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The Use of Model Making in Teaching Human Organ Systems

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Abstract **-** Teaching science is a dynamic process. Along with the advancement of technology, the methodology of the teaching process must be innovative to adapt to the current trends of education. Teachers then are prompted with perseverance to the task of providing innovative answers to modern need of the science curriculum. This quasi - experimental study aimed to determine the effect of model making as a tool in teaching selected human body systems. The study was conducted to a total of 102 university freshmen enrolled in Biological Sciences. Pre-test, post-test and interview guide were conducted to gather the data. Analysis on the pre-test and post-test scores revealed a significant improvement on the performance of the students. Furthermore, the group when exposed to the model making activity showed a significant mean difference between the pre-test and the post-test scores. The feedback of the students indicated that the model making activity made the learning process more challenging and interesting. Results showed that with model making, the teaching of selected human organ systems is effective. Model making, therefore, could be an alternative teaching technique to enhance students' creative thinking and better understanding of the concept.

Keywords - Education Model Making, Teaching Technique, Human Organ Systems, Quasi-experimental Design, Philippines

INTRODUCTION

Science teaching is a dynamic process. With the advancement of technology, the methodology of the teaching process must be innovative to adapt to the current trends in education.

Teaching biology like other sciences is challenged by attempts to incorporate in classroom instructions the contemporary ideas in science and issues that affect the learners as in the report of studies conducted by Reiss & Tunicliffe, (2001), Procop and Francovicova (2006), Özsevgeç (2007), Boo, (2007), Bahar etal., (2008), Çimer (2012) and Magtolis (2013). Teachers then are prompted with perseverance to the task of providing innovative answers to modern need of the science curriculum (Çepni etal., 2004; Barbero etal., 2008; Procop etal., 2009; Özsevgeç etal., 2012). In agreement with other educators that teaching biology today should gear on being effective by stimulating the learners to develop better attitudes to gain an in-depth understanding of the science concepts as established in the studies of Hedi & Harackiewiez (2000) and Procop etal. (2007). Literature reveals studies that were conducted to explore on varied alternative teaching methods that may be employed in teaching biology concepts (Çepni etal., 2004; Barbero, etal., 2008; Procop, etal., 2009; Özsevgeç etal., 2012).

In most cases, students tend to be passive learners of rote memorization and enumeration. Researchers like Tekkaya (2001) and Cimer (2004) reported reasons that led students to learn the material through memorization. These include overloaded Biology curricula and nature of biological science which include many abstract concepts, events topics and facts. Çimer (2004) and Çepni etal., (2004) also supplemented that teacher' styles of biology teaching and teaching methods and techniques are also factors that affect students' learning biology. Hence, students enrolled in biology cannot help but look at the subject as one full of tedious memorization. From this perspective, it appears that students whose interest is not on memorization get bored. Consequently, the students' performance is affected.

Because of their importance and the difficulty of the subject, science teachers seek for alternative teaching approaches in their teaching (Çepni etal., 2006). In the same study of Çimer (2004) it reported on some students' suggestions on what they think could make biology learning effective. The Turkish students suggested various strategies or techniques like teaching biology through the use of visual materials. The participants also indicated that they should see what they are learning. Further, they stated that in biology, if the teachers use various visual teaching and learning materials and tools such as figures, models, computer simulations, videos and real – life objects both teaching and learning of biology may become more effective (Çimer

2004, 2007 cited in Çimer, 2012).

Pagar (2001) mentioned in his study that models and modeling were essential in learning science. So much so that using models in teaching has provided a wide range of tools to enhance student learning. Biology is the study of life as defined by authors. However, the study of biology is not only about the different forms of living things; it also teaches us to ask, explain, and understand natural occurrences.

Thus, this study explored the effect of model making as a strategy for helping students to understand biological concepts better. This made use in particular the body systems, specifically, the digestive, circulatory, excretory, and respiratory systems. Human organ systems were reported to be one biology topics that students find difficulty with along with photosynthesis, cellular respiration, cell division and gene and chromosomes (Çepni et al., 2004; Magtolis, 2013).

