International Journal of Learning, Teaching and Educational Research
p-ISSN: 1694-2493
e-ISSN: 1694-2116
Vol. 15, No.4, pp. 32-41, ©IJLTER

Issues-Oriented Approach: Effects on Students' Concept Reconstruction and Achievement in Biology

Mariam A. Sunggod
Mindanao State University
Marawi City, Philippines
mariams_101@yahoo.com

Abstract
This quasi-experimental study was undertaken to determine the effects of the issues-oriented approach (IOA) on concepts reconstruction and achievement of students towards Biology. This study utilized both quantitative and qualitative methods of research specifically pretest – posttest control group design. Two (2) comparable intact sections of grade eight junior high school students at Mindanao State University- Integrated Laboratory School (MSU- ILS) were involved in this study. Data were gathered using the concept map, achievement test, journal writing, and interview. The data gathered were analyzed statistically using t-Test and Pearson Correlation Coefficient. Findings showed that both groups hold many misconceptions on the selected topics in Biology before and still even after the intervention but it considerably decreased in the experimental group. In reconstructing students' concept in Biology, the issues-oriented approach (IOA) group significantly performed better compared to the traditional lecture-based approach (TLBA) group. Thus, it can be concluded that the issues-oriented approach (IOA) in teaching Biology has a positive effect on the achievement of students, as well as on the concepts reconstruction of the students. The results imply that IOA lead to better understanding of some biological concepts as revealed in the refinement and reconstruction of the concepts of the students and their higher achievement in biology on the topics regarding Ecology, Taxonomy, and Evolution. It is then recommended that science teachers in different grade eight junior high school students use this kind of method as one mode of their teaching instructions, in order for the students to become issues-oriented and increase awareness to their environment.

Keywords: Achievement, Concept Reconstruction, and Issues-Oriented Approach

Introduction

The Philippines educational system focuses on the attainment of quality education, particularly in science education as mandated in the 1987 Philippines Constitution. It is cited in another article in the Constitution that science and technology are essential in national development. It has been stressed further by Senator Angara (2008) that "a strong foundation on new science and technology will lead the Philippines to development." However, it seems that this old dream of achieving quality education and advancement in science is yet to be achieved. Based on the report of the Third International Mathematics and Science Study (TIMSS) and the Second International Science Study (SISS), the Science Education in the Philippines is lagging behind and placed in a disadvantaged position among participating nations (Orleans, 2005; Schmidt et al., 2001; DECS, 2000). Furthermore, the poor quality of education is shown by the National Achievement Test in which only 15.3 % of elementary school pupils crossed the 75 % level required for high school, and that less than 1 % of high school graduates crossed the 75 % level

in the 2006 National Achievement Test, according to the press statement of Senator Legarda (2009). She further emphasized that clearly there is something wrong with the method and content of teaching in our elementary and high schools. These findings are very alarming, that is why the researcher has conducted this study, in the hope to contribute in addressing these problems in the educative process. Several studies on students' concepts reconstruction and achievement in Biology have been conducted by the different researchers, but most of these studies do not adequately address the problem. One cannot deny the fact that misconceptions have serious impacts on the individual's learning. It can be a profound barrier to understanding science. Based on the findings of Gabriel (2007), Web-enhanced instruction can promote students' concept construction, achievement, and attitude towards biology. Her findings also suggest a need to conduct a similar study, this time with the researcher using an Issues-oriented approach instead of Web-enhanced instruction. Moreover, Jenkins and McDonalds (1989) argue that alternative teaching methods of science itself might provide opportunities for some meaningful learning. Moreover, the teacher needs to innovate on instruction to be able to prepare the students better for the modern society – that is, to make them competitive in these challenging times (IBM eMentor, 2006). In order to integrate issues, teachers may need to innovate their methodology (Lewis, 2003).

One of the teaching strategies/ methods integrating current issues in teaching is the "Issue-Oriented Approach." The term "issue" refers to a subject that is of current interest and general concern in society and is open to public debate and the formulation of opinion among individuals or groups. Many of them may be controversial, such as cloning, genetic engineering and abortion (Mathison, et al., 1997; Yager et al., 1981). Furthermore, Lewis (2003) stresses that through the use of issues in the science classroom, students can develop good qualities such as improving their critical analysis skills; easily adapt to the dynamic nature of science in society; understand the importance of scientific issue in making decision; and make science "come alive." Therefore, using issues in teaching science can cater to the different needs that we could be inculcated in student learning and could provide them with all-important skills for economic survival in today's workplace if this approach could be applied effectively.

