. The author judged the success or failure of the submitted preparations by microscopic observation; those without salivary gland or with salivary gland plus other organs or tissues were regarded as failures. The

ratios of successful preparations to the total in the control and experimental groups were examined for the difference between the two groups. As a result, there was no significant difference in the ratio between the two groups. This suggested that the movies could not have any effect on the students' performance; these movies might not include sufficient teachers' tacit knowledge. Thus, a questionnaire survey of all the attending students regarding the degree of difficulty of the experimental procedures was conducted. Six students answered OP3-2 and three students answered OP2 as the most difficult procedure.

As stated above, it was hardly possible to express the teachers' tacit knowledge by only recording their operation. So, the author try to analyze the teachers' tacit knowledge for some steps, especially OP2 and OP3-2, referring to a method called "Skill Analysis Methods for Training" (Mori 2005) which had been introduced in industrial circles. This method indicates the following: (1) all the operations by an expert teacher, who has the tacit knowledge on such life science experiments, are recorded on video, (2) while watching the recorded performance together, his tacit knowledge is possibly extracted by an interview, and then (3) his tacit knowledge is expressed by using numeric representation and images. Interviewing has been considered to be very effective in accessing teacher's practical knowledge, which is often tacit and implicit, because they do not incline to articulate their practical knowledge (Meijer *et al.* 1999, Zanting *et al.* 2003). Interviewing may be effective to extract the specific knack for a particular step in life science experiments. Thus, in this study, the author tried to extract the teachers' tacit knowledge by interviewing. Then, by using the above method, the author made the teachers' tacit knowledge into transmittable forms, such as shown in Figure 1, and assembled them into a lab guiding tool, as shown in Figures

2. Figure 1 shows a still picture that shows the proper angles between the razor blade and specimen and the forceps and specimen. Figure 2 shows a part of the new lab guiding tool, which contains the experimental procedures, some still pictures, and a built-in movie on OP3-2. This part shows how to identify salivary gland for separating it from the entrails, based on the fact that salivary gland is transparent, while the rest (e.g., entrails) is translucent or opaque.

The new lab guiding tool was developed for use on a tablet PC, because the tablet PC is easy to use in playing back images, has good operabilities, and occupies a minimal space on the lab bench.

The subject of study

Sixty-seven second-year students of an upper secondary school were involved in the implementation of the new lab guiding tool. The subject students were divided into two groups: a

control group and an experimental group. The similarity of the subject students in the control and experimental groups was given careful consideration. The 35 students in the control group were divided into five subgroups and the 32 students in the experimental group into four.

The students in the control group used an ordinary lab instruction, a print, which had been used for this student lab so far. The print contained the experimental procedures and some still pictures. The students in the experimental group used the new lab guiding tool.

Verification process

The following factors were investigated to verify the benefits of the new lab guiding tool on learning: (1) the number of successful students, (2) the time required to complete the whole task (“Total time”), (3) the time required to read or watch the lab instruction or the new lab guiding tool (“Manual time”), (4) the time required to complete the whole operation steps (“Operation time”), and (5) the number of discarded specimens.

The verification process is as follows: the students all seated and started the experiment simultaneously. The availability of apparatus (e.g., the number of forceps) was the same in the control and experimental groups. Though the both groups performed the task in the same room, any conversation and the exchange of information between them were forbidden. The students were asked to declare the completion of the whole task. Each of the students could use specimens up to 10 and had to submit three complete preparations. They performed all operations by themselves. Teachers did not answer any question concerning the operations for preparation.

The time needed to complete the whole task had been estimated 30 minutes. The operations performed by each student were recorded by video cameras. The time required for the op-

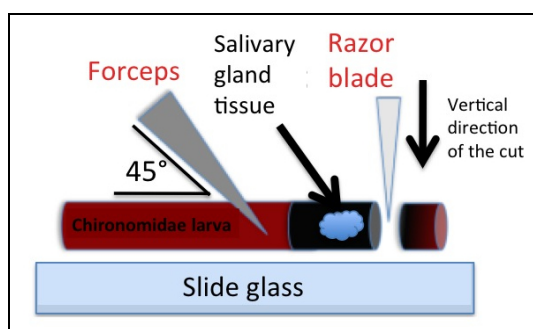


Figure 1 The still picture of operation step 2



Figure 2 The instructions of operation step 3-2 in the new lab guiding tool

erations was measured with stopwatches. The video recordings could provide such data as the number of times the movies were viewed and the number of specimens used by each student.

The preparations that were submitted by each student were numbered from 1 to 3 (1st Preparation, 2nd Preparation, and 3rd Preparation), in the order of submission. For each submission, teachers examined whether the preparation was successful. At the end of the class, both submitted and discarded specimens were counted.

Results

The students, whose full operations could not be recorded on video, who abandoned the experiment, who used more than 10 specimens,

who were unable to submit three preparations, or who did not follow the instructions, were dropped from the roster. As a result, the number of students in the two groups went down to both 28.

Comparison of the number of successful preparations

Table 3 shows a comparison of the number of successful preparations between the two groups. The number of successful preparations was larger in the experimental group than in the control group, i.e., the chi-square test ($df = 1$) for the difference in the number of successful preparations showed the existence of a significant difference ($p < 0.01$) between the two groups.

Table 3 Comparison of the number of successful preparations

	Number of submitted preparations	Number of successful preparations	SD
Control group (N=28)	84	28	**
Experimental group (N=28)	84	47	

** $P < 0.01$

Comparison of the number of successful students

Figure 3 presents a comparison of the number of successful students on each submission of preparation. Significant differences between the control group and the experimental group

were observed in the number of successful students of the 2nd Preparation ($p < 0.05$) and the 3rd Preparation ($p < 0.01$). This result indicates that the new lab guiding tool used by the experimental group increased the proportion of successful students.

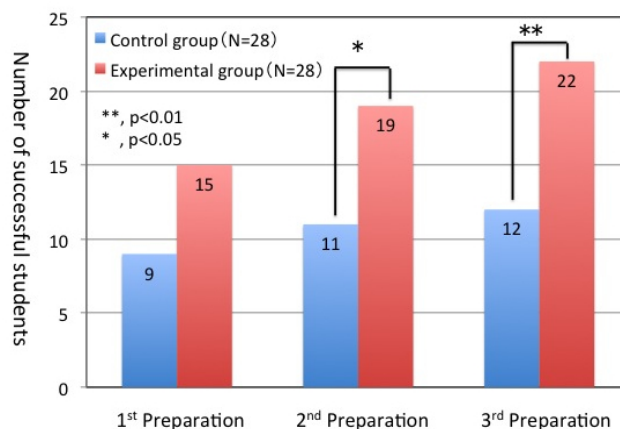


Figure 3 Comparison of the number of successful students

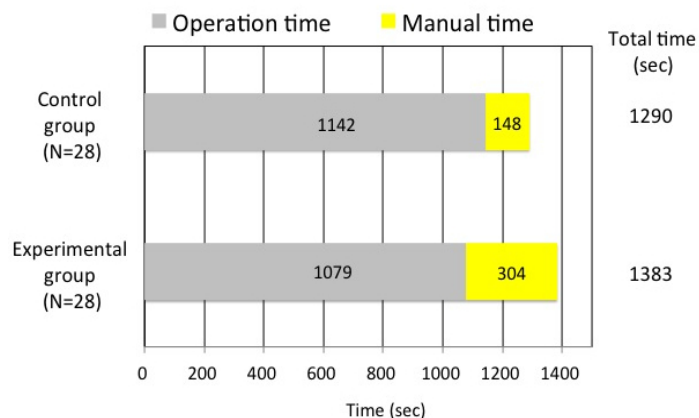


Figure 4 Comparison of the “Total time” of the two groups

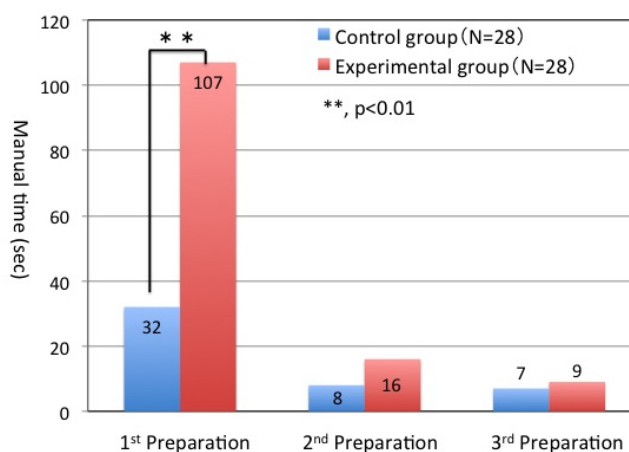


Figure 5 Changes in the “Manual time” of the two groups

Comparison of the “Total time”

The “Total time”, “Manual time” and “Operation time” of the both groups were compared (Figure 4). The Mann-Whitney test for the “Total time” between the two groups (1290 sec and 1383 sec) did not show a significant difference. On the other hand, the chi-square test ($df = 1$) for the difference in the ratio of “Manual time” to “Operation time” between the two groups showed the existence of a significant difference ($p < 0.01$).

Changes in “Manual time”

The “Manual time” for completing each preparation was measured, averaged, and used in

the subsequent analysis (Figure 5).

This result indicates that the “Manual time” decreased in the two groups as the experiment progressed. The Mann-Whitney test for the “Manual time” between the two groups yielded a significant difference ($p < 0.01$) for the 1st Preparation (32 sec and 107 sec). In the early steps, “Manual time” was much longer in the experimental group than in the control group. However, no significant difference between the two groups came to exist as the experiment progressed. This may mean that it took time for the students in the experimental group at first to select the requisite information from the lab

guiding tool because they had a difficulty in determining which information was relevant to the task in dealing with and important in completing the task.

Changes in “Operation time”

The “Operation time” for each submitted preparation in the two groups was measured, averaged, and used in the subsequent analysis (Figure 6). The “Operation time” for the 1st Preparation in the experimental group (249 sec) was longer than that in the control group (185 sec). The Mann-Whitney test revealed that the difference (between the two groups) was significant ($p < 0.01$). As the experiment progressed, the

“Operation time” in the control group did not get shorter markedly (the 1st Preparation: 185 sec; the 3rd Preparation: 181 sec), while that in the experimental group seemed to decrease apparently (the 1st Preparation: 249 sec; the 3rd Preparation: 185 sec). The Wilcoxon test for the “Operation time” between the 1st Preparation (249 sec) and the 3rd Preparation (185 sec) in the experimental group showed the existence of a significant difference ($p < 0.01$). This indicates that there was a difference in the “Operation time” of the two groups only in the early stage of the experiment.

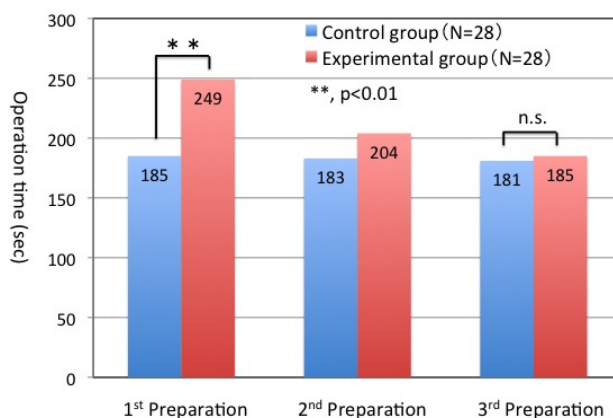


Figure 6 Changes in the “Operation time” of the two groups

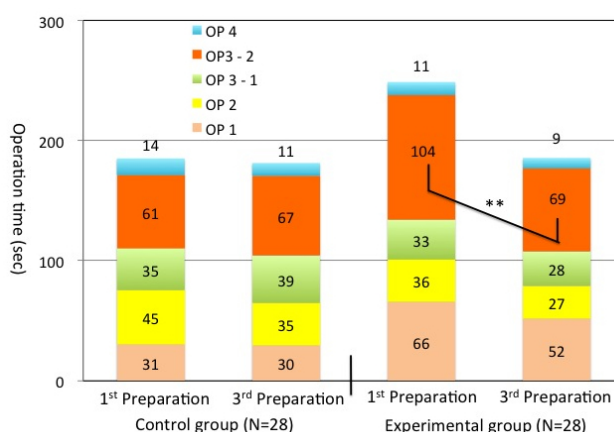


Figure 7 Comparison of the time required for each operation step

In order to clarify the reason for the difference in the “Operation time” in the early stage,

the author compared the duration of each operation (from OP1 to OP4) required for submitting

the 1st Preparation and the 3rd Preparation of the both groups (Figure 7). The Wilcoxon test was performed to examine the difference in the time of the two groups. There was a significant difference (at the 1% significance level) in the time required for OP3-2 between the 1st Preparation and the 3rd Preparation in the experimental

group. The time required for OP3-2, "Separation of salivary gland from entrails," decreased in the experimental group as the experiment progressed. This result indicates that through viewing of the movies the students obtained teachers' tacit knowledge needed for the separation of salivary gland.

Table 4 Comparison of the number of discarded specimens

	Number of discarded specimens	SD
Control group (N=28)	116	
Experimental group (N=28)	62	**

** P < 0.01

Comparison of the number of discarded specimens

Table 4 shows a comparison of the number of discarded specimens between the two groups. The number of discarded specimens was less in the experimental group, and the chi-square test (df = 1) showed the difference was significant (p < 0.01). The result indicates that the lab guiding tool used by the experimental group might contribute to the reduction in the number of discarded specimens.

GENERAL DISCUSSION

By analyzing the descriptions of "Observation of mitosis in onion root tip cells" in textbooks and teaching plans in *Study I*, it was confirmed that experiments conducted in lower and upper secondary school science classes in Japan were teacher-led, and the lab instructions that had been used focused on the explanation of experimental procedures and included almost no tacit knowledge, such as knack. Teachers' knowledge is tacit rather than explicit, and personal rather than collective (Robertson 2005). Moreover, the teachers, who have tacit knowledge, are apt to protect their intellectual property (Zhang 2008). It may be difficult for such teachers to

realize the significance of their tacit knowledge and to turn it into explicit knowledge by themselves, because these teachers often perform their instructions without any consciousness.

As a result of this analysis, it appeared that an environment supporting students in reconfirming the teacher's instructions had not been established. With the development of information technology and computers, interactive movies that are watched on PCs can provide students with support for their deeper comprehension, because students can review the important information that they have missed (Merkt and Schwan 2013, 2014). Movies can be one of the valuable sources of information for students in biology education (Smith and Reiser 2005). But as a result of the author's preliminary implementation, it was confirmed that the movies in which mainly the operation procedures were shown could not have any effects on the students' performance; these images might not include sufficient teachers' tacit knowledge even if students could reconfirm the movies. The results revealed that the teachers' tacit knowledge was hardly possible to transfer to students by only showing their operations in life science experiments that required the specific knack.

The lab guiding tool developed in *Study II* possibly provided the teachers' tacit knowledge to students, because it improved the success rate and reduced the number of discarded specimens. The high success rate in the experimental group was due to good ideas generated on the basis of information that students had obtained by reconfirming the images that included the teachers' tacit knowledge. In addition, the reduction in the number of discarded specimens was due to the decrease in both the waste of motion and the failure in student performance. These results reveal that, for improving the students' performance in life science experiments, it needs not only to assemble the still pictures and movies into a lab instructional tool, but also to combine it with teachers' tacit knowledge extracted by interviewing.

It is found that the lab guiding tool required more time for reading the print, looking at still pictures, and watching movies in the early trials, so that it did not decrease the "Total time". However, this result can be interpreted as showing that the students were not busy with the operations, but instead performed the task by thinking by themselves with referring to the lab guiding tool. Their efforts toward the acquisition of teachers' tacit knowledge bore fruit in the latter trials, so that the "Total time" of two groups was almost the same.

CONCLUSIONS

The author can conclude that if students would be given a lab guiding tool that possibly provided them with the teachers' tacit knowledge, they could perform their experiment better.