The use of model making in the teaching of selected human organ systems could be beneficial to the Biology teachers to enhance their lessons and to reinforce facts and principles. Through model making, the students will be able to build upon what they know, represent concepts in their minds and organize ideas. Hence, the learning process will be enhanced and with added interest they will be able to apply the concepts learned to their daily activities.

To a certain degree, the study showed how much of the strategy model making can facilitate the learning of the basic biological concepts. This study will develop a teaching device that will help the teacher and the students in the learning process, as well as put life and interest into what is so often a dead study of life.

FRAMEWORK

The current trend of education is the application of the learned concepts in addition to the student-centred teaching as a shift from teacher-centred learning environment. Studies show that effective science teachers use a variety of instructional strategies, teaching skills and instructional materials within a given lesson (Çimer, 2004). As opposed to lecturing the whole period, these teachers may begin with a demonstration, move on to a brief lecture, conduct a hands-on activity and end with a review of major points. The quality of their instruction is evidenced by the amount of student engagement as reflected by the amount of student learning that occurs. A number of researches have established that regardless of students' intellectual ability benefit from the implementation of a good teaching strategy (Cimer, 2004).

The findings of Chiappetta's study (1998) also agreed that exemplary science teachers use these skills frequently to give students concrete examples, ensuring the opportunity to construct understanding. In addition to, Dillon (2008) reported that students need to see what they are learning or to experiment with what is being taught because biology include may abstract. The same was reported by Çimer (2007) and Joyce (2000) that when students engage in practice work, they can test, rethink and reconstruct their ideas and thoughts thus enabling the students to learn the topic through various cognitive activities. Therefore, it was suggested that teaching through practical work in biology lessons might make biology teaching and learning more effective.

Various studies about models and its implications had been conducted. One of such is by Keating, T. et.al., (2002) implied that by engaging students in model building activities can quickly compare their existing understanding with their model and then re-evaluate their understanding based upon feedback from their interactions with their model. And that this process is facilitated when students are provided activities that engage students in direct experiences with the concepts under study (Keating, T. et.al., 2002). This is due in part because educators have recognized that model - based reasoning can facilitate the development of mathematical – scientific understanding of the natural world (Keating, T. et.al., 2002).

The study of Pagar (2001) concluded that the use of modeling in Physics instruction significantly improves the performance of the problem solver. Selley's (2002) findings on his study have implications for the teaching of all science theory, but especially for conveying the purpose of models and the process of modeling. In his study, he asserted that the most versatile and powerful of the iconic models currently employed in the physical sciences is the particulate model for matter.

In another study conducted by Reuter and Perrin (1999), the effectiveness of dynamic computer simulation models for helping students understand ecological interrelationships and students' attitudes toward technology was explored. This study concluded that simulation software is very valuable in many disciplines, including biology.

Model was also used in the study by Inman (1999), where students constructed the three dimensional topographical model and concluded that the students comments were positive about their experience.

It is said that the future of man rests upon his ability to apply the achievements of science. This being the case, it is of utmost importance that the youth be thoroughly schooled in the principles of science so that they may properly understand and contribute to this progress. In this future ventures a leading part will be played by our teachers of science. For this reason the teacher of the life sciences should have a clear understanding on the basis for his profession and a command of the facts of science as well as the ability to encourage and inspire the students who study under his direction.

OBJECTIVES

The major thrust of this study was to test the use of model making in teaching selected human organ systems. Specifically, it endeavoured to find out the effect of model making approach in the academic achievement of students on the human organ systems and its advantages and disadvantages based on their perceived experiences.

METHODOLOGY

This study employed the quasi - experimental method of research using the pre test – post test design. It involved two classes, both experimental groups, of teacher education students of Leyte Normal University taking Biological Science with the approval of the university. The respondents were oriented on the purpose of the study and were assured of strict confidentiality of their responses.

