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ARTICLE

Manifestations of environmental principles in bridging scientific context, reasoning and behaviour: framework in the development of environmental education programmes in the Philippines

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Abstract

This study explored the relationship between scientific context (SC), scientific reasoning (SR), and scientific behaviour (SB) across the environmental principles to show their significance as essential scientific competencies in the development of environmental programmes in the Philippine K-12 curriculum in a process where environmental education has a key role to play. One hundred and seventy-seven high school students from Bongabong, Oriental Mindoro in the Philippines were selected through the cluster purposive probabilistic sampling method. A descriptive normative survey method of research was employed in this study. The students' SC had a high relationship with their SR, which is a direct indicator of SB. This was a sign that SC, SR, and SB all work together in a continuous way. Findings of this study will serve as baseline information for the framework of environmental education programmes through science, in the K-12 Philippine Science curriculum. So, when students learn things in the real world, they gain environmental effect, which is thought to be a key reason why people act in ways that are good for the environment and an important goal of environmental education.

Keywords: environmental education; environmental principles; scientific environmental competencies; scientific context; scientific reasoning; scientific behaviour; environmental programme

Introduction

Environmental education (EE) allows individuals to investigate environmental issues, engage in problem-solving, and act to improve the environment. People learn more about environmental issues and are then able to make decisions that are well-informed and responsible (US-EPA, 2021). This helps people develop their knowledge, skills, values, and attitudes about and toward the environment. Pro-environmental behaviour is any action that aims to keep the environment from getting hurt or to protect it (Steg & Vlek, 2009), whether it's done in public (like joining an environmental movement) or in private like recycling (Hadler & Haller, 2011).

However, EE is frequently viewed as an elective rather than a core requirement (McBride et al., 2013). EE can work well in schools if it is taught alongside science. This can be done by having students interact directly with the real environment. In order for students to acquire the knowledge and skills necessary to become environmentally active and responsible citizens, it is essential that they examine environmental issues and concepts in the context of both local and global environmental situations.

This could be a shared responsibility in the school community that may require the mutual use of scientific context (SC), scientific reasoning (SR), and scientific behaviour (SB).

However, education in and education about the environment are only beneficial if they support education for the environment by imparting skills and knowledge (Thomas, 2005). Therefore, a convergence between science and EE with an emphasis on EE programmes should be implemented beginning in preschool and continuing throughout all grade levels. This can be accomplished by developing the minds (cognitive), hearts (reflective) and deeds (behavioural) components (Smollan, 2006) that foster a sense of connection with nature in schools. A good learning environment can effectively transmit EE at an early age. The child's perception of the environment is influenced by formal schooling and, to a lesser extent, informal education at home (Pandey & Mishra, 2012). This can be accomplished in schools by providing opportunities for teachers to work with students to develop knowledge and skills about the natural world and become engaged with it beyond the classroom. The foundations of EE consist of providing students with lessons about the natural world and interactive learning experiences that will pique their interest so they can see the relevance of their classroom studies.

In order for citizens to be environmentally responsible, they must be equipped and trained to comprehend and value the SC, as environmental knowledge is only the tip of the iceberg (Ardoin, et al., 2018). The belief that knowledge is power is reflected in Hungerford and Volk's (2005) assertion that harnessing people's knowledge and transforming it into awareness and, ultimately, solutions is effective. People will act more responsibly toward the environment when they have a greater understanding of the environment. As such, EE is a holistic approach to education rather than a distinct academic discipline (Kollmuss & Agyeman, 2002). It involves a progression from SC to SR to SB. This can be accomplished by explicitly integrating cognitive knowledge (SC) into students' lives and allowing them to engage in collaborative affective decision-making (SR), which is essential for undertaking action-oriented tasks (SB) aimed at addressing real-world environmental challenges. A way for the students in the Philippines to build on scientific knowledge and practice collaborative affective decision-making and action-oriented tasks, is to incorporate EE with the real-world environmental challenges into the K-12 science curricula.