The essence of science education is to foster the capability of students to develop an interest in natural phenomena and pursue them scientifically through their own successful experiences in experiments. This entails the learning of the methods of scientific inquiry. Thanks to the lab

guiding tool that provides teachers' tacit knowledge, a further step can be taken toward such ideal education. In other studies, the author will examine the functions of the lab guiding tool in life science education, the methods of enhancing and maintaining students' interest in experiments, and the functions of a tablet PC and moving pictures required for the lab guiding tool.

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Notes

^{1) 2)} Knowledge has been considered to divide into two types: one is explicit knowledge, which is easily determined through texts, and the other is tacit knowledge, such as knack, which is defined as "knowledge that is hard to express and transfer to the other." Tacit knowledge is thought to be acquired through experience, and can be classified into a wide variety of types (Polanyi 1958, 1966, Nonaka and Takeuchi 1995, Spear and Bowen 1999, Leonard and Swap 2005, Mori 2005).

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Practical Note

"Meet a Microbiologist" (MAM) Program: A Teaching Strategy for Motivating Undergraduate Microbiology Students

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This practical note introduces a teaching strategy that can be employed in undergraduate microbiology classes. Results and evaluation of this activity implemented in three universities in the Philippines are presented in this paper.

Keywords: *learning activity, lecture, microbiologists, student perception, teaching strategy*

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INTRODUCTION

Teaching microbiology is a challenge for many teachers of undergraduate biology or microbiology courses. Motivating students to learn microbiology and/or pursue research or a career in microbiology is equally challenging. With many distractions from the cyberworld, it is important for those handling microbiology courses to find ways to motivate their students to learn more about the subject matter. Teachers of microbiology often develop several teaching strategies aimed in making our lectures more lively, fun, and appealing to our students.

Some of the active learning activities often employed in classes are games, skit-writing, and role playing as exemplified by the "General Hospital" assignment (Dolberry 2011), conducting laboratory experiments or research projects (Kaga and Arai 2004, Jacinto *et al.*

2011, Rios-Velazquez *et al.* 2011), writing essays or reflection papers, and facilitating group discussion during lectures or role-based panel discussion aimed in teaching the principles and socio-economic impacts of a particular topic in microbiology (Vrabl and Vrabl 2012).

Curricula or programs are also developed that prepare students for the needs of the industry (Hamilton *et al.* 2012) or that immerse students in current issues, e.g. in public health (Ascencio 2012).

Sato *et al.* (2004) also developed technologies that can be applied in classrooms or in the field.

Equally important are learning activities aimed not only to disseminate information or knowledge but also to motivate students. For example, the Undergraduate Teaching Assistant (UTA) Experience program which Schalk *et al.* (2009) developed provided students with

microbiology knowledge and laboratory skills, and enhanced their communication and leadership abilities needed to be successful in careers in science. Davis *et al.* (2012) used webinar technology which allows interaction between students and invited guests from distant institutions and also enhance the analytical skills of the students. Baynham (2010) also suggested the idea to host scientists in our classrooms. The invited scientists talked about paths they took that led to their present career. They could also provide a more personal view of why they loved science. Students who attend these talks appreciate the speakers and looked forward to life after college.

To update our students with recent trends and developments in science, it is also effective to invite guest researchers, well-renowned scientists, or distinguished professors to talk about their researches or simply present the latest trends in science. However, these delivered lectures tend to be conducted in a more formal setting, *i.e.* in our huge lecture halls or large auditoria where many students can be accommodated. In this paper, we present an alternative approach, the Meet a Microbiologist (MAM) program, in disseminating information and inspiring students through a pool of guest lecturers who can be invited to talk in a classroom setting.

PROCEDURE

Step 1: Identify and invite potential members of the lecture pool

For this purpose, three or four teachers of microbiology from different universities can meet at the beginning of the semester to plan the MAM program. It is noteworthy to invite colleagues from nearby universities or from universities within the same city. This is to ensure that invited guest lecturers will not have diffi-

culty travelling to the host university. Networking is essential to come up with a list of potential guest lecturers. Cooperation between the invited guest lecturers is crucial to the success of this teaching program.

Step 2: Meet with the invited guest lecturers of the MAM program

Plan with them the topic each of the guest lecturers will teach in the respective host classes. Each guest lecturer will deliver one lecture to each of the different host classes at different universities. The topics can be a lecture unit or chapter in the course syllabus, any topics related to the course units, or current or previous researches by the lecturer. Personnel from the industrial sector can also be invited to give a talk. Examples of topics include "culture collection as repository of microbial strains" delivered to students taking an industrial microbiology course, or "taxonomy and ecology of myxomycetes" shared to students of mycology. An invited lecturer from the brewing industry talked on "the magic in brewing: tap into the art and science of beer" delivered to students of industrial microbiology and mycology. Invited lecturers also shared their career path. In this paper, the authors from different universities (Ateneo de Manila University - ADMU, Far Eastern University - FEU, and University of Santo Tomas - UST) and from the brewing industry (Asia Brewery) served as the guest lecturers and/or host professors.

Step 3: Deliver the lecture in the host class

Each lecture can last for 30-40 minutes. The lecture is followed by an open-forum initiated by the supervising instructor. During the open-forum, students freely ask questions regarding the topic talked or any other related topics. Students are also free to ask about the work experiences of the invited lecturer. The lecture is delivered in an informal classroom

setting and attended only by students of the class (Fig. 1). No administrators or other faculty members are invited to the lecture to make the atmosphere of the lecture less formal for the participating students. Only the teacher in charge of the class is present to facilitate the activity.

Step 4: Assess the activity

An evaluation form is accomplished by



Figure 1 A guest lecturer from one university delivered a lecture on a specified topic

the students to assess whether the activity would be effective. The students are informed about conducting the post-survey prior to the lecture. Consents to the survey are given by the students prior to the learning activity. No points on grades are given to students for their answers to these evaluation forms.

EVALUATION OF THE CLASS ACTIVITY

In this paper, three cases where 32 sophomore students of B.Sc. Microbiology (UST), 26 junior students of B.Sc. Biology (FEU), and 25 junior and senior students of B.Sc. Life Sciences and B.Sc. Biology (ADMU) participated in this learning activity are reported. Ages of students were between 16 – 20 years old. Five key questions in the

evaluation form were answered by the students as positive [yes], negative [no], or no change in perception [same as before] (Fig. 2). The answer to these questions were then tallied up and presented in Figure 3.

Data analysis of the students' perception survey (Fig. 3) showed that 80% of the students appreciated more the role of microorganisms after the lectures. About 68% were motivated to do research in microbiology while 56% changed their viewpoint about microbes. The highest percentage approval (83%) by the students was on their motivation to learn more about microbes. Sixty-three percent of the students indicated that they want to pursue a career in microbiology and other related fields. From these students' perceptions, it can be concluded that the MAM program offers an alternative teaching strategy that can motivate students to learn more about microorganisms and microbiology.

Teaching microbiology and inspiring students to pursue a career in microbiology are equally challenging for many undergraduate teachers. Educators have developed a variety of teaching strategies and learning activities, e.g. hosting scientists, inviting students to attend symposia or conferences, facilitating internships or the on-the-job trainings, etc. Schalk *et al.* (2009) in their detailed study of their UTA Experience program highlighted the importance of such immersion activities. Undergraduates participating in UTA Experience program gained benefits similar to those the student interns in research institutions gained. The UTA Experience program also provided opportunities for participating undergraduates to work closely with a faculty member in developing skills valuable to their future professional careers (Schalk *et al.* 2009).

The MAM program brought together lec-

School _____
 Course _____ Year Level _____

Evaluation of Class Activity: Meet a Microbiologist Program

Instructions: Kindly evaluate the activity and answer the survey questions below. Note that no points will be added to your grades in completing this survey. Participation in this survey is voluntary. The purpose of this survey is to assess the usefulness of the activity in teaching microbiology and motivating students.

Encircle your choices.

After listening to the talk, did the lecture help you

- | | | | |
|--|-----|----------------|----|
| 1. change your perception of microorganisms? | YES | Same as Before | NO |
| 2. appreciate more the role microorganisms play in nature? | YES | Same as Before | NO |
| 3. motivate you to learn more about microorganisms? | YES | Same as Before | NO |
| 4. motivate you to do research in microbiology? | YES | Same as Before | NO |
| 5. motivate you to pursue career in microbiology or related field? | YES | Same as Before | NO |

Any comments or suggestions on the class activity?

Figure 2 Evaluation form accomplished by the participating undergraduate students

urers from different institutions to aid in teaching certain topics in microbiology. The student participants of this program benefited from the different teaching styles and experiences of the invited guest lecturers. Furthermore, the MAM program allowed students to interact with their guest lecturers and to learn more about their career path. The MAM program avoids the formality of a lecture-seminar often given in a lecture hall or auditorium, and thus, renders the students to be at ease during the lecture. Since different teachers are invited to give different lectures in a class, the students also benefited from the different teaching styles and experiences of the lecturers.

A lecturer from the industry can also provide a different perspective or approach to the topic. Baynham (2010) noted a positive impact on student’s career considerations when several speakers were invited to talk to a class in person or via videoconference or videotaped self-interview. Students who attended these activities commented how happy they were to hear what life is really like after college and to hear more about the scientists as human beings. Similar feedbacks were also noted following the MAM program.

**ALTERNATIVE TEACHING ACTIVITY:
*Interview a Microbiologist (IAM)***

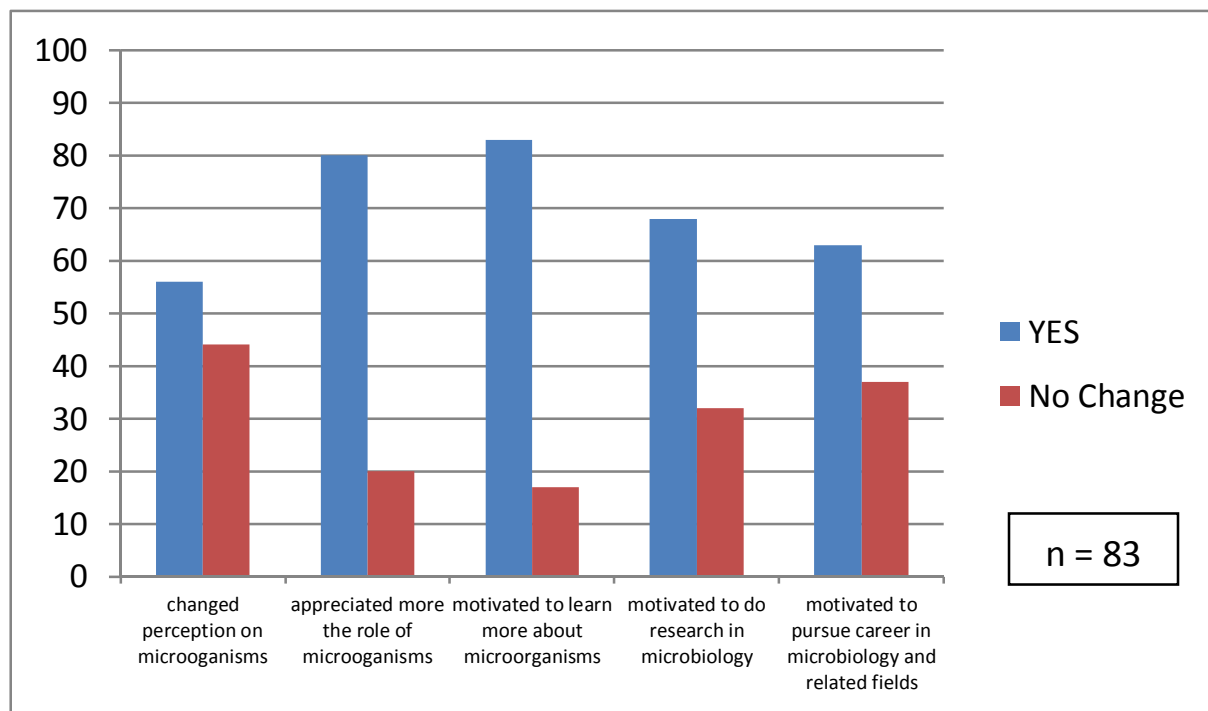


Figure 3 Percentage of the students’ responses to the five perception survey questions

A variation of the MAM program, the “Interview a Microbiologist” or IAM program can be an alternative to the teaching activity presented in this paper. In this IAM program, students are tasked to interview a microbiologist and learn more about the microbiologist’s researches, motivations and goals, and road to success. Prior to the interview, students will prepare 10 questions they will ask. The teacher or instructor of the class can then facilitate the meeting of the students with an appropriate microbiologist from another university, research institution, or industry. Students may record or videotape the interview with permission from the interviewee. Students can then present orally their experiences to the class or write reflection papers. This variation of the MAM teaching activity can also inspire students to learn more about microorganisms and motivate the students to pursue a research or even a career in microbiology.

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Abstracts of the Papers Presented at the 24th Biennial Conference of the AABE

The 24th Biennial Conference of the AABE was held at University of the Philippines, Diliman, Quezon City, Philippines, from 5th to 9th December, 2012. The theme of the Conference was “The Century of Biology: Towards Transformative Education.” Nearly 150 people from ten countries including outside of the Asian region attended (Figure 1).



Figure 1 Attendants assembling in front of the conference venue.

There were five plenary lectures, four country reports, 32 oral presentations and 34 poster presentations. In addition, three workshops were presented.

The best presentation awards were given to the following papers:

(Oral presentation)

Diong, C. H. & Oh, S. S. Importance of Parasite Diversity in the Understanding of Global Biodiversity.

Obusan, M. C. M. Where Dolphins Are.

(Poster presentation)

Yamanoi, T., Iwasaki, W. M., Takemura, M. & Sakura, O. Origami Bird: A Teaching Material Linking Mutation, Natural Selection and Speciation.

Chiga, S. & Ohshika, K. Development of Teaching Material Using Owl Pellet of the Zoo.

The Book of the Abstracts of Papers presented at this conference was published and provided to the attendants of the conference. The following abstracts are reprinted from the book.

<Plenary Lectures>

The Asian Biodiversity Crisis: The Other Crisis in Asia

Perry S. Ong

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Asia is one of the most biodiversity rich regions in the world. Six of the 17 megadiversity countries are found in the region: the Philippines, China, India, Malaysia, Indonesia and Papua New Guinea, while nine out of 34 biodiversity hotspots are from Asia.

These six countries comprise nearly 40% of global population, which exerts tremendous pressure to transform these biodiversity resources into material wealth that will lift their people out of poverty. The impact of one of the drivers of biodiversity loss is being felt across the region.

To illustrate this twin distinction of pride and grief, of the 633 species of primates all over the world, about

54% are under various categories of threat. Of course, the top 25 endangered primate species had been identified, of which nine species are from Asia: Vietnam = five species, Indonesia = three species, and China = one species. This means Asia is home to 36% of the top 25 endangered primates in the world.

Thus, the loss of biodiversity and the need to conserve this valuable resource is a common thread across the region. One of the reasons for the loss is the low level of awareness about the rich biodiversity the region possesses. The role of education, in particular the Asian Association for Biology Education (AABE), cannot be over emphasized. While the Internet is a powerful tool to assist in educating the general public, we should ensure that science-based information is communicated. The key message for all to disseminate is that “A healthy, living and thriving biodiversity is the foundation of a sustainable future for Asia and the rest of the world.”

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From *Gessellschaftlich* to *Gemeinschaft*: What Does It Takes to Teach with and for Meaning in Biology?

Allan B De Guzman

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The changing landscape of today's society brought about by forces of consumerism, globalization, environmental degradation, poverty, economic inequalities, illiteracy, and poor health delivery services, among others poses a challenge to basic and higher education sectors to adopt a transformative pedagogy through which learners are reunited with their environment in the name of learning excellence and in the spirit of genuine service. This emerging pedagogy puts premium on the reciprocal relationship between student centrality and community instrumentality in developing an authentic way of knowing (cognitive), an experiential way of doing (conative) and a more reflective way of responding (affective).

