

Assessing Environmental Literacy Integration and Student Proficiency in Grade 9 Science Curriculum

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Sri Lankan policymakers prioritize sustainable development through biodiversity conservation and the creation of clean residential environments. The development of environmental literacy (EL) skills among citizens is identified as a key factor in achieving this goal. The nation is currently undergoing school curriculum reform, highlighting the need for studies to identify areas for improvement. This study aims to: (1) identify the level of EL in the Grade 9 science learning outcomes, (2) identify the level of EL in the Grade 9 science content, and (3) measure the EL skills among Grade 9 science students. A pragmatic, deductive mixed-method approach was followed, employing content analysis and survey research strategies. Stratified random sampling was used to select the sample of students for the survey. Thematic analysis and descriptive statistics were used to analyze the data. The results revealed that the Grade 9 curriculum incorporates EL skills in Competencies 1 and 4, representing 25% of the total learning outcomes. The content accommodates all EL skills but gives greater priority to ecological knowledge and issue identification and analysis. The students' average EL score is 41%, which is not satisfactory. Students obtained medium-level scores for ecological knowledge (68%) and issue identification and analysis (59%), but other skills were below 40%, considered a weak score in the Sri Lankan education system. The study highlights the need to incorporate EL skills into all competencies and recommends actions to improve students' EL skills in action planning, verbal and actual commitment, environmental sensitivity and feeling, and problem-solving and prediction.

Keywords: *Environmental Literacy; Science; Curriculum; Grade 9*

Background

Sri Lanka is a nation contemporarily focusing much on sustainable development by preserving its biodiversity and creating a clean residential environment. Policymakers always attempt to reach this goal. Grimmette (2014) highlights that developing EL among citizens is paramount to conserving nature. In 2017, the Republic of China introduced an Environmental Education Act, which mentioned that Environmental Education is a discipline that enhances environmental awareness, environmental ethics, and national responsibility. This is crucial for safeguarding the ecological balance of the environment, respecting lives, promoting social justice, and cultivating environmental citizens and learning communities. This act was the first to introduce the importance of citizens' responsibility to safeguard the environment along with sustainable development.

EL is a conscious attitude toward protecting the environment to maintain its balance. It entails not only having knowledge but also being responsive and able to provide solutions to environmental problems

(Kusumaningrum et al., 2018, cited by Nugraha et al., 2022). The UN Sustainable Development Goals also recognize the importance of EL under Goal 12, which deals with sustainable consumption and production, and under Goal 13, which deals with climate change.

Agalya & Vinoharan (2024) identified 6 major skills of EL such as Ecological Knowledge, Issue Identification and Analysis, Action Planning, Verbal and Actual Commitment, Environmental Sensitivity and Feeling and Problem-Solving and Prediction

Sri Lanka is in the process of curriculum reform to produce citizens suitable for the contemporary world. Studies related to the current curriculum and recommendations for improvement will help policymakers identify the areas needing greater priority.

This study aims to:

1. Identify the level of EL in the grade 9 science learning outcomes.
2. Identify the level of EL in the grade 9 science content.
3. Measure the EL skills among grade 9 science students.

Grade 9 was selected for this study as it is the grade where basic scientific principles are introduced into the curriculum. Subjects like science, geography, and PTS incorporate scientific skills, with science specifically integrating EL skills with scientific principles.

Methodology

The study followed a pragmatic research philosophy, which includes the ontological assumption that nature is complex, and external, and practice emerges from an idea. A deductive approach was adopted, using the EL skill framework developed by Agalya & Vinoharan (2024). A mixed-method approach was chosen as the methodological framework. To identify the level of EL in grade 9 science, a quantitative content analysis was conducted. To measure the EL skills among grade 9 science students, a quantitative survey method was used. For identifying the level of EL in the grade 9 science content, a qualitative content analysis was employed. The study is cross-sectional, with thematic analysis and descriptive statistics used to analyze the data. A sample of 96 students was collected for the survey through stratified random sampling.

