Significance of Environmental Concepts in the Science Curriculum of Secondary Education in Sri Lanka

U.Mathura, K.Piratheeban

Department of Education, Faculty of Arts, University of Jaffna, Sri Lanka.

Abstract

Environmental threats are serious concerns in the present world. Therefore, to reduce environmental threats, an environmental literate generation with positive attitudes and behaviours towards the environment should be created. In this manner, environmental education was introduced globally as a tool to create an eco-friendly generation. In Sri Lanka, environmental education was not introduced as a separate subject but rather as an integrated concept within the Science curriculum. Since, it is doubtful whether the existing curriculum satisfies the scope of environmental education, this qualitative study on content analysis is designed to examine the extent to which environmental concepts are emphasized compared with other science concepts in the secondary level science curriculum of Sri Lanka. Additionally, it aims to evaluate the extent to which the existing curriculum is expected to bring attitudinal changes related to the environmental. Secondary sources such as school textbook from grade six to eleven, teachers' instructional manual and other relevant written documents of the government and various researchers were analyzed for this study. It is proved that less importance is placed to direct environmental concepts rather than other concepts in the curriculum. Accordingly, the number of instructional periods allocated for environmental-related units in the school text books are relatively low (Grade 6,7,8,9,10,11 : 11.2%, 15.4%, 0, 8.3%, 0 and 13.4% respectively). Furthermore, most of the learning outcomes that the students are expected to achieve focus on the development of knowledge dimension of environmental concepts rather than fostering eco-friendly attitudes. Therefore, there is a need to pace greater emphasis on environmental concepts in a manner that promotes attitudinal changes in students, which can ultimately result in the development of an eco-friendly generation.

Keywords: environment; environmental attitude; secondary level curriculum; science-curriculum

Introduction

A healthy functioning ecosystem is essential for sustaining human life. It is the duty of every individual and every organization to be aware of such an environment and take action to protect it. To preserve and maintain a sustainable environment there must be adequate knowledge of the environment (Alwis & Silva, 2020; Makki et al.,2003). In this manner, environmental education was recommended at the United Nations Conference in Stockholm on Human Environment (Kelani, 2015; Sachitra & Kaluarachchi, 2018). Hence, environmental education was considered as an important component in the school curriculum since 21st century after the United Nations conference (Msengi& Doe, 2017; Wiredu, 2001).

In the case of Sri Lanka, due to various environmental threats such as inappropriate climate change and the effects of uncontrolled human activities, environmental education was introduced as a combined concept with Science and other subject areas. However, it is said that the existing curriculum does not satisfy the expectation made at the United Nations conference (Alwis& Silva, 2020).

Sri Lanka's exam-oriented curriculum places less emphasis on environmental concepts compared to other concepts. Furthermore, when compared to countries like Singapore and India, the attention given to environmental concepts in Sri Lanka's science curriculum is relatively low (Aturupane et al., 2011). Therefore, the educational community should recognize the significance of prioritizing environmental concepts in the school curriculum to promote a shift in environmental attitudes and understand the potential consequences of not doing so. On light of this, the following gaps have been identified in the existing curriculum.

1. The emphasis given to environmental concepts in Sri Lanka's secondary-level science curriculum is relatively low compared to other scientific concepts.
2. The environmental concepts which are included in Sri Lanka's secondary science curriculum are mainly theoretical or philosophical and are not found to be satisfactory in producing the desired behavioral and attitudinal change in students.

Therefore, with the purpose of examining the extent to which environmental concepts are emphasized in the Sri Lanka's secondary science curriculum,the following objectives were focused.

Objectives of the study:

1. In what extent the units of secondary level science curriculum focus on environmental concepts compared with other scientific concepts
2. In what extent the environmental related attitudinal changes are emphasized and expected to be achieved in the existing curriculum

However, this study focuses only on the environmental concepts in the junior secondary level and senior secondary level stage I science curriculum where science is implemented as one of the main subjects. To facilitate a meaningful comparison of the curriculum, teacher's instructional manuals of grade six and ten were analyzed since they are the transitional levels of secondary levels. Further, under the competencies relating to the environment, only the biological environment and physical environment were considered since expanding these concepts will change the attitude of the students and prepare them to face the environmental challenges. Therefore, this is designed as a qualitative study with the above limitations.