Purpose Statement of the Study

Addressing the concerns and issues presented above, this study was conducted to determine the effect of using the IOA on students' concepts reconstruction and achievement in Biology. Specifically the study aimed to determine the effects of the Issues-Oriented Approach (IOA) on the concepts reconstruction and achievement of students in Biology. IOA and the traditional lecture-based approach (TLBA) were compared to find out which teaching instruction was more effective in reconstructing concepts and progressing students' achievement. Seven research questions guided the study. First, what misconceptions do the students have on selected topics in biology prior to the intervention? Second, what were the misconceptions that are reconstructed for both groups after the intervention? Third, is to identify if there a significant difference between the pretest-posttest mean gain score of the students taught by way of the IOA and the students taught using the TLBA; fourth, is to find if significant difference in the posttest mean scores of the students taught by way of the IOA and the students taught using the TLBA. Fifth, is to evaluate if there is a significant difference between the post-instructional concept map mean scores of the students taught by way of the IOA and the students taught using the TLBA; Sixth, is to determine if there is a significant difference in the concept map mean gain scores between the students taught by IOA and the students taught using the TLBA; and seventh, is to determine if there is a significant correlation between the concept reconstructions and academic achievements in both groups?

Method

Participants

Two (2) intact sections of grade eight junior high school students at MSU-ILS were the respondents of this study. The respondents were matched on the basis of their average grades from first grading to third grading in biology. Levene's Test was used to say that (there is a basis for comparison) the two groups were comparable. Assigning of experimental and control group was done through the tossing of a coin. The experimental group underwent the issues-oriented approach (IOA) on three selected topics in Biology while the control group underwent the traditional lecture-based approach (TLBA) on the same topics.

Design

This quasi-experimental study employed the Matching – Only Pretest – Posttest Control Group Design. It employed both quantitative and qualitative methods of research to determine the effects of the issues-oriented approach on the students' concept reconstruction and academic achievement in biology. The quantitative aspect follows the experimental design of research specifically quasi- experimental research design.

Materials

Four (4) research instruments were used in data gathering. These are the concept map, achievement test, journal writing and interview. A concept map was used to identify the prior knowledge and misconceptions of the students. While an achievement test was a teacher made 90-item test which was utilized to evaluate the achievement of the students in both group and it has a 0. 771 value of Cronbach's Alpha. The questions in this test covered the topics in the fourth grading period (Ecology, Taxonomy, and Evolution). An interview and journal writing were used to substantiate the data gathered from the questionnaire and concept map.

Procedure

Prior to the intervention, permissions from the gatekeepers were sought to conduct the study on the selected second year high school students as respondents of the study. It happened that the two intact sections were handled by the researcher. To ensure that the researcher did not deviate from the lesson plan, participation of one science teacher as observer was asked. Moreover, the researcher administered first the pre- achievement test in the experimental and control groups. The researcher administered the tests herself to ensure the uniformity of testing procedure. Instructions on answering the tests were explained properly and the students were given ample time to finish the tests.

Checking and scoring was done immediately after the pre-test and before the intervention took place for analysis. Prior to the intervention, the researcher asked the students in both groups to make pre- instructional concept maps regarding the selected topics in biology to know the prior knowledge and misconceptions of the respondents on these topics. After the construction of the pre- instructional concept maps, science classroom instruction was conducted using the issues-oriented approach on the experimental group and traditional lecture-based approach on the control group. At the end of every topic, they were required to make their post- instructional concept map on the lesson presented and they were reminded to accomplish their journals.

An interview was conducted also to confirm the reconstructed concepts of the students for both groups. After the intervention, the post-test on achievement was administered on the two groups of students. Then, the data gathered was analyzed and interpreted. The duration of

the study was more than six (6) weeks or one grading period. For the whole period of the intervention, both groups were given the same objectives, topics, instructional materials, quizzes and assignments but different methods of instructions. In addition, laboratory activities and reinforcements were given to both experimental and control groups for uniformity of activities.

Quantitative data were analyzed through the Statistical Package for Social Sciences (SPSS) software. Mean score describe the scores of the respondents that are exposed to the two teaching strategies in understanding the biological concepts. t-Test (for correlated mean) was used to determine the significant differences between the two groups in the achievement test scores and concept mapping scores. Specifically, it was executed on the mean gain scores of the achievement test and concept map between groups. Moreover, to find significant correlation between the concept reconstructions and academic achievements of the two groups Pearson Correlation Coefficient was used. For qualitative data, hand analysis was used.

