

EVALUATION OF ENVIRONMENTAL EDUCATION MELCs-BASED SELF-LEARNING MODULES IN ASYNCHRONOUS LEARNING MODALITY DURING THE PANDEMIC

ABEGAIL A. SOLIMAN¹, ARLYNE C. MARASIGAN, Ph.D.²

<https://orcid/0000-0002-5401-6409>¹, <https://orcid/0000-0003-2362-7634>²

soliman.aa@pnu.ed.ph¹, arlynecmarasigan@gmail.com²

Philippine Normal University

Manila, Philippines

ABSTRACT

The Covid-19 pandemic created a historical shift in the modality of education all over the world that transitioned from face-to-face to blended learning. In the Philippines, the modular learning became the option of most learners due to the absence, or the intermittent internet connectivity. The Environmental Education (EE)-based Most Essential Learning Competencies (MELCs) Self-learning Modules (SLMs) were evaluated using descriptive analysis and evaluative review of text data from an inductive perspective of specific to general themes, and the researcher is the inquirer that generates meaning from the data (Creswell, 2014). Validation from curriculum and content experts were also sought. EE-based MELCs is 15 percent in elementary while only three percent in Junior High School. The SLMs used for asynchronous learning in the public schools are not uniformed in terms of the parts and content. These modules were based from competencies in the public school system that were trimmed down to the MELCs. The EE-based SLMs develop independent learning, integrate Filipino socio-cultural values, and advocates environmental literacy. However, the contents and the assessments do not promote higher order thinking skills.

Keywords: Self-learning Modules, Environmental Education, Asynchronous Learning, Most Essential Learning Competencies

INTRODUCTION

Education on environment need not be another platform to alter teachers' expectation to the learners but rather showcase the most efficient teaching strategies that will lead students to involvement in sustainable lifestyle practices and will engage them to a lifelong change of habits that has damaging impacts to the environment (Paul and Bandiez, 2015). More than just educating sustainable growth, environmental education is a comprehensive assessment that must be taken by the learning environments involved, based not just

on transmitting sustainability content, but on incorporating values into their culture, policies and everyday practices (Ortilla, 2018). A local literature noted that environmental education responsive to the needs of the times will help foresee how problems that might arise in the future can be addressed or mitigated (Malay and Lopez, 2019). But during the pandemic, the critical consideration is the way by which educators incorporate pro-environment values in their subject.

In the Philippines, Republic Act 9512 an act that promotes environmental awareness through environmental education and for other purposes declares the country's commitment to foster environmental conservation measure through

education which is believed to be the most efficient way to disseminate the information, and hopefully translate to sustainable behavior modification. With the new challenges of the times, according to Karaarslan & Teksöz (2016), people must look at new perspectives in solving the perennial problems of the environment. The Covid-19 pandemic shifted the modality of education that transitioned from face-to-face to blended learning. Some countries have a system of education that has established blended learning as an option prior to the pandemic, and apparently is more prepared for the transition.

However, in the case of the Philippine educational system, this has not been tried on a larger scale in adopting blended learning modality prior to the pandemic. When schools were forced to close down, teachers and administrators needed to adjust to the new modality and technology. In time, the Department of Education released the “Adoption of the Basic Education Learning Continuity Plan for School Year 2020-2021” which identified blended learning as a teaching modality under distance learning (D.O. No.12 s. 2020). Blended learning is defined as “a learning delivery that combines face-to-face with any or a mix of online distance learning, modular distance learning, and TV/Radio-based Instruction.”

Modular learning became the best option among schools that do not have, or have poor internet connections. Even schools in urban areas provide their learners option if they ought to study under modular learning. Self-learning modules (SLMs) became the most efficient option in the delivery of educational services to learners during the time of pandemic. DepEd also trimmed the learning competencies of the K-12 curriculum to what is now known as the most essential learning competencies (MELCs). It is important that while learners are studying at the comforts of their homes, the concepts they learn about caring for the environment has an impact not only in their head, but will lead them to action, and develop better conviction about their individual impact to the environment.

