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Integrating STEM Curriculum Across the Schools' Learning Environment to Reflect & Impact Life Practices

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Abstract.

John Dewey's quote, "Education is not a preparation for life; education is life itself," emphasizes the importance of an education system that goes beyond preparing students for the future but also impacts their present lives. To achieve the United Nations Sustainable Development Goal #4 of Quality Education, educators must adopt an approach that fosters sustainability and critical thinking in students, both inside and outside the classroom. One effective approach is implementing a STEM curriculum (Science, Technology, Engineering, Mathematics) across various subjects and grade levels. STEM education can serve as a catalyst for developing students' mathematical minds and problem-solving abilities, especially when addressing current environmental challenges. By integrating STEM education throughout the learning environment, students can engage in practical activities and explore meaningful strategies that contribute to sustainability and life preservation. The benefits of incorporating STEM education extend beyond the classroom, as students can transfer their competencies to their home, work, and social environments, promoting sustainable living. The paper will explore how a STEM curriculum can be applied across the wider school community, demonstrating the potential impact on children's actions beyond the classroom. By equipping students with knowledge, skills, and competencies for sustainability, they can contribute to preserving the environment and improving the quality of life. The paper will also address limitations in current classroom practices that affect the environment and propose practical remedies to improve sustainability. Reflecting on the impact of these basic classroom practices on society and human life, the research will showcase how STEM education can empower students to make a positive difference in the world.

Keywords: STEM curriculum, school environment, technology, sustainable development, environment

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1. Introduction and Background

In 2015, 195 countries at the United Nations signed on to a Sustainable Development Goal (SDG) policy document in an effort to improve the lives of humanity and to consciously change the course of the earth's demise. Seventeen global goals are addressed in hope of fulfilling a mandate to slow or halt, as it is impossible to reverse, the detrimental impact of human actions in our lives and society by the year 2030. With only eight years of this global initiative remaining since the signing of the SDGs, world leaders continue to invest and focus in all disciplines to continue the effort to address climate change and to ensure global sustainability. This paper will triangulate three SDGs, #4 Quality Education, #11 Sustainable Cities & Communities, and #13 Climate Action, to demonstrate how educational institutions can significantly contribute their part to positively effect communities as we steer towards the ending of the 2030 timeline.

Only recently in November 2021, world leaders attended the World Leaders Summit in Scotland to present a report card of the progress of their society. While several leaders, especially those from developed countries, raved about the significant contribution they are making towards the SDGs, many leaders, especially those in developing countries, expressed their disappointment that the efforts being made are insufficient and their country can now be considered as a vulnerable state (News18.com, 2021). The targets set by greater nations, mainly those who are the major contributors of emitters and who are least likely to be affected by the target year, are unreasonable for states in coastal areas and more vulnerable to the effects of these airborne toxins. These vulnerable nations are, as we speak, experiencing the effects of such deficiency. To add insult to injury, some of the countries that measured the largest emitters of airborne toxins were absent from this reporting session and unable to listen to the negative impact of their actions and the pleas from representatives of many vulnerable nations.

Some of the alarming reports indicated that climate finance has decreased by 25% since 2019 (Timperley, 2021). This is a significant fall and one-third of the developed countries who are benefiting from being major emitters are leaving two-third of the rest of the nations in the world under siege due to the lack of finance to mitigate the effects caused by their deliberate actions to develop their own nation. Developed countries and those recorded has major emitters must continue to increase the finances to support developing countries with the goals for a sustainable future (Voegele & Puliti, 2022).

The target 4 degrees Celsius increase (World Bank, 2012) in climate atmospheric temperature that developed countries and major emitters are aiming to avoid is unreasonable because some vulnerable nations, only with a 2-degrees increase, will bring

catastrophic impact to their nation. These vulnerable states can only afford a limit of 1.5 degrees, not four degrees, for their nation and its people to continue to survive and exist. Any degree warmer threatens the fabric of their society (The Climate Reality Project, 2021). If world leaders from developed nations ignore the 1.5 degrees limit pleaded by leaders from vulnerable nations, significant portions of many counties will cease to exist by the end of this century. For smaller island countries, cartographers will need to start working on a new map of the world with less land mass and less countries.