Results and Discussion

Students' misconceptions and concept reconstructions were assessed through concept map and it were supported from the evidences in the journal writing and interview of students from both groups. Findings revealed that prior to the intervention; the number of students who committed misconceptions in the experimental group was moderately higher compared to the students in the control group. Results also show that some student committed more than one misconception. After the intervention, there were misconceptions which were corrected and restructured but there were students also who still had misconceptions even after the intervention. It can be noticed too that most of the respondents' misconceptions significantly decreased particularly in the experimental group, as evident in their concept map and journal entries. During interview before the intervention, the students were asked about their idea on the definition and meaning of ecology. These were their responses:

Researcher:
In your own idea, describe what Ecology is.
Respondent:
*For me, Ecology is the study of living things… Shal, (*Experimental Group:)

According to Capco and Yang (2010), Ecology is the branch of biology that deals with the study of the relationship between organisms and their environment. Based on the quoted response above, there seems to be a misconception in the ideas of the students about ecology.

Another view about the meaning of Ecology was also expressed by Asno from the Control Group where this student relates ecology with the environment.

Interview (01/25/10) Ecology is concerned with environment. Ecosphere and Biosphere is under the environment. Asno, Control Group: *Interview (01/25/10)*

It is obvious that these students have a limited knowledge about ecology.

After the intervention, there are changes in the concepts of the students. Some their responses were quoted below:

Researcher:
After our discussion about Ecology, what can you say about this topic?
Respondent:

I learned that Ecology is a branch of biology that deals with the study of the relationship between organisms and their environment.

Researcher:

What else did you learn in the lesson?

Respondent:

I also learned in this lesson that the biotic and abiotic is different and it is not the same. I learn that abiotic is a non-living thing and biotic is living things.

Shal, Experimental Group: Interview (02/12/10) a quite similar concept was conveyed by the students in the Control Group. Ecology consists of biotic factors, ecosphere and abiotic factors.

Asno, from Control Group: Interview (02/12/10) which can be seen from the above interview excerpt indicate that students in the experimental group have better knowledge of this topic after the intervention, compared to students in the control Group. But both students relate ecology to biotic and abiotic factors. They both had misconceptions in directly relating Ecology to these factors. The student in the control group was not able to establish that Ecology was a branch of biology.

Furthermore, the students need deeper understanding of phenomena that reveal multiple levels and scales in order to understand and apply ecological concepts, and therefore, identifying that while one does not always predict an outcome, they can recognize factors, their magnitude and roles (Stamp et al., 2006). During the conduct of interview before the intervention, the usual response of most of the respondents are, *"I don't know, ma'am, or I don't have any idea*." Some students' gesture was just to shrug their shoulders, indicating indifference or lack of knowledge. It was observed also that students are hesitant to answer the questions. It might be because they were not used to being asked these questions. It was evident also that after the intervention, the number of misconception committed in the topic of Ecology decreased. It can be noticed, too, that there were fewer misconceptions. The erroneous implication could lead to more confusion or to another alternative concept that is why it is very important to correct it immediately. These may result in chains of misconceptions that can obstruct the student's higher learning. This view is supported by Guro (2011) that if these misconceptions were not corrected, they would lead to other misconceptions that can hinder higher learning of the students.

Misconceptions in ecology "strike at the heart of a general understanding of ecology" and influence opposition in tackling and solving problems of the environment (Munson, 1994). The implications of these matters are quite alarming. The students need to understand this lesson clearly for them to appreciate their role in preserving and taking care of their environment. On the other hand, determining misconceptions in ecology is quite hard (Stamp et al, 2006).

Another concept included in the study is the Ecosystem and its components. Capco (2003) defines ecosystem as an ecological unit that includes all interacting parts of an environment in an area. It consists of the interaction between the living (biotic) factors and the nonliving (abiotic) factors. All living organisms are considered as biotic factors while the physical conditions that influence the interaction of the two components is the abiotic factors (Manosa and Talaue, 2007).