Anchored on Ballard's triad of the change process, which consists of (1) *awareness* of what is happening and what is required; (2) *agency* or ability to find a response that seems personally meaningful; and (3) association with other people in groups and networks, this paper is an attempt to couple service learning or education in action and sustainability as a means to pedagogize the existing teaching-learning paradigm in today's education system. As a multi-tiered pedagogy that can be implemented at any level of education, pre-school through graduate school, service learning (SL) or community engaged teaching (CET) recognizes and appreciates the value of the community as responsive and effective partners in students' learning and maintains the centrality of students as active players and contributors to sustainable development. In the final analysis, pedagogy of sustainability (PS) becomes a critical variable in defining not only the proactiveness of today's schools, colleges and universities but more importantly as an effective compass in asserting education's leadership presence and extraordinariness toward the creation of a common future through an integrated teaching, research and extension

service framework anchored on service learning.

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Education Transformation and Intel STEM

Yvonne Garcia Flores

Intel Philippines

Intel advocates the systemic approach to transforming education, providing interventions that acknowledge and address issues of the whole education environment: Policy, Curriculum and Assessment, Professional Development, Research and Evaluation, and Information and Communications Technology. This particular presentation will showcase Intel's latest education resources specific to Science, Technology, Engineering and Math (Intel STEM), such teacher professional development, online tools and platforms.

Does Postmodern Ethics Have Anything to Say to the Sciences as Presently Constituted?

Fr. Luis S. David, S.J.

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The social sciences emerged in the 19th century, on Michael Foucault's account, in the confluence of two orders of knowledge, one, traditional, going all the way back to Plato and Aristotle, that decidedly was intuitive, inductive, experiential, etc., and the other, springing from the principal philosophies of modernity, including those of Descartes, Rousseau, and Hobbes, which was conjectural, speculative, suggestive of what Hannah Arendt calls, "a science of prophecy." The latter practice, which underservedly wraps itself around with the mantle of scientific legitimacy borrowed from the former, arguably has led to totalitarianisms and genocidal events. We face the challenge, therefore, of reinforcing the claims of the former, and insisting that the latter, when unavoidable, sooner rather than later receive "traction" through its correlation with inductive work. This requires that we "work on ourselves," that in our communities of scientific practice we remain grounded in what is observable, intersubjective, etc., that our

work be understood as always “in process,” “in progress,” etc., subject to the A to Z of what is “political” and therefore communitarian.

An Interdisciplinary Approach to Biology Education

Lourdes J. Cruz

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Biology, the study of living organisms interfaces with other disciplines of science. Understanding the structure, function, growth, origin, evolution and distribution of organisms requires application of the principles of chemistry, physics, mathematics, geology and other fields. An interdisciplinary approach is necessary for the students to fully understand the principles of biology and to learn how living organisms relate to the physical and social world around us. Students must be well equipped to face the problems that confront us today such as food security, sustainability, and climate change because these problems will become more serious as we pass on the baton to the younger generation. To illustrate how an interdisciplinary approach can be used in biology education, aquaponics will be discussed as an example of the interplay of organisms in an ecological system and the importance of chemical and physical factors in sustainably maintaining the system. The backyard aquaponics system has a great potential as a means for poor families to regularly have food on their table. If expanded, the system can be used as an alternative means of livelihood.

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<Country Reports>

Biology Education in Australia

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An Australian national curriculum covering “Foundation schooling”(preparatory year) through to Year 10 has recently been introduced into Australian schools. Previously, each Australian states or territory had responsibility for school curricula, funding and overall

educational policy. States and territories still have responsibility for the final two years of school years – Years 11 and 12 which usually cover ages 16 to 18.

Science forms one of the 13 key *learning areas* in what is now known as the Australian Curriculum. Each learning area is based on seven generic capabilities relating to Literacy, Numeracy, Information and Communication Technology Capability, Critical and Creative Thinking, Ethical Behaviour, Personal and Social Capability, and Intercultural Understanding, and three cross-curriculum properties (Aboriginal and Torres Strait Islander histories and cultures, Sustainability and Asia, and Australia’s engagement with Asia). The 13 year Science curriculum has four strands –one of which is Biological Science which covers evolution, ecology, organism structure and function as well as consideration of life’s major groups.

In my own State of Victoria, Year 11 and 12 are covered by a range of qualifications, the most popular of which is the Victorian Certificate of Education (VCE). Students typically take English (compulsory) and four other subjects in their final year. Biology is still the most popular of the core sciences (and in 2011 was the 7th most popular subject), although its popularity is stable as students seek more applied and focussed subjects, such as Health and Human Development which last year had over 1500 more enrolments and Psychology had over 3000 more enrolments than Biology. The VCE Biology Curriculum has been updated and modified program of study will commence in 2013. The four units to be taken (covering two years of Biology study) are

Unit 1: Unity and Diversity

Unit 2: Organisms and Their Environment

Unit 3: Signatures of Life

Unit 4: Continuity and Change

The unit titles and most content is the same as that reported by me in the 2008 Country Report, but assessment has been changed to better reflect the expected student outcomes.

In universities, Biology is still a popular and often core component in science degrees. However, in many applied degrees, science educators are becoming increasingly concerned at the fragmentation of content and learning in Biology, so that while graduates may have detailed expertise in specific areas, they might

totally lack fundamental knowledge in others that provide the building blocks for the application of Biology to areas such as health or environmental science. One of the greatest challenges for educators today will be the transition of Cloud Learning.

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Biological Learning Contents for High School Students in Textbooks According to 2009 National Science Curriculum of Korea

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New national science curriculum of Korea was revised in 2009. On the basis of that, new science textbooks were developed for high school students. High school science textbooks are Physics I, II, Chemistry I, II, Biological Science I, II Earth Science I, II and Science, which is so called 'Fusing Science' or 'Convergence Science.' Objectives of them consist of four domains regarding as cognitive, inquiry, affective, and STS ones. High school students have to select and learn some subjects for more than 15 credits. Science of the 2009 revised curriculum has two unites related to biological sciences such as 'Evolution of Life' and 'Human Health and Technology.' Biological Science I has 'Understanding of Biological Sciences,' 'Cell and Continuity of Lives,' 'Homeostasis and Health,' and 'Human in the Nature.' Biological Science II has 'Cell and Metabolism,' 'Gene and Bioengineering,' and 'Evolution of Organisms.'

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New Biology Education in Japan: Characteristics of the New Course of Study and New Program for Biology Teachers in Japan

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The New Science Curriculum which based on the revised Course of Study prescribed by the ministry of Education, Culture, Sports, Science and Technology in

2008 and 2009 had started in all school levels from elementary to senior high school in Japan. The New Science Curriculum focuses on the systematical formation and enrichment of scientific contents, inquiry-based activities with emphasis on experimentations and observation, and real life experience.

However, there are some problems in carrying out biology education under the New Science Curriculum. For example, time is considered as a limiting factor for teachers to teach biology contents which it require. In the New Science Curriculum, time element is so short to teach the subject matter. Most of the young teachers have not enough confidences to teach biological content knowledge, conduct classroom experiments and outdoor experiences because of their background in the former biology curriculum during their baccalaureate courses and they had little exposure to biological content knowledge and pedagogical skills. Furthermore, the New Biology Curriculum adds some new contents at each school level. For example, the topics on invertebrates, non-vascular plants and evolution were transferred to junior high school biology; DNA and genetic engineering were added. Therefore, it is suggested to develop and formulate many programs for teachers and students in biology education. All teachers were required to take workshops or lectures in 30 hours to update their own teacher certification every ten years.

To support science classes, there are special lectures offered through the Science Partnership Program and Super Science High School Program that support schools and universities or specialists in science. This undertaking will lead to the development of the newest and creative biology education in Japan through these policies and programs.

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<Oral presentations>

Where Dolphins Are

Marie Christine Merca Obusan

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Space use models were developed for spinner dolphins (*Stenellalongirostris*) in Tañon Strait, Philippines.

Home ranges were generated based on kernel density, minimum convex polygon, Jennrich-Turner primary axis, site fidelity test, and spider analysis using the Animal Movement Program (version 2) as an extension of Arcview. Analyses of developed models validated the need to consider seasonal patterns in designing management strategies for the conservation and protection of the cetacean species in site. The spatial and temporal information provided can serve as basis for associating the dynamics between dolphin survival and human activities such as local fishing and tourism.

Prof. Marie Christine Merca Obusan, Institute of Environmental Science and Meteorology, College of Science, UP-Diliman, Quezon City; Philippine Science High School - Bicol Region Campus, Goa, Camarines Sur, Philippines

Multipla-loci cpDNA Cladistic Frameworks Reveal Polyphyly of *Antirhea* Juss (Guettardeae-Rubiaceae) and a Circumscription of a New Philippine Endemic

Jayson Chavez

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In the last comprehensive synopsis of the paleotropical *Antirhea* Juss., the genus which distribution is highly concentrated in the Philippines is divided into three subgenera: *Antirhea*, *Guettardella* and *Mesocarpa*; a classification proposed primarily based on classical taxonomy and up until now, is a subject of disputes among systematics. For the present study, a molecular phylogeny of the genus was constructed for the first time with the following objectives: (1) test the monophyly of *Antirhea* and its relationships to related genera, (2) evaluate the subgenera of *Antirhea* proposed by Chaw and Darwin, and (3) determine the identity of an unusual *Antirhea* species collected during the recent botanical expedition of the Thomasian Angiosperm Phylogeny and Barcoding Group (TAPBG). Sequences of two plasmid markers (*rps16* and *trnL-F*) were analyzed separately as well as combined using parsimony (MP) and Bayesian (BI) approaches. Our results highly support the polyphyly of *Antirhea* as currently circumscribed, but further support the monophyly of *Antirhea* subgenus *Guettardella*. Such inferences reveal disparities with the phonetic classifica-

tion of the genus. Extensive investigations on *Antirhea*, which involve a wide-ranging survey (e.g., denser taxon sampling, thorough morphological examinations, and cladistic analyses of DNA markers with high evolutionary rate) are currently ongoing to delimit its taxonomic boundaries. In addition, based on herbarium and field study, the atypical *Antirhea* species is treated as a new endemic species: *A. acuminata* Di-matatac, Chavez & Alejandro, which is proposed here.

Some Easy and Effective Microtechniques for Morpho-anatomical Characterization of Plants: An Essential Tool in Transformative Learning

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Morphology and anatomy are indispensable aspects that are employed to study and extensively characterize our flora and fauna. It is an essential tool for documentation of plant species, especially those which are newly discovered or understudied, as it gives relevant information about their physiology, ecology and life history. Thus, knowledge in microtechniques is indispensable for both researchers and educators of plant biology. However, tools and special equipment for microtechniques are not always readily available. Expensive microtomes that are used for cutting thin tissue sections are not always available especially in schools in rural areas. In this paper, easy and effective microtechniques are discussed, using two Philippine indigenous plant species, *Medinilla magnifica* (chandelier plant) and *Strongylodon macrobotrys* (jade vine) as models. This paper aims to give information on how to process plant tissue sections without the use of expensive cutting equipment, so as to practically aid researchers and educators in their study of indigenous plants. Free-hand sectioning method was used for the vegetative structures of both specimens. Prior to cutting, the specimens have undergone fixation in formalin-acetic acid-alcohol (FAA). Portions of leaves and stems were sectioned manually using razor blades to produce very thin sections of tissues. These sections were then subjected to series of dehydration using ethyl alcohol (30%, 50%, 70%, 90%, and 100% EtOH).

The sections were then stained and counterstained using Safranin and Fast Green, respectively. The tissues were washed with water and were destained in 70% EtOH and were subjected to series of cleaning using xylene (30%, 50%, 70%, 90%, and 100% xylene). Finally, the cleared sections were mounted in glass slides. The whole procedure which took only about an hour produced mounted tissue sections which can be used for characterization of ground and vascular tissue structures of vegetative organs of the specimens. This easy and rapid tissue processing is an essential tool for teaching biology and research, hence making the laboratory activities more enjoyable and fun.

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The Importance of Understanding Relationships among Biological Species Using a Phylogenetic Tree

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A phylogenetic tree (also known as evolutionary tree or a cladogram) is a branching diagram depicting the relationships and affiliations among biological species. The taxa included to build a “tree” are joined together based on either morphological features or genetic characteristics or combination of the two. The resulting tree reflects that the taxa have descended from a common ancestor. The arrangement of biological species in a phylogenetic tree is easier for the students to understand and interpret relationships. In this lecture, an introduction to phylogenetics will be presented. The concept of groupings approaches terminologies and methodologies in phylogenetics will be outlined. The usefulness of molecular data in phylogenetics will be discussed using examples from the studies done by the Thomasian Angiosperm Phylogeny and Barcoding Group (TAPBG).

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Compliance Status to CHED Policies and Standards on Teacher Education and Institutional Performance of Teacher Education Institutions in Region IX

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This study purported to create an accurate picture of the teacher education discipline in the light of CHED Policies and Standards on Teacher Education and bring to the fore the institutional performance of Teacher Education Institutions (TEIs) in Region IX. Specifically, the study endeavored to answer the following research questions: (1) What is the compliance status of TEIs in Region IX to CHED Policies and Standards, in terms of program administration-dean, faculty, physical facilities, laboratory facilities, research, admission and retention, library holdings, voluntary accreditation, curriculum, and instructional standards; (2) Is there a significant difference in the compliance status of TEIs in Region IX to CHED Policies and Standards when data are grouped according to type of TEIs (public or private); (3) What is the institutional performance of TEIs in Region IX in terms of passing percentage in Licensure Examinations for Teachers (LET) for elementary and secondary levels and frequency in landing among the Top Ten schools in LET; (4) Is there a significant difference in the institutional performance to TEIs in Region IX when data are grouped according to type of TEIs (public or private).

When data are grouped according to type of TEIs, it was hypothesized that (1) there is a significant difference in the compliance status of TEIs in Region IX to CHED Policies and Standards in terms of the ten given areas of academic operations and (2) there is a significant difference in the institutional performance of TEIs in Region IX in terms of the passing percentage in LET.

The study employed descriptive research design and used qualitative and quantitative approach in answering the set of research questions. Such process was facilitated with the use of a researcher-made interview schedule/guide which helped generate data inputs from the responses/interview proceedings made to 71 purposively selected middle level administrators, faculty and staff coming from the ten participating TEIs in

Region IX. Proceedings from actual interview, analyses of documentary evidences and data-output from statistical tools used revealed the following findings: TEIs in Region IX showed full compliance on six academic operations of CHED Policies and Standards: administration-dean (2.7), faculty (2.4), physical facilities (2.76), admission and retention (2.4), curriculum (3.0) and instructional standards (2.52), but manifested partial compliance on four other academic operations, to wit: laboratory facilities (1/95), research (1.95), library holdings (1.92) and voluntary accreditation (1.8). Inferential findings of the study revealed higher group mean of public TEIs (2.55) relative to private TEIs (2.26). Moreover, t-test analysis showed a probability value of 0.72 greater than alpha level 0.05, that implies no significant difference in the compliance status of TEIs in Region IX to CHED Policies and Standards. Latter finding showed that the type of school does not influence the TEIs adherence to CHED Policies and Standards. Both public and private TEIs have similar compliance status to CHED Policies and Standards. Moreover, the type of school does not influence the institutional performance of TEIs in terms of passing percentage in LET for elementary and secondary levels. In addition, the performance standing of TEIs in Region IX commensurate national recognition as evidenced by its frequency in landing among the Top Ten performing schools in LET for elementary and secondary levels during the fiscal year 2008 and 2010. It is, therefore, recommended for CHED Regional Office IX to conduct periodic standard monitoring with a show of report to feedback TEIs for self evaluation and improvement; and for school's top management to foresee enhancement of personal and professional competencies of the faculty and improve the inadequacies of school facilities, equipments, and library holdings, while middle level management must do periodic review of the curriculum to see subject offerings appropriateness; improve the efficiency level of the faculty along areas of research, extension and production; and for other research enthusiasts to integrated TEI graduates employability as one of the independent variables to get clearer and better picture of its institutional performance.