Materials and Methods

With the purpose of identifying the emphasis given to environmental concepts, this study is carried as a relational analysis. Therefore, Sri Lanka's science curriculum of grades six to eleven was considered. In order to conduct a content analysis, the science textbooks of Sri Lanka's secondary education science curriculum from grades six to eleven and secondary data sources such as written documents related to the Sri Lankan curriculum, studies published by researchers, printed government documents related to curriculum change, electronic documents and publications related to this study were analyzed since these are the limited documents support and comment the existing curriculum. In addition, the teacher's instructional manual given to teachers as a resource for teaching secondary education and the learning outcomes mentioned in the teacher's guide that the students are expected to achieve were also examined. With the purpose of exploring the emphasis of environmental attitudinal change in the science curriculum, grade Six and grade Ten Science Teacher's Guides were analyzed in depth (NIE 2007 & 2015).

Results and Discussion

The first sub-section of this section is to study the environmental concepts in science textbooks. The second sub-section is to study the emphasis of attitude change through environmental concepts.

Environmental Concepts in Science Textbook

A total of eleven subjects are covered in the textbook given to Grade Six students. Among them, there is only one unit, unit 3: "Water as a natural resource", is directly related to the environment. A total of 134 lessons are allocated for the three terms, but only 15 periods are given to the unit directly related to the specific context. Therefore, approximately 11% of periods are given to the unit that makes direct connections to environmental concept (Table 1). In grade Seven textbook, three units are allocated with emphasis on the three main components of the environment: Land, Water and Atmosphere. A total of 156 periods are allocated for fifteen units in the Grade Seven Science Textbook. Only 24 (15%) of them are given to the units dealing directly with the environment (Table 1). Only two of the nineteen units covered in grade nine science textbook directly refer the environment. Out of the 157 allocated periods, only 13 periods (approximately 8%) directly connect with environmental concepts (Table 1). 164 periods are provided for fifteen units in grade eleven. It is noteworthy that only 22 periods (approximately 13%) are given for environmental concepts (Table 1).

In the grade eight science textbook, none of the fifteen units establish a direct connection to the three components of the natural environment. Furthermore, none of the allocated 148 periods are dedicated to subjects directly related to the environment (Table 1).

Similarly, in the grade ten science textbook, none of the twenty units are directly related to the three components of the environment. Additionally, none of the allocated 160 periods are assigned to units directly connected to the environment (Table 1).

Table 1.

Grades 6 to 11 allocated lessons and periods for environmental concepts

Grade	Total periods	allocated periods	allocated percentage
6	134	15	11.2
7	156	24	15.4

8	148	0	0
9	157	13	8.3
10	160	0	0
11	164	22	13.4

Emphasis of Attitude Change through Environmental Concepts

It has been explained in the previous section that some of the units covered in the secondary level science textbooks provided to students are directly related to environmental concepts whereas some are indirectly related. Among the directly and indirectly related units, very few of the learning outcomes that are expected from the students to be achieved are designed to create eco-friendly attitudinal change.

Table 2.

Unit of Grade 6 : Water is a natural resource

Competency: 1.0. Explores life and life processes in order to improve productivity of biological systems	
Learning outcome	
Name three physical states of water describe ground water	K
Describe ground water, precipitation and surface water as sources of water	K
Give examples for ground water, precipitation and surface water	K
Describe importance of water for the existence of life	K
Insist importance of water for human activities	K
Classify water based on salinity and modes of precipitation	K
Compare amount of salt dissolved in fresh water, sea water and brackish water experimentally	K
Present information about water indicating it as a limited resource	A
Accept water as a limited natural resource	A
Appreciate water as a valuable resource	A

Out of the eleven units in grade six, only one unit, "Water as a Natural Resource", is directly related to the environment. Fifteen periods are allocated for ten learning outcomes under that unit. Among the ten learning outcomes expected to be achieved through this unit, seven learning outcomes are designed for knowledge development, while only three learning outcomes (20%) are intended to instigate eco-friendly attitudinal changes in students (Table 2).

Table 3.