Integrating environmental management in the school curriculum is important not only in creating awareness to environmental issues, but more on providing a learning environment and

opportunities where learners can be actively engaged in sound and practical decision making and problem solving of related issues (Goldman et al., 2018). Environmental literacy can be efficiently achieved when teachers employ various pedagogies that integrate cognitive, emotional, and psychomotor skills among diverse learners (Kaya and Elster, 2019). Education for sustainability is only realized when the content is translated to personal transformation and living a lifestyle of increased sense of responsibility and respect for all that the environment constitutes of (Buchanan et al., 2019). With the given scenarios, this study aimed to look into the contents of the primary learning materials used during the pandemic. The results will determine how learning competencies relevant to environmental literacy is integrated into the modules that students are expected to acquire.

Science education is a tool for learners to concretely understand the cycle of material consumption and its impact to the environment, which puts the burden to individual learners to change their consumption practices and ultimately their behavior towards nature (Goldman et al., 2018). Teachers approach to environmental education need to operate by balancing both pro-environmental and pro-pedagogical ends, yet teachers must remain mindful of the learning outcomes and technology that are towards sustainability (Buchanan et al., 2019).

Science teachers are in a position where they merge scientific with environmental knowledge so that what the students will learn is to appreciate both disciplines and its relevance to their life, and eventually adopt sustainable lifestyles that will not endanger the future (Karaarslan and Teksöz, 2016). Furthermore, science education for sustainable development is about transformative learning where teachers must have a clear understanding that the competencies involved must bank on developing skills, values, beliefs and attitudes that are pro-environment (Napal et al., 2020).

Teachers and Environmental Education

Teachers will need to arrange for a more enticing forum with persuasive resources that

make environmental education a pleasant adventure, and encourage the community to challenge traditional practices and to pursue new and improved lifestyles to inspire children and parents as well (Paul and Bandiez, 2015). They must be adept with the connections of social, economic, and natural sectors of life that will lead learners to become responsible members of the society by being engaged in citizenship projects (Karaarslan and Teksöz, 2016). To develop environmentally-literate learners, teachers must first be environmentally-literate but most of all must have exemplary behavior that is reflective of their sustainable lifestyle (Kaya and Elster, 2019).

National initiatives still need to be increasingly strengthened particularly in terms of curricula, improving educational experiences, enhance teachers' skills in implementation, and review (Ortilla, 2018). In terms of environmentally-relevant concepts in the curriculum, the education system often emphasizes on head knowledge rather than on competencies that integrates behavioral and values change (Ardoin et al., 2018). Pedagogical approaches that are employed in teaching environmental education must be student-centered and inquiry-based to be able to achieve significant pro-environmental outcomes (Buchanan et al., 2019).

Teachers of environmental education are guided and rather limited by strict adherence to content and the time restraints in covering all necessary academic competencies (Aikens et al., 2016). The involvement of the teachers of environmental education is only at an academic level that usually ends after the course timeline is served (Goldman et al., 2018). Learning competencies must start with what knowledge and skills learners are expected to acquire at the end of the lesson, thus planning for classroom activities must be based on specific objectives and intended learning outcomes (Napal et al., 2020).

Role of Modules in Learning

Modules have been one of the materials that educators are exploring whether as a supplementary, or stand-alone learning material that will provide learning opportunity to all. Modules serve its purpose as part of blended learning

modality or as a stand-alone learning material and can be considered as a substantial educational material for the future for it caters to the needs in new learning modalities such as distance and independent learning (Patel et al., 2018). When modules were used in the face-to-face learning modality as a supplemental learning material, students manifest greater interest and enjoyment in learning, and express that is of great help in accomplishing learning tasks like assignments (Holmes, 2015). Students who use modules as supplement to lectures in class manifest positive attitude in learning. (Hill et al., 2015). Modules provide opportunities to develop independent learning, ingenuity, and self-reflection to learners in new education modality that is not bounded within the classroom setting (Thuneberg et al., 2018).

Learning modules are designed to optimize student engagement and retention because it is intended to be self-paced and the content is written in a language appropriate to the level of learners (Patel et al., 2018). Furthermore, modules provide concepts, and attain learning objective in a new perspective, and promote more mastery of knowledge because it has better assessment designs. Modules with assessments that does not promote higher order thinking skills and only require knowledge-level answers to questions is found to stunt learning growth and does not serve the purpose that modules are designed for (Hill et al., 2015).