The researcher-made test served as the Pre test and Post test which was utilized to test the effectiveness of the use of model making in teaching organ systems. This was composed of 80 – item multiple choice tests with 20 questions for each selected human organ system. The table of specification and item analysis were made to validate the content of the instrument. The interview guide questions were formulated to get feedback of the students about the model making activity with its validity established by colleagues in the field of biology education based on its relevance, clarity and understandability (Çimer, 2004). Revisions were made based on their comments and suggestions.

The model making activity was incorporated in a lesson sequence which contained a series of lesson plans. The activity consists of the drawings and procedures (illustrations were adapted from The Body Book by Wyne, P.J. and Donald M. Silver, 1993) to guide both the students and the teacher. The lessons in the lesson sequence are the digestive (Lesson 1), circulatory (Lesson 2), respiratory (Lesson 3) and excretory systems (Lesson 4) with model making as a learning task. A try out lesson on the skeletal system was conducted to orient the students to the whole process.

The lesson sequence, containing the four lesson plans with the model making activities, was also subjected for validation. This was carried out in the two classes taught by the same teacher (Çimer, 2004). The two classes received the treatment of model making activity, in addition to the lecture style of teaching biology concepts. However, the model making activity in each class was done alternately. While class A was introduced to the first lesson with model making approach, class B was introduced to the first lesson with no model making approach. Instead, the first lesson in Class B was taught with the usual way of teaching the topic. In other words, model making activity was employed in the first lesson for Class A but not for Class B. Hence, Class A was the experimental group while Class B was the control group for lessons 1 and 3. Then, for the second lesson, Class B made the model. Therefore in the lesson 2 and 4, Class A was the control group while Class B was the experimental group. The class was then divided into groups of four members for the model making activity.

Five students in each class were chosen purposively based on the pre test results. On the basis of the transcribed answers from the individual audio – tape recorded interview and researcher's observations, the model making procedures were looked into.

The pre test scores within the class were compared using the independent samples t-test. The paired samples t-test was used to compare the pre test and post test results between the two classes.

Effectiveness of the Model Making Approach

The effectiveness of the model making approach in teaching selected human body systems were determined through the lesson sequence involving freshmen education students of Leyte Normal University. The pre test and post test results and the recorded interviews provided the data whereupon the assessments of the model making were based.

A. Pre Test and Post Test Results

The mean pre test scores of the two groups are shown in table 1.

Table 1. Mean pre-test scores of class 1 and class 2 on the four tests in selected human body systems.

Subtest	Class A (n=49)		Class B (n=42)		Computed t - value	p - value
	Mean	Standard Deviation	Mean	Standard Deviation		
L1	6.2	1.97	7.0	2.75	1.635	0.106^{ns}
L2	6.7	2.24	6.6	2.47	0.255	0.799^{ns}
L3	8.6	2.23	8.7	3.07	0.256	0.798^{ns}
L4	8.0	1.97	7.6	1.91	0.923	0.358^{ns}
L1+L3	14.73	3.03	14.19	3.08	0.783	0.436^{ns}
L2+L4	14.69	3.04	14.19	3.08	0.847	0.399^{ns}

^{ns} -not significant

As reflected in the table, the performance of Class A in the second and fourth subtests is higher with a minimal difference compared to Class B. On the other hand, Class A performed better than Class B in the first and third subtests. The result of the t-test for independent samples revealed that the pre test scores of the two classes did not differ significantly since the p-value of the four subtests were higher than 0.05. Therefore, the pre test mean scores on the four subtests between the two groups were comparable. Consequently, Table 1 showed that the two groups were assumed to be equivalent in terms of their knowledge on the selected human body systems taught before these classes were exposed to the model making approach in teaching selected human organ systems.

In the same manner, the study conducted by Çepni etal., (2006) also established the respondents' present knowledge that was very close to each other and there was not a statistical difference between the groups before the treatment was conducted. Their purpose was to investigate the effects of Computer Based Assisted Instruction Material (CAIM) related to photosynthesis topic on students' cognitive development, misconceptions and attitudes. It is important to know what prior knowledge students bring to a learning environment in order to help them construct new knowledge (Tsai, 2000; Çepni etal., 2006).