Unit of Grade 6 : Food related interaction

Competency: 4.0. Explores nature, properties and processes of earth and space by understanding natural phenomena for intelligent and sustainable utilization	
Learning outcome	
identify herbivores as animals which consume plant materials	K
identify carnivores as animals which consume animal materials	K
identify omnivores as animals which consume both plant and animal materials	K
understand that all animals directly or indirectly depend on plants for food	K
describe food chains and food webs as an interactions among plants and animals	K
identify the hierarchy of food related interactions in nature	K
categorize animals as herbivores, carnivores• and omnivores according to their food habits	K
develop food chains through observations and experiences	K
build up food webs using the inter-connections between food chains	K
highlight food chains in a given food web	K
accept that each and every organism plays a key role in the balanced environment	A
act responsibly not to disturb the natural balance of the food webs	A

However, there are few units in grade six that do not directly relate to the environmental concepts but they are indirectly connected to the environment. Unit "Food related interaction" is considered as one of them. "Explores nature, properties and processes of earth and space by understanding natural phenomena for intelligent and sustainable utilization" is mentioned as the competency of the above unit. Although this unit is designed with the competency level to judge interactions among the organisms according to their food habits and categorize organisms according to their mode of nutrition, only two out of twelve expected outcomes (17%) of this unit are designed to build eco-friendly attitude (Table 3).

Table 4.

Unit of Grade 10: Chemical Basis of Life

Competency: Explores life and life processes in order to improve productivity of biological systems	
Learning outcome	
state carbohydrates, proteins, lipids and nucleic acids as major bio molecules of living matter.	K
state that carbon, hydrogen, oxygen and nitrogen are most abundant elements in living matter	K
state the composition and examples of carbohydrates, proteins, lipids and nucleic acids	K
introduce enzymes as proteins which catalyze chemical reactions in the cell or body	K
conduct simple activities to demonstrate the action of enzyme.	S
briefly explain unique characteristics of water related to life (respiratory medium, as a solvent, thermal regulation of body, as a medium of transport, and living medium).	K
describe the roles of carbohydrates, proteins, lipids, nucleic acids, minerals, vitamins and water.	K
illustrate the importance of minerals and vitamins to the biological systems.	K
state the deficiencies of minerals and vitamins	K

| appreciate the nature of living matter. | A |
| accept that water is essential for life forms on the Earth. | A |

Since grade ten science textbook lacks any units directly related to the environmental concepts, the unit "Chemical Basis of Life" which is indirectly related to environmental resources was investigated. The expected competence of this unit is to "Explore life and life processes in order to improve productivity of biological systems". Ten periods are allocated to the eleven learning outcomes expected through this unit. Among them, only two learning outcomes (18%) create a direct eco-friendly attitude change in students on behalf of the water environment (Table 4).

While specific competencies in grade six and ten generally align with an emphasis on environmental concepts, the prioritization within the learning outcomes predominantly focuses on the development of contextual knowledge. Unfortunately, attitude development and skill development receive relatively limited attention. Given that attitude change is a precursor to behavioural change, the insufficient emphasis on environmental attitude change in the school curriculum raises questions about Sri Lanka's ability to achieve the global goals it aspired to through environmental education.

Conclusions

Based on the analysis of science textbooks from grades six to eleven, it's evident that while some subject units can be indirectly related to the competency associated with the environment, units directly focused on the environment are less common than the other concepts. Consequently, the number of periods allocated to environmental concepts is relatively low (Table 1). Notably, in both grades eight and ten, there are no units directly related to environmental concepts. It is evident that the lack of emphasis on environmental concepts in the Sri Lankan curriculum will keep Sri Lanka lagging behind in achieving environment literate generation.

Furthermore, the Sri Lankan curriculum is not adequately structures to achieve the intended goal of fostering attitude change among students. In this curriculum, a significant portion of the learning outcomes expected from students primarily centers on knowledge

development. It places emphasis on the recall, application, and understanding of environmental concepts. However, the curriculum falls short in promoting the acceptance of environmental concepts and the ability to generate attitudinal change and manifest it in action. Additionally, the allocation of lessons dedicated to fostering eco-friendly attitudes is also limited.

Science should be a quest for knowledge and a response to global challenges. Based on this, scientific education for the right to life is universally accepted (Vithanapathirana, 2014). In that way, the curriculum should be seen as a response to environmental challenges. Therefore, units in the textbook, which is the primary medium for the students, should be changed to directly address environmental concepts. Also, the learning outcomes to be achieved through those units should emphasize the skills and attitudes. In this manner, environmental attitude and behaviour change can be expected in the students and subsequently in the society.

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