In the digital age, modules can be electronic and thus more interactive. Modules, whether they be physical or electronic, must incorporate the balance of concept-focused and representation focused instruction (Hill et al., 2015). Hands-on module enhances cognitive learning by encouraging learners to be creative (Thuneberg et al., 2018). In the virtual learning environment, the modules enhanced student engagement and independent learning (Holmes, 2015). When modules are designed to communicate the content in age and level-appropriate to learners, it ensures significant learning gains (Hill et al., 2015). It is imperative that modules be holistically designed to be self-learning, easy to follow, and have accurate content to provide the learning opportunity even without the assistance of the teacher.

OBJECTIVES OF THE STUDY

This study determined whether K-12 curriculum is committed to the development of learners who are pro-environment even if it trimmed to the MELCs during the pandemic through asynchronous modality of education. Specifically, this sought answers for the following objectives:

1. To assess the contents of the EE-based MELCs in elementary and junior high school science.
2. To evaluate whether self-learning modules (SLMs) of Grade 5 and 6 Science integrate/reflect the curriculum strategies of the National Environmental Education Action Plan (NEE-AP) 2018-2040 of DENR.
3. To determine the Filipino Socio-cultural Values in EE-based MELCs SLMs.
3. Proposed the Curriculum Strategy for EE-Based MELCs.

METHODOLOGY

This is qualitative research that employed descriptive analysis and evaluative review of text data. Qualitative research is a process of research that involves data analysis from an inductive perspective of specific to general themes, and the researcher is the inquirer that generates meaning from the data (Creswell, 2014). The data collected were through document analysis of the Science Most Essential Learning Competencies, and self-learning modules of Grades 5 and 6 science of public schools in the Department of Education. Six SLMs, specifically two from Grade 6, and four from Grade 5 science were reviewed for content analysis.

EE-based MELCs in elementary and junior high school were lifted from the MELCs. The percentage of EE-based MELCs were computed by dividing it with the total MELCs of elementary and junior high school science, by each level, respectively. SLMs were evaluated by reviewing the content based on the corresponding MELCs in science. The different parts of the module were analysed whether it was aligned with the strategies of TNEE-AP. The overall contents of all the modules in the study were also subjected to thematic analysis to come up with a descriptive

pattern of the type of self-learning modules that learners are using during blended learning modality. Curriculum and content experts were requested to further evaluate the content of the modules for triangulation purposes. But ultimately, the modules were reviewed for the content that is expected to promote the aims of environmental education.

RESULTS AND DISCUSSION

1. EE-Based MELCs in Science

The Most Essential Learning Competencies (MELCs) in elementary and junior high school Science that reflect environmental education (EE) content are illustrated in Table 1.

MELCs in bold are the EE-based MELCs and number (n) of the modules evaluated in this study. The SLMs used for asynchronous learning for public schools were not uniformed in terms of content. SLMs in NCR contain eight parts which were almost the same, but they differ in the name and in some contents. The seven similar parts include expectations, pretest, looking back/recap, brief introduction/lesson, activities, remember/wrap up, and posttest. The part before the post-test in one SLM is checking the understanding while in another it is valuing. The former is described in the module as the part that will verify how students learned from the lesson, whereas the latter is described as the part that integrates a desirable moral value in the lesson. Valuing is more appropriate than merely assessing cognitive learning especially in lessons about environmental education. Surprisingly, SLMs in one region only has three parts which are named 1) what happened, 2) what you need to know, and 3) what have I learned. Compared to the NCR SLMs, their modules do not include engaging and interactive activities.

The first part is where learners answer objective type exercises or tests. The second part is rich in the content of the lesson and that which occupies the largest part of the module. The last part is the evaluation which requires learners to answer fill in the blanks or matching type posttest. The content is more of a textbook type reference than a modular learning material.