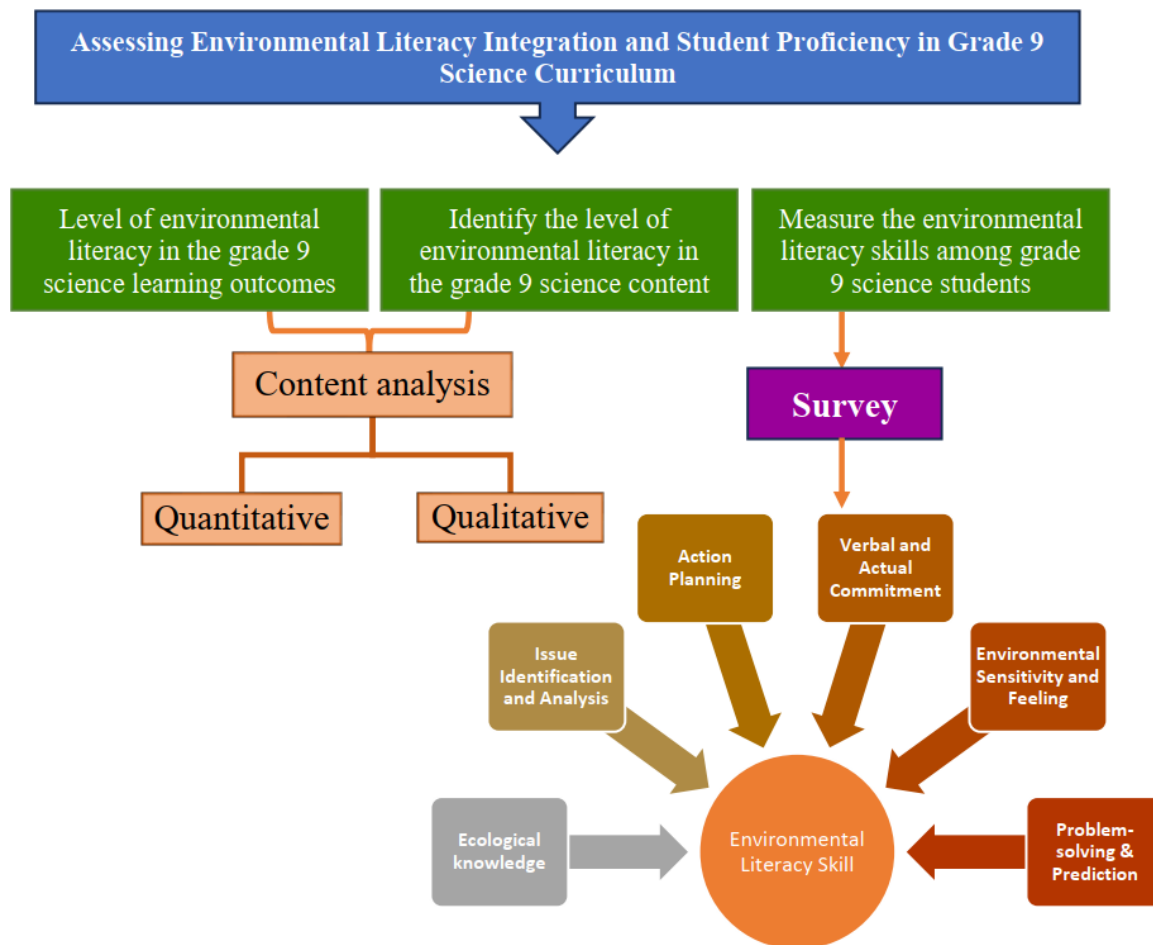


Image 1: Conceptual Framework (Agalya & Vinoharan, 2024)

Results and Discussion

The grade 9 science curriculum organized into four key competencies:

- ⊙ Competency 1-Explores life and life processes in order to improve the productivity of biological systems.
- ⊙ Competency 2- Investigate matter, properties of matter and their interaction to enhance the quality of life.
- ⊙ Competency 3- Utilizes various forms of energy, their interaction with matter and energy transformation by maintaining efficiency and effectiveness at an optimum level.
- ⊙ Competency 4- Explores nature, properties and processes of earth and space by understanding natural phenomena for intelligent and sustainable use.