The mean post test scores of the two classes are shown in the next table.

Table 2. Mean post test scores for L1-L3 and L2-L4
of the experimental and control groups.

LESSON	L1 – L3		L2 – L4	
	Experimental (Class A)	Control (Class B)	Experimental (Class A)	Control (Class B)
MEAN	31.90	19.07	30.81	17.24
STANDARD DEVIATION	3.809	4.386	4.718	3.503
COMPUTED t-VALUE	14.931		15.705	
p-VALUE	0.000**		0.000**	

** highly significant

The result of the Post test scores of the experimental group and control groups is reflected in Table 2. In the two lessons L1 (digestive) and L3 (respiratory), the experimental group was Class A, which received the treatment of model making activity, and Class B was the control group, which was not exposed to the treatment. As shown, the mean post test score of the experimental group is significantly higher in terms of these lessons than the post test score obtained by the control group. When the t-test was applied, the post test mean scores differed significantly since the p-value associated to the computed t- value of 14.931 is much less than ∂ = 0.01.

Conversely, Class A was the control group while Class B was the experimental group for Lessons 2 (circulatory) and 4 (excretory) systems respectively. It is shown in the table using the t-test that the post test score of Class B is significantly higher in terms of these lessons than the score obtained by Class A. The students in the experimental groups performed better by gaining higher post test scores than the students in the control group. Hence, Table 2 supports the effectiveness of the model making approach in the two classes.

The paired samples t-test was used to analyze the pre test and post test scores within each class. This was to verify if the mean difference in the mean scores between the pre test and the post test scores of the two classes was significant. The next table shows the result.

Table 3. Paired Sample t-test

Group	**Pretest**		**Posttest**		**t – value**	**p-value**	**Mean Difference**
	Mean	Standard Deviation	Mean	Standard Deviation			
Class A **E=L1+L3** **C=L2+L4**	14.73 14.69	3.033 3.043	31.90 17.24	3.809 3.503	27.613 5.294	0.000** 0.000**	17.17 2.55
Class B **C=L1+L3** **E=L2+L4**	14.19 14.19	3.078 3.078	19.07 30.81	4.386 4.718	6.084 21.616	0.000** 0.000**	4.88 16.62

** highly significant

As can be gleaned from the table, the two groups post highly significant post test results taking into account the lessons with model making activity. The pre test and post test scores of class A revealed an increase in the mean difference for Lessons 1 and 3, the lessons with model making activity. In the same manner, class B performed better in Lessons 2 and 4 where model making activity was employed in teaching the lessons. The application of the model making approach yielded a better performance of the students. The mean difference evidently shows a steep increase in the lessons with model making than the lessons with no model making activity. This observation is true to both classes. With this, Table 3 also supports the effectiveness of model making approach in teaching the selected human organ systems. Studies in literature indicated that for students to learn more effectively teachers should make biology lessons interesting and attractive (Cimer, 2004; Cepni etal., 2006).

B. Interview Responses

The use of this approach helped the students understand the lesson better as disclosed in their responses. The interview revealed that most of the students' responses and comments were confirmatory towards the model making approach in teaching selected human body systems. The models made by the students as the output of model making activity are also shown in the subsequent figures.

On Digestive System. *"The model helped me understand the lesson better. I came to know the structures and its functions. The different organs of the digestive system are the mouth, esophagus, stomach, small intestine, large intestine, rectum and anus. The liver and the pancreas are the accessory organs. The mouth serves as the entrance of food. It contains the teeth, tongue and salivary glands which cut, tear, push and moisten the food. The esophagus is the passageway of food from the mouth to the stomach. The stomach squeezes, grinds and twist the food. Mechanical and chemical digestion of food takes place in the stomach. In the small intestine complete digestion of food takes place. The large intestine absorbs large amount of water and eliminates undigested food through the rectum and out of the anus. The accessory organs release enzymes that help in the chemical digestion of food."*

"Through the model, I could now trace what happens to the food in each organ as it passes from one organ to another. Also the digestive juices and accessory organs that aid the process. The food in its simplest form will be absorbed to the blood stream and be distributed to all parts of the body. The undigested food will do to the large intestine where large amount of water will be reabsorbed. The undigested food will be eliminated out of the body through the rectum and anus."