Many developing nations in the coasts are already suffering from global warming. The sudden rise in sargassum across the shores of many coastal countries are now suffering from the toxins for the hydrogen sulphide gas and ammonia being released (Denoble, 2020). Hurricanes are becoming stronger and quantifying. Floods and lightening storms are becoming more frequent and more intense. All these drastic changes can be linked to climate change and global warming (Chung et al., 2021). Although some nations are currently safe from these disasters, or might even be in denial of the impact of these, it is sooner, not later, that they will eventually experience the rath of the irresponsibility of their actions that contribute and connect to the negative impact of climate change.

From all the global activities regarding climate change, we the people need to act responsibly and act immediately. Education and using our students to bridge this cap can be a strategic way to address the issue. Current research studies indicated that students' knowledge towards the SDGs is limited (Sianes et al. 2022; Yuan, et al. 2021). As educators, we need do our duty and our part to educate our students at all levels, from preschool to tertiary, about the seventeen sustainable development goals, the intentions for 2030, and the implications if countries fail to meet these goals. It is our obligation to inform and to curve the minds of our young citizens who will eventually take up the leadership role in the quest of preserving and saving our earth. Education goes beyond simply informing students of their role and responsibilities to their community. As John Dewey stated, "Education is not a preparation for life; education is life itself." Sustainable development should be an ongoing natural part of the curriculum where the SDGs are debated, and policies are formulated with the input of all stakeholders (Dlouháa & Pospíšilová, 2018). In schools, students need to live the actions that contribute to the SDGs which should be reflected in every fibre of their community.

2. Problem Statement

Many school programs are fixated on the academic delivery of their curriculum. A high focus for students is to secure the knowledge of concepts and being able to regurgitate

content during tests, examinations, and state assessments. Although knowledge of concepts is important, it should not be the major assessment area in any curriculum. Demonstration of skills and practices in the school environment to reflect that of which is aligned with real life and the development of a holistic global student should be the central focus for any school curriculum. The SDGs are a high priority for most nations in the world, hence, school programs should now re-design their curriculum to ensure that key areas are addressed in their school program. The leadership, teachers, students, and parents should be focused on fulfilling the SDGs both at the school and in the home environment. There must be a connection between the practices in school, home, and the workplace.

3. Research Questions

This paper will address three research questions. The first research question of this paper is: What are the practices in schools to fulfil the SDGs? This research question will address realistic activities that can be carried out in schools for students to understand the reasons for the SDGs and for them to develop a mindset to contribute towards the SDGs. The second question is: What are SDG practices in the schools that can be reflected in the homes? This question will share practices in the schools that can be transferred to practices in the homes for families to view and understand the connection of the SDGs in the two environments. The third question is: How can schools and homes work together to fulfil the SDGs? This question will address how the entities in the two environments can work on sustaining a relationship to ensure continuous contribution towards the SDGs.

4. Aims/Objectives

The objective of this paper is to illustrate the importance of bridging the school's SDG practices with that of the home environment. It will suggest practical activities in schools that justified SDG practices, which should be practiced and reflected in the home environment, and furthermore the working environment.

5. Purpose of the Research

The purpose of this paper is to share with school leaders and teachers that a conscious decision to incorporate SDG practices is possible and imperative. School leaders should

consider to lead a school with a curriculum that addresses the SDGs across all subject areas. Teachers will be mindful of SDG activities that can be incorporated in the subjects they teach and to ensure that these are embedded in their objectives. Parents will recognize that there should be a connection between the SDG practices at school and at home.

6. Significance of the Research

The significance of this paper is to ensure that all schools consider a long-term impact of the SDGs and to develop polices in the schools to contribute towards the fulfilment of the SDGs. The impact of Climate Change is affecting everyone, hence, every school, collectively, should work towards developing a long-term plan of action to ensure that students' mindset react positively to improve the current global situation.

7. Theoretical Background

The framework below as used by Zamora-Polo et al. (2019). It illustrated the SDGs taught in schools through competencies, rather than mere knowledge-based or an understanding of key concepts. The competencies demonstrated by students are assessed using different strategies and methodologies carried out in the school environment.