It is challenging for educators to provide plans that are not only focused on the present curriculum's science content, but also concisely define the new educational framework, which seems to be a relationship between environmental concepts in the Philippine K-12 science curriculum. To address environmental issues in formal school education, EE must equip students with the ability to weigh competing perspectives. To address this issue, the national academic standards must provide an engaging platform for acquiring and applying knowledge. These standards must be grounded in skills (education in) in the real world (education about) and engage in an authentic learning process. Lastly, these standards must be part of an integrated learning process (education for all). According to UNESCO, EE 'requires the integration of three essential dimensions: education in, about, and for the environment' (Karama, 2016). There are certain elements of teaching and learning that can be done through 'out of doors experience' in which a learner constructs knowledge, skill, and value from direct experiences (Environmental Management Programs Directory, 2015) while not strictly environmental in nature.

As important as 'integrative learning' is in EE, it must be implemented alongside national curriculum innovations. This necessitates the implementation of thematic approaches demonstrating six environmental principles in the K-12 science curriculum of the Philippines. These thematic approaches will likely increase students' appreciation for the environment by engaging them in learning about environmental issues and the interconnections of Earth's systems. Moreover, a framework that resonates with the literature on EE must be conceptualized during the development of EE programmes (Yueh & Barker, 2011). In addition, special attention should be paid to integrating EE across all learning areas so that all science teachers, regardless of their area of expertise, are embraced. The expected outcome of implementing integrative learning is to provide students with experiential learning that enables them to implement action strategies with real-world applications. For the analysis of school practice, the educational reform efforts for the new curriculum must be a manifestation of whole-school phenomena (Eames, Barker, Wilson-Hill, & Law, 2010).

In this instance, the recent implementation of the K-12 science curriculum was viewed as a chance to advance school practice in EE. Consequently, it is necessary to develop a framework for the environmental programme in the K-12 science curriculum. The framework for an EE programme for the K-12 science curriculum will be the first step toward the integrated teaching and learning of EE's foundational concepts. The proposed framework will then serve as a basis for the analysis of future school practices through ongoing planning, implementation, and evaluation of EE programmes that are aligned with national academic standards. For this is the essence of environmental knowledge: people should apply their knowledge to the environment and its problems through their words, thoughts, and actions.

Importantly, EE does not advocate a specific viewpoint or course of action, but rather empowers the learner to make an informed decision. Incorporating environmental concepts into the instruction of a variety of topics or subject areas, such as biology, general science, chemistry, physics, ecology, mathematics, and others, is therefore most effectively accomplished in the classroom. In the proposed EE programme in the Philippines, the motivation to put the strategies into action needs to be looked at and made official.

The Philippine K-12 science education curricula must not only include book knowledge related to environmental and scientific concepts but also knowledge that goes beyond an understanding of the environment, despite the fact that the content of the new Science K-12 curriculum may impose limitations on the integration of environmental concepts.

In this study, the manifestations of environmental principles are viewed as inherent aspects of developing EE programmes and relating these principles to the incorporation of EE into the Philippine K-12 science curriculum. The analyses found in this study reflected the broader notions of the six environmental principles, which must be incorporated into the development of EEal programmes for the intended Philippine K-12 science curriculum. Moreover, the learning outcomes of proposed EE programmes should not be limited to EE alone but should also include a societal transformation that promotes transformative learning by connecting lessons to real-world experiences, which is marginalized in the current curriculum.

Given the educational discourse in the current Philippine K-12 science curriculum, policymakers and education stakeholders must reevaluate EE pedagogy in order to engage scientifically and critical students. EE pedagogy offers students more opportunities and meaningful learning in EE to foster connection in the natural world as a lifelong learning platform, preparing students to construct their own concepts that promote change in values and behaviour, thereby creating lifelong learners. Thus, when students develop knowledge-gaining experiences in the real world, they gain environmental effect, which is regarded as a crucial driver for participation in environmentally responsible behaviours, the profound goal of EE.

Six Environmental Principles

This study not only highlights the difficulty of constructing critical, complex, and reflective thinking in the science curriculum but also encourages educators to play a strategic role in the progressive development of EE in the schools' daily life to motivate students to be lifelong learners in the broadest sense. This led us to the environmental principles of Galang et al. (2003) (Table 1), which serve as a guideline for the management and conservation of the environment: (1) Finiteness of Resources, (2) Diversity and Stability, (3) Change, (4) Materials Cycle, (5) Balance of Nature, and (6) Interdependence. In this study, we looked at how these environmental ideas are taught in the Philippines' K-12 science curriculum.