Figure 1. Model making on digestive system.

"I find the model making activity enjoyable and challenging to come up with the model and follow the instruction. It encourages us to think.". "It develop teamwork at the same time learning together"

On Circulatory System. "*The model made me understand the lesson easily through its structures. The heart has 3 structures, the septum, valves and chambers. Septum is a flap of tissues that separates the heart into two sides – right and left sides. The right side collects deoxygenated blood from the body and pumps it to the lungs. The left side collects oxygenated blood from the lungs and pumps it to the body. The valves prevent the backflow of blood."*

"It gave me the idea on how blood circulates in the body as well as the structures of the heart. The blood from all parts of the body enters to the right atrium passes to the right ventricle, to the pulmonary artery then to the lungs. Then the oxygenated blood from the lungs enters to the left atrium, to the left ventricle, to the aorta and to all parts of the body where oxygen is delivered and carbon dioxide is collected. And the blood continues to circulate."

"I can picture out now the flow of blood and need not imagine anymore."

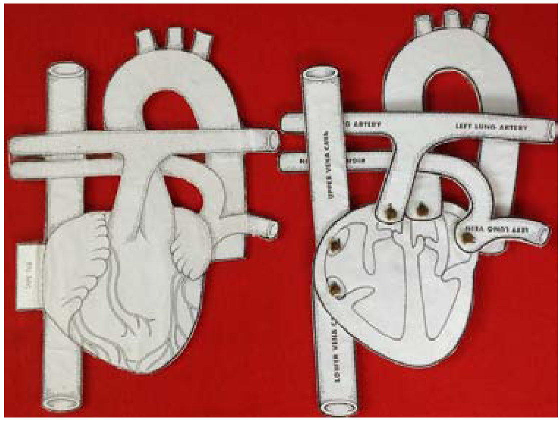

Figure 2. Model making on circulatory system.

"It was difficult at first but the instructions enlightened us with what to do and helped us overcome the difficulty"

"It gave us challenge to construct the model."

On Respiratory System. *"The model helped me understand more about its organs and where will air pass through. The air passes through the structure of the respiratory system which are the nasal cavity, pharynx, larynx, trachea, bronchi and the alveoli."*

"The model illustrates the path of the air and how the organs are like, arranged and structured inside the body."

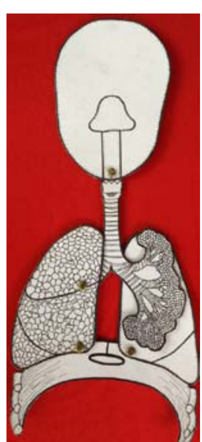

Figure 3. Model making on respiratory system.

"It was exciting and enjoyable because I know I will gain more information about the system". "It was easier because there were few pieces we need to connect and the instruction was clear enough."

On Excretory System. *"It made me realize how urine is formed. Urine is formed through filtration. Blood enters through the renal artery then to the kidney. Inside the kidney are the arterioles, glamerulus, bowman's capsule, loop of Henle, nephron, capillaries and renal vein. From the kidney, urine will pass through to the ureter, which transports the urine to urinary bladder. Then the urine will pass out of the body through the urethra."*

"During the discussion, the model helped me visualize the structure of the urinary system and its location in the body. The structures of the kidney are the cortex, outer section, medulla the middle section and the pelvis the inner section. The cortex, contain nephron, the filtering unit, containing the Bowman's capsule and the loop of Henle. The pelvis is where the collecting tubules come together."

Figure 4. Model making on excretory system.

"The following of instruction and putting the pieces together was challenging."
"It was easy because the instruction was clear and the parts were not too complicated."
"It was enjoyable and worthwhile. I didn't need to imagine anymore."
"It was fun working with group."