Among those competencies curriculum incorporated EL Skill under the competency 1 & 4. In Competency 1, competency levels such as 1.1 and 1.6, namely “Investigate the application of micro-organisms” and “Explores the importance of the evolutionary process in biodiversity”, respectively, incorporate environmental literacy skills. Similarly, in Competency 4, specifically in 4.3, 4.4, 4.5, and 4.6, namely “Inquires into the scientific background of natural disasters”, “Investigates biodiversity”, “Investigates artificial environments and green concepts”, and “Identification of natural resource

distribution and sustainable use of natural resources”, respectively, environmental literacy skills are incorporated.

Further curriculum consists of a total of 208 learning outcomes, with 54 of them focusing on EL skills. This represents 25% of the total learning outcomes. Among these, 43% of the learning outcomes deal with ecological knowledge, issue identification and analysis, environmental sensitivity and feeling, verbal and actual commitment, problem solving and prediction and Action planning with percentages of 28%, 11%, 9%, 6% and 4% respectively. Grade 9 curriculum has room to accommodate the EL skills in all the competencies it failed to incorporate in competence 2 & 3.

Table: 1 EL skills in Competency 1 of Grade 9 Science curriculum

No	Learning outcomes	Environmental Literacy Skills
1.	Group micro-organisms by observing characteristics as bacteria, fungi, protozoans and algae giving examples.	Ecological knowledge
2.	Identify viruses as a group in between the living and non-living	Ecological knowledge
3.	State that micro-organisms are employed in environmental conservation decomposition of oil spilled on oceanic waters, absorption of heavy metals, and recycling of plastics.	Environmental sensitivity and feeling
4.	Accept the fact that no other organisms can exist without microorganisms.	Environmental sensitivity and feeling
5.	State simply the notion about the origin of the planet Earth	Ecological knowledge
6.	State that life originated as a result of a biochemical process	Ecological knowledge
7.	State that evolution is the emergence of living beings at present from the simple organisms that lived at the beginning	Ecological knowledge
8.	Describe the importance of fossils among other evidence that support evolution.	Environmental sensitivity and feeling
9.	Demonstrate how a fossil is created using a simple activity	Ecological knowledge
10.	State that bio-diversity is a result of evolution.	Ecological knowledge
11.	Accept that the future of biodiversity depends on the process of evolution.	Environmental sensitivity and feeling

Table: 2 EL skills in Competency 4 of Grade 9 Science curriculum

No	Learning outcomes	Environmental Literacy Skills
1.	State that the reason for the greater tendency for some natural disasters is the increase in global warming.	Issue identification & analysis
2.	Name a few factors affecting the increase in global warming.	Issue identification & analysis

3.	State that the depressions in the atmosphere is the cause for depressions whirl winds and storms	Ecological knowledge
4.	Forward a report on the losses of lives and property caused by whirl winds and storms in Sri Lanka during past 50 years.	Issue identification & analysis
5.	Explain simply the geological factors leading to earthquakes and earth tremors.	Issue identification & analysis
6.	Explain simply the causes leading to a tsunami states	Issue identification & analysis
7.	State that the earthquakes and tsunami tend to occur along the tectonic plate margins of the Earth.	Ecological knowledge
8.	Present a report on the tsunami conditions emerged globally.	Issue identification & analysis
9.	Explain simply the conditions leading to wild fires.	Issue identification & analysis
10.	Present information about the wild fires erupted globally	Issue identification & analysis
11.	Accepts that natural disasters cannot be prevented but the loss can be minimized by awareness and preparedness.	Action planning
12.	Conduct a simple activity to demonstrate the concept of biodiversity.	Ecological knowledge
13.	State what is Bio diversity.	Ecological knowledge
14.	Describe the importance of Bio diversity	Ecological knowledge
15.	Explain threats to Bio diversity	Issue identification & analysis
16.	State the important features of eco systems	Ecological knowledge
17.	Give examples for natural and artificial ecosystems.	Ecological knowledge
18.	List major eco systems in Sri Lanka	Ecological knowledge
19.	State the importance and major characteristics of main eco-systems of Sri Lanka and map the locations of them.	Ecological knowledge
20.	Accept the importance of biodiversity for existence of our planet.	Environmental sensitivity & feeling
21.	Explain simply about artificial environment and green concept.	Ecological knowledge
22.	Describe the importance of using organic fertilizers over the inorganic fertilizers.	Issue identification & analysis
23.	Prepare a report on the traditional agricultural methods that can be used to control pests	Issue identification & analysis
24.	Discuss the importance of correct water management in farming.	Issue identification & analysis
25.	Describe the importance of maximum use of cultivated lands in farming related to reducing forest cover.	Issue identification & analysis

