International Journal of Scientific Research and Management (IJSRM)
||Volume||09||Issue||10||Pages||EL-2021-1908-1917||2021||
Website: www.ijsrm.in ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v9i10.el03

Teaching the Environmental Science Education in the 21st-Century

Donnalyn Bacolod

Palawan State University

Abstract
The school should reflect the real world. It should serve as the training ground for students to prepare in the actual workplace. The context in which courses are taught and learned has changed tremendously throughout the years. The advent of technology, the innovations in teaching, the demands of society, and the past and emerging environmental issues contributed to these changes. Environmental science is commonly an underestimated course compared to others despite its critical role in environmental sustainability, community, and solving climate change-related problems. Students show less appreciation of its importance and difficulty in learning and applying its concepts to reality. The way that Environmental science courses should be more like the reality. A new paradigm is needed to address these things to prepare students once they have embarked in their actual workplace. A meaningful learning that is non-fragmented, dynamic, adaptive, technology-supported, flexible, future work-ready, and enhances critical thinking is imperative. Though there are already existing multiple frameworks in teaching environmental science, a new framework that offers students an opportunity to build and empower students' learning ability through effective syntax is crucial in today's era.

Keywords: 21st-century skills, innovations in teaching and learning, environmental education

Introduction:

One of the 21st-century's significant issues is the unprecedented environmental emergency. Biodiversity depletion, climate change, ice melt, plastic waste, ocean pollution, ocean acidification, and desertification are some global environmental issues that constitute this ecological crisis. In contrast, habitat loss and degradation, extreme urban development, overconsumption of natural resources, and waste disposal are problems at the local level (Hadjichambis & Reis, 2020). The root cause of several environmental issues is driven by human activity (Kioupi & Voulvoulis, 2019). Hence, these issues demand an urgent response from humanity. The United Nations (UN) 2030 agenda created the 2030 Agenda for Sustainable Development, including 17 Sustainable Development Goals (SDGs). The SGDs emphasize sustainable development and equality, focusing on education as stated in Goal 4 (Kioupi et al., 2019). According to them, education and sustainable practices are acknowledged as means to achieve the remaining goals. On 25 September, 2015; 193 UN member states adopted these targets to end poverty and hunger and reach sustainable growth by 2030 (FAO, 2017). Many countries across the world work together to accomplish such targets.

As the Philippines moves toward attaining those targets, it has demonstrated a commitment to protect and conserve its natural resources. The government expressed itself to environmental conservation and natural resource management through a robust legal and regulatory framework to resolve the many ecological issues (Punzalan, 2020). The need for environmentally-trained individuals leads to creating an Environmental science program in higher education institutions. Two national environmental education networks, such as the Philippine Environmental Education Network, Inc. (EENP) and the Philippine Association of Tertiary Level Educational Institutions in Environmental Conservation and Management (PATLEPAM), complemented the attempt to incorporate sustainable growth in school programs and campus management. The formation of undergraduate and doctoral programs in Environmental science through academic institutions and educational programs is a significant development in Environmental Education for Sustainable Education (EESD) (Galang, 2010).

There are about 91 colleges and universities in the country offering environmental courses (climatechange.denr.gov.ph, 2020). At the tertiary level, the Environmental science program utilizes interdisciplinary methods to research the environment and the effect of human society on it and the setting of foundations for successful environmental management (CMO 35, s. 2015). Despite its good cause and a comprehensive curriculum, the program has not been enticing to many students. Most universities consider the program as one of the undersubscribed courses compared to courses like nursing, business administration, and teacher education. While low enrollment and graduation rates are common dilemmas faced by most universities and colleges offering it, other problems are also surfacing in its implementation. Research has shown that higher education students frequently misunderstand environmental conditions because of inadequate information and significant misconceptions (McCaffrey & Buhr, 2008). This problem defeats the prime purpose of the Environmental science program. With misconceptions and a lack of knowledge, a learner will not appreciate the beauty of the program and most likely not be effective in his field of expertise.