As observed, model making activity encouraged involvement of students. Students jumped into work enthusiastically. This result illustrated that the activity influenced students' attitudes towards the lesson in a positive way. It is believed that the enthusiasm was evident because the students loved to use their hands and created structures with their group mates. This observation supports the findings of the study of Çimer (2004) and Çepni etal., 2006.

Aside of having the students work and cooperate in small groups, the model making activity also supported the use of higher levels of thinking when they made the models (Lyon,2002). As part of the activity, they must discuss and describe each as a part of the model. The assembling of the pieces together and oral explanation encourage the students to do higher level thinking. Bloom's taxonomy tells that asking the students to evaluate, synthesize, analyze and apply what they know requires higher level of thinking skills than just understanding the basic knowledge. As the students use higher level thinking skills and so their intellectual behaviour is being developed (Lyon, 2002). The enthusiastic learning went on in the classroom for the whole duration of the treatment.

The students' high performance in the post test of the lessons with the treatment and the feedback of the students have proven that model making is an approach that may be employed in teaching selected human organ systems. The study conducted separately by Keating (2002), Pagar (2001) and Selly (2000) also concluded that the use of model making activity significantly improved the performance of the students.

As a whole the results in this study supported the effectiveness of model making approach. Likewise, it pointed out that students in the class exposed to model making activity tended to perform better and achieve more compared to the performance of those who were not into model making activity. Moreover, model making activity is another teaching tool that may help students develop better attitude towards the subject and improve their academic performance.

As cited in the work of Cimer, (2004) previous researchers also promote teachers' using visual materials like pictures, posters, models and computers in the lessons, which were found to be effective for making the lessons attractive and interesting for students. Further, recent studies have indicated that students remember best those ideas or concepts that are presented in a way to relate their sensory channels like audio and visual representations, pictures, charts, models and multimedia (Cimer, 2004). Also, teaching with visual materials can provide more concrete meaning to words, show connections and relationships among ideas explicitly, provide a useful channel of communication and strong verbal messages in students (Cimer, 2004; 2007). In the end this makes their biology learning more effective (Cimer, 2004).

CONCLUSION

Literature have reported various studies recommending a certain alternative teaching approach or material under study to be more influential to the students' attitudes and on students' academic achievement than the regular way of teaching the lesson (Kali, 2000; Tsai, 2000; Keating, 2002; Çepni etal., 2006; Dillon, 2008; Barbero etal., 2008). Similarly, this recent study concerning the effects of model making activity on students' achievement also supports the above mentioned authors.

The results showed that the two classes involved are comparable in terms of their knowledge on the selected human organ systems used in the study. Comparing the results, it generated a significant difference between the pre test and post test scores between the control and experimental groups. The students performed better and achieved more when exposed to the lessons with model making activity. The outcome of the interview reveals a challenge and interest in the learning process of the students. The students also made positive feedbacks concerning the model making approach as it has challenged them to think while enjoying as they construct the model. The activity has made the learning process interesting. However, these feedbacks are not adequate enough to argue that the activity have changed students' attitudes towards biology lessons. On the basis of the students' feedback, the clarity of the instructions in making the model have been revised and improved. Another important point that needs to be taken into account is that the model making activities are time consuming. Thus, taking into consideration the lesson time for biology (Çimer, 2012), the study suggests that teachers need to be definite in carrying out the allotted time.

In the light of these findings, it may be said therefore that model making is an effective tool in teaching selected human organ systems. Furthermore, model making approach may be used as a tool in teaching selected concepts in biology as it challenges and encourages better academic performance in students in addition to the usual way of teaching the lesson. However, this conclusion is limited to the number of respondents used in this study. Future studies may be designed to a bigger number of respondents for more comprehensive results.

RECOMMENDATION

The study suggests that the students' interest is aroused and they tend to learn more when model making approach is applied in the teaching of selected human organ systems. Model making may then be applied by teachers in the life sciences to encourage and inspire the students under their care. It is then another teaching technique to enhance students' creative thinking and for them to attain a better understanding of the concepts. Furthermore, it is also recommended that the model making activity be developed to teach all the human organ systems. Similar studies may be designed to enrich the results of this study.