Table 1
The EE-based Most Essential Learning Competencies in Science

Grade	Quarter	Week	MELCs
3	2	4	State the importance of plants to humans
	2	6	Explain how living things depend on the environment to meet their basic needs
	2	7	Recognize that there is a need to protect and conserve the environment
	4	1-2	Relate the importance of surroundings to people and other living things
4	1	6-7	Identify changes in materials whether useful or harmful to one's Environment
	2	5	Describe the effect of the environment on the life cycle of organisms
	2	7	Describe the effects of interactions among organism in their environment
5	1	5-6	Design a product out of local, recyclable solid and/ or liquid materials in making useful products
	1	7	Explain how different materials become useful/harmful in the community (2)
	2	7	Explain the need to protect and conserve estuaries and intertidal zones (2)
	4	2	Investigate extent of soil erosion in the community and its effects on living things and the environment
6	2	6	Discuss the interactions among living things and non-living things in tropical rainforests, coral reefs and mangrove swamps (1)
	2	7	Explain the need to protect and conserve tropical rainforests, coral reefs and mangrove swamps (1)
7	4	2	Cite and explain ways of using Earth's resources sustainably
8	4	5	Explain the advantage of high biodiversity in maintaining the stability of an ecosystem
	4	7	Suggest ways to minimize human impact on the environment
9			None
10			None

Nonetheless, DepEd required all regional offices to make self-learning modules that can be used in the blended learning modality during the pandemic for the School Year 2020-2021. The students who have no means to attend synchronous online classes may opt to use modular asynchronous learning modality. Regional offices and even division offices did not adopt similar templates in making the self-learning modules based on the samples used for review in the study. All the SLMs however have topics that is aligned to the prescribed MELC of DepEd.

2. EE-based MELCs in Science SLMs for Asynchronous Learning

The result described here discusses in detail the EE-based MELCS integration in the different parts of the module. The part of the SLMs rich in environmental education can be found where the lesson content is discussed and is described as "brief introduction," "lesson" or "what you need to know" part. These contents were aligned with the prescribed MELCs. In addition, the specific objectives, or expectations were also met in the aforementioned part of the SLM and it was discussed here in detail. The contents were also appropriate to the level of learners because the concepts were discussed in simple and

understandable language. However, there were also flaws in the proper sequencing of contents.

Concepts about environmental education are also illustrated in clear diagrams and pictures. The details of the lesson comprise the largest content of the module compared to the other parts like recap, activities, valuing, and pretest and posttest. The lessons were not only facts but also include ways of conserving and protecting the environment. The environmental education contents were also reflected in different parts of the SLMs. In the parts like recall/recap and pretest, the module begun with review of previous lesson by means of test questions in the form of identification, multiple choice questions, unscramble letters to form a word, or presenting a situation that compels learners to make a decision. These preliminary activities can be described as engaging because it captures the attention of the learners through interesting and practical questions. The pretest was followed by the lesson, then activities that learners need to perform which also served as assessment whether they understood the concepts presented in the discussion of the lesson. The activities in some modules develop higher order thinking skills. The studies of Paul and Bandiez (2015) and Hill et al. (2015), claimed that modules promote learning gains when designed with interactive activities.



In one module, an activity pointed learners to a link of a documentary film from Netflix entitled Chasing Coral which was about the phenomena of coral bleaching and fluorescing. After watching the film, the learners were required to write a short paragraph to express their own point of view on how to prevent the increasing damages in the coral reef ecosystem. This was an interactive activity because it involved a video but only to those who have access to internet and has subscription to Netflix can watch it. Students chose the modular learning modality primarily because they do not have access to internet, or have very poor connection. The activity with video link may be fun and engaging but it limits learners who have no means to access resources available only in the internet. With this, teachers may opt to include video links but only optional and as a supplementary material.

Compared to the activity-type assessments, the post-tests contain more items that do not promote Higher Order Thinking Skills (HOTS). One validator noted that an item in the posttest presented the question as a knowledge-level test and the correct answer among the options was obvious because it was not relevant with the rest. Questions about environmental education content must promote environmental literacy where knowledge is vital, but what is more

significant is an avenue that allows learners to reflect on their current behavior towards change. As Karaarslan and Teksöz (2016) noted, environmental education must translate knowledge into visible actions that improve the so-called sustainable practices. The posttest must not include questions that merely require learners to recall the concepts in the content. Rather, the items must present contextualized scenarios where learners can apply the concepts that they learned, develop informed decision-making skills, and allow learners to position themselves as contributors to environmental conservation both in a local and global context.