Consequently, critical thinking skill is one of the skills that they need to master in the 21st- century, particularly in dealing with the complex problems that may arise in their day to day living and future academic life or workplace (Pursitasari, Suhardi, Putra, & Rachman, 2020; Quita-damo, Faiola, Johnson & Kurtz, 2008; Khasanah, 2018). Applied knowledge and skills are equally crucial to the students of the program. The nature of the discipline requires both a thorough understanding of the concept and effective integration and application to other fields that will eventually translate to plans, programs, or activities to solve an environmental problem in the community. The abovementioned problems need to be addressed if the institution wants to produce quality graduates who are practical and efficient members of society in the future.

How should Environmental science courses be taught and learned? According to Robinson (2011), successful teaching in this field needs to consider previously studied misinformation and find opportunities to create new environmental awareness. For Kirkup and Johnson (2013), investigation and problem-solving are central to scientific advancement and key scientists' practices. Inquiry pedagogies, such as problem-based learning, are among the most effective learning methods available. In addition to these, the 21st-century classroom demands a new way of learning. Learning in the 21st-century requires creativity and innovation, especially in scientific and environmental education, because working in environmental protection involves using all learning skills, e.g., Higher-Order Thinking Skills (HOTS) (Ichsan & Rahmayanti, 2020). In this era, additional high competencies are required for students to gain, such as critical thinking, collaboration, communication, and creativity (Boholano, 2017). The 21st-century learners must have both self-direction and a collaborative approach to learning approach. Also, the integration of technology in the teaching and learning approach is highly encouraged because of its positive impact on cognition (Al-Hariri & Al-Hattami, 2017), self-esteem and enthusiasm (Fouts, 2000), motivation (Hartnett, 2016), and collaboration (Costley, 2014). Likewise, the skills and qualifications of future employees will have to evolve (Benesova et al., 2018). Jobs created today may not exist years ago (Hajkowicz, 2016), and students will be working in jobs that have not yet been invented (Ozyer et al., 2015). For this reason, Industry 4.0 will affect both the labor market and education (Benesova et al., 2018). Nevertheless, education must align students' learning needs, technology, and future workplace' demands to cope with the changing society.

A framework that will address the gap of teaching and learning approach in Environmental science is vital. Such a framework that will cater to the needs of 21st-century learners for comprehensive, versatile, and in-depth learning is paramount at present. Integrative learning that promotes Higher Order Thinking Skills and is project-based learning will help narrow the gap. Such a form of teaching engages students in novel, non-fragmented, work-ready, and authentic tasks. However, such an approach is quite underestimated. This paper poses the question of how environmental science courses be delivered and learned given all of these concerns in instruction and learning. It provides a brief discussion of the role of higher education institutions; the role of education in solving environmental problems; the connection of teacher, teaching, training, and environmental education; the Learning in the 21st-century; the Higher Order Thinking Skills; the constructivism approach, the

project-based learning; and the integrative learning, higher education, and sustainable development, in attaining the revolutionary pedagogical framework in environmental science.

Role of Higher educational Institution

Higher education is critical in meeting the Sustainable Development Goals (SGDs) of the 2030 Agenda. For Fonseca et al. (2018), higher education institutions are essential for achieving sustainability and sustainable development goals. Likewise, Tasdemir and Gazo (2020) agreed that they are a robust sector in advancing concepts of sustainability and sustainable development because they have the ability to fulfill the need for a skilled workforce. At the same time, they can educate the youth while helping them reach a state of intellectual and scientific knowledge saturation. They further added that universities are trying to develop sustainability curricula that are intended to increase the general population's sustainability awareness, as well as to provide undergraduates with a set of skills that would be a valuable asset in the job market. Efforts can be made by the school by using a teaching model that can improve students' thinking abilities (Şener, Türk, & Taş, 2015). Traditional teaching methods like lecture-based learning produce less success in comparison to more engaging and active teaching methods (Freeman et al., 2014). Employing effective teaching strategies will positively contribute to the success of students. As institutions of higher education wrestle with how to meet 21st-century needs for engaging, inspiring, and empowering learners, there will be added pressure on institutions to improve teaching and learning practices, especially those dedicated to connecting learning in different settings (Gebauer, Wade, Muller, Kramer, Leary, Sopper, 2020). By addressing this concern, the university can ably produce competent graduates who are adept in their respective fields. Syamsiara et al. (2020) believed that as part of its mission, the university has a responsibility to produce competent and prepared graduates to enter the world of work. This includes being proficient in the skills that are relevant to today's workplace.