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Secondary Teachers and Pre-service Teachers' Conceptual Understanding of Photosynthesis: A Cross Regional Study

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This study aimed to identify misconceptions that secondary in-service teachers and pre-service teachers have of photosynthesis and compare their knowledge structure of photosynthesis. The misconceptions of in-service and pre-service secondary teachers from conveniently selected high schools in Regions V and IX were identified using Treagust and Haslam's Two-Tiered Diagnostic test on Photosynthesis and Cellular Respiration (1987). Interviews with randomly selected secondary and pre-service teachers were done to determine the knowledge structure of the respondents. Generally, for both secondary in-service and pre-service teachers, the misconceptions revolve on any one or a combination of the following: failure to differentiate between photosynthesis and respiration, failure to give a functional understanding of the chemical basis of biological processes and for some, failure to correctly identify the site of biological processes. The respondents have shallow and flawed understanding of both photosynthesis and cellular respiration. The inability to explain and show how the foregoing concepts relate is more pronounced among the pre-service teachers. The foregoing misconceptions point to faulty, fragmentary and incomplete knowledge structures across all respondents. Thus, the conceptual understanding is at the knowledge level only for most pre-service teachers.

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Incorporation of Mother Tongue in Biology Subjects: Preference among Philippine Science High School Central Visayas Campus Students

Sherry Ramayla

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This paper is based on the mandate of the Department of Education to use the mother tongue in primary schools as medium of instruction. The goal of this study is to determine language preferences of the students of Philippine Science High School – Central Visayas Campus, Argao, Cebu, in their Biology classes. A survey was conducted June 28, 2012, using structured questionnaires. The sample consisted of 22 second year students, 22 third year students, and 26 fourth year students. The respondents were randomly selected. Findings showed that majority of the respondent preferred bilingual medium of instruction (English and the mother tongue in Cebu, Cebuano). Students find the combination of English and Cebuano as conversational or it encourages classroom interaction between teacher and student or student and student and it allows the students to grasp more of the meaning of the concept of Biology if the two languages are used inside the classroom.

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Secondary Teachers' Biological Conceptions of Natural Selection: A Cross Regional Study

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This mixed method research determined the conceptual understanding of pre-service and in-service secondary biology teachers in Bicol and Zamboanga about 'Natural Selection' by generating: level of understanding, knowledge structures, alternative conceptions and misconceptions. A total of 113 respondents took the Conceptual Inventory of Natural Selection in the first part of the study. In the second part, interviews of 37 were analyzed using NVivo9 and content analysis. The level of understanding of teachers about the Natural Selection is generally *low*; they found most of the test items to be *difficult*, and they expressed numerous alternative conceptions and misconceptions. Seven dominant alternative conceptions were identified and are affirmed by four nodes, namely, "Need," "Use and

disuses," "Progress," and "Purpose." Based on the results, recommendation on instruction, curriculum and research were forwarded.

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The Silkworm as a Teaching Material

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The silkworm is well-known and has already been used as a teaching material for a long time widely in Japan. As the silkworm is very useful for teaching of several contents, it is expected that it will be good teaching material in Asian countries other than Japan.

In primary school biology, the silkworm is suitable for the observation of the life cycle of insect. It has egg, larva, pupa and adult stages. Students can observe how it feeds in the mulberry leaves and how it makes a cocoon, and they can also observe the mating behavior of it. The students can discover many things in magnified image.

In lower secondary school biology, the silkworm is useful for the observation of structure of insect in the Arthropod. Students can observe the spiracle dorsal vessel, the nail of legs and the simple eyes. The mating behavior is also very attractive for the students.

In upper secondary school biology, students can understand the role of the silk gland which produces the silk. As the silkworm vomits the digestive juice when it receives an electric shock, the students can confirm the function of the digestive juice by using it. One of the phenotypes of the silkworm is the markings of its body. The students can confirm Mendel's Law by using the phenotype.

Active Contents-based Learning in Science Education

Kazutoshi Tamura

Niigata Municipal Bandai Senior High School, Japan

New contents-based learning plan is implemented in two years. The plan is the contents-based learning incorporated with inquiry-based learning. We call the plan of learning "Active contents-based learning."

We suggest that the method of the inquiry-based learning is attractive and effective when it is used as the part of the contents-based learning. Inquiry-based learning and contents-based learning are complementary each other. Therefore, a problem of these methods is that how to unite the methods of inquiry-based learning and of the contents-based learning. In Japan, education of biology is cling to think about merely description of organism's phenomenon, not enough to think about principles of life and to gain the idea of organisms systems, thus mainly done the contents-based learning. Therefore, Active contents-based learning is valid in Japan.

From this year, 2012, senior secondary school curriculum guidelines are changed in Japan. New contents are increased in textbooks. Also, inquiry-based learning is recommended by the guidelines, because the OECD test scores (PISA) in all areas have been gradually decreased since 2003. However, inquiry-based learning method is not enough increased. One reason is that inquiry-based learning becomes the solitary new one subject. The other reason is that high school teachers do not understand enough the inquiry-based learning. In Japan, high school education is relatively poor to gain the creativity, to try new action in science and also many areas in culture. High school education is needed to change such the matter in Japan. However, it is difficult to alter the cultural situation. Fortunately, our nation has also somewhat abundant history of science research. Biology education and science education will be changed gradually like to our plan, "Active inquiry-based learning."

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An Innovative Approach in Teaching Total RNA Isolation in Genetics, Cell and Molecular Biology Laboratory

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The method of isolating DNA from various types of organisms, in particular using a formulated and modified DNA isolation protocol instead of a commercial kit, is oftentimes introduced in laboratory classes in Genetics, as well as in Cell and Molecular Biology in

the Philippines. The method of isolating RNA, however, is rarely introduced in these classes except in the thesis of collegiate level biology students in some universities in the country. The preference for introducing DNA isolation rather than RNA is obvious, in that the DNA, being double stranded is more stable than RNA and hence the outcome for DNA extraction is oftentimes guaranteed relative to RNA, specifically with the use of a laboratory concocted isolation protocol.

The use of commercial kits for RNA isolation is certainly very expensive. Consequently, the high cost of commercial kits for RNA isolation is a limitation to many universities in the Philippines. Hence, the aim of this paper is to present an innovative, less expensive method for total RNA isolation. The method basically focuses on total RNA isolation of indigenous Philippine plants with valuable commercial and medicinal attributes, such as *Artemisia vulgaris* (damong Maria) and *Zingiber officinale* (ginger). A modified procedure for isolating total RNA from a mushroom, *Ganoderma lucidum* is also introduced in this paper. The formulation of this modified RNA isolation method enabled the students to become more creative and become less dependent on kits. Although kits have advantages, such kits can serve as technical crutches that dull the students' ability to interpret experiments and understand where they have gone wrong, and may lose their ability to troubleshoot effectively.

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Transmission Electron Microscopy of In Vitro Biofilms Formed by *Candida albicans* and *Escherichia coli*

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PAMET, PASMETH, PSM, MIMLS, Philippines

Bacteria and *Candida* may adhere to surfaces or grow in matrix-enclosed biofilms. This study investigated biofilm architecture of *Candida albicans* and *Escherichia coli* sessile cells in pure and co-cultures *in vitro*.

Significance: How biofilms are formed is key to understanding effects in the human host when pathogenic

organisms: *Candida albicans* associated with yeast infections and *Escherichia coli* the most common cause of gastro-enteritis and urinary tract infection establishes a community. Interaction between these organisms would demonstrate phenotypic characteristics which will serve as basis in discovering appropriate strategies and interventions particular to these microbial communities.

Methods: Clinical isolates of bacterial and fungal cells were grown in thioglycollate broth. Sessile cells (biofilm phenotype) were harvested by decanting the bulk fluid, swabbing the slides of the test tubes and planting in BAP, MAC and CAP. Sessile cells were then grown on copper grids for 72 hours and negatively stained with 2% phosphotungstic acid for Transmission Electron Microscopy examination. Sessile cells were also grown in Eppendorf tubes with thioglycollate for 72 hours, fixed with glutaraldehyde and processed for positive staining. Ultra-thin sections were stained with 7% methanolic uranyl acetate solution and lead citrate.

Results and Discussion: *C. albicans* sessile cells in pure and co-culture with *E. coli* in thioglycollate did not produce hyphae or pseudohyphae; it maintained the blastospore (yeast cell) morphology. Biofilm architecture of towers predominated in *C. albicans* pure culture and demonstrated the formation of “blobs.” Networking architecture was observed in pure colonies of *E. coli*. Negative staining as superior in demonstrating exopolysaccharide structures because of absence of dehydration process. However, positive staining was superior in demonstrating cell walls. Sessile cells of *E. coli* and *C. albicans* in *in vitro* co-cultures in thioglycollate broth resulted in down-regulated biofilm formation demonstrated by decreased cellularity of biofilms and degradation of yeast cells.

Retrial to Select Biological Terms for Secondary School Science Education in Japan

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As a result of the latest reform of the national curricu-

lum standard, the Course of Study (CS), by the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), the contents of biology-related subjects have significantly changed. In particular, the CS for upper secondary schools has been very much modernized. In addition, the relaxation of the textbook screening process by MEXT has resulted in a wide variety of synonymous biological terms appearing in biology textbooks which are published by some private publishers. This is particularly remarkable in the upper secondary school level. Upper secondary school students, therefore, must remember all of these terms if they will take university entrance examinations. It must be a burden on these students. The Society of Biological Sciences Education Japan (SBSEJ) has organized a working group (the SBSEJ Examination Committee for Biological Terms) for selecting biological terms appearing in biology textbooks for upper secondary schools to reduce the burden on the students and for revising the Glossary of Biological Terms which was published in 1998. In the presentation, we will report our activities to date. We also show some data such as the number of biological terms appearing in the glossary section of Basic Biology - Biology for All - textbooks which were published last March and the redundancy of some of these terms among these textbooks.

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Scientific Researches among Articles of Scientifically Gifted Students for Biology Education

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This study is to analyze articles of scientifically gifted students, which were published in Korean Journal of Young Scientist. They were written by scientifically gifted students who were high school students. The papers were reviewed by scientists and most of them were research papers resulted from scientific research-based mentoring programs. The scientific mentoring

programs were performed by high school students with being helped by university professors or institute scientists. Their research themes were related to mathematics, physics, chemistry, biological sciences and earth sciences. Articles of them related to biological sciences showed in experimental methods and tools including DNA and protein works. The results implied that various laboratory experiences motivated and facilitated them to understand biological properties, and writing an article should be useful to facilitate ecentific ability of scientifically gifted students.

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Utilization of Learner-centered Principles in Grade 4 and 5 Math and Science Instructional Activities in a Jesuit School in Metro Manila

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In any Jesuit school, *cura personalis* means having personal care for the students. The learners serve as the focus of the academic program and institution. Researchers claim that students increase their motivation sand achievement if teachers provide them with utmost care and positive learning environment. This research aims to study what and how academic subject teachers in Math and Science utilize to make their institutions and teaching practices learner-centered. The methodology used in this research was a qualitative descriptive research. Participants were randomly selected using fishbowl sampling technique from a total of 576 grade 4 and 5 students. The students' perception was measured by a simple student questionnaire on how their teachers' use of learner- centered principles affects their motivation and academic performance. Selection of teacher participants were grade school math and science teachers and were categorized as novice, junior and senior teachers. Grades 4 and 5 math and science teacher participants were asked to answer the questionnaire. Likewise, they were observed in their classes by their respective department head. Documentary analysis was utilized to gather data from the classroom observations conducted by the

department heads. Focus was on the learner- centered instructional activities provided by the math and science teachers in this study. Correction was established with the students' motivation and academic performance and the teachers' use of learner-centered principles in math and science subjects specifically on instructional activities.

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Development and Application of Concept Based Objective Tests (CBOTs) for High School Students' Understanding of the School Biology Syllabus

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Identification and characterizing of misconception generally involve considerable effort. Different tools are used by different researchers to study the effectiveness of any remediation program in the context of students' misconception. Most frequently used techniques for extracting students' ideas are, clinical interview, 2-tier diagnostic test, concept inventories, concept maps and multiple choice tests which incorporate common misconceptions as item distracters. Other approaches have used drawing, sorting and word association tasks and computer simulations. The objective of this study was to develop a CBOT about the subject of "Life Processes" in 9th grade Science curriculum and to argue the efficiency of this test on students' achievement. The researcher developed four Concept-Based Objective Tests (CBOTs).

The CBOTs development procedure had three general steps: defining the content boundaries of the test, collecting information on students' misconceptions, and instrument development. Misconception data were collected from open-ended questionnaire, interviews and content analysis. The data were used to develop CBOTs multiple-choice items.

The researcher decided to use multiple choice questions with four alternatives. The stem of each of the multiple choice items was describing the concepts, structures, processes, or functions. A correct answer

and three distracters were provided for each of the items. After each question, space was provided to write the reason for selection of their answer.

The results of the study showed that the CBOTs were effective on determining the students' misconceptions and also it might be used as an alternative to the traditional multiple choice test for of assessment and evaluation of students' misconceptions. Through these CBOTs, not only the students' understanding of the life processes was revealed but misconceptions among the students were also detected.

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Analysis of Biology Education in Japanese School in Terms of Its Priority among Science Subjects

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The 21st century is referred to as “the era of biology.” However, it is unclear if the 21st century world wide education systems are prepared for this challenge in terms of their structure and contents – if they place an appropriate emphasis on “Biology” in contrast to other science subjects. This research aims to analyze characteristics and factors defining a relative prioritization of physics and chemistry compared to biology in Japanese schools, and to learn if such prioritization is accomplished internationally. Analysis is based on the results of international educational comparison, international and Japanese publications and interviews with stakeholders of Japanese school education.

While PISA shows higher rate of interest of Japanese pupils to biology than to other scientific fields and this subject is chosen by a prevailing number of them, biology is considered to be more suitable for low performers in science. Also, it is supposed to be more appropriate for the mentality of girls than that of boys. International research has discovered that life and environmental science topics are taught to lesser percent of pupils than topics in physics and chemistry in Japan compared to majority of participating countries. OECD indicates that scientific literacy of Japanese population is lower in biological concepts. Some of

these trends are not specific on a cultural basis, but can be found in other countries. A number of them (German, Australian, etc.) experienced and over came periods of undervaluation of biology at different stages of development. Other systems of education, for example, that of Ukraine and Russian Federation presently show certain tendencies similar to those of Japan.

However, new national curriculum standards for school science were introduced from April 2012 in Japan. They aim to end the “minimum curriculum age” and may promote the sustainable development of this subject.

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The Role of Bioscience Training Partnerships in Expanding Employment Opportunities for Bangkok's Urban Community Case Study

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This project was initiated during the history worst flooded of Bangkok and vicinity during 2011. The flood cause the massive migrate of many valuable industries from Thailand to countries such as Vietnam, Laos, Cambodia and Myanmar. This study addresses a gap in the providing of golden opportunities in regarding the extent to which public workforce and volunteer in utilizing a biological knowledge-intensive expand employment for a nontraditional, i.e., less-educated or displaced workforce. Specifically, it investigated the problem of knowledge generate institute to help to provided useful education to the communities for mitigation of the disaster phenomenon in Bangkok and urban area. The study also examined the mechanisms through which educators influence volunteer and hiring practices, focusing on strategies to encourage employers' active engagement in the partnership and to facilitate extensive collaboration among key partners. To evaluate impact on community practices, and determine the factors associated with successful (or unsuccessful) program intervention in the sample phenomenon.

We conducted intensive training and publicity to make

the public understand of the basic biological concept that can help to solve the problem in need. The programs have succeeded in ensure of the concept and knowledge we training future technicians to meet the needs of urban communities; and in negotiating skills-based, as opposed to credential-based application. Finally, the evidence shows that partnership efforts produce biological training, and services; facilitate the learning necessary to generate program innovation; and establish relationships of trust with communities. Together, such outcomes positively shape the opportunity structure facing community to create jobs base on biological innovation knowledge.

