Integration of environmental knowledge across biology, physics and chemistry subject at secondary school level in Malaysia

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Abstract

Environmental Education in Malaysia is applied across the curriculum at both primary and secondary levels for all subjects. Under the constraint of educational system, schools and teachers, curriculum content has become the only important component that can sustain the implementation of these additional elements. Science content of Biology, Physics and Chemistry are assumed to have more parallel integration with Environmental Education content. This study aimed to determine how much environmental knowledges are integrated across the current science curriculum content in those subjects. The methodology of this study is an analysis of Form Four and Form Five’s Biology, Physics and Chemistry syllabus. The results of this study showed that Biology have the more extent to adopt environmental knowledge compared to Physics and Chemistry. These findings also serve as a guide for science teachers to make additional efforts to apply Environmental Education in their classroom.

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Introduction

1. Introduction

The implementation of Environmental Education has started to be stressed out globally since this issue was discussed seriously in Tbilisi Conference at 1977. Argument of this issue emerges as there were several environmental destructions began to cognizant at that time. In Malaysian educational context, Environmental Education refers to teaching and learning process to understand the interaction between human and the environment; and also how the environment managed wisely and responsibly towards the sustainable of life on the Earth (Malaysia Department of Environmental & LESTARI UKM, 2004). This involves education about the environment, through environment and for environment.

At primary school level, Environmental Education once was implemented in Man and Environment subject for ten years started at 1983. This subject was repealed due to the highly packed content that includes knowledge component for history, geography, science and civic (Chelliah, 1992). This subject was then replaced with Science and Local Study, which their curriculum content developed separately and arranged more systematically. While at
secondary level, Environmental Education had been integrated through Science and Geography subject from the beginning.

In 1998, Curriculum Development Centre has prepared Environmental Education guide book for teachers to implement Environmental Education across curriculum of all subjects. This effort showed how much the importance of environmental literacy to be implemented to students for environmental sustainable purposes. However, based on previous researches, it seems that the level of students’ knowledge towards environment is still dissatisfied.

Research by Mageswary et al. (2006) shows that the level of environmental knowledge among students reported to be high but still not sufficient to contribute to the changes in attitude and their behavior. While studies conducted by Norlila (2007) shows that 3R practice among students is at the moderate level and Nachimuthu (2008) said 5R practice among them is at low level. Thus, the purpose of this study is to identify to which extent the curriculums in science subjects had integrated environmental knowledge in their core content.

2. Environmental Knowledge

Providing environmental knowledge was one of the objective components in implementing Environmental Education other than enhancing awareness, attitude, skills and behaviour towards environmental among students. According to Tanaka (2000), environmental knowledge can be defined as individual understanding on how environment functioning; how human interact with the environment; how environmental problems arise; and in what way these problem can be overcome. For Rohiza (2004), environmental knowledge can be explained in the context of environmental literacy component regarding to knowledge of issues related to environmental sustainability and its influence on human life. Environmental literacy according to Rowe (2002) refers to the foundation of understanding towards the concept and knowledge on relevant issues and information with health and environmental sustainable. This includes environmental issues relating to human health.

Hungerford et al. (1994) have listed down scope of Environmental Education which should be implemented at middle school level. The scope was classified into three categories that are Ecological Foundations and Humans as an Ecological Factor; Environmental Science and environmental Health; and Issue Investigation and Citizenship Action Training. While Erdogan et al. (2009) divide environmental knowledge under three themes namely (i) knowledge of natural history and ecology; (ii) knowledge of environmental issues and problems; and (iii) socio-political- economic knowledge.