Role of Education to solving Environmental problems

Education serves as a powerful tool in solving many societal problems, including environmental issues. Education is a fundamental step in prevention and resolution of environmental awareness (Genc 2015; Makki, Khalick, & Boujaoude, 2003; Oweini & Houri, 2006; Taskin, 2005; Tuncer, Ertepinar, Tekkaya, & Sungur, 2005) for it is the only means of reducing the number of environmental problems and increasing the number of environmentally sensitive individuals (Genc, 2015). Kioupi and Voulvoulis (2019) viewed education as a means of achieving the sustainability goals (SGDs) established by the United Nations. Moreover, education plays a significant role in implementing national and international policies to prevent environmental issues and achieve their goals apart from setting such policies (Yucel & Ozkan, 2015). Through education, students' knowledge and skills to solving environmental problems and concerns are developed (Dalida, Malto, & Lagunzad, 2018). Students realize the relevance of their acquired learning to their societal and environmental roles. Establishing environmental education has an end goal of understanding nature, its processes and inculcate among students the love and responsibility of conserving them through sustainable growth. Eilam and Trop (2012) viewed environmental education as capable of "influencing actions and developing responsible citizenship." This is further supported by the study of Keselman, Levin, Kramer, Matzkin, and Dutcher (2011), which tells that environmental science education will help create people who are environmentally literate and take social action in issues regarding environmental health.

Environmental education offers students environmental ethics, which can prevent many ecological imbalances and environmental problems from emerging and teach them to be accountable for protecting their inhabitable environment (Cepel, 2006). The study of Hoffmann and Muttarak (2020) in the Philippines indicated that education and pro-environmental behavior have a strong positive link. According to them, they are likely to practice recycling, proper garbage disposal, and planting trees. Studies reveal that more educated individuals are more likely to follow energy-saving practices that lower a carbon footprint, such as buying energy-efficient appliances (e.g., Ma et al., 2013; Wijaya and Tezuka 2013), and are turning to renewable energy sources, which is a deliberate effort to conserve energy (e.g., Lacroix and Gifford 2018; Niamir 2019). Education about the environment may improve learners' knowledge about environmental issues and lead to an increase in

awareness about the consequences of their actions (Wals & Benavot 2017). Hence, education fosters students' environmental knowledge, skills, attitudes, and awareness that will eventually transform them into empowered problem solvers and productive citizens with a sustainable perspective towards the environment.

Teacher, Teaching, Training, and Environmental education

The teacher's role in the inculcation and enhancement of skills is vital in the learning process. To thrive in today's 21st-century environment, educators must consider the development of important skills of the learners rather than the understanding of the concept alone. It's difficult to conceive of a teacher or school leader who is not cognizant of the necessity to impart higher-order thinking skills required to assist students in today's rapidly changing times (Collins, 2014). To a greater extent, students of the 21st-century are expected to be equipped with a range of abilities, not just the traditional academic areas such as reading, writing, and basic numerical ability. A primary expectation is to possess high-order thinking skills such as critical literacy, critical numeracy, and cross-cultural competencies (Forester, 2004). However, teaching higher-order thinking skills demands time and constant effort on the part of the teacher. They have to continually innovate their pedagogical skills, employ various methods, and improve their content knowledge and competence to do such goals.

Additionally, there are other external factors contributory to the development of students' competence. For instance, studies highlighted that educational conditions, teacher competence and teaching practices, limited teacher training, narrow curricula, and bureaucracy (Li, 2013) impact environmental education. If these issues are not appropriately addressed, it can negatively affect learning. Fishman et al. (2014) stated that it is apparent that having little or no pedagogical knowledge or content knowledge is detrimental to learning. Teachers have the most significant impact on educating the next generation of environmental advocates (Esa, 2010). Hence, it is crucial to address issues concerning environmental education. More effective environmental education demands active learning methods. Cheong (2005) found that using teaching methods that encourage more active student engagement improves students' environmental attitudes and conceptual understanding. In addition to teaching students about environmental education, teachers must also educate their students with environmentally sustainable approaches to build multiple skills and attitudes based on an environmental perspective (Philipson-Mower & Adams, 2010).