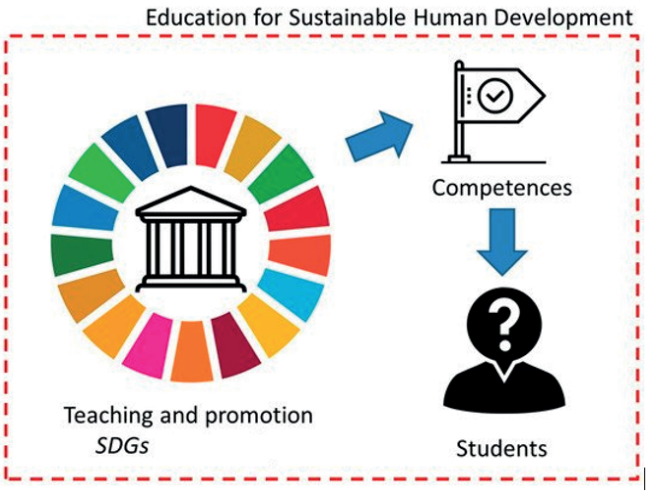

Figure 1: *Zamora-Polo et al. (2019).*

Figure #2 is a modification of Zamora-Polo et al. (2019) framework illustrating that, instead of the learning of the competencies stops with the student, the student is placed as the link between the practices of the competencies at school and at home. Using this model, the student is placed as the link between the school and the home to reinforce

the competencies taught in the school. Using this model, the SDG practices can impact the home and community.

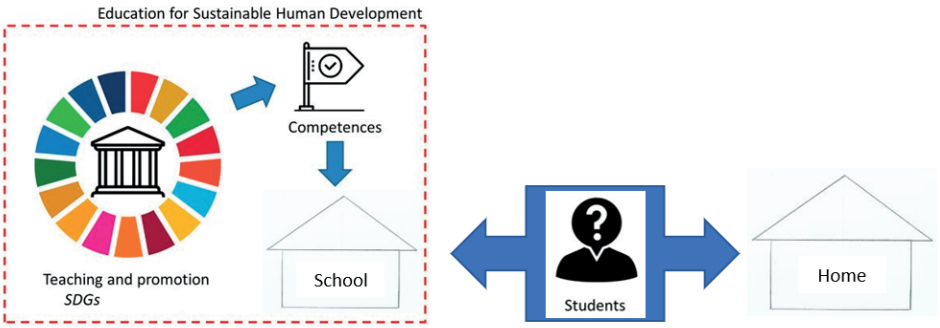

Figure 2: Student as link between school and home.

8. Methodology

This paper used a document analysis approach to extract key activities that are aligned with SDG practices in the school environment. A total of 57 articles from NU Search, Google Scholar, ERIC database, and ProQuest database were retrieved. Of these, 13 articles were used that included reference to the school environment, reference to STEM practices, practical activities for students towards meeting the SDGs, and papers recently published within the past six years. The articles were analysed and incorporated with realistic practices that connected the school environment and the home environment to meet the fulfilment of the SDGs with reference to a STEM program.

9. Findings and Discussion

As educators, it is important to live the SDG in our institutions. All stakeholders, students, teachers, leaders, parents, and the wider community, involved must embraced the concepts of a Green School, Green Energy, Waste Management, Sustainable Development, and Climate Change. These concepts should ring across all grade levels, all classrooms, and all disciplines. These concepts should be evident in the core curriculum, the co-curriculum, the extra-curricular curriculum, and the hidden curriculum. There must be a move to ensure that technology is not only integrated into the curriculum, but must be use for students to gain the full impact of any curriculum to contribute to the SDGs attainment (Park & Savelyeva, 2022).

A STEM curriculum should be adopted for students to explore all possible solutions. Mathematics will allow them to develop critical thinking and problem-solving skills to use

science and technology to engineer solutions that will contribute to a more sustainable future. The STEM curriculum should be embraced by all teachers and chart the way to improve students' knowledge and performance in the application to the SDGs (Tunc & Bagceci, 2021). These combined elements will promote in students the concept of Green Energy and the Blue Economy. The government and business sectors should work on frameworks and policies for practical actions such as ensuring all schools are equipped with LED lights, solar panels, and water aeration systems. All energy must be invested to create the most environmentally friendly learning settings for students to live in and adopt this mindset for their own homes (Grainger-Brown & Malekpour, 2019). Students need to live in the concept of the Green School.