LITERATURE CITED

Bahar M., Johnstone AH., and Hansell MH.
2008 Revisiting learning difficulties in biology. Journal of Biological Education. 33(2):84 – 86. Retrieved on September 24, 2013 from http://scholar google.com.ph/scholar?start=0&q=Is+biology+boring%3F+Student+attitu des+toward+biology&hl=en&as_sdt=0,5&as_vis=1

Barbero, A., and Novoa, J.
2008 Teaching integrative physiology using the quantitative circulatory physiology model case discussion method: evaluation of the learning experience. Advan in Physiol Edu. 32:304-311. Retrieved on September 24, 2013 from http://advan.physiology.org/content/32/4.toc

Basili, Patricia A.
1991 "Conceptual Change Strategies and Cooperative Work in Chemistry", Journal of Research in Science Teaching. 28(4).

BOO, H.K.
2007 Primary Science Assessment item setters' misconceptions concerning biological science concepts. Asia Pacific Forum on Science Learning and Teaching. 8(1):1- 13. Retrieved on September 24, 2012 from http:// scholar.google.com.ph/scholar?q=primary+science+assessment+item+setter s%27+misconceptions+concerning+bological+science+concepts+boo+&bt nG=&hl=en&as_sdt=0%2C5&as_vis=1

Çalik, Muammer and Özsevgeç, Tuncay
2012 "Investigating Senior Science Student Teachers' Conceptions of 'Environmental Chemistry' Issues: A Preliminary Study" Athens: ATINER'S Conference Paper Series, No: EDU2012-0041Retrieved on September 24, 2012 from http://www.atiner.gr/papers/EDU2012-0041. pdf

Capco, Carmelita M.
2003 BIOLOGY. Quezon City; Phoenix Publishing House, Inc.

Campbell, Neil & Jane Reece.
2005 Biology 7th ed . CA.: Benjamins/Cummings Publishing Company)

Çepni, S., Taş, E. and Köse, S.
2006 The effects of computer – assisted material on students' cognitive levels, misconceptions and attitudes towards science. Computers and Education. 46:192-205.

Chiappetta, Eugene L. et al.
1998 Science Instruction in the Middle and Secondary Schools Fourth Edition. Prentice – Hall Inc. New Jersey.

Çimer, S.O. and Ursavas, N.
2012 Student Teachers' Ways of Thinking and Ways of Understanding Digestion and the Digestive System in Biology. International Education Studies. 5 (3) :1-14. Retrieved on September 24, 2013 from http://scholar.google.com.ph/scholar?q=Student+teachers%27+ways+of+thinking+and+ways+of +understanding+digestion+and+the+digestive+system+in+biology&btnG=&hl=en&as_sdt=0%2C 5&as_vis=1

Çimer, A.
2012 What makes biology learning difficult and effective: Students' views. Educational Research and Reviews. 7 (3) :61-71. Retrieved on September 24, 2013 from www.academicjournals.org/err/PDF/Pdf%202012/January/.../Cimer.pdf http://www.academia.edu/1482935/The_effects_of_computer- assisted_material_on_students_cognitive_levels_misconceptions_and_attitudes_towar ds_science

Clayman, Charles.
1995 The Human Body an Illustrated Guide to the Structure, Function and Disorders. London: Dorling Kindersley Limited

Dela Cruz, Suzana B.
2003 Biology. Phoenix Publishing House, Inc.

Dillon, J.
2008 A Review of the Research on Practical Work in School Science. Retrieved on September 24, 2013 from score-**education**.org/media/3671/

review_of_**research**.pdf

Gay, L.R.
1987 Education Research: Competencies for Analysis and Application. 3rd edition. Columbus, Ohio: Merill.