3. The Filipino Socio-cultural Values in EE-based MELCs SLMs

It was articulated in the national environmental education plan 2018-2040 of DENR that teaching modules on environmental education should be guided by the SDGs and Filipino socio-cultural values such as cooperation, thrift, and concern, and other suitable cultural values could be included if necessary (DENR, 2017). Also, EE must incorporate sustainability values into the culture, policies, and everyday practices (Ortilla, 2018).

Table 2
Filipino Socio-Cultural Values in the EE-based MELCs SLMs

Socio-cultural Values	Framework	Example
Bayanihan (cooperation)	NEEAP	Join tree-planting programs, clean-up drives, and environmental conservation and protection campaigns in your school and community
Malasakit (concern)	NEEAP	Using a map, identify where you think mangroves should be planted and devise a proper plan to protect the vulnerable areas in the Philippines
Pagtitipid (Thrift)	NEEAP	Make your own products cuts down on packaging wastes and reduces the release of household chemicals that can contribute to air and water pollution
Respeto sa kalikasan (Respect for the environment)	Emergent	At the beach, do not disturb or keep animals that you found along the shoreline
Maging mabuting halimbawa (Being a good example)	Emergent	In the beach, make sure you keep all your wastes during picnics in a safe bag and dispose it properly
Maparaan (Resourcefulness)	Emergent	Use recycled materials for your school projects Make a simple garden in your small backyard

Aside from the socio-cultural values articulated in NEEAP 2018-2040 presented in the conceptual framework of this study, the other Filipino values that emerged in the thematic analysis of the SLMs and some examples were shown in Table 2.

Environmental education in the curriculum integrated in the science subject is aimed at developing environmental literacy. Environmental literacy is not much about learning the scientific concepts of environmental protection and conservation, but towards the transformation of

wasteful habits towards sustainable lifestyle practices. Young learners who were mostly receptive of new learnings can internalize good values when they can see concrete applications aside from factual information that they read. It is important that these self-learning modules must contain Filipino socio-cultural values that must be passed down to the next generation, and future leaders of the nation. If modules are what most learners use during blended learning, then DepEd must have standards and guidelines to make sure that these materials have accurate content and all other parts that increase academic engagement and develop love for learning. The modality of learning during the pandemic is both challenging to the teachers and learners. Because young learners are vulnerable and may be shocked from all the sudden changes, they are deemed to be at greater risk of resisting that might compromise their capacity to learn. Thus, educators must craft learning materials which are accessible, but still upholds educational standards that promote autonomy in learning, provide equal learning opportunities, and develop HOTS.

4. Curriculum Strategy for EE-Based MELCs

The study is anchored on the national environmental education action plan 2018-2040 of the Department of Environment and Natural Resources (DENR, 2017). It is a document that serves as guide to complement education in terms of crafting environmental literacy curriculum integrated in the subject matter of the Philippine educational system. The action plan presents sustainable development goals aligned with local and global context but specifically designed in the socio-cultural values of the Philippine society. The following are the strategies in terms of integrating the action plan in the curriculum, and the teaching and learning materials of the Department of Education that can be used as a conceptual framework for the study.

Curriculum

Design modules based on the Sustainable Development Goals (SDGs) for educational use and suitable for classroom use

A master curriculum must be designed for every level of education with clear objectives, content, skills output, and outcomes based on the SDGs. It could be delivered as a stand-alone subject, integrated into existing subjects or used to enhance Higher Order Thinking Skills (HOTS).

Teaching and Learning Materials

Develop teaching module on environmental education and sociocultural values. While the process of developing environmental education syllabus and modules is time consuming other short-term measures could be taken. One of the viable options is to compile and provide recommended reading lists and links to schools. This way students and teachers could do their own referencing and self-directed learning.