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Performance Evaluation of School Divisions in Mindanao: Education for All 2015

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The educational process cannot exist without pedagogical resources: study programmes, textbooks, and instructional materials adapted for the different age groups found within the educational system. Here again, the tasks of conceptualization, elaboration, usage, evaluation, review often fall to the universities. Achieving the “Education for All” goals within the framework of the United Nation’s Millennium Development Objectives requires a concerted effort and synergy amongst all societal players, from the individual to the institutional standpoint. Universities do have a major role to play, cooperating closely with public institutions and civil society. The study was conducted to evaluate the technical and productivity performance of schools divisions in Mindanao from period of 2002 – 2010. The profile factor of input and output variables were computed using Descriptive Statistics whereas the Technical and Allocative Efficiency scores and Total Factor Productivity were calculated using DEA with output orientation while the sources of inefficiency of the schools divisions were calculated using the Tobit Regression and the significance of the difference were calculated using SPSS version 16. Based on the findings, among 48 schools divisions in Min-

danao, 10 of these have achieved full technical efficiency level. Meanwhile, 38 schools divisions were inefficient due to lack of factors inputs like the numbers of male and female enrollees, desk, classrooms and MOOE. Thus, these are the determinants in the number of male and female graduates that would affect the performance that resulted to the inefficiency of the schools divisions. Components of the productivity change are due more to technological and total factor productivity changes with efficiency changes providing a gap.

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Exploring Perceptions of Climate Change in Year Eight Secondary School Students in Victoria, Australia

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Education is an important platform for providing the skills and knowledge required to address environmental problems, such as, the impacts of greenhouse gas emission. Changing climate is a complex issue that is now regarded as one of the world’s most significant environmental challenges. In Australia, however, very few studies have been undertaken to explore student perception about climate change and examination of the Victorian curriculum reveals that climate change is not a focus for any teaching levels from Grade 5 through to Year 10. Understanding student’s knowledge of climate change can provide the basis for curriculum development and ensure students are well informed about an issue that is likely to have broad environmental, social and economic consequences for future generations.

This paper reports on the results of an investigation designed to gather data about student knowledge and perceptions of climate change. Using a combination of qualitative and quantitative methods, Year 8 science students from three regional secondary schools in south-west Victoria, Australia, participated in the research activities. Results showed that students vary in their level of understanding associated with the causes, impacts, and solutions to climate change. They demonstrated low levels of concern and indicated that their

main source of information about climate change was from the media and to a lesser extent from school. Many students were clearly confused and misinformed about many aspects associated with the influence of green house gas emissions and how it is influencing climate.

During the course of the study, it was also found that demographic factors, such as gender and the location of the school did not influence student responses. The most influential factor appeared to be the method used to elicit these responses. This study has shown that the use of triangulated methods can strengthen research associated with research of climate change education. If this small scale study does in fact provide a representative sample of students within Victorian schools, a greater emphasis on climate change is required to ensure that current students can implement and/or understand the need for adaptation to climate change now and in the future.

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Importance of Parasite Diversity in the Understanding of Global Biodiversity

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A substantial proportion of global diversity is represented by diverse groups of organisms, parasites. Parasites are highly adaptable organisms that have been recognized as contemporary probes of biodiversity. Several groups of parasites are disease agents affecting human health, others are of agricultural, epidemiological, and veterinary importance. The diversity of metazoan parasites of wildlife vertebrates is far from complete. Parasitological surveys and parasite inventories are not evenly represented across taxa. Increasingly however, parasites are included in biodiversity surveys and to study parasite diversity. A number of determinants of parasite diversity seems to have evolved independently in different host-parasite systems. Measures used to study parasite species richness patterns are usually investigated at the infracommunity and component community levels. Parasite diversity provides insight into the structuring of ecosystems, zoogeography, impacts on local biodiversity

by non-indigenous host-transported parasites into naturalized habitats, colonization-extinction dynamics, and importantly, biodiversity on a local, regional, and global scale.

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Educational Implication for Mangrove Rehabilitation in Barangay Catadman Cuyo, Palawan

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Barangay Catadman is one kilometer away north of the town of Cuyo. The island town is 156 nautical miles away from Puerto Princesa City. In the past, the residents of Cuyo Island found the place as the source of marine resources which served as their major source of livelihood, but due to climate change and anthropogenic activities, it resulted to the diminished mangroves in the areas. The PSU-Cuyo through its Extension Services had spearheaded a project to rehabilitate the mangroves. Hundreds of mangroves had been planted in the place. A database of some marine resources in the area is also being established for future reference. A program was already started which shows a way of mitigating the effect of climate change by educating the residents of the importance of a well-preserved environment, demonstrate the proper care and rehabilitation of the diminished natural resources. The reasons for the diminishing marine resources are illegal fishing, traditional way of fishing using *lamnek*, *lagtang*, *makaslaand sarap*, cutting mangrove to be used as decoration, firewood, charcoal, stock house building, for the construction of their *ku-boor nipa* hut and *kaingin*. Adding to the degradation of the area observed later was due to the unpredictable climate changes. Much later the use of commercially bought poison for live fish catching had aggravated the degradation of the marine resource. From the views of the residents and observations by the faculty and students, the reasons for the mangrove preservation and conservation are protection from extreme heat, strong winds, large waves, typhoons, windbreaks for the whole shoreline of the community; protection from soil,

beach and sand erosions; breeding and nursery area for marine organisms and shelter for inland animals like reptiles, insects and birds.

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Implementations of the Lesson Using Diatom Project: Web-based Educational Aids in Seven Language Areas of Asian Countries

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Diatom Project is an international Web-based educational system for promoting awareness to the nations about river environment*. In the past three years, we have developed it in 17 languages with four modules: SimRiver – a Web-based program simulator that uses diatoms to enhance the understanding of the relationship between human activity and water quality; streaming videos – introducing basic knowledge of diatoms; visual tools – informing circumstances of various water environments in both different areas and time frames; and reporting system – for feedback from learners.

Effectiveness of the system was assessed in classes using six languages in five countries. Before and after the classroom activity, students described answer for the same question: What thought do you have about river today? The descriptions were treated with text mining software followed by correspondence analysis (CA). In comparison of the pre-and post-tests, Japan

and Korea showed similar shift of student groups in which their awareness was oriented toward improvement of riverine environment. In Indonesia and two Indian language (Kannada and Marathi) areas, they were rather oriented to SimRiver program and diatom itself. Thai students showed intermediate shift between eastern and southern Asian countries. The difference of the group positions in CA may be caused by different learners' awareness about river environment for sustainable development and will allow us to invite people from any country to join the project. Very recently we had a class activity using the Diatom Project in the Philippines. We will also show the result of this analysis in comparison with those of other Asian language areas.

* <http://www.u-gakugei.ac.jp/~diatom/>

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Comparative Assessment in Using Textual Graphical and Traditional Instructional Material in Teaching Biology

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The Philippine education, particularly the basic education, is now faced with a great challenge upon implementing the K-12 scheme of education. One of the challenges concerning this is the selection of appropriate instructional materials. Instructional materials play very important aspect in the teaching and learning. In fact, this is one of the many factors that are blamed for the poor quality of education in the country. One of the predicaments is addressing the issue of the instructional materials appropriate and suitable with the type of learners. Sufficient theories and literatures are available stating the advantages and disadvantages of using instructional materials presented in heavy text, graphical and traditional means. Therefore, as a prelude, this study's main concern was about assessing the significant effects of text, graphical and traditional presentation of instructional material. In the conduct of the experimental research, the tool used to determine the significant difference on the performance of students in particular topics in biology intervened by

heavy text module, graphical module and the traditional instructional material. As a result, in its finding, it shows that there is no significant difference between students' performance intervened with book and those that intervened with text. Also, there is no significant difference on the performance to those intervened with book and those with graphical material. However, there is a significant difference between those students intervened with graph and text. This draws the conclusion that students learn and perform more if they will be using more graphic material. From this study, it is further recommended to construct instructional materials with more graphics. Also, apply the graphical concept to other topics in Biology as well with other subjects. Lastly, the study may also be utilized in other subject matter for validation.

Opinions of Japanese University Students about Issues of Bioethics: The Case of Gene Diagnosis and Amniotic Fluid Examination

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We investigated Japanese university students' opinions on "gene diagnosis" and "amniotic fluid examination" as examples of bioethical issues, which are important component of biology education, by questionnaire in July 2012. The number of respondents was 322 from three universities. The questions were "Would you want to have a gene diagnosis, if this examination were available for any applicant?" and "Would you want to have an amniotic fluid examination for yourself or your spouse, after you married and you or your spouse were pregnant?" Respondents chose one answer from four alternatives: (1) I strongly hope so, (2) I hope so, (3) I do not hope so, and (4) I strongly do not hope so. According to the collection of all responses, the most common response was alternative (1) and the second was alternative (2) for both questions. Total rates of selection of positive answers, namely alternatives (1) plus (2), were 83.7% for "gene diagnosis," and 73.8% for "amniotic fluid examination." There were little gender differences in the tendencies of selecting alter-

natives. As to "gene diagnosis," the selection rate of alternatives (1) and (2) were 45.3% and 36.7% respectively for male students, 39.4% and 46.8% respectively for female students. As to "amniotic fluid examination," total selection rates of positive alternatives, (1) plus (2), for male and female students were 76.2% and 70.2%, respectively. As shown in the above data, there was a tendency that female students have relatively more negative opinions than male students for having "gene diagnosis" and "amniotic fluid examination." However, the cause of this tendency may not gender difference, but might be that the majority of female student were nursing majors.

Opinions of Japanese University Students about Issues of Bioethics: The Case of "Organ Transplantation and Brain Death" and "Preimplantation Genetic Diagnosis"

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Bioethics relates to every aspect of life in nature and social environments. In recent years, the necessity of guidance about the "preciousness of life" has been proposed by many researchers for science education. However, our research has revealed that in Japan, implementation rate of bioethics education in lower secondary school was about 20%, and in elementary schools and upper secondary school, it was only about 10% (Iwama *et al.*, 2012). We investigated Japanese university students' opinions on "organ transplantation and brain death" and "preimplantation genetic diagnosis" in July 2012. The results of the study are as follows: 1) Firstly, on "organ transplantation and brain death," 65% of the students (91 of 140) approved "conditional promotion," that is, "I accept both organ transportation and brain death, and I hope artificial organs will be developed." The number of "promotion" students was 17%. So the great majority of students (82%) accepted the promotion of organ transplantation. 2) Secondly, on "preimplantation genetic diagnosis" in order to treat the first child who is suffering from "fanconi anemia," 37% of the students (52 of 140) approved "conditional restriction," that is, "We should not

request the second young child who has no will to become the means of the treatment.” The number of students answering “restriction” or “negation” was 27%. Thus the majority of students (64%) had negative opinion. Japanese students usually study about the issues of bioethics at classes such as “Integrated Studies,” “Ethics” and “Contemporary Society” in upper secondary school. However, bioethics relates closely to the body and life of living things, so it also should be taught in school science education.

Alternative Conceptions of Human Cardiovascular System Concepts Among BS Nursing Students in Zamboanga City

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This study was conducted to elicit the alternative conceptions of human cardio-vascular system (HCVS) concepts among BS Nursing students in Zamboanga City. Specifically, the study aimed to identify the specific alternative conceptions of students on heart structure and functions; nature and components of blood; blood functions; blood vessel structure and functions; blood circulation, HCVS general function; HCVS disorders. The respondents of the study were 312 BS Nursing students coming from the Ateneo de Zamboanga University, Western Mindanao State University and Univeridad de Zamboanga. A random multi-stage sampling design was used to select the actual respondents from each university. Students' alternative conceptions on essential content areas of HCVS were identified through the analysis of items and choices of the respondents on the researcher prepared two- tiered diagnostic test. Individual responses and group output of the respondents were noted and identified. Results showed that BS Nursing students in Zamboanga City continued to have alternative conceptions on HCVS concepts even after formal instruction. The students had the highest percentage of alternative conceptions on blood components (65%); HCVS general function (52%); understanding hypertension (46%) and nature of blood (38%). The least percentage of alternative conceptions was detected on blood circula-

tion (3%), heart structure (5%) and blood functions. Hence, these findings support the claim that HCVS is a topic in Biology where students often hold considerable number of alternative conceptions.

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Using TED As Supplementary Materials for Teaching Biology

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It is mainly science textbooks that provide information to students. However, textbooks fail to cover the latest scientific developments, as their information is at least 10 years old. The most recent scientific progress is often introduced through various materials from simple black-and-white photos to more sophisticated videos. One of the most up-to-date materials is TED videos. TED is open to anyone with access to the Internet via computers or smart phones. Speakers of diverse backgrounds share their unique ideas through a 5 to 20-minute lecture on various themes and videos of those lectures are updated every week. This presentation aims at introducing some of the TED videos that could be used for teaching biology: functions of mushrooms, honeybee breeding, colour recognition of a monochromat, life in the deep oceans, and medical use of archeological discoveries.

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Analysis of Japanese Science Curriculum for Connecting to Our Daily Life: Crosscurriculum with Health Education About Human Bodies

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Science education has necessity for connecting the learning contents to daily life in Japan. Therefore, we established purpose of this study which connects learn-

ing human bodies to daily life with using health education. So, we compared Japanese science curriculum with health education curriculum. The results of analysis of “Japanese Course of Study,” learning contents about human bodies have been in science curriculum all periods after World War II. The results of analysis of science textbooks which is used in compulsory education, bone structures, muscles, embryogeny, respiration, digestion, blood circulation and principal internal organs are learned at the latter half grades of elementary schools. On the other side, at lower secondary schools, nervous systems, reproduction, and advanced contents of elementary school level are learned. We analyzed learning contents which were described in health education textbooks. There are many learning contents to understand health on daily life at elementary schools. The learning contents of health education at lower secondary schools are to understand health concretely with viewpoints of structure and function of human bodies. Therefore, when the contents of health education are introduced in science learning, science curriculum can connect to daily life strongly. If teachers use the contents of health education at introduction of science learning activities, students become to have motivation to learn science by feeling affinity to science. If teachers use them at the last of science learning activities, teachers become to be able to emphasize the connection of science learning and daily life. Furthermore, there are many modernistic problems about human health which are explained scientifically on health education textbooks. If these problems are applied to science learning activities, students have opportunities that they use basic knowledge of science that they have learned. Then, we think that students’ desire to learn science can be improved.

<Poster presentations>

Assessing the Potential for Transformative Learning in a Field Biology Course

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The Field Biology elective is a three-week program

offered to incoming senior students of the PSHS-Main Campus. Participants undergo rigorous on-campus training, team-building, and orientation activities prior to being deployed to a variety of ecosystems in Luzon where they employ field techniques to collect and analyze data on ecological interactions and human impacts on the environment. Its informal, experiential, collaborative, and immersive nature makes it a good venue for effecting transformative learning. Quantitative data in the form of scores on Frederick’s Cognitive Reflection Test (2005) and Strathman Consideration of Future Consequences Scale (1994) showed that a majority of the course participants focused more on the potential future outcomes of their current behavior, a trait associated with increased environmental awareness. Qualitative data from interviews and reflection papers showed increased interest in the biology as a career choice, increased awareness of environmental issues and modification of unsustainable behavior, and development of life skills. Learning experiences that have contributed to these shifts in thoughts, feelings, and behaviors are also identified.

Development and Practice of Pre-service Teacher training Program for Elementary Science: A Plan for Teachers’ Competency in Biological Observation and Experiment in the New Japanese Course of Study

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Since 2011, the new Japanese Course of Study has been implemented. One salient change in the Course of Study was the increase in the number of contact hours for elementary science, from 350 hours to 450 hours. New observation activities and experiments have been also brought into the new elementary science. The purpose of this study was to develop a special pre-service teacher training program for elementary science teaching guided by the new Course of Study, and to investigate the effects of the program to prospective elementary teachers. The training program was conducted for 26 university hours filled with observation activities and experiments, which covered most of the science contents in the new Course of

Study. A total of 800 prospective teachers from various departments and/or colleges of Ehime University participated for the academic year 2011-2012. It can be implied in the results that the participants acquired basic scientific knowledge and competency in observation activities and experiments through the program. Although the program is non-credit, prospective teachers who actively participated in at least 70% of the list of activities were given certificate of completion. The success of the program is deemed important in improving and ensuring the high quality of pre-service teacher training program for elementary science teaching.