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Table 1. The six (6) environmental principles of the Philippine K-12 curriculum

Principles	Description
1. Finiteness of Resources	• Guiding principle regarding the exploitation and modification of natural resources, resulting in the contamination of air, water, and land with the by-products of technological innovations
2. Diversity and Stability	• The interconnectedness within an ecosystem when all things on earth are interconnected. This highlights the interactions that exist in any ecosystem and demonstrates the interdependence of life's component
3. Change	• To address the issue of human-induced changes that disrupt natural ecosystems • To promote environmental justice
4. Materials Cycle	• Gives emphasizes to waste management due to the inability of natural systems to move or assimilate organic waste quickly enough, resulting in pollution
5. Balance of Nature	• Addresses nature's capacity to regulate, perpetuate, maintain its balance, and keep both living and nonliving components stable
6. Interdependence	• Explains that all living organisms have the inherent right to exist and that diverse ecosystems give rise to diverse life forms

Source: Haribon Foundation for the Conservation of Natural Resources, Inc. (2006); Galang et al. (2003).

Scientific Environmental Competencies

The term 'scientific environmental competences' (SEC) refers to the three different domains of knowledge in this study. These are SC, SR, and SB. However, the demographic, external (economic, social and institutional) and internal (knowledge, motivation, attitudes, etc.) are factors that are areas of concerns between that create gaps between environmental knowledge and environmental actions (Tian & Liu, 2022). It is anticipated in this study that EE, individual learners will acquire the knowledge, skills, and values necessary to make decisions that may promote transformative action in addressing real environmental problems.

In order to create a dynamic exploration of EE, it is necessary to develop the knowledge and skills required to participate in activities associated with EE. In this regard, it is crucial to emphasize the SC, which emphasizes the underlying environmental knowledge and information or the presentation of facts about environmental issues. However, advancing critical thinking skills is also a desired general objective in science education and other core disciplines, which can be enhanced by the elements of the second scientific environmental competency, SR. This dynamic exploration of learning about and in the environment gives students the tools they need to become action-oriented people who can help solve environmental problems. It also gives them a chance to learn about the environment so they can take actions that are credible and help them become environmentally aware citizens. This addresses the action-oriented domain of SB.

These essential elements of EE are based on a foundation of basic science knowledge with an emphasis on the development of critical thinking skills in a systematic manner that targets barriers to behavioural change (Disinger & Monroe, 1994). The goals of EE, which are to turn environmental knowledge into actions and practices, depend on both science and EE.

Methods

A total of 177 students participated in the study. Data was gathered through observations, interviews, and surveys. Presented on Table 2 is the summary of the validated content of the research instrument used. It also features the basis to where the questions used in the study. The native language of the student-participants is Tagalog, but during the conduct of this study, English was

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Table 2. Content validity of instrument used in the study

Tool	Content	Intraclass correlation coefficient
Scientific Content (SC)	• Competency which resembles the science context behind the environmental knowledge and information or presentation of facts about environmental issues • Competency that provides quantities of content material related to environment which promotes critical thinking skills that can lead to personal and behavioural change	0.918
Scientific Reasoning (SR)	• Competency which refers to collaborative decision-making about the formative processes in the science context allowing the students to develop their own conclusions to equip the students to use problem-solving abilities that promotes environmental action	0.933
Scientific Behaviour (SB)	• Competency that is related to the action-oriented domain aimed at helping students develop the ability to solve problems. It refers to overt and observable actions taken by individuals through learning in the environment.	0.936

used as a medium of instruction and means of communication between the researchers and student-participants. All of the data collected in this study were analysed in order to identify data trends, which were then used to develop EE programmes. During the interview, student-participants were given 15–20 minutes to respond. They were allowed to suggest activities connected to their natural environment. The curriculum guides used for 7th through 10th grade was also looked at and analysed to find the most important environmental science skills.

For this study, a descriptive normative survey method was employed to examine and test the differences in SC, SR, and SB across age, curricular year level, and gender. Three (3) researcher-made instruments were utilized in this study — SC, SR, and SB. Before the instruments were administered to the student-participants, they were reviewed, checked, and evaluated by a panel of three validators who are experts in science and EE. These three instruments were subdivided into Galang et al.'s (2003) six environmental domains: (1) Finiteness of Resources, (2) Diversity and Stability, (3) Change, (4) Materials Cycle, (5) Balance of Nature, and (6) Interdependence.