Learning in the 21st-century

Learning in the 21st-century is dynamic and definitely changing the game of education. Learning itself and its process has evolved (Tekkol & Demirel, 2018). Long gone are the days that learning could be acquired primarily through dictation and memorization. Debates about how education will cope with the changes are emerging. Adapting to future changes is crucial for modern education because, for Komala, Lestari, and Ichsan (2020), the success of learning in the 21st-century lies in the students' ability to refine their thinking. Also, learning in the 21st-century requires 21st-century skills. In this age, it is of great importance to raise individuals who have 21st-century competencies (Selçuk & Yilmaz, 2020), such as collaboration, digital literacy, critical thinking, and problem-solving, that schools should be teaching to help students thrive in today's world (Allington, 2010). Wagner (2008) argued that instead of focusing on educational content, experts stress the academic skills students need to succeed in the wider world, such as "critical thinking and problem solving, collaboration across networks and leading by influence, agility and adaptability, initiative and entrepreneurship, effective oral and written communication, accessing and analyzing information, and curiosity and imagination." These competencies are stated in the 21st-Century Partnership Learning Framework (Yanto, Festiyed, & Enjoni, 2021), and these are needed to support Education 4.0 and respond to Industry 4.0. Industry 4.0 will affect the labor market and education (Benesova, Hirman, Steiner, & Tupa, 2018). As technology advances, the way people produce things has changed (Santos, Mehrsai, Barros, Araújo, & Ares, 2017). Likewise, the skills and qualifications of future employees will have to evolve (Benesova et al., 2018). Jobs created today may not exist years ago (Hajkowicz et al., 2016), and students will be working in jobs that have not yet been invented (Ozyer et al., 2015). Nevertheless, education must align students' learning

needs, technology, and future workplace' demands. With such alignment of teaching and learning, universities can ensure their students will be prepared for the 4th Industrial Revolution.

Higher Order Thinking Skills

The importance of Higher Order Thinking Skills (HOTS) is paramount in 21st-century educators. It is one of the essential 21st-century learning skills (Rahmayanti et al., 2020; Husamah *et al*., 2018; Saputri *et al*., 2019). Teachers are compelled to develop higher-order thinking skills to better prepare them for effective performance in a competitive job market. Consequently, teaching strategies play a vital role in the formation of HOTS (Shukla & Dungsungnoen, 2016). HOTS is how a person can analyze, evaluate, and create a solution (Ichsan & Rahmayanti 2020; Saido et al., 2018). In 1956, Benjamin Bloom developed higher-order thinking to classify levels of intellectual behaviors (Towsend, 2018). Though it is not directly seen in the hierarchy, higher-order thinking or critical thinking is associated with Bloom's taxonomy's analysis, synthesis, and evaluation levels. Emerging out from the taxonomy was the Revised Bloom's Taxonomy of Anderson and Krathwohl (2001). The Revised Bloom's Taxonomy is a widely used and recognized approach to education that offers a way of grouping, organizing, and focusing on different aspects of learning objectives (Baghaei, Bagheri, & Yamini, 2021). It encompasses the six levels of the cognitive domains under which Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating are included (Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths, & Wittrock, 2001). Creating the highest level in the revised taxonomy should be the highest ability that students must possess in the 21st-century (Chalkiadaki, 2018; Saputri et al., 2018; Talmi, Hazzan & Katz, 2018).