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Do Bell Peppers Photosynthesize? ~ Inquiry into Photosynthesis ~

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In elementary and lower secondary school, students learn about photosynthesis: leaves of a plant catch sunlight and make nutrition such as starch. How do students conceptualize photosynthesis occurring in different parts of the plant? I surveyed secondary school and university students. The key question I asked the students was, "Does the fruit of red bell peppers and green bell peppers photosynthesize?" Thirty-seven percent of the students answered that red bell peppers do photosynthesize, while 49% answered that green bell peppers do not photosynthesize. Some fruits contain chloroplasts, like leaves do. Students will be better able to understand that flowers evolved from leaves by inquiring more about photosynthesis in the fruit of bell peppers. Furthermore, by including peapods in the inquiry activity and by observing stomata in the epidermis of peapods students can recognize the commonality of leaves and fruits. The experimental method was as follows: (1) Prepare the materials such as bell peppers of different colors, peapods, and spinach leaves. Cut each of them into an appropriate size so as to keep each one at the middle of a test tube. (2) Put 1 ml of pH indicator in the bottom of the test tube (In this step, I used a mixed solution of thymol blue and phenol red as a pH indicator). (3)

Put materials in the test tube avoiding contact with the pH indicator solution, and make the test tube airtight with a rubber stopper. Prepare a test tube with only the pH indicator in it as a control. (4) Prepare another set of test tubes in the same way, and wrap them in aluminum foil to block light. (5) After placing all test tubes under a light for a while, examine the color of the pH indicator in each test tube.

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Elementary School Teachers' Beliefs about Education for Sustainable Development

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The purpose of this study was to investigate elementary school teachers' belief about education for sustainable development (ESD) in South Korea. Subjects were 75 (male 25, female 50) elementary school teachers. Questionnaires, developed on the basis of Yang *et al.* (2010) which was for measuring of the beliefs of secondary school teachers, consisted of values of ESD (respect and care for the community of life, ecological integrity, social and economic justice, democracy, non-violence and peace) and teaching beliefs of ESD (relevance to daily life, students' need in the future, integrated teaching). The results of this study were as follows: Elementary school teachers generally showed positive beliefs about values of ESD and teaching beliefs related to curriculum content, pedagogy, and learning and teaching beliefs of ESD. But they showed negative beliefs about social and economic justice comparatively.

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Development of Environmental and Experiential Program for Understanding the System and Environment of Local River

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In the new Japanese Curriculum, the integration of real life experiences, utilization of scientific museum, and

the use of local resources in teaching science were given emphasis as strategies in science teaching. The idea was applied to the use of following three rivers: Kiso River, Nagara River, and Ibi River located in Chubu area at the center of Japan. The area is rich in natural resources with high diversities of living things around. The place could be served as a good study site in which different topics and concepts in environmental science can be demonstrated in different year level of education, such as functions of river for grade 5, the living things and their environment for grade 6, and physicochemical survey of water quality of the river for the junior high school level. In this research, the environmental educational program was developed with a theme intended for local rivers for the students to learn local natural environment and living things, and to practice formal and informal educational opportunities. This program has three main themes based on the characteristics of Kiso River: the natural environment, commercial use, and the tradition and culture of the local people. In this research, we focused on the natural environmental section. Using this program, students experienced real life situation or living things in local rivers, and teachers could teach about the river without having special skills. Because students are able to learn about the local rivers experientially, they will continue to learn by themselves and develop their own understandings in the future.

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Origami Bird: A Teaching Material Linking Mutation, Natural Selection, and Speciation

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We improved the origami bird protocol (Westerling, 1992), a teaching material for natural selection, by incorporating Gametes mutation box that links gene alteration to changes in phenotype and Origami bird simulator that links natural selection and speciation. A comparison between the pre-and post-test results suggested that this protocol successfully enhanced

Japanese high school students' understanding of linkage between mutation, natural selection and speciation, and removed misconceptions about topics such as Lamarckism and orthogenesis. Our improved protocol could be used widely because, in many countries, teaching materials linking microevolution and macroevolution are lacking (Catrely, 2006) and foreign students also have teleological conception about evolution (Bardapurkar, 2008).

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Development of the Vegetable-based Methods for Learning Molecular Systematology in Japanese High School Biology Course

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Over the past several decades, tremendous growth has occurred in our understanding of genetic phenomena and the intricate and complicated mechanisms that mediate genetic effects. During study in secondary schools in Japan, modern genetics is an important area for high school students. Now we are developing new teaching materials for learning molecular systematology, which includes processes necessary for producing a molecular phylogenetic tree by the students themselves. Because vegetables are regarded as familiar for students, we are trying to use them as new teaching materials. We introduced the hypothesis that "the edible portion of vegetables and the form of a flower reflect the systems of these vegetables" to this teaching material. We established methods of making phylogenetic trees using sequences of *rbcl* genes of some vegetables. Vegetable-based methods are thought to incorporate "artificial selection," and are expected to include effective educational points related to species and scientific names. Using these teaching materials, students are thought to be able to learn about molecular evolution, molecular phylogenetic trees, molecular clocks, scientific names, and classification systems of living things. Herein, we present the results obtained by application of these teaching materials for Japanese school students.

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Development of a Simulation Activity for Learning Evolution

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In the new Course of Study of Japan, it is to learn biology from a perspective of regularity and biodiversity at the high school level. "Evolution" is one of the important topics to learn in biology. However, it is difficult to observe directly the process of evolution and to conduct experiments. In addition, it is difficult to develop teaching materials for the topic of evolution. In this research, we developed a simulation activity on natural selection (based on the activity of Burton *et al.*, 2009), and observed the effectiveness of this activity in the teaching and learning process. In the activity, students use table utensils such as spoon or fork. Students observe the change in the number of utensils during the conduct of this activity. The activity was tried out to the undergraduate science major students to find out its effectiveness in developing the concepts in evolution. Before and after the conduct of the activity, the students were given questionnaire to assess their understanding about natural selection as well as their views about the activity. From the results of analysis on students' responses, many students considered the activity was very interesting and easy. Furthermore, they could understand the process of evolution in this activity. Therefore, we recommend this activity as an effective material to teach natural selection in the topic evolution in high school biology.

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Development of Teaching Material Using Owl Pellet of the Zoo

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Raptors are known for vomiting pellets that contain undigested matter such as bones or hairs. Pellets are used as a general method of investigating the feeding habits of raptors. Owl pellets are used as a teaching

material for food webs in the United States. Ohshika *et al.* (2010) carried out a lesson with owl pellets as a teaching material imported from the United States; it was suggested that pellets are effective as a teaching material for food webs at junior high schools. However, pellets are not familiar for Japanese children and it is a problem for the teachers to identify the contents of the pellets. Under the new Japanese Course of Study, real life experience, utilization of science museum, and application of local resources are given emphasis. In this research, teaching material of owl pellets from a local zoo in Japan was developed. Owl pellets were collected from nine zoos in Japan, and subjected to content analysis. As a result, owls in many zoos consume mainly two types of animals, either mouse or chicken. Therefore, the "bone charts" of a mouse and a chicken were developed. Then, the "bone charts" and the pellets were introduced in science classes at the 8th grade and 9th grade. Results show that many students could examine pellets positively and the students' ideas about the owl being herbivores were changed into carnivorous animals. Furthermore, they are more interested in the feeding habits of other animals and morphological features of the skeleton of the mammals. Therefore, we believe that owl pellets are effective teaching material to understand the feeding habits of the owls.

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Effect of Learning DNA and Gene Using an Experiment of DNA Extraction at Junior High School

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In the new Japanese Course of Study, learning the concepts of DNA and gene through observations and experiments and understanding the regularity of the organisms through the study of the nature and structure of DNA are emphasized. DNA extraction is now included in the new junior high school science textbooks in Japan. However, this experiment has hardly been done in junior high school because of some problems about protocols and effects. In this research, the best protocol for conducting the experiment on DNA ex-

traction was tried out in 9th grade students. Pre- and post-questionnaires were administered and analyzed to determine the effectiveness of the activity. It was revealed by the pre-questionnaire that most of the students had known the term DNA through TV programs but many of the students thought that plants are not organisms and do not have DNA. From the results of pre-questionnaire, it is important for students to experience DNA extraction from both animal and plant. The “cod roe” (an animal material) and “banana” (a plant material) were used for the experiment and students could extract DNA from these materials. Students’ responses in the post-questionnaire showed that they realized plants are organisms and all organisms have DNA. Many students could realize the correct concept about DNA through this activity. We believe that misconceptions of junior high school students regarding DNA and genes will be corrected through this activity.

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Science High School Students’ Conceptions about Climate Change

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There were no studies that focused on students’ correct conceptions (extent of knowledge and comprehension), misconceptions, and alternative conceptions on the basic concepts, causes, effects, mitigations of, and adaptations to climate change. This study determined the science high school students’ conceptions on the aspects of climate change. It involved randomly selected 122 science high school students who took the researcher-made multiple choice climate change test. In each item, the students encircled their choice, provided brief explanation about their answer, and determined the source of information about the concept. Their answers were coded to determine their climate change conceptions. Students hold correct conceptions on the observable phenomenon that indicates climate change, product that produce greenhouse gases, direct effect of climate change on freshwater, activity to participate in for climate change mitigation, and strat-

egy to cope with the impact of climate change on biodiversity. However, misconceptions on relationship of climate change and weather, factors that change the Earth’s climate change, effects of climate change on coastal areas, products to buy to support carbon sequestration, and strategy to cope with the impact of extreme weather conditions on agriculture were revealed. Furthermore, more alternative conceptions (ideas, views, beliefs about climate change that are not consistent with scientifically accepted views but are not considered to be errors or incorrect) on relationship of climate change and health problems and strategy to cope with freshwater stress than the other concepts on climate change were also noted. Male respondents have more correct conceptions than female respondents who have more misconceptions on climate change mitigations. Second year respondents have more correct conceptions; the first year respondents have more alternative conceptions. Information from home/community decreases the incorrect views and alternative conceptions of students on the basic concepts of climate change. Media increase misconceptions but decrease the alternative conceptions on the effect of climate change.

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Small Group Instructional Diagnosis (SGID): A Reinforcement Strategy

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This mixed research study focuses on the Small Group Instructional Diagnosis (SGID) to improve academic performances of the students. The chosen respondents were the classes of Microbiology and Humanities both with two sections. The respondents were purposely chosen to compare whether the SGIS Process can really help improve the performances of the students. The simple random-lottery sampling was used to level off the respondents for the Non-SGID groups. To determine the differences between the academic performance of the same group – Class A1 (Microbiology) and Class A2 (Humanities), the paired *t*-test was used. To determine the differences between the aca-

ademic performance of the two groups, SGID and Non-SGID, the *t*-test was employed. Results revealed different approaches that the teachers used during the class discussion that included group activities, individual activities, class participation and handouts. According to the students, these approaches help them improve their learning. If they stated different approaches that enhanced their learning, they also have distracters that detract their learning that includes “noise.” Majority of them voted noise as one of the most known distracters that really detracts them from learning. The grades of the students from the four classes, Class A1, Class A2, Class B1 and Class B2, increased, but the SGID groups had higher improvement compared to the grades of Non-SGID groups. It was also shown that there was a significant improvement on the academic performance of the students who were administered with SGID. Also there was a significant difference between the groups of SGID and Non-SGID. Thus, SGID is significant in improving student’s good performance.

Elementary School Teachers’ Knowledge and Attitudes Towards Renewable Energy Sources

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The purpose of this study was to investigate knowledge and attitudes of elementary school teachers in South Korea towards Renewable Energy Sources (RES). Subjects were 74 (25 males and 49 females) elementary school teachers. Questionnaires, developed on the basis of Liarakou *et al.* (2009) to measure the knowledge and attitudes of elementary school teachers consisted of socio-demographic characteristics of teachers, general knowledge of RES and sustainable development, general attitudes towards RES, attitudes towards wind and other solar farms, domestic uses of RES, teaching about RES. The results of this study were as follows: Elementary school teachers (1) generally showed affirmative perceptions of RES to sustainable development; (2) expected RES to be used as main future energy sources. But in-service training, sustainable educational material, lesson plans, and ex-

tracurricular educational programs in order to deal with RES are still needed by the elementary school teachers in South Korea.

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Using Scientific Research-based Monitoring Model for Scientifically Gifted Students

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The purpose of this study was to examine educational implications of the scientific research based mentoring model (SRMM) for scientifically gifted students, which was proposed by Shim and Kim (2005) and Shim *et al.* (2009). The SRMM consists of six phases, *i.e.*, introducing, exploring, planning, performing, verifying and concluding, to facilitate scientific inquiry of gifted students in the process of experimental performance. In addition, they could be provided with concrete experimental experiences through laboratory practices, and challenging tasks and feedback at the requisite stage. In this paper, the model was applied to biological research theme, which was the auto-inhibition and inter-inhibition of germination and seedling growth during early stages of plant growth, and educational potentials were examined in Science Education Institute for the Gifted, adjacent to University, Korea.

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The Effects of Science, Technology, Engineering, Art, Mathematics (STEAM) Programs in Biology and Sports Science

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Kyungjun Ahn, Jinhee Park, Hyokwan Dong,
Jaeho Sim**

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Now, there is paradigm shift to the society of creative intelligence with emotion. In the future, it will be important not only the creative personality and emotion but also artistic merit. So we adapt Science, Technology, Engineering, Art, Mathematics (STEAM)

education as a convergence education. The purposes of this study were to analyze students' perceptions about convergence study and to find out the effectiveness of STEAM programs. For this study, we had developed STEAM programs on bio and sports sciences. Fourth graders, 6th graders, 8th graders and 10th graders were participated. The results showed that the STEAM programs were very interesting for students and effective to promoting creativity in science.

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Various Laboratory Experiences Facilitate Gifted High School Students to Write Scientific Research Articles

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The purpose of this study was to analyze articles of scientifically gifted high school students, which were published in Korean Journal of Young Scientist. Scientists reviewed the papers and most of the research papers were results of scientific research-based mentoring programs. High school students performed the scientific mentoring programs with the assistance from university professors or institute scientists. Their research themes were related to mathematics, physics, chemistry, biological sciences and earth sciences. Articles related to biological sciences reflect experimental methods and tools including DNA and protein works. The results implied that various laboratory experiences motivated and facilitated them to understand biological properties, and writing an article should be useful to facilitate scientific ability of scientifically gifted students, and to understand the nature of scientific researches.

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Integrating Multiple Methods in teaching Biology to Improve Achievement of Students with Varied Learning Styles

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This research investigated the learning styles of students enrolled in general Biology second semester of SY 2011 – 2012 and assess the effectiveness of four different teaching methods introduced into Biology classroom. Cooperative learning, class discussions, concept maps and lecture were integrated into the course to compare students' levels of participation. The study utilized qualitative and quantitative data in an attempt to explore students' conception of selected topics of biology. The Kolbs Learning Style inventory was used to categorize students learning styles and Biology Concept Test was used as research instruments. Results showed that out of 42 students, 24 students were convergers, 9 students were divergers, 4 students were assimilators, and 5 students were accommodators. based on thinking encouraged most of the class participation wit a mean score of 4.2. All three methods, however, had a significantly greater level of student involvement than in traditional lecture. The use of different methods caused significant increase in the achievement of biology students with varied learning styles.

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A Correlational Study on Catechol-O-Methyltransferase (COMT) VAL 158MET Single Nucleotide Polymorphism and Academic Performance of Selected Senior Public High Schools in Manila, Philippines

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Catechol-O-methyltransferase (COMT) is a methylation enzyme that catalyzes the degradation pathway and inactivation of dopamine which has been widely accepted in playing a role in the mediation of human cognition, emotional response, executive cognition and

working memory. The COMT genotypes of student-respondents, determined through DNA isolation, amplification and restriction endonuclease digestion, were correlated with their final grades in school and scores from National Career Assessment Exam (NCAE), an annual assessment program held by the Department of Education to evaluate student's strong points and help them for choosing future career. Results showed that COMT ¹⁵⁸Met/Met homozygous students showed a trend towards poorer performance in mathematics (academic subject) ($p = 0.035$) and in all subtests of the NCAE as compared to students homozygous for ¹⁵⁸Val/Val ($p = 0.036$) or heterozygous for ¹⁵⁸Val/Met ($p = 0.002$). However, the performances of the COMT Met/Met homozygous students in the science and mathematics subtests ($p = 0.001$ and $p = 0.01$, respectively) were significantly poorer than that of the other two groups. The genotypic distribution of the samples in the study revealed 34.2% Met homozygotes, 29.5% Val homozygotes, and 36.2% Val/Met heterozygotes. The low percentage of Filipino students homozygous for COMT ¹⁵⁸Val allele translates into poor performance in the subject areas mentioned above. Numerous educational system amendments have been proposed as they often associate the academic achievement of the students to the effectiveness of the educational scheme. Very little light has been shed on other aspects such as psychological, social and even biological factors that actually affect the academic performance of students.