The SC Instrument is a paper-and-pencil test consisting of forty (40) multiple-choice questions with four options and one correct answer. The SR Instrument consists of (30) items designed to assess student-participants' pro-environmental reasoning in relation to their moral obligations to the earth. The instrument consists of a 40-item behavioural checklist aimed at tracking how people change their personal practices to help reduce negative pressures on the environment. Both SR and SB items were assigned with corresponding points.

After the questionnaires were retrieved, the data gathered was analysed using Pearson-*r* and *t* test for correlation to determine the correlation among the dependent (demographic variables) and independent variables (SC, SR, and SB). The levels of significance were all set at 0.05.

Findings and Discussion

Scientific Environmental Competencies (SC, SR, SB) across the Six Environmental Principles

Table 3 shows the ranks in SC, SR, and SB by the student-participants across the six environmental principles. Although the learners' population received the highest mean score in the domain 'Change' in SC, it does not mean that environmental concepts are well-received, especially in regard to human actions toward the environment without considering nature's systems and processes. The results show that although the students are generally aware of global environmental

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Table 3. Mean responses on the SC, SR, and SB across the six environmental principles ($N = 177$)

	SC			SR			SB		
	Mean	Mean	Mean	*SD*	Rank	*SD*	Rank	*SD*	Rank
A. Finiteness of Resources	0.36	0.245	5	3.23	0.346	5	2.85	0.470	2
B. Diversity and Stability	0.33	0.172	6	3.24	0.387	4	2.74	0.475	5
C. Change	0.44	0.246	1	3.07	0.403	6	3.03	0.458	1
D. Materials Cycle	0.43	0.187	2	3.45	0.417	1	2.66	0.547	6
E. Balance of Nature	0.38	0.196	3	3.33	0.383	2	2.79	0.545	3
F. Interdependence	0.37	0.214	4	3.29	0.391	3	2.75	0.582	4
Composite	0.38	0.130		3.27	0.289		2.80	0.418	

problems such as climate change, it was not reflected in their SR. However, they feel generally uninformed about the impacts on health of chemicals used in everyday products, as shown in the domains 'Finiteness of Resources' and 'Change'.

Results in the domains 'Materials Cycle' and 'Change' call for the integration of science education and EE, for instance, proper waste disposal. It should be taught in a manner that will make the students see its relevance in their own lives. This scenario calls for the public's attention to minimize pollution and environmental damage, starting from teaching EE to students in school. This could lead to make learners become much aware of sustainable environmental issues. Similarly, the levels of their SC in 'Balance of Nature' and 'Interdependence' need to be addressed. For the domain 'Balance of Nature', the students were asked to rate their knowledge regarding the threats to extinction of species, the methods causing ecological damage, the importance of composting, the 3R's (reduce, reuse, recycle), the human activities threatening ecological imbalance, the result of deforestation, and the interconnectedness of biotic and abiotic factors. For the domain 'Interdependence', the students responded to the questions relating to the importance of every organism as a vital link in the chain of life. These findings may be representative of a more general disconnect between science education instruction and the students' daily life activities. To address the gaps in the present situation in the science curricula, students should be able to apply the concepts they learned in their daily activities, and they should be applied continuously throughout their lives as part of lifelong learning. Teaching and learning process should centre on making students understand the core of EE on real-world context.

Results also showed that the SC of the learners' population in domains 'Finiteness of Resources' and 'Diversity and Stability' translates limited knowledge about the following topics: government laws attempting to limit the use of finite resources; human activities which contribute to the scarcity of resources; the impact of unlimited use of our natural resources; and the significance of the diverse species and stability of biodiversity to attain global sustainability. Even though this study is local, understanding EE is a collaboration of content and pedagogy that gets students interested in studying the environment to 'encourage behaviour change and action' (Thomas, 2005).