Develop teaching modules on environmental education guided by the SDGs and socio-cultural values such as – cooperation, thrift, and concern. Other suitable cultural values could be included if necessary. This document aimed to align the curriculum to have EE-based competencies that develop learners who possess critical thinking and 21st century skills. With this, the ability of students to think can be divided into lower-order thinking skills (LOTS), and higher-order thinking skills (HOTS). LOTS involve learning through remembering, understanding, and applying concepts, and information, while HOTS is learning through incorporating the processes of analyzing, evaluating, and creating (Komala et al., 2020). On the other hand, HOTS are the learning processes that promote critical thinking, whereas 21st century skills may comprise a much wider category of skills important to adjust to the fast-changing world, and critical thinking may be under such category. Twenty-first century skills have been defined in so many ways, put it simply as the combination of skills that are important in a modern society and workforce (Care et al., 2018 on Ercikan and Oliveri, 2016).

CONCLUSIONS

The self-learning modules (SLMs) used in asynchronous learning modality during the pandemic are designed to provide learning

opportunity to learners who do not have access to internet connectivity. These modules are based from competencies in the public school system that are trimmed down to the most essential learning competencies (MELCs). The EE-based SLMs that are evaluated in the study developed independent learning but not HOTS.

RECOMMENDATIONS

The SLMs in DepEd may adopt a uniformed format in terms of the different parts. In this manner, when uploaded to the DepEd commons website, all DepEd teachers from different regions may use them as a stand-alone learning material in their asynchronous lesson or as a supplemental reference in their synchronous class. Writers of SLMs may have a training or orientation in developing these learning materials that promote critical thinking and 21st century skills, contextualized, and integrate practices that encourage behavioural change, especially in EE-based MELCs. Valuing, instead of simple recall of the lesson may be the section after the lesson and before posttest. The SLMs may undergo thorough review of practitioners, and content experts before being distributed to the learners, or before being uploaded to accessible websites. Researchers who plan to embark on a similar study may opt to evaluate SLMs in lower grade levels to determine if there are different themes of EE-based MELCs SLMs across grade levels.

REFERENCES

- Aikens, K., McKenzie, M., & Vaughter, P. (2016). Environmental and sustainability education policy research: a systematic review of methodological and thematic trends. *Environmental Education Research*, 22(3), 333–359. <https://doi.org/10.1080/13504622.2015.1135418>
- Ardoin, N. M., Bowers, A. W., Roth, N. W., & Holthuis, N. (2018). Environmental education and K-12 student outcomes: A review and analysis of research. *Journal of Environmental Education*, 49(1), 1–17. <https://doi.org/10.1080/00958964.2017.1366155>
- Buchanan, J., Pressick-Kilborn, K., & Maher, D. (2019). Promoting environmental education for primary school-aged students using digital technologies. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(2). <https://doi.org/10.29333/ejmste/100639>
- Care, E., Kim, H., Vista, A., & Anderson, K. (2018). Education system alignment for 21st century skills: Focus on assessment. *Center for Universal Education at the Brookings Institution.*, 1–40. <https://cutt.us/0EekQ>
- Creswell, J. W. (2014). *Research design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). Sage Publications, Inc. www.ceil-conicet.gov.ar/wpcontent/uploads/2015/10/Creswell
- DENR (2017). The National environmental education action plan 2018-2040. Department of Environment and Natural Resources
- D.O No.12 s. 2020 Adoption of the basic education learning continuity plan for school year 2020-2021 in light of the CoVid-19 public health emergency . https://www.deped.gov.ph/wp-content/uploads/2020/06/DO_s2020_012.pdf
- Department of Education (2020). Most essential learning competencies (MELCS). <https://www.xpcourse.com/most-essential-learning-competencies-2020-pdf>
- Ercikan, K., & Oliveri, M. E. (2016). Assessment of twenty-first century skills: The issue of authenticity, assessment and teaching of 21st century skills. *Educational Assessment in an Information Age*. Springer, Cham. https://doi.org/10.1007/978-3-319-65368-6_2. <https://link.springer.com/>
- Goldman, D., Ayalon, O., Baum, D., & Weiss, B. (2018). Influence of 'green school certification' on students' environmental literacy and adoption of sustainable practice by schools. *Journal of Cleaner Production*, 183, 1300–1313. <https://doi.org/10.1016/j.jclepro.2018.02.176>
- Hill, M., Sharma, M. D., & Johnston, H. (2015). How online learning modules can improve the representational fluency and conceptual understanding of university physics students. *European Journal of Physics*, 36(4). <https://doi.org/10.1088/0143-0807/36/4/045019>