3. Environmental Education in Science

Across curriculum approach refers to the integration of content and skills into existing courses in a manner so as to focus on that content (and/or skills) without jeopardizing the integrity of the courses themselves (Hungerford et al., 1994). Science is available as one of the most relevant subjects to apply the environmental knowledge through this approach because there is mutual dependency relationship between the content itself and the environment. In the context of Malaysia, this can be seen in four out of ten science curriculum objectives outlined by the Curriculum Development Centre (2005a; 2005b; 2005c; 2006a; 2006b; & 2006c) in the syllabus for science subjects for Form One to Five. That four objectives are (i) to acquire knowledge of science and technology and connecting them with phenomena of the nature and everyday experience; (ii) to understand the knowledge of science related to development science and technology field, nature management and their sources; (iii) recognizes the importance of mutual relations between the management of wildlife and nature for the continuance of human life globally; and (iv) to realize that scientific research findings were based on an endeavor and the ability of the human mind to understand the natural phenomena towards achieve well-being of mankind. While White (2000) thought that the concept of science can be viewed as a field of science that emphasizes the environmental sciences for understanding phenomena through scientific equipment. Equipment in this term is defined as observations, measurements and scientific experiments.
4. Methodology

The study was conducted using documents analysis design. The documents used were curriculum specification for Biology, Chemistry, and Physics subject for Form Four and Form Five; and also a checklist table of environmental education adapted from the checklist provided by Hungerford et al. (1994) that allies under Ecological Foundations and Humans as an Ecological Factor; and Environmental Science and Environmental Health theme. A checklist was used to see whether the curriculum contents of every subject have indirectly integrated teaching and learning of environmental knowledge. The curriculum content was identified based on the learning outcomes that to be achieved by students for each subtopic listed in those curriculum specifications.

5. Result and Discussion

The result of analysis of applying environmental knowledge across the curriculum content of Biology, Chemistry and Physics for Form Four and Five are shown in Table 1.

Table 1. Checklist of environmental knowledge application across the curriculum of science subjects.

| Environmental Knowledge                       | Biology Form 4 | Biology Form 5 | Physics Form 4 | Physics Form 5 | Chemistry Form 4 | Chemistry Form 5 |
|----------------------------------------------|----------------|----------------|----------------|----------------|------------------|------------------|
| What Is Ecology? What Do Ecologists Do?      | X              |                |                |                |                  |                  |
| Individuals, Populations, and Levels of Organization in Ecology |                |                 |                |                |                  |                  |
| The Ecosystem Concept Develop                |                |                |                |                |                  |                  |
| Energy and Ecosystems                        |                |                | X              |                |                  |                  |
| Ecological Succession                        |                |                |                | X              |                  |                  |
| Populations and Their Dynamics               |                |                |                |                |                  |                  |
| Humans as an Ecological Factor               | X              |                |                |                |                  |                  |
| Humans: Their History of Resource Consumption|                |                |                |                |                  | X                |
| Soils and Allied Problems                   |                |                |                |                |                  |                  |
| Water and Allied Problems                    |                |                |                |                |                  |                  |
| Food Production and Hunger                   |                |                | X              |                |                  |                  |
| Forest Resources                             |                |                |                |                |                  |                  |
| Plant and Animal Resources                   |                |                |                |                |                  |                  |
| Air Pollution                                |                |                |                | X              |                  |                  |
| Water Pollution                              |                |                |                | X              |                  |                  |
| Noise Pollution                              |                |                |                |                |                  |                  |
| Solid Waste Disposal                         |                |                |                |                |                  |                  |
| Hazardous Waste                              |                |                |                |                |                  | X                |
| Human Population Growth and Control          | X              |                |                |                |                  |                  |

Table 1 shows that Biology is a subject that most widely adopted environmental knowledge its curriculum content. Almost all the topics of environmental knowledge have been applied through this subject. However, the focus of the application of the knowledge in this subject is more in the Form Four’s syllabus than in Form Five. The last two chapters in Form Four’s syllabus, namely ‘Dynamic Ecosystem’ and ‘Endangered Ecosystem’ are intended to mould environment knowledge under ‘Investigating the Relationship between Living Things and The Environment’. Another chapter in the biology curriculum that applies the knowledge of the environment is the chapter of ‘Nutrition’. This chapter discusses the environmental knowledge related to Food and Hunger in the
aspects of the food that feeds the world, world food problems, the green revolution, sustainable agriculture, and responsibilities of the individual. While in Form Five Biology curriculum only one topic of environmental knowledge is applied through a subtopic ‘Appreciating the contribution of science and technology to human reproduction’ in chapter ‘Reproduction and Growth’. This topic is related to human population growth and control. Among the scopes of the knowledges contained in this subtopic are human population dynamics, issues associated with, economic development and population changes, and birth control and population dynamics.