Take, for instance, the issue of global warming, which is one of the predominant problems of climate change (Tolppanen & Aksela, 2018). For an issue this big, experts should not shoulder the burden alone of rectifying the problem and providing the necessary solution. Learners experience climate change. Thereby, issues in climate change must go beyond classroom experience. The much-needed actions should start from individuals who are knowledgeable and capable enough to participate in protecting and caring for the environment. It is a shared responsibility for all global citizens; therefore, it requires public involvement (Hunter & Brehm, 2003). However, challenges in climate change education are highly affected by the media (Schreiner, Henriksen, &

Hansen et al., 2005; Svihla & Linn, 2012), and the science behind climate change is quite complicated (Svihla & Linn, 2012). There should be a deeper understanding of the nature of science based on scientific research and findings (Hodson, 2008, 2011), which is crucial in answering students' questions about climate change (Tolppanen & Aksela, 2018). Students' understanding should be enough to connect the dots among the species and realize the role each plays in the world's one big ecosystem wherein human beings have a huge responsibility.

Findings showed that everyday activities that could help reduce environmental effect were part of learners' comprehension of the concept of 'Change'. These include using labour to reduce waste and achieve carbon neutrality, using efficient lighting, and recycling and reusing materials. It also showed that the ideas of conservation, preservation, proper allocation of natural resources, and responsiveness to practices are relevant to the learners' comprehension of the domains of 'Finiteness of Resources,' 'Balance of Nature', and 'Interdependence'. Such activities do not pose a threat to natural processes and cycles of nature. The community clean-up activity will invite people to attend and give emphasis to reducing instead of reusing and recycling waste. And taking pictures instead of getting souvenirs from the natural habitat and reducing meat consumption to cut down on 'our carbon footprint'.

With regard to SB, the issues that need to be addressed in this study are the domains of 'Diversity and Stability' and 'Finiteness of Resources', which focus on action skills as follows: pro-environmental practices such as preservation of wildlife species, reducing waste by using existing materials instead of buying new ones, reusing containers because plastics take hundreds of years to degrade, and recycling materials to lessen a pile of waste. It was also revealed that the student-participants were more motivated in the domain of 'Change' while the domain of 'Materials Cycle' needed more pro-environmental attention. The result showed that student-participants need to be engaged in actions and behaviour reflecting a positive impact towards achieving a more sustainable environment. As part of the solution to environmental problems (Braun & Dierkes, 2017), people need to get back in touch with the natural world by interacting directly with its parts.

All the six environmental domains obtained a narrow mean score difference from each other and received the same remark of 'Fair'. This indicates that environmental concepts were not highly included in the student-participants' curriculum. Thus, environmental information that may provide useful inputs through EE programmes must be observed in the learners' cognitive development. It was also noted that the prevalence of knowledge gained a central focus in the EE evaluation (Stern, Powell, & Hill, 2014). Hence, educators must not only be more equipped with cognitive skills to provide factual information to students, but they must also create a learning environment that encourages learners to utilize experiences as a vital role in increasing the knowledge of the populace and thereby inculcating a positive attitude and behaviour towards the environment (Erhabora & Don, 2016) in order to inform more effective processes for achieving educational change.

What emerged from this study was coherent evidence for cause-and-effect relationships and evidence that SB of students can be strengthened in schools through the integration of structured or unstructured EE programmes that have an important role to play in the process of changing society. EE should be a bigger part of the curriculum than just 'adding' environmental issues to what is already being taught (Conde & Sanchez, 2010). This is in line with the Philippine national standards.

Correlation Matrix of the Variables

Based on the correlation (Table 4), the results showed that there was a highly significant relationship (p-level = 0.009) between SC and SR. There was also an extremely significant relationship (p-level = 0.000) between SR and SB.

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Table 4. Correlation matrix between demographic variables and scientific environmental competencies

	SC	SR	SB
SR	0.197**		
	2.658		
	0.009		
SB	−0.024	0.378**	
	0.318	5.401	
	0.751	0.000	

**Correlation is significant at 0.05 level (2-tailed).

Findings from this study show that SC is a key aspect in translating SR, which is a precursor to positive behavioural actions. These behavioural changes of students can then be strengthened in schools which serve as an avenue for the incorporation of EE programmes into the curriculum aligned with conceptual, behavioural, and action-oriented principles underlying EE. Research findings have shown that behaviours and attitude towards environmental responsibility maybe influenced by the individual's knowledge about the issue (Sadik & Sari, 2010; Sadik & Sari, 2010). Moreover, students should have ample opportunities to put the theories they have learned into practice in a real environmental setting through environmental activities, thereby, encouraging actions towards the resolution of environmental problems (Torkar, 2014). Curricula on EE should, therefore, include common issues related to the environment relevant to the students' knowledge, behaviours, and experiences (Rickinson & Sanders, 2005; Malone & Tranter, 2005).