The rich biodiversity and complexity of the ecosystem are vital to the survival of the organisms and the natural environment (Guro, 2011). Biodiversity in the ecosystem is our wealth and shared natural resources. Students' awareness of their biodiversity's role in maintaining the ecosystem is very crucial. In the interview students were asked what ecosystem is and describe its

components. This question could evaluate their environmental awareness of the preservation of the biodiversity of the ecosystem. Results are further supported by another reflective insight of the students in their journal writing after the intervention. Students responses wrote in their journal were made after the task to know their own insights and understanding about the lesson discussed with them, using the Issues-oriented approach. Student appreciates the lesson and recognizes her own role in preserving the ecosystem. As supported by Minkoff and Baker (2001), biology should be seen as a process of discovery rather than a series of facts to be memorized.

The issues approach in teaching could ensure that students learn to think critically about the role that science plays in their world. In connection with this aim, Respondents Journal Entry gives an idea about their environmental awareness and how they were able to reflect and remind themselves of their responsibility in protecting and conserving the environment. These results simply implied that students' misconceptions can be corrected with the use of appropriate teaching methods.

Generally, findings of this study revealed that the MSU-ILS grade eight junior high school students had misconceptions in the topic Ecology, Taxonomy and Evolution. However, after the intervention, the experimental group had a perceptible decrease of misconceptions, as compared to the control group. These results support other related studies on misconceptions in science such that of Guro, 2011; Tan-Paiton, 2008; Gabriel, 2007; and Stover and Mabry, 2007. The importance of these findings is that the identified misconceptions of the students from both groups reveal a great deal of information on the teaching-learning process in Biology. It is very crucial to know the different factors that could badly affect the learning of the students', such as committing misconceptions.

One cannot refute the fact that misconceptions have severe impacts on student's learning. They could be a hindrance to the understanding, as well as the positive reception, of students towards science, but when misconceptions are found, they can be useful indicators of concepts that are potentially confusing to students (Hershey, 2005). By knowing these misconceptions earlier, it could be addressed properly and immediately to prevent them from continuing. This study's findings also suggest that the use of the issues- oriented approach on students' concepts reconstruction on selected topics in Biology is more effective as compared to the traditional lecture-based approach, since it can be noticed that the misconceptions of the student in the Experimental Group declined as compared to those in the Control Group. This occurrence may be best explained by the argument of Mathison and Freeman (1997) who stressed that issues increase the students' awareness, improve their capability in making decision in times of controversy and enrich their understanding and tolerance for contradictory opinions.

In the aspect of student's achievement in the pretest and posttest, results revealed that both groups has almost the same score during the pretest, however in the posttest they showed an increase in their mean scores in the posttest. However, experimental group means score is significantly higher than the control group means score. This result implied that the IOA group revealed a higher mean score than the TLBA group was that the students became more adept with the lessons presented because it was related to recent issues in the society, which made the lesson engaging and current. It also awakened their awareness regarding the different controversial issues in their surroundings that somehow affected their lives. As pointed out by Minkoff and Baker (2001) that the issues approach in teaching could ensure that the students learn to think critically about the role that science plays in their world.

It is vital to note that there is really a significant difference in the two groups in terms of their achievement posttest mean score. This may imply that Experimental Group had performed better in improving their achievement in biology as compared to the Control Group. This might

be due to the use of the issues- oriented approach which made the lesson current and engaging. As supported by Lewis (2003), using issues in the science classroom helps students develop the skills of critical analysis and lifelong learning and deal with the changing nature of science in society.

Thus, using this approach makes learner a lifelong learner. Furthermore, it involves students in the improvement of their decision making skills and attitudes and inspires them to make sound judgment towards issues in science and technology (Heath, 1992). It can be inferred from the results above that there is a significant difference of the students taught by way of the issues- oriented approach and the students taught using the traditional lecture based approach based on the outcomes of their achievement test. This may imply that the issues- oriented approach is effective in improving the academic achievement of the students because this approach makes science "come alive." Students can easily understand the lesson tackled because these are related to and connected with the current and controversial issues in society. This finding was supported by the studies done by Hanegan, Price and Peterson (2008), who scrutinized how the use of socioscientific bioethics issues influence the teacher expectations of students' general performance and student confidence in their own work in a scientific argumentation.

The teacher's use of bioethical issues in the classroom can not only provide biology content knowledge but also improve their skills in decision-making. Moreover, through scientific argumentation, learning bioethics provides students a chance to express their ideas, formulate their opinions and respect other point of view. Concept Map Mean Scores of the Students shows that the experimental group obtained higher mean scores on the topic Ecology and Taxonomy compared to the control group. The results may be attributed to the fact that these topics might have been taught to them in small details in their science subjects in their earlier years of education, which is why the experimental group had more prior knowledge on these topics.