Prof. Josefino R. Castillo, Department of Biological Sciences, College of Science, University of Santo Tomas, Manila, Philippines

Unraveling the Magnificent Code of Life: Modular Approach in Teaching the Structure and Function of DNA in High School Biology

Shela V. Ruiz, Leah V. Carballo

Central Bicol State University of Agriculture, Philippines

This module generally aimed to present clearer understanding of the structure and function of DNA through activities and discussions primarily designed for second year high school students. The 5 E's of learning was used as a method in the presentation of each lesson in

this module. This includes Engage, Explore, Explain, Elaborate and Evaluate. The module engaged students in practical work activities such as simulation, picture puzzle, model constructions, brainteaser sessions, laboratory investigations, and group output discussion were used. Interaction and collaboration through maximum "minds-on" activity accompanied with "hands-on" and "hearts-on" activities were used as strategies in this module. These activities were done in games and group competition. The discussion of the learning concepts was through teamwork and collaborative learning among students. An output presentation was done every after activity either independently, in pairs, or in groups. The in-depth discussion included in this module provided the teacher a clear understanding on the main concepts to be learned by the students. Finally, this module integrated how the genetic information from parents to offspring is expressed through the central dogma of molecular biology. This would help the teacher and students relate those concepts to the role of the genetic material in the perpetuation of every living organism.

Prof. Shela V. Ruiz, Central Bicol State University of Agriculture, Camarines Sur, Philippines

Two Novel Endemic Philippine Species in *Gynothodes* Blume (Morindeae-Rubiaceae) and Molecular Support on the Reclassification of *Morinda elliptifolia* Merr. and Quisumb

**Joshua Johnedel P. Salvacion¹, Gerson C. Cntreras¹,
Wei Yi D. C. Hung¹, Fernan Macrin C. Ramos¹,
Diana Grace B. Ysaac¹, Jayson G. Chavez²,
Grecebio Jonathan D. Alejandro¹**

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Recent phylogenetic works on the systematics of Morindeae have proposed new generic delimitations of the tribe and the adoption of a narrow circumscription of the nutraceutical genus *Morinda* known as "noni." The proposed transfer of all lianescent *Morinda* species including the Philippine endemic *M. elliptifolia* to its conglomerate *Gynochthodes* have raised the question whether this taxonomic amendment is supported by molecular dataset. To address this, samples of *M.*

elliptifolia and two *Gynochthodes* cf. specimens were collected in the island of Palawan. *53trnT-F* (cpDNA) sequences were utilized for cladistic analysis. Bayesian inference (BI) of the plastidial data supports the generic transfer proposed by Razafimandimbison & Bremer with strong divergence values (PP = 1.00). The genus is united by marginal hairs along stipules and bracts; axillary, racemose or cymose inflorescences with white and shortly pedunculate flowers; recurved calyx tubes; and corollas with long hairs within the tubes and on the adaxial side of the lobes. Furthermore, the two sampled *Gynochthodes* cf. nestled on the basal polytomy of *Gynochthodes* subclade proving their generic affinity (PP = 1.00). Comparisons between the Malesian *Gynochthodes* and these specimens have shed light to the proposal of two new endemic *Gynochthodes* species. In relation to these taxonomic breakthroughs, implications of Philippine biodiversity, and the industrial and medicinal applications of *Gynochthodes* are presented.

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Structural Development and Morphometric Analysis of Male and Female Gametophytes of Nitrogen-absorbing *Canna x generalis* Bailey (Banderang Español)

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Because of their nitrogen-absorbing ability, canna beds have been used as an ecological remediation strategy for polluted water treatment. In the Philippines, coincidentally, banderang español or canna lily is planted in the road islands of flood prone areas such as España and Marikina. This study aims to trace the ontogeny of *Canna x generalis* Bailey (banderang español) gametophyte and to characterize the development patterns using morphometrics and statistical tools such as repeated multiples ANOVA, *t*-test, and Cohen's *d* for mean difference. The study deemed to be significant because of the possible relatedness of the gametophyte development to its nitrogen-absorbing ability which

confers the capability to remedy polluted water. Freehand cross sections of the anther, ovary and seed were prepared and stained with acetocarmine, safranin, and iodine. Banderang español androecium consists of two trimerous whorls: the epipetalous staminate inner whorl and the episepalous outer whorl. Septa homogenization and stomium opening characterize the maturation of the bisporangiate anther. In microsporogenesis, the microsporocysts undergo successive cytokinesis, callose deterioration, and mitosis to form a vacuolated microspore giving rise to vegetative nucleus and two sperm cells. Pollen germinates best at 20% sucrose peaking on the 24th hour (*d* = 0.91). *C. x generalis* ovary follows the monosporic polygonum development. A megasporocyte divides meiotically giving rise to a megaspore tetrad with the only functional megaspore undergoing mitosis thrice to form an octanucleated gametophyte. Morphometric analysis revealed a positive correlation between the anther size and the ovary size. While petal size and sepal size are proportional, they pose no significant relationship to the staminode growth. Also, anther growth peaks at the length of 1.71 cm (± 0.4 cm). Recommendations for further studies include usage of other histochemical stains and through study of embryogeny.

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Using Ecological Studies about Naturalization Rate of Alien Plants in Teaching Biology

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Invasive alien species are one of main factors to affect on indigenous plants, ecosystems and biodiversity. After surveying plants, which habituated in some areas, both indigenous and alien plants were listed and naturalization rate of alien plants (NRAP) were calculated. Study sites are railway and riparian ecosystems, where could be often mediated to by transport, animals and humans. Collecting data were analyzed comparatively to examine ecological implications. The use of NRAP can be an effective tool to understand natural

environment ecologically and ecological impacts of invasive alien plants. Challengeable topics and well-structured experiments for students could derive students actively to engage and to motivate their curiosities. Ecological studies should induce scientific meaning related to topics, experimental experiences and then encourage them to invent original ideas. Practical works based on ecological studies have potentials to facilitate scientific inquiry activities.

Prof. Kew-Cheol Shim, Department of Biology Education, Kongju National University, Gongju, Chungnam, South Korea

Scanning Electron Microscope (SEM)-aided Screening of Wild Type *Bacillus thuringiensis* Parasporal Crystalline Protein-based on Structure against *Aedes aegypti* Larvae

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Maria Luria S. Orbita, Franco G. Teves**
MSU-Iligan Institute of Technology, Philippines

Dengue has claimed thousands of Filipino lives in the past few years with incidence that defy the traditional seasonality of this mosquito-borne viral infection. Preventive measures include destruction of known mosquito habitats, use of mosquito nets and house screens, fogging and use of chemical insecticides. While adults may be killed or prevented from spreading the virus through bites, the eggs and larvae can survive and continue to spread the virus to the human population. To date, there are only very few identified strains of the bacterial species *Bacillus thuringiensis* that produce the parasporal crystalline protein effective against Dipteran insects such as mosquitoes. Moreover, there seems to be a relationship between protein crystal shape and its efficiency as larvicidal protein. The gold standard for bacterial identification is considered to be 16S rRNA sequencing. However, in this study, SEM was employed to determine the parasporal crystalline protein structure and deduce its larvicidal strength through actual *Aedes aegypti* larval toxicity assay. The method is fast, straightforward, and comparably cheaper than the alternative molecular technique in identifying candidate bacterial strains as sources of bioinsecticides against the dengue-carrying mosquito *A. aegypti*. It was also demonstrated in this study that a single bacterial strain could produce differ-

ent crystal shapes corresponding to characteristic LC50 (lethal concentration that kills 50% of the mosquito larvae). This is the first SEM study on *B. thuringiensis* parasporal crystalline protein in the Philippines as far as literature is concerned.

Prof. Jing R. Bautista, Department of Biological Sciences, College of Science and Mathematics, MSU-Iligan Institute of Technology, Iligan City, Philippines

Ethnobotany of Ferns and Fern Allies in Mount Macabol Marilog District Davao, Philippines

Adorico M. Aya-ay
University of the Immaculate Conception, Philippines

Ethnobotany of ferns and fern allies was conducted in an indigenous community at Mt. Macabol, Barangay Salaysay, Marilog District, Davao City, to document the tribal uses of the different species of pteridophytes in the forest. The gathering of data was done through interview with the chosen members of the community and through the collection of herbarium specimens. Seventy-one species of ferns and fern allies are collected. Thirty-seven species (52%) have uses in the tribe. These useful species serve wither as food, medicine, ornament, ceremonial materials, or in other forms of uses for the community. This paper presents the local/common names, scientific names and the specific uses of the plants. The data obtained show that despite human encroachment, Mt. Macabol remained a home to a good number of ferns and fern allies useful to the residents.

Prof. Adorico M. Aya-ay, University of the Immaculate Conception, Bonifacio Street, Davao City, Philippines

The Distribution and Relative Abundance of Medium-sized Arboreal Mammals at Mount Mahuson, Mount Apo Key Biodiversity Area

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Field surveys of arboreal mammals were conducted in the forests of Mt. mahuson in Arakan Valley, North Cotabato Province from October 2009 to March 2011. With concentration on the prey items of the Philippine eagle *Pithechophaga jefferyi*, the team searched for

Mindanao flying lemur *Cynocephalus volans*, Mindanao flying squirrel *Petinomys crinitus*, palm civet *Paradoxurus hermaphroditus*, and long-tailed macaque *Macaca fascicularis*. The team conducted mammal surveys for a total of 48.38 observation hours in seven contiguous line transects (with a total length of 14 km). The team was also able to gather data from opportunistic sampling and dialogues with parabiologists. Results indicate that among these species, the long-tailed macaques are most abundant particularly in the remaining forests at lower altitude (below 1300 masl), followed by the Mindanao flying lemur and palm civet. The Philippine tree squirrel scored only “frequent” whereas both the Mindanao flying squirrel and pygmy squirrel were found rare in the study area. The greater number of individuals encountered in those particular forests at lower altitude could be attributed to the greater quality of (i.e. thicker canopy cover, larger trees) habitats in the area. The greater abundance of macaques relative to lemurs in the area suggests that the lemurs are not the primary prey items of the nesting pair in Mt. Mahuson. This is contrary to the fact that a large bulk of prey items of the Philippine eagle population in Mindanao consists of flying lemurs. Future research should focus on testing this hypothesis in order to further assess the prey population and foraging behavior of the eagle pair in the mountain.

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Vegetation Analysis of the Pasonanca Natural Park in Zamboanga City

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This study analyzed the vegetation of the Pasonanca natural Park in Zamboanga City. The sampling sites covered Canucutan, Muruk 3 and Baluno. Three stations were established at intervals of 300 m each in Canucutan and Muruk 3 and four stations in Baluno. Five nested quadrats, each measuring 100 m² with subplots measuring 5 m × 5 m and 1 m × 1 m were plotted at intervals of 10 m in each station. There were 283 individuals belonging to 45 species, 27 genera and 25 families. The taxonomic composition is mainly angiosperms and pteridophytes comprising 82.2% and

17.8%, respectively. There are 30 species with known geographic range; and of these, 60% are endemic or native, 33.3% are cosmopolitan and 6.7% are exotic. Data on species composition, distribution, importance values, and diversity indices all suggest that species diversity is high in all three sites. Species evenness though was fairly high in Canucutan compared to Muruk 3 and Buluno based on Simpson’s measure of evenness. Conversely, all three sites have comparatively high species evenness based on Shannon-Wiener’s index. There are few species under the threatened category (either vulnerable or critically endangered). Several species though are either not threatened (33%) or not evaluated (27%). The ecologically important species belong to families Araceae (*E. pinnatum* and *Rhapidophorra* sp.), Arecaceae or Palmae (*Arenga* sp., *Calamus* sp. And *Caryota* sp.), Euphorbiaceae (*M. tanarius*), Maranthaceae (*D. canei-formis*) and Athyriaceae.

Prof. Jocelyn D. Partosa, Ateneo de Zamboanga University, Zamboanga City, Philippines

Assessment of the Mangrove Forest Structure of Selected Marine Protected Areas of Southeast Cebu

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A study was conducted to assess the mangrove forest structure of selected Marine Protected Areas of Southeast Cebu using the descriptive survey method. Specifically, the study sought to identify the mangrove species composition, density and describe the community types and zonation of the selected study sites. There were five identified study sites which included: (1) Brgy. Bagacay Marine Fish Sanctuary, Sibonga; (2) Sitio Pungtod, Siala, Sibonga; (3) Brgy. Taloot, Argao; (4) Brgy. Cawayan Marine Sanctuary, Dalaguete; and (5) Sitio Nonoc, Brgy. Daan-lungsod, Alcoy. The study identified 19 mangrove species which included 12 major mangrove species, four minor mangrove species and three mangrove associate species. The densest tree stand was located in site (3) followed by site (1), (4), (2) and the least stand density as in site (5). Summing all densities from all sites for each species, it

was found out that the most dominant major mangrove species was *Rhizophora* sp., followed by *Avicennia* sp. and *Sonneratia* sp. These three species are characterized as highly adapted to sandy/muddy substrates which is the most common feature of all the study sites. All study sites were categorized as riverine forest types which are tall flood plain forests along flowing waters such as tidal rivers and creeks. Conditions in this type of forest are favorable for extensive growth due to flushing by daily tides.

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Seed Morphology of Two Endemic Species of *Medinilla* Gaud (Melastomaceae): Its Implications for Disposal and Germination

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The morpho-anatomy of seeds of *Medinilla magnifica* and *Medinilla* sp. was studied under light and scanning electron microscope (SEM). The goal of this study is to delineate the morpho-anatomical characteristics of seeds of two closely resembling *Medinilla* spp. Aside from acrodromous leaf venation, melastomaceae is recognized among dicots with their numerous exalbuminous seeds. This is true among *Medinilla* species, where seeds develop from anatropous ovules of the epigynous ovary of the flower. Based on the close resemblance of the two plants in terms of vegetative and reproductive anatomy, one would expect that the seeds of the plants would also be similar in terms of their form. However, the investigation revealed that there are several notable differences in their form, especially in their external features. In terms of shape, mature seeds of *M. magnifica* are round oval as compared to those of *Medinilla* sp. Which are rather flattened toward the micropylar end. A strikingly remarkable difference was observed between the surface textures of the seeds under SEM. The seeds of *Medinilla* sp. Has rather smooth surface due to tabular cells forming jigsaw puzzle-like pattern. The seed surface of *M. magnifica*, on the other hand, has a relatively rougher surface due to cells forming blister-like projections. The seed coat surface has been studied to

have significant role in seed dispersal by biotic and abiotic factors. The rough seed surface of *M. magnifica* could be of great advantage when it comes to adherence to aerial substrates during dispersal while the smooth seed surface of *Medinilla* sp. Could be adaptive to dispersal by animal frugivores. With regards to internal anatomy, particularly to embryo form and position, the seeds of two plants are relatively similar conforming to the general characteristics of Melastomaceae. The short embryos of the seeds are straight or slightly bent, lying along the long axis. At longitudinal section, the lignified seed coat is thicker in the chalazal end of the seed and diminishing towards the micropylar end. The form and position of the embryos are reflective of the phanerocotylar germination of the seeds, which is common in the family. In conclusion, the seeds of *Medinilla* sp. and *M. magnifica* have distinctly different external features but have relatively similar internal anatomy. The observed morpho-anatomical differences and similarities of the seeds reflect morpho-functional and developmental adaptations, which are important for dispersal and establishment of the plants. These observations are of great consideration for conservation of the plants since *M. magnifica* and *Medinilla* sp. are considered endangered and rare, respectively.