The forms of learning experience that encourage and produce active and informed minds (Torkar, 2014) is a prerequisite to effectively address environmental problems, different types of environmental initiatives that should be implemented. Predicting behaviour in terms of environmental practices was a difficult task influenced by numerous factors (Environmental Management Programs Directory, 2015). There is a widespread agreement that solutions to environmental problems must involve the public (Rogayan & Nebrida, 2019), and that there are many possible routes for accomplishing this task. If students who are knowledgeable about the environment act positively towards the environment, it is consistent with their knowledge that EE must become a part of the school curriculum through structured or unstructured EE programmes. In this way, EE not only promotes the development of students' skills and knowledge for the future but may also affect the choices that these students will make as part of society. This is where the schools play as an avenue and an important place in EE. To raise the environmental awareness that translate favourable action towards the environment, based on science education cited in Hadzigeorgiou and Skoumios (2013) can offer real-life learning experiences to students by presenting environmental problems or issues as context for learning, thereby, providing students with a purpose to reflect upon interrelationship between the physical and the social world. At the same time, it is also imperative to engage the students in a wide range of socio-environmental issues that empower them to act upon the moral principles that guide their decision-making to promote pro-environmental behaviour.

Alongside it, a multi-perspective approach should be used when educating students about the environment (Williams, 2011). The teachers, as facilitators, must guide the students to appropriate learning resources in order for them to be more independent and action-driven learners by finding an array of teaching strategies to improve learning outcomes. Since there was minimal environmental content in the Philippine K-12 science curriculum, the need to incorporate EE through

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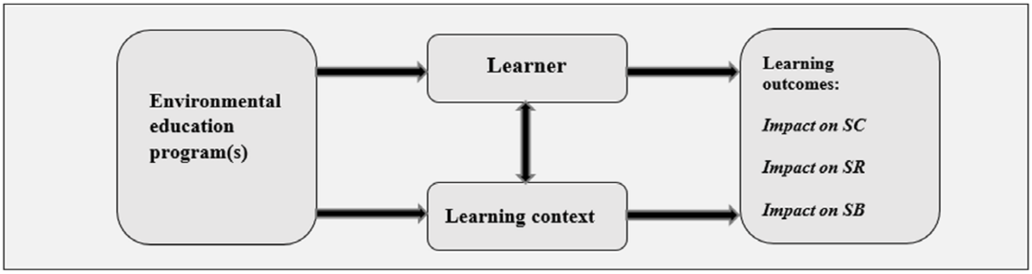

Figure 1. Logic model of framework in the development of environmental education programme.

structured or unstructured EE programmes must be in the context of science concepts by exploring cognitive skills to broaden the students' understanding of their environment, thereby nurturing a pro-environmental citizenry. To change and transform society's favourable behaviour towards the environment, EE programmes must be available and be provided at all educational levels, thereby integrating EE into school subjects by primarily demonstrating its need, clarity, complexity, and practicality to solve environmental problems. To be motivated to work toward environmental solutions, the integration of EE must be grounded in the students' experiences and the need for a change from their present practices, thus developing a sense of personal attachment with the environment. In the teaching of EE, environmental knowledge is a significant cognitive factor (Duschl, Schweingruber & Shouse, 2007; Metz, 2008) that leads to the development of skills and attitudes (Sadik & Sari, 2010) necessary for responsive environmental behaviours (Dietz et al., 2009; Zelenika, Moreau, Lane & Zhao 2018).

Proposed Skeletal Framework of EE Programme(s)

In Figure 1, the constructs and pathways emerged from our literature review and the findings of this study. The framework of EE programmes as output of this research is expected to be effective tools in capturing students' enthusiasm for learning multi-disciplinary science subjects.

The framework made use of a logic model (Rothm, 2014) to explain the connections among the activities, inputs, and outputs of environmental programmes.