The Green School should be visible and promoted on all school grounds and campuses. There should be a constant in thinking about the sun, the wind, water, land, and nature to ensure a sustainable future; protecting and capitalizing on these elements. Schools should consider a paperless environment by providing applications, registrations, letters, files, handouts, assessments, and books using an electronic platform or system. A conscious effort should be made to minimize the use of paper and explaining to students, teachers, and parents the vital reasons for this practice. Every sheet of paper requires the use of trees. Every tree that falls to produce paper damages the ecosystem and deprives our planet of oxygen for trees are the only producers of oxygen and the air must have oxygen for the human race to survive (Somwaru, 2016). Students must have knowledge of all these facts.

Every school should integrate the knowledge and skills of a gardening project for students to learn how to grow their own food. Student must learn that engaging in gardening in school and their home has many benefits. The most obvious is creating their own food, and can even contribute to SDG #2 Zero Hunger, but gardening also provide us with fresh air in our immediate environment, cooler atmosphere, therapeutic activity, and it decreases the wastage of foods and scraps by recycling materials back into the soil as biodegradables. Using containers such as water bottle containers, old containers, tires, bamboo, old tree trunks, and plastic pipes found in the environment helps to remove these objects from the community. Students can learn the art not only of horizontal gardening, but also learn to engineer vertical gardening. With strategic planning, washbasin water can be reused irrigate the plants on the school grounds or campus. A garden contributes to producing oxygen in the air we breathe, and this must be instilled in students for no one person can live beyond a few minutes with the absence of air. Embracing the Green School idea will motivate students to reflect these

in their own home environment (Somwaru, 2016). Bringing this concept in the homes will support the fulfilment of SDG#11 Sustainable Cities & Communities.

Considering the seriousness of the impact of climate change, the absolute conscious state of mind for sustainable development should echo in all our practices. One very realistic solution to the problems created by humans is that of recycle. Every community in every state should engage in the practice of recycle. For this to be a constant practice, facts about state of our planet due to our own irresponsibility must be share with students. They must know that humans produce 100 million tons of plastic every year. Ten percent of these end up in the ocean and most in the Pacific Garbage Patch which is negatively affecting marine life, and indirectly, the quality of human life. “Malaysia is tracking global trends in both the overall generation of plastic waste and the consumption of single-use plastics and since 2017 has been the world’s largest importer of plastic waste” (Chen, et al. 2021). With a foundation of knowledge behind the issue, students will be able to formulate a comprehensive understanding of the greater past of the problem and will appreciate the efforts and practical actions being made to assist in the cause. Schools are in every society and should be used as a medium to achieve the goals set in 2015.

Several reasonable and practical actions exist that can be implemented. All schools must engage in a recycle program if leaders expect to see positive changes towards meeting the SDGs by 2030. This cannot simply be words spoken by leaders at a conference or in congress, but should exist in each learning institution. All governments must be held accountable in their own country to ensure the proper facility, equipment, and program is in place for a recycle program. Students in schools should be taught to sort paper, plastics, plastic bottles, and metal in their respective containers (Valdivia et al. 2018). This can only be done if a system is created and set in place by the leaders of our community. If a recycle system is in place, students and the people will learn the practice of putting garbage in its proper container instead of picking up garbage from the environment. Only if recycle programs are in place, students will be able to understand the effects of recycling, practice recycling, and even learn to develop ways to further address our environmental concerns. (John & Chen, 2021). Every person should be conscious to start looking around in institutions and in their community to find out if a recycling system is in place.

Another reasonable and realistic practice is that of integrating environmental art into the curriculum. Materials for art are solely recycling materials. In every art session, students are encouraged to bring items from home and the environment to stimulate their creativity. Each individual piece of art is unique, designed, and created from pieces

of materials found in the environment to explore students' creativity and support the preservation of the environment. Art can be incorporated into a STEM curriculum, across the various disciplines, and considered as a STEAM curriculum. This can instil in students the appreciation of art for them to be creative in their ways of thinking and contributing to the preservation of the environment (Mansour et al., 2018).