Constructivism Approach

A constructivist learning model is needed in the development of 21st-century skills. It holds a central place in educating the students with 21st-century skills (Selçuk & Yilmaz, 2020), and this approach in which students construct their knowledge is popular today (Balim, 2013). Constructivism provides a way for students to apply their science knowledge to the world around them (Cetin-Dindar, 2015) by utilizing critical thinking, creativity, motivation, and engagement. It relies on the notion that students actively engage in the learning process by applying their prior knowledge to construct new information, thus learning with the guidance of a teacher (Selçuk & Yilmaz, 2020; Kanlı, 2010). They have the opportunity to discover different ideas and develop them further, conduct experiments, collect data, and analyze them to draw their conclusions (Bhowmik, 2015). In summary, the constructivist learning environment allows students to search for different information, proceed with a different viewpoint, draw links between the learning process and their culture and experience, reinforce different learning styles, and encourage self-reflection on the learning process (Sasson et al., 2018).

Project-based learning

College readiness depends on more than just academic knowledge these days. For this reason, educators are tasked with elevating their subject comprehension and tailoring teaching to fit the needs of the twenty-first century. Teaching students to solve community problems as part of a real-world scenario enhances their understanding of the concepts and allows them to develop essential competencies. With a large number of available pedagogies, including many technological innovations, project-based learning (PjBL) offers a good platform in catering to learner's needs because of its close link to real-world problems that help students learn and apply 21st-century abilities. The practical application provides for a seamless connection to real-world applications. Project-based learning develops students' skills in multiple ways, including future employment. They're given the opportunity to interact with others, discuss new concepts, and introduce and pursue new ones. With these exercises, they will improve their ability to think critically and resolve problems (Kwietniewski, 2017). According to Hutchinson (2015), students who are exposed tin PBL are found to be cultivating 21st-century thinking habits, collaboration, communication, and problem-solving skills, as well as their own ability to be self-directed. Project-based learning is an important tool that enables students to have

autonomy and guide their learning. Its driving components are critical thinking, authenticity, motivation, collaboration, reflection, and output (Baird, 2019).

Integrative Learning, Higher Education, and Sustainable Development

A significant concern facing universities today is how development-based education can be translated into practice to transform society effectively. Universities assume to positively impact a sustainable future, as is explicitly reiterated in public policy documents. Among the many challenges that higher education institutions face today, perhaps the most difficult is bridging the gap between current practices and a future vision of sustainable development that incorporates everything from curricula to campuses, to communities, and scientific research (Cortese, 2005). While it is clear that much more comprehensive approaches to sustainability must be developed, universities around the world have been largely unsuccessful so far in incorporating education for sustainable development throughout the entire curriculum (Shiel and Paço 2012).

There is an increasing trend of integrating sustainability as a transversal theme, which benefits all university students (Filho, Shiel, & Paço, 2014). They added that universities are important for providing formal environmental education, but this education is not always practical. The interdisciplinary approaches to sustainability and environmental themes require complex solutions that are difficult to attain in a university setting (Pearson et al., 2005). Environmental education is essential to promoting awareness about the environment and ensuring that future generations have the information they need to be proactive. The role of universities is vital in identifying sustainable and innovative solutions in the future (Brandli et al., 2011). One approach tool that may be used to promote sustainability in higher education is the utilization of integrative approaches.

An integrative approach to education promotes students' conceptual understanding of the interdisciplinary and intradisciplinary connections between their diverse curricular and co-curricular activities. For most college students, there is continuous exposure to new knowledge from a diverse array of settings, but this presents a significant challenge as to how these students are implementing new knowledge (Gebauer et al., 2020). The study of Brandli et al. (2011) argued that HEIs have two central roles in sustainable development: they aid in the future decision-making process concerning environmental issues and implement environmental management systems, which present practical examples of sustainable management for all societies.

Conclusion

The school should reflect the real world. It should serve as the training ground for students to prepare in the actual workplace. Therefore, the teaching and learning in Environmental science courses should be more like the reality. The discipline will require the development of Higher Order Thinking Skills (HOTS), the application of real-life situations, and immersion activities. However, these do not entirely address the teaching and learning gap in the field. Major program courses need to be delivered in an adaptive and non-fragmented manner while it covers essential concepts connected to it. Therefore, revisiting and revolutionizing the existing framework to teach and learn environmental science courses is imperative. With the teaching and learning design, students can develop their understanding and skills toward the course and be effective members of the future workplace in the 21st-century era.

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