Hedi, S. & Harackiewiez JM.
2000 Motivating the academically unmotivated: a critical issue for the 21st century. Review of Educational Research. 70(2):151-179 Retrieved on September 24, 2013 from http://scholar.google.com.ph/scholar?hl=en&as_sdt=0,5&as_vis=1&q=Hidi+%26+Harac kiewicz+2000%09motivating+the+academically+unmotivated

Inman, John C.
1999 "Soil Survey Manuals, and 3-D Models Tools for Teaching Concepts of Land Use in Environmental Science", THE AMERICAN BIOLOGY EACHER. 61(9).

Joyce, B., Weil, M. and Calhoun, E.
2000 Models of Teaching. *Research in Science Education* 31: 383-399. Retrieved on April 07, 2012 from http://link.springer.com/article/10.1023/A:1013116228261

Kali, Yael. CILT
2000. "Visualization and Modeling", Journal of Science Education and Technology. 11(3).

Keating, Thomas at al.
2002. "The Virtual Solar System Project: Developing Conceptual Understanding of Astronomical Concepts Through Building Three- Dimensional Computational Models", Journal of Science Education and Technology. 11(3).

Lardizabal, Amparo S. et al.
1996 Principles and Methods of Teaching. Quezon City: Phoenix Press Inc.

Levine, Joseph A. er al.
1991 BIOLOGY Discovering Life. Massachussets: D.C. Health and Co.

Magtolis, J.M.
2013. Students' Conceptions on Human Organs Systems: The Case of University New Entrants. IAMURE International Journal of Education. 6(1): 104 – 121. Retrieved on September 24, 2013 from http://iamure.com/publication/index.php/ije/article/view/498

Odom, Louis etal.
2002. "Technology Knowledge and Use: A Survey of Science Educators", Journal of Science Education and Technology. 11(4).

Ornstein, Allan
1990 Strategies for Effective Teaching. Harper Collins Publishers Inc.

Özsevgeç, L.C.
2007. What do Turkish Students at Different Ages Know about Their Internal Body Parts Both Visually and Verbally?.Journal of Turkish Science Education. 4 (2) :31-44. Retrieved on April 07, 2012 from http://www.tused.org/internet/tufed/arsiv/v4/i2/metin/tusedv4i2s3.pdf

Pagar, Art Gimelo.
2001. "A Metacognitive, Model-Building Approach and Physics Students' Problem-Solving Performance and Strategy", SCIENCE, MATHEMATICS AND TECHNOLOGY LITERACY': Strategies for the 21st Century.

Prokop, P. & Fanèovièov.
2006. Students' Ideas About the Human Body: Do They Really Draw What They Know?. Journal of Baltic Science Education.2 (10): 86-95.

Procop, P., Procop, M., and Tunicliffe, S.D.
2007. Is biology boring? Student attitudes toward biology. Educational Research. 42 (1): 36 – 39. Retrieved on September 24, 2013 from http://scholar.google.com.ph/scholar?start=0&q=Is+biology+boring%3F+Student+attitudes+toward+biology&hl=en&as_sdt=0,5&as_vis=1

Project 2061
1990 Science for all Americans. Oxford University press, Inc.

Selley, Nicholas J.
2000. "Students Spontaneous Use of a Particulate Model for Dissolution", Journal of the Australian Science Research In Science Education Research Association. 30(4).

Talisayon, Vivien etal.
2001 Science, Mathematics and Technology Literacy for the 21st Century. Quezon City Philippines.

Tekkaya, C., Özkan, Ö., & Sungur, S.
2001 Biology Concepts Perceived as Difficult By Turkish High School Students. *Journal of Hacettepe University Education Faculty* 21: 145-150.

Tsai, C.
2000 Enhancing science instruction: the use of "conflict maps". International Journal of Science Education, 22 (3): 285 – 302. Retrieved on September 24, 2013 from score-**education**.org/media/3671/**review**_of_**research**.pdf

Tunnicliffe, S. & Reiss, M.
2001 Students' Understanding About Human Organs and Organ Systems. *Research in Science Education* 31: 383-399. Retrieved on April 07, 2012 from http://link.springer.com/article/10.1023/A:1013116228261

Wyne, P.J. and Donald M. Silver
1993 The Body Book. USA.

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