In the schools, note the materials being used and the practice of reusing. In every aspect of the institution, reusing materials should be evident. Students are encouraged to write on each blank page to save paper. Scrap papers are collected from printing companies and used for activities and projects in the school. Used printing papers are reused by teachers to print or to create activities. Any paper overused and unfit to be used in the classroom are shredded and used as mulching for the garden project outside. No piece of paper is left unused. Signs that say "Only reusable water bottle container allowed on campus" or "only paper or reusable paper containers are allowed" are evident. In the cafeteria, it can clearly be observed that reusable plates, cups, and utensils are used. Reusing initiatives and programs indicated a positive impact on students' knowledge, attitudes, and behaviours towards the conservation and preservation of the environment (Banchonhattakit et al., 2022).

Ultimately, school practices should be reflected in the community, single use plastic is no longer a practice. People are seen drinking from a reusable container, with a paper straw if needed or without a plastic straw. Items from the store are packaged in reusable bags brought by customers because a sign at the counter reads "no plastic bags available". Customers responding about their satisfaction of the product they received from an online store on an app now marked 3/5 stars instead of 5/5 stars due to three additional pieces of plastic bags and the unnecessary bubble wrap used to send the pair of jeans pants that they ordered. Customers justify their rating as support for sustainable development, conscious of climate change, and against excessive use of plastics in the environment. With schools networking and collaborating with the community, positive impact in the mentality and actions of all community members for sustainable development is evident (Banchonhattakit et al., 2022).

The science and mathematics curriculum must be integrated with the practices in the school in consideration of sustainable development. Students will learn to calculate energy usage in mathematics. They will secure knowledge of the different types of energy and the importance of conservation. They should see the connection of these mathematics and science classes in the school's environment. To conserve energy in schools, education institutions need to be designed with consideration of natural air and natural lights. Everyone must work at keeping the lights off if the room is bright, keeping

the air condition unit off if the climate is cool enough or when not in a room. The doors should be kept opened or closed to sustain adequate room temperature. Students in school learn from the practices of conserving energy when these are embedded in the curriculum. As they practice in school and provided with practical application to conserve energy, these activities influence the practices at home to conserve energy (Gill & Lang, 2018).

One research study indicated that only 33.8% of primary school aged children in Malaysia have good knowledge of water conservation. From that same survey, 43% indicated that they had a positive attitude towards conservation of water (Praveena & Themudu, 2022). For water conservation, students must learn to use minimal water to wash their hands. Toilets should be installed that allows for minimal water wastage. Students should understand the importance of conserving water and encourage their family members to practice at home by taking short showers, using washing water to water plants, and using a bucket of water to wash a car instead of a running hose. Students, when presented with the knowledge, indicated that they are willing to implement water conservation practices in their homes (Praveena & Themudu, 2022).

10. Conclusions & Recommendations

With the student serving as the bridge between the school and the home, the competencies for the SDG can be endorsed in the home and the community. The methods and strategies used in the school will align to the home practices. Business institutions, NGOs, and Government departments must encourage an active agenda to support the sustainable development goals in schools and in the homes. Significant investment in schools and STEM programs can be used as a catalyst to bring a positive attitude towards the SDGs.

Schools should ensure that students are well informed of all SDGs and the reason for the develop of the SDGs. School should encourage practical activities in the classrooms and around the school campus for students to apply and live the experiences. Application of the SDG activities should be realistic. Projects such as setting up recycle containers around the community, engaging in environmental art projects, creating awareness posters, and developing videos to illustrate best practices for sustainable development and consideration for climate change must be a constant.

Students must comprehend the magnitude of the environmental crisis and the reason SDGs were created. We the people must bridge the gap from the policy created by our leaders to the actual actions in each community. Only by investing in education

and action can this be achieved. World leaders and the leaders in our community can no longer simply develop dynamic speeches surrounding the topic of sustainable development. They can no longer stand from their pedestal as mere observers. The people, especially those from countries that are recorded as the highest emitters, must hold their government accountable and take the responsibility to invest and support vulnerable nations who are currently being affected by the actions of their development. They should not present themselves as being so numb to appreciate the pleas of humanity about sustainable development and climate change. They must take a stand for sooner or later, they will start to feel the rath of the reaction of their very own actions. They must invest more in education and in the actions to ensure that all nations have a fair opportunity to live with a peace of mind in a world that is healthy and safe.

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