Physics is the subject that has the least environment knowledge content in its curriculum. In fact, it is found that this subject is not applying any environmental knowledge in Form Five’s syllabus. However, in the Form Four’s curriculum, knowledge of the energy and ecosystem was integrated through subtopic of ‘Understanding work, energy, power and efficiency’ in the learning area of ‘Force and Motion’. Through this topic, students are exposed with the knowledge on the need for energy generally.

In Chemistry subject, environmental knowledges are applied comparatively in both Form Four and Form Five’s syllabus. But still there is much more environmental knowledges that are not applied in this subject. The knowledge that is most widely applied in the Form Four Chemistry syllabus is about hazardous waste. Three subtopics in this syllabus that involved in exposing students to this knowledge are ‘Appreciating the Existence of elements and compounds’, ‘Develop awareness and practices Showroom When handling chemicals used in electrochemical industries’, and ‘Appreciating various synthetic industrial materials’. Knowledge on hazardous waste contained in these subtopics are the sources of hazardous waste, hazardous waste disposal, and issues surrounding hazardous waste disposal. While in the Form Five level syllabus, students are only provided with the knowledge mostly related to pollution. However, the subtopic is not focused specifically to any type of pollution, despite the pollution issues are discussed as a consequence of human activities that exploiting the use of chemicals and managing them unwisely. Besides the issue of pollution, other knowledge such as energy and ecosystem, human’s history and resource consumption, food production and hunger, and human population growth and control are also discussed ordinarily.

Result of the analysis that based on learning outcomes listed in the curriculum specifications also showed that the topic of ‘Solid waste disposal’ have not integrated directly in any one of these three science subject syllabus. Based on further analysis of the content of text books, this issue seems to be underlying in the topic related to pollution in Biology Form Four syllabus. This is quit frustrating since the solid waste disposal had been one of the serious issues in Malaysia. This issue should be taken seriously because it may lead bad impact to the environment. For example, as stated by Mohd Nizzam (2004), water discharge from the landfill will flow into a nearby river, especially through ground water and this could directly contaminate the river.

The result of this study can be used by teachers as a guide to identify which issues are not included in the current curriculum. It will be the teachers’ responsibility to put some effort in imposing other environmental knowledge and to conduct discussion with students about other environmental issues which are missing in the current syllabus. To do so, teachers themselves should master environmental knowledge as well. Fewer teachers would have to be trained in the content, skills, and methodology associated with the program (Hungerford et al., 1994) as it is not easy to deliver additional content of knowledge and skills through across curriculum approach. Teacher will need to master not only pedagogical content knowledge for their core subject, but also pedagogical content knowledge for that integrated curriculum (Koehler and Mishra, 2009). As stated by Schmidt (1996), teachers’ practice in Environmental Education is depends on their level of environmental knowledge mastery among them. In addition, we suggest that if there is any new science curriculum going to be developed, they should take into account to integrate all scopes of environmental knowledge and also the current environmental issues. We believe that discussion related to environmental issues will further enhance students’ knowledge towards environment. Researchers asserted that environmental knowledge is the basis component to develop environmental attitude (Tiwi, 2006), environmental sensitivity (Khor, 2006) and environmental behaviour (Sharifah et al., 2005).

6. Conclusion

This research has provides insight into the gaps and potential for infusion of environmental knowledge within science curriculum. The result of this study shows that the current science curriculum is just providing
environmental knowledge on the surface. There are still some important environmental knowledge should be covered in depth and infused in the teaching and learning of science based on consideration to the current environmental issues. Teachers and curriculum developer are suggested to give thought to this matter as environmental knowledge is a basic component that should be mastered by all citizens in order to further develop awareness, attitude, skills and finally participation towards the environment. Furthermore, the latest Environmental Education curriculum was developed in 1998. So, it will be necessary to reform a new curriculum of this subject since there were a lot of changes pertaining to the environmental issues have been occurred within a decade.

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