Providing the students with equitable EE programmes that integrate cognitive knowledge (SC) to translate into collaborative affective decision-making (SR) and transform learning by connecting lessons to real-life experiences by taking action-oriented tasks (SB) promoting lifelong learning opportunities. In the teaching of EE, environmental knowledge is a significant cognitive factor (Duschl, Schweingruber & Shouse, 2007; Metz, 2008), which is a precursor to the acquisition of and retention of reasoning that leads to the development of skills and attitudes (Sadik & Sari, 2010) necessary to engage in responsible environmental behaviours (Chawla, 2015; Zelenika et al., 2018; Zelenski, Dopko, & Capaldi, 2015).

This paper discusses how EE can be applied to a variety of situations in order to promote the effective use of EE programmes to positively influence scientific environmental competencies (SC, SR, SB), such as schoolyard habitat and greening of school grounds, waste reduction, enviro-clubs, community clean-up, multi-disciplinary art environmental programmes, and outreach programmes (Erhabor & Don, 2016). The acquisition of new knowledge and skills must be strengthened in schools as an avenue and an important part of these EE programmes. As a formal ground for teaching and learning, schools have a vital role to play in preparing students to acquire the knowledge, skills, perspectives, and practices they need to be environmentally responsible citizens (Ontario Ministry of Education, 2007). In the integration of these EE programmes, the school curriculum must take full advantage of the potential of EE to provide opportunities to gain insights into the fields of sciences and their connection to the natural world. This means that

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schools should be an avenue to teach children how to become pro-active in environmental management as well as environmental protection.

Learning and exploring the natural environment through science beyond the four walls of classrooms (Barton & Pretty, 2010; Kaplan & Kaplan, 2011) could foster an effective safe use of environmental resources, thereby making the most space in schools (Jensen & Schnack, 2006; Williams, 2011). In addition, Matthies-Lindermann et al. (2009) mentioned that teachers should be trained since they have a big multiplier effect and to enable them to facilitate the teaching and learning of EE (as cited in Kimaryo, 2011). Teaching methods that are active as well as participatory and are related to real-life situations may be used to raise environmental awareness. To easily transform the students' SC, teachers should find ways to help the students acknowledge environmental issues and problems (SR) and acquire positive SB.

Integration of EE should be perceived as a universal responsibility and must happen beyond the four walls of the classroom. To expand learning beyond the four walls of the classroom, the school ground can serve as an integral part of the outdoor space for learning to provide students with opportunities to use real-life situations to make learning more meaningful. Learners should be encouraged to think about all sides of environmental issues. This will not only help them understand the topic better, but it will also help them develop critical thinking skills. In addition to its effects, natural settings provide a more supportive context for learning (Kuo, Barnes, & Jordan, 2019) and are associated with intrinsic motivation (Fagerstam & Blom, 2012; Hobbs, 2015), which is crucial for student engagement and longevity of interest in learning. Findings in the study further revealed that learning experiences in the classroom can teach students to improve their environmental behaviours and positively respond to natural changes.

The integration of environmental issues into the EE programmes gives the positive behaviour modification and action competence required to emulate environmental practices (Jensen & Schnack, 2006). The school as an important place of EE sheds light on considering diverse perspectives in the teaching of EE in the science curricula across school levels. However, it must be pointed out that direct experience with the environment is not the simple answer to a more intact EE among students. Outdoor experiences are only useful if students know what to do when they are in direct interaction in the context of study, such as an actual environmental setting. However, without prior environmental knowledge, they may not be able to see the environment in the way that is expected of them, nor would they become engaged in hands-on, experiential, and often outdoor environmental practices (Borchers et al., 2013). Lessons and activities in school as an important part of EE must be more than academic schooling and behaviour modification. In teaching students to become environmentally responsible citizens, it is necessary to make present and future citizens capable of acting on a societal as well as a personal level through real-life experiences aimed at integrating EE. Exploring EE can serve as a teaching opportunity to engage students in the lessons, as it has the potential to combine the outdoors with instructional practices. The school curriculum, as part of the process in the teaching of EE, must be necessarily open and flexible, not in the form of isolated teaching units but as clear connecting axes of objectives, content, and procedural principles endowing the different subjects with coherence and solidarity (Conde & Sanchez, 2010), safeguarding the interconnections of science and EE into all areas of knowledge and in the everyday lives of students in schools.

In the context of these concerns, interactions that take place during learning serve as progressions that could establish positive behavioural outcomes as outputs of the proposed EE programmes. Creating synergy between science education and EE can be linked through EE programmes which provide opportunities for new forms of education (Wals, Brody, Dillon, & Stevenson, 2014) which are more responsive to the current situation in the Philippines as well as to global challenges.