26. State the scientific basis of using mixed crop farming and agricultural land management.	Issue identification & analysis
27. State the harmful effects of using chemicals in food production, food transportation, food storage and food preservation	Problem solving & prediction
28. State the importance of using post-harvest technology in food security to minimize waste of foods.	Verbal & actual commitment
29. Tabulate the chemicals used in industries and their harmful effects on the environment.	Problem solving & prediction
30. Describe the importance of disposal of chemicals used in industries in a safe way	Verbal & actual commitment
31. state the importance of the construction of environment-friendly building in relation to power-saving	Verbal & actual commitment
32. Appreciate the use of green transportation	Verbal & actual commitment
33. Explain briefly about natural resources.	Ecological knowledge
34. Explain simply sustainable use of water. (using rain water harvesting)	Action planning
35. State available methods used to extract minerals from soil.	Ecological knowledge
36. Explain characteristic features of gems.	Ecological knowledge
37. Present unique characteristics of different types of gems	Ecological knowledge
38. Present a report about adverse effects caused to the environment and to the human due to gem mining industry.	Issue identification & analysis
39. Give examples of plants for various uses of them as natural resources	Environmental sensitivity & feeling
40. Collect and present information of different types of wood in Sri Lanka and their specific uses.	Ecological knowledge
41. Explain scientific basis of wood decomposition	
42. List out the methods used to prevent wood decomposition.	Verbal & actual commitment
43. Accept the importance of sustainable use of natural resources.	Problem solving & prediction

The Grade 9 curriculum in content wise provides an in-depth exploration of ecological knowledge, covering various components and dynamics of ecosystems, as well as environmental issues. It extensively discusses the components of ecosystems, including microorganisms and their biological features, alongside the origin of Earth and life. The dynamics of ecosystems are analyzed, particularly focusing on the evolution of organisms and interactions within the ecosystem, such as between living and non-living elements.

Issue identification and analysis are prominent, with discussions on threats to biodiversity, man-made environmental problems, adverse effects of nanotechnology, and natural disasters like cyclones,

earthquakes, and tsunamis. The textbook delves into causal factors, highlighting human activities leading to biodiversity loss, synthesized chemicals' detrimental effects, and human-induced causes of earthquakes.

Action planning strategies are outlined, including conservation measures like in-situ conservation and sustainable development practices. Promoting sustainability is emphasized through green concepts and sustainable resource use. Proactive measures are encouraged, such as adopting environmentally favorable agronomic practices and reducing carbon footprints and food miles.

Verbal and actual commitments to supporting the environment are stressed, with discussions on the importance of microorganisms in environmental conservation and the significance of biodiversity. The textbook encourages actions like bioremediation, using microbes for environmental conservation and assignments related to environmental conservation actions.

Behaviors towards the protection of the environment are fostered, emphasizing emotional connections with the environment and sensitivity to biodiversity. Problem-solving and prediction skills are honed through critical analysis of the relationship between global warming and natural disasters, predicting potential outcomes of human behavior, and exploring solutions to environmental problems.

Grade 9 students' average Environmental Literacy (EL) level is 41%, which is comparatively low. Additionally, students obtained medium scores for ecological knowledge and issue identification and analysis skills. However, the scores for other skills were very low, below 40%, which is considered a weak level in the Sri Lankan educational system.