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GIS Mapping on Invasive Aquatic Plant *Eichhornia crassipes* (Commelinales: Pontederiaceae) among Wetlands and Farmlands in Carcar, Cebu, Central Philippines

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Aquatic invasive plant species are widely considered to be one of the greatest threats to biodiversity. Water hyacinth (*Eichhornia crassipes*) is the subject of the study on its invasive nature. The objective is to create a GIS database to model for management of its occurrence, verification, and control. The data included both physical and environmental parameters surveyed

in the field specifically its location and coordinates. There are ten villages surveyed having wetlands and its corresponding coordinates through GPS counter. Research study points were identified prior to actual recordings. Quadrat methods were established randomly to determine species relative density. Elevation varies from 0.7 – 88 m above sea level. Station 6 has the highest percentage covered having 41.41% and Station 1 having 3.38% as the lowest. Relative density and evenness was achieved highly at Station 2 - 5 having 281 species per 10m² and Station 2 - 4 has the lowest record having 102 per 10m²

Prof. Alejandro C. Manlangit, Jr., Biology Department, University of San Carlos, Cebu City, and Carcar Central NHS – Carcar City Division, Cebu, Philippines

Comparative Developmental Morpho-anatomy of Idioblastic Oil cavity in Stem, Leaf and Rind of *Citrus x sinensis* ‘Satsuma’ (L.) Osbeck (Sweet Orange) and *C. x microcarpa* Bunge (Calamansi)

Emmanuel D. Delocado, Josh Nathan L. Ngai, Carol Angeline G. Yu, Reshan D. Baoas, Sol Kim, Vivian S. Tolentino

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Five years ago, the international market with crisis as prices of petroleum products fuelled up by almost 600%. Because of this, the search for an alternative energy source among local species has been a fad. This study investigates the development of idioblastic oil cavities in the stem, leaves, and fruit rind of *Citrus x sinensis* (L.) Osbeck (sweet orange) and *C. x microcarpa* Bunge (calamansi). Data from this study serves as a progeny study for oil extraction strategies and as a contribution to the growing literature on oil cavity development. Freehand cross sections of the stem, leaf and fruit pericarp for both plants were prepared and stained using Nile Blue sulphate, Sudan IV, and Sudan Red. Oil cavities originate as parenchymal oil cells which differentiate into polyhedral inner cells and flattened boundary cells connected to the epidermis with a copule. Eventually, the flattening and swelling of inner cells leads to lysigenic development of oil cavities. Oil particulates start moving to the cavity periphery and attract possible remaining oil substances

in the now flattened inner cells. The ontogeny of the idioblastic oil cavity culminates with the oil deposit forming in the cavity. Three layers of cell wall are observed on rind oil cavity of both plants: a suberin layer sandwiched between two cellulose layers. Oil deposits stain positively in all three histochemical stains. ANOVA (95% confidence level) reveals a positive correlation between the diameter of the *C. x sinensis* fruit and the diameter of the oil cavities. In addition, the diameter of oil cavity of *C. x microcarpa* increases significantly as it matures, then stop after it ripens. Recommendations for further studies include the preparation of fresh and permanent sections, morpho-anatomical investigations of root and flowers, the usage of other histochemical stains, and an exploration on oil extraction techniques.

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Two New Generic Records in Philippine Rubiaceae Based on Plastid and Nuclear DNA Sequence Data

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The tribe Vanguerieae (Rubiaceae) in the Philippines is represented by *Canthium* (20 spp.) and *Psydrax* (monotypic). Recent studies done in the tribe showed that most of its representatives form a heterogenous assemblage. The genus *Canthium* was restricted by having supraaxillary spines. This raised questions on the position of the PPhilippine *Canthium* as members are without spines. In this first molecular study of two Philippine *Canthium* (*C. monstrosum* and *C. ramosii*), *trnL-F* and ITS regions were sequenced, assembled and aligned manually using Se-Align v2.0 and subsequently analyzed using MrBayes 3.1.2. Interestingly, the majority-rule consensus tree revealed that the two Philippine species were nested in two different clades with high support; *C. monstrosum* within the *Keetia* clade (PP = 0.92) while *C. ramosii* grouped with the *Pyrostria* clade (PP = 0.98). Therefore, we proposed two new combinations, the *Keetia monstrosum* (A. Rich.) Arriola & Alejandro and *Pyrostria ramosii*

(Merr.) Arriola & Alejandro. This study establishes for the first time the two genera (*Keetia* and *Pyrostria*) in the Philippines. The IUCN red list declared that conservation status of *Keetia* and *Pyrostria* were from vulnerable to critically endangered.

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Reproductive Characteristics of *Grapsus tenuicrustatus* (Herbst, 1783) (Decapoda: Grapsidae) Found in Talim Bay, Lian, Batangas, Philippines

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Understanding the breeding potential of a well dispersed marine invertebrates, like crabs, entails determining variation of its productive characteristics (Duran, 1991). The present study determined some reproductive characteristics of *Grapsus tenuicrustatus* (Herbst, 1783), a brachyurans (true crabs) which are among the most widespread and diverse groups of invertebrates. Samples of *G. tenuicrustatus* were collected at Talim Point (130° 57' 55.43", 1200 36' 20.36"E), a portion of Talim Bay at Barangay Ligtasin, Lian, Batangas, at rocky areas near the seagrass beds. Results revealed that there were more male *G. tenuicrustatus* (n = 81) than female (n = 52) with a sex ratio of 1.13:1. Thirty percent of the samples were ovigerous females. Ovigerous female crabs have the largest carapace length (CL) (mean ± SE: 31.25 ± 1.43) compared with the males (mean ± SE: 22.14 ± 0.73) and non-ovigerous females (mean ± SE: 26.63 ± 1.12). Based on one-way ANOVA, the CL differences were significant (F = 20.383, df = 2, p < 0.01). Difference in CL between non-ovigerous and ovigerous females was also found to be significant based on t-test for independent samples (t = 2.582, df = 70, p < 0.05). There was a non-conspicuous bi-modal size distribution for all the crabs, with non-normal distributions for all crabs (one-sample Kolmogorov-Smirnov (KS) = 1.735, p < 0.05) and for males (KS = 1.464, p < 0.05), but not when all females or ovigerous females only were grouped together. The size-frequency distribu-

tions of males and females are significantly different from each other (KS = 2.582, p < 0.0001). The same was observed between the size frequency of ovigerous and non-ovigerous female crabs (KS = 1.502, p < 0.05). Moreover, there were more ovigerous crabs belonging to the first year age class (CL = 16 – 33) (53%) than those that belong to the older class (CL = 34 – 43) (47%). The fecundity of *G. tenuicrustatus* ranged from 4400 (CL = 16 mm) to 26,400 (CL = 43 mm) eggs. Egg volume ranged from 0.40 ml to 2.40 ml. <Sorry for missing some of the last sentences.>

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Anti-bacterial Potential of the Cultivated and Wild Type Adlai (*Coix lacryma-jobi* Linn.) Plant Extracts

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Antibacterial potential of aqueous, ethanolic and methanolic extracts of the different plant parts of the cultivated and wild types of "adlai" (*Coix lacryma-jobi* Linn.) was investigated against *Staphylococcus aureus* and *Escherichia coli*, gram-positive and gram-negative bacteria, respectively. The antibacterial activity was performed by paper disc-diffusion method. The presence of antibacterial agents in the plant extract was determined by phytochemical analysis and thin layer chromatography. The zones of bacterial inhibition produced by the test organisms were subjected to analysis of variance and the differences in treatment means by DMRT at P=0.05. No activity was seen in the aqueous extracts while a slight antibacterial activity was observed on the ethanolic and methanolic stem and root extracts of both plant types except the methanolic stem extract (50mg/ml) of the cultivated type which showed a very significant growth of inhibition against *S. aureus* (14.5mm) and *E. coli* (13.2mm). The antibacterial activity was comparable with the standard antibiotic, streptomycin (15.2mm). Results of the phytochemical studies revealed the presence of alkaloids, steroids, flavonoids, saponins and polyphenols which were active against both gram-positive and gram negative-bacteria. Moreover, thin-layer chromatography confirmed the presence of sterols, phenols and essential

oils which is rich in triterpenes in the methanolic extract of the stem (cultivated type). The ethyl acetate:methanol (95:5) showed the greatest resolution with 4 spots using different detection method and is recommended as the mobile phase which provides a R_F value of 0.59 – 0.76. The results obtained in the present study suggest that the plant can be used in treating diseases caused by the test organisms and provide very important information to the medical and pharmaceutical industries in developing cheaper drugs of plant origin.

Prof. Jeany Cuaresma Dupo, Benguet State University. La Trinidad, Benguet, Philippines

A Study on the Anti-Diabetic Potential of Pansit-Pansitan (*Peperomia pellucida*) Extract

**Patricia Anne P. Bonifacio¹, Jason C. Alcares¹,
Edna A. Amparado²**

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²*University of the Philippines, Diliman, Philippines*

The use of pansit-pansitan (*Peperomia pellucida*) extract as a substitute treatment to high blood glucose levels of diabetic patients was verified to provide a more affordable alternative to diabetic maintenance medications. One kilogram of leaves was acquired and air-dried for two weeks, then steeped in 99% ethanol for three nights. The pure extract was obtained through a rotary evaporator then air-dried for one day. Alloxan was initially supplemented at a 150 mg/kg-body weight dosage to four groups of mice with three replicates per setup to induce diabetes. Controlled variables include environmental conditions and diet, while experimental variables consist of extract concentration and blood glucose levels. The 50.00 mg/kg-body weight extract was prepared in ethanol at 50 – 75% concentrations then administered to two setups on non-diabetic mice. Glucose levels were checked after the first hour, then after every four hours for 24 hours. Preliminary data showed significant lowering in the levels of mice treated with extract solution. The ANOVA tests confirmed this initial conclusion. The success of this study presents a cheaper alternative diabetic treatment to underprivileged patients. A new source of income may also be ascertained if the me-

dicinal potential of this common plant is further investigated.

Patricia Anne P. Bonifacio, Philippine Science High School – Main Campus, Quezon City, Philippines

<Workshops>

Create a Sheep Mascot While Feeling the Texture of Wool

Hirofumi Naekawa

Tokyo Gakugei University, Japan

Despite sheep is a familiar animal for people, we believe that the number of children and students who have never seen or touched the animal in their life has been increasing in recent years. This workshop is an experience-based booth where you can actually touch wool and create a sheep mascot while feeling the texture of wool. I will exhibit how to make the mascot. You can bring the sheep mascot back to home. As the mascot materials for one person, you only need one gram of wool, two laces with wire 24 cm in length, and scissors.

Dr. Hirofumi Naekawa, Department of Biology, Tokyo Gakugei University, Tokyo, Japan

Integrating Environmental Education into Integrated Science Courses in the K-12 Curriculum – A Workshop on Adapting Ideas from Native Seasons, Project Wet, Wild and Learning Tree into the Filipino Context

John Paolo Dalupang

Ateneo de Manila University, Philippines

With the implementation of the new K-12 curriculum in the Philippines, educators in various levels in Basic Education have raised concerns about challenges in implementing an all-integrated and spiraling approach in teaching science. This concern is most resonant in the 7-10 grade levels where concepts in the major science courses, namely biology, chemistry, and physics, are taught in the same grade levels within the same school year. While textbooks and instructional materials are still being developed for this new curriculum, teachers are left with their creativity and ingenuity on how to effectively cover these topics.

This workshop will provide educators in various levels with ideas that can help with creating learning resources and lessons that can help with the issue of integration. The main ideas that will be presented in the workshop will come from established environmental education curricula that have been used in the United States for over 10 years – Native Seasons, Project WET, WILD, and Learning Tree. Through developed in another country, the activities presented in these learning materials are very flexible and can be easily adapted to the context of its learners. Grounded in environmental education, these curricula used what's available in the learner's community environment to understand the concepts in science. The workshop will begin with a brief description of the tenets of environmental education and the background of each of the curricula. The rest of the session will consist of hands-on and lively activities that are mostly geared to some topics in the new Philippine K-12 Grade 6, 7, and possibly Grade 8 (if time permits) science curricula in science. Attendees from other countries might want to prepare a list of topics for their Grade 6- or 7-equivalent levels for referencing with the learning materials. The proponent of this workshop neither in any way represent the organizations that developed the mentioned learning materials nor is connected with the same organizations. The proponent just wants to share options that became useful during his teaching career. It is a workshop where teachers can share

ideas to help cope with the demand of the new curriculum.

Prof. John Paolo Dalupang, Ateneo de Manila University, Quezon City, Philippines

A Simple Laboratory Work on DNA Extraction at Secondary School Level

Yoshihiko Yonezawa, Noriko Banba
Naruto University of Education, Japan

For a biology class at the secondary school level, a simple method for DNA extraction from flower buds of broccoli was developed using a mixture of 4% NaCl solution and 1% SDS (sodium dodecyl sulfate) solution (24:1) as an extraction medium. However, this simple method is unsuitable for the DNA extraction from fruits of banana and strawberry, because the UV absorption spectrum of the ethanol precipitate from the extracts of banana and strawberry did not show the typical absorption curve of DNA. Therefore, we propose broccoli, which can be obtained at any time and by the reasonable cost, as a plant material. In addition, the diphenylamine-colorimetric method is also proposed for detecting extracted DNA. In this workshop, we demonstrate this simple method for DNA extraction from flower buds of broccoli.

Prof. Yoshihiko Yonezawa, Department of Biology, Naruto University of Education, Tokushima, Japan

Publication

A book, *Biology Education for Social and Sustainable Development*, was published in 2012 by Sense Publishers, Rotterdam, Netherlands. Some papers presented at the **23rd Biennial Conference of the AABE** which was held in Singapore in October 2010 were compiled in this book by the co-organizers of the conference, Dr. Mijung Kim and Dr. C. H. Diong. You can refer to the abstracts of these papers in **the sixth volume of the Asian Journal of Biology Education** (2012).



Obituary

Dr. Chung Yong-Jai, who was the chairman of the AABE from 1988 to 1990 and organized the 13th AABE Conference (Seoul, Korea) in 1990, passed away peacefully on the 6th February 2013 at the age of 88. His continuous participation in the AABE activities during the early stages of the association was worthy of note.

May he rest in peace!

From the Editor-in-Chief

The seventh volume of the *Asian Journal of Biology Education* (AJBE) contains two research papers, one practical note and the abstracts of the presented papers at the 24th Biennial Conference of the AABE, which was held at the University of the Philippines, Diliman, Philippines, from the 5th to the 9th of December, 2012.

I still have some articles contributed from the AABE members and others. These articles are in the reviewing process and may be included in the next issue which will be published in 2015. The next issue will include the abstracts of papers presented at the 25th Biennial Conference of the AABE which will be held at the University of Malaya, Kuala Lumpur, Malaysia, from the 13th to the 16th of October, 2014.

Everyone can contribute their research paper, practical report, or the report on biological resources to AJBE. So, I would like to ask the readers to contribute their articles to this journal.

The articles contributed to AJBE last year have been reviewed by the following persons as well as the Editorial Board members: Dr. Raman Anantanarayanan (Charles Sturt University, Australia), Dr. Takeshi Fujita (Chiba University, Japan), Dr. Kei Kano (Shiga University, Japan), Dr. Hideo Kitano (Tokyo Institute of Biology Education, Japan), Dr. Takayuki Sato (Hirosaki University, Japan), Prof. Morakot Sukchotiratana (Chiang Mai University, Thailand), Dr. Merle C. Tan (UP NISMED, Philippines), Dr. Kunio Umeno (Japan University of Economics, Japan), Dr. Robert Wallis (University of Ballarat, Australia), Dr. Shigeyoshi Watanabe (Kumamoto University, Japan), Professor Yoshihiko Yonezawa (Naruto University of Education, Japan). I am very thankful to them for their efforts to review the articles.

Dr. Nobuyasu Katayama