Furthermore, the results could be explained by the fact that before instruction, learners brought with them a set of assumptions and beliefs that could serve as mental framework for learning (Mendija, 2005). On the topic Evolution, the control group obtained a modest increase in the pre-instructional concept map mean scores over that of the experimental group, although this does not indicate a significant difference. This may indicate that the use of the Issues-Oriented Approach on the experimental group was effective in correcting the misconception of the students. This may also means that during the intervention, the students may have gained better understanding of these topics, as shown in the improvement and conceptual refinement of their concept maps. Furthermore, it was unexpected that during the intervention, there were many issues in the society due to the effects of the El- Nino phenomenon. Most of these issues were unexpectedly related to and correlated with the topics discussed. This may be the reasons why students had a profound understanding and knowledge of the different topics presented to them since they experienced it in their daily life in the society, as evident in the result of the post-instructional concept map means score of the experimental group. They were actively engaged in their learning due to the societal issues that were related to the lesson during the intervention. As pointed out by Johnson (2007), using current issues in teaching biology can spark curiosity to non-science majors through inspiring them to link real-world issues to biological concepts which are significant in their own lives.

In the analysis done on the post- instructional concept map mean score of the experimental group and the control group. Finding shows that their levels of concept reconstruction, as designated by the mean score in their post- instructional concept map on the

different topics, showed the two groups to be significantly different. This results imply that the intervention used in the experimental group is much effective than the traditional method of teaching. In relation to the above results, this trend is expected under the assumption that during the intervention the students had acquired additional knowledge and had gained better understanding of the topics that brought about by the intervention. This may also imply that there was an improvement in the conceptual understanding of the students in the experimental group. This was perhaps due to the use of the Issues-oriented Approach, in which the students easily understood the lesson because they could relate it to the different issues in their own society where they have a first-hand experience. Studies reveal that students can learn best in an event that tackle what they know, test their misconceptions, and allow them to integrate new knowledge with the previous (National Research Council, 1999).

Additionally, they had a greater retention of the lesson since it was connected to the controversial issues in their environment where they become aware of it and understood it a little deeper because it was tackled inside the class. This result supports the contention of Bodzin and Mamlok (2000), which emphasizes that when students are taught using controversial and authentic issues, science instruction becomes current and engaging.

It **is** essential to note that before the intervention, the levels of concept formation between the two groups were solely dependent on prior knowledge of the students; for this reason there were many misconceptions identified prior to intervention, as shown in their pre-instructional concept maps, journals and informal student interview. Accordingly, after the intervention, the misconceptions of the students in the IOA group were distinctly decreased as shown in their post-instructional concept maps. Finally, they were able to reconstruct their previous concepts and elaborate further on the relationships among the concepts in their post-instructional concept maps. With regard to the control group, there was also concept reconstruction, but not as reflective and profound as that of the experimental group.

In the aspect of concept reconstructions and academic achievements in both groups results revealed that there is very little correlation between the concept reconstructions and academic achievements. Particularly, the value of the correlation coefficient (r) for achievement (gain) and ecology (gain) is 0.150 with a p-value of 0.343 which is greater than 0.05 level of significance. This means that the academic achievement of the students was not correlated to their concept reconstructions in the topic ecology. This may imply that change in the concept reconstructions may not lead to academic achievements. It further implies that, academic achievement is not the appropriate way to measure concept reconstruction. This finding is supported by the study of Mendija (2005) which states that the student's performance on examinations questions does not accurately reflect the students understanding of concepts.

Conclusions and Recommendation

The Issues-Oriented Approach (IOA) strategy is effective in the process of teaching and learning. In this strategy, students are led to think deeply of the topics since they can relate it to the different issues currently occurring to their environment and which they presently experience. IOA has positive effects on the concepts reconstruction and achievement of students Biology. It means that this approach leads to better understanding of some biological concepts as revealed in the refinement and reconstruction of the concepts of the respondents and improvement in respondent's achievement. Thus, teachers are encouraged to identify the students' misconceptions before the start of the lesson and be given enough attention and apt action in order to minimize pre-conceived misconceptions. Follow up studies are imperative to understand better the effects of using different methods, particularly the Issues- Oriented Approach, in addressing these concerns to correct students' misconceptions. Future studies

would be able to better assess long-term impacts of using the Issues- Oriented Approach in concept reconstruction of biology students. Students' Achievement Through the teacher-constructed achievement test, the achievements of the students were assessed and evaluated.

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