By providing equitable EE programmes that integrate cognitive knowledge (SC) to translate collaborative affective decision-making (SR) and transform learning by connecting lessons to real-life experiences by taking action-oriented tasks (SB), we will enable the learners to have a sense of connection with their environment, promoting lifelong learning opportunities. Thus, the key aspects in the acquisition of new knowledge and skills that translate into positive behavioural actions bounded by environmental principles can be achieved by gaining optimal insight into the subject at hand and seeing its relevance in a wider context while becoming active learners in the 21st century.

Conclusions

EE was identified as relevant to students' everyday lives to be environmentally literate–ready to face environmental and social challenges. All the six environmental domains obtained a narrow mean score difference from each other which indicates that environmental concepts were not highly included in the student-participants' curriculum. It is, therefore, evident that SC, SR, and SB of the learners' population need to be addressed through EE programmes. Environmental information that may provide useful inputs through EE programmes must be observed in the learners' population cognitive development. It was also noted that the prevalence of EE was deemed essential for students to be environmentally literate and prepared to face environmental and social challenges in their daily lives. All six environmental domains received a narrow mean score difference, indicating that environmental concepts were not highly emphasized in the curriculum of the student-participants. Therefore, it is clear that EE programmes must address the SC, SR, and SB demographics of the learner population. Through this activity, students are transformed from passive observers into active participants and problem solvers. In addition, it was noted that the prevalence of knowledge became a focal point of the EE evaluation (Stern et al., 2014). Educators need to have better cognitive skills so they can give students factual information. They also need to create a learning environment that encourages students to use their experiences as a key part of learning and an important educational approach for the development of young peoples' care for the environment and nature Direct experiences with the environment could provide them with experiences on how governing processes work and how they can themselves take an active role in the society as a learner and as a responsible pro-active citizen in the environment.

As students apply what they have learned to real-world situations, the findings indicate a need to cultivate their critical thinking skills while emphasizing environmental issues. Using an EE programme that incorporates outdoor science instruction, students can apply their classroom knowledge to study a sustainability issue and interact with community members (Brundiers, Wiek, & Redman, 2010) through real-world learning experiences. In order for students to learn about the environment, they should be exposed to a variety of educational methods, including hands-on activities and direct exposure (Wells & Lekies, 2006; Ewert, Place, & Sibthorp, 2005; Federspiel, 2007). While the Philippine K-12 Science Basic Education Curriculum is already localized and contextualized, we suggest that EE programmes be realigned to be more easily integrated into science education and aligned with national content standards. Nature and nature-based pedagogy must be included as learning and development resources in the Philippines' K-12 science curriculum. This is because what can be taught in a classroom is thought to encourage people to act in environmentally friendly ways.

The existence of a learning continuum progression can be demonstrated by the fact that the results of this study indicate an extremely significant relationship between SC and SR, the direct criterion for SB. The increase in cognitive knowledge correlates with the increase in positive environmental attitudes and behaviours (Stern et al., 2014). Therefore, acquired knowledge that is not applied is useless and will be lost. Thus, the evaluation of EE programmes should be based on the student's practical application. Therefore, it is recommended to apply SC to teach pupils to care for and appreciate the environment, as this will encourage the development of SR and practice SB.

Then, it makes sense to pursue the development of EE programmes through science in the Philippine K-12 science curriculum, in which the cognitive content (SC) must not be limited

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to explicit behaviours, but rather illuminates the collaborative decision-making skills (SR) required for taking habitual actions (SB) towards the environment that must continue throughout their lifetime, thereby creating lifelong learners in the 21st century. To prepare students to be environmentally responsible citizens in the 21st century, it is crucial to implement EE programmes that integrate EE into the curriculum within the school itself.

Consequently, the school as a fundamental teaching resource must not only be a source of SC, which builds SR, which is a direct criterion to translate habitual SB, but also a fertile ground for the development of environmentally minded students for the 21st century through science in the Philippine K-12 science curriculum. EE does not occur solely within the four classroom walls and during school hours. It is something that should be ingrained in our society's daily practices. This is the purpose of EE — the application of knowledge to effect change in our environment.

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