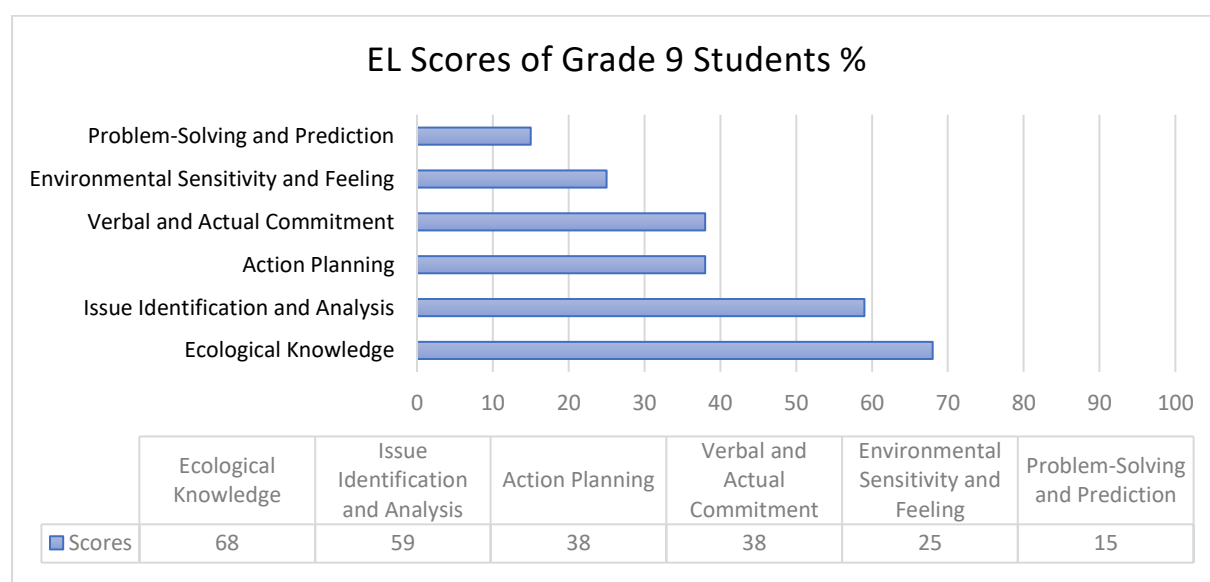


Figure 2: EL scores of Grade 9 students

Conclusions & Recommendations

The Grade 9 curriculum does not prioritize Environmental Literacy (EL) skills, with only 25% of the learning outcomes related to EL skills. There is room to accommodate EL skills across all competencies,

but they are not included in Competencies 2 and 3. Although the curriculum incorporates all EL skills in the content area, it prioritizes ecological knowledge and issue identification and analysis. The students' average EL level is also not satisfactory, at 41%. Since the curriculum prioritizes ecological knowledge and issue identification and analysis, students scored comparatively higher in these areas. Therefore, curriculum developers need to focus on developing other EL skills among students.

References

- Agalya, V. & Vinoharan, V. (2024).** Assessing Environmental Literacy in Sri Lankan Junior Secondary Science Syllabi: A Quantitative Content Analysis (Unpublished manuscript). SLAAED.
- Environmental Education Act, LEX-FAOC173904 (2017). <http://epa.gov.tw/>
- Grimmette, K. A. (2014). The impacts of environmental education on youth and their environmental awareness (Undergraduate thesis). University of Nebraska-Lincoln.
- Nugraha, L., Saud, U. S., Hartati, T., & Damaianti, V. S. (2022). Profile of learning environmental literacy in elementary school. *PrimaryEdu: Journal of Primary Education*, 6(2), 211–222.
- The United Nations Sustainable Development Goals 2030. (2021). In *Encyclopedia of sustainable management* (pp. 1–5). Springer International Publishing. https://doi.org/10.1007/978-3-030-02006-4_1