- Holmes, N. (2015). Student perceptions of their learning and engagement in response to the use of a continuous e-assessment in an undergraduate module. *Assessment and Evaluation in Higher Education*, 40(1), 1–14. <https://doi.org/10.1080/02602938.2014.881978>
- Johannes, P., Bandiez, M. (2015). Environmental education at primary schools in Iloilo City, Philippines and options to enhance value formation for solid waste management. https://www.academia.edu/14846537/Environmental_education_at_primary_schools_in_Iloilo_City_Philippines_and_options_to_enhance_value_formation_for_solid_waste_management
- Karaarslan, G., & Teksöz, G. (2016). Integrating sustainable development concept into science education program is not enough; We need competent science teachers for education for sustainable development – Turkish Experience. *International Journal of Environmental and Science Education*, 11(15), 8403–8425.
- Kaya, V. H., & Elster, D. (2019). A critical consideration of environmental literacy: Concepts, contexts, and competencies. *Sustainability (Switzerland)*, 11(6). <https://doi.org/10.3390/su11061581>
- Komala, R., Lestari, D. P., & Ichsan, I. Z. (2020). Group investigation model in environmental learning: An effect for students' higher order thinking skills. *Universal Journal of Educational Research*, 8(4A), 9–14. <https://doi.org/10.13189/ujer.2020.081802>
- Malay, C., Lopez, J.J., (2019). *Awareness and attitude towards climate change of selected senior high students*. www.apjmr.com
- Napal, M., Mendióroz-Lacambra, A. M., & Peñalva, A. (2020). Sustainability teaching tools in the digital age. *Sustainability (Switzerland)*, 12(8), 1–14. <https://doi.org/10.3390/SU12083366>
- Ortilla, A. (2018). Teaching sustainable development in the Philippines: Looking through the lens of Education for Sustainable Development. *Akademika Nusa Internasional*, 2018, 1–9. <http://www.pbic.tu.ac.th/wpcontent/uploads/2019/10/2018-Ace-proceedings.pdf>
- Patel, S. R., Margolies, P. J., Covell, N. H., Lipscomb, C., & Dixon, L. B. (2018). Using instructional design, analyze, design, develop, implement, and evaluate, to develop e-learning modules to disseminate supported employment for community behavioral health treatment programs in New York State. *Frontiers in Public Health*, 6(May). <https://doi.org/10.3389/fpubh.2018.00113>
- Republic Act No. 9512. National environmental awareness and education act, 2008. An act to promote environmental awareness through environmental education and for other purposes. <https://www.ecolex.org/details/legislation/republic-act-no-9512-on-national-environmental-awareness-and-education-act-2008-lex-faac091238/>
- Thuneberg, H. M., Salmi, H. S., & Bogner, F. X. (2018). How creativity, autonomy and visual reasoning contribute to cognitive learning in a STEAM hands-on inquiry-based math module. *Thinking Skills and Creativity*, 29(April), 153–160. <https://doi.org/10.1016/j.tsc.2018.07.003>

AUTHORS' PROFILE



Abegail A. Soliman is Master Teacher II and former OIC of the Special Science Class in San Juan National High School, Division of the City of San Juan. She graduated Cum laude at the

Philippine Normal University with a degree in Bachelor of Secondary Education Major in Physics under Preservice CHED scholarship. She obtained MA in Education Major in Physics Teaching at UP-Diliman with DOST-ASTHRDP scholarship grant. She is currently taking her Ph.D. in Science Education at the Philippine Normal University under DOST-CBPSME scholarship program. Her work interests include research in physics education, quality teaching and the science curriculum.



Dr. Arlyne C. Marasigan is the director of Graduate Research Office (GResO) and an assistant professor at the Philippine Normal University-Manila. She holds a PhD in Educational Leadership and Policy

major in Comparative Education from Beijing Normal University under Chinese Government Scholarship (CSC). Also, she completed academic



requirement in PhD in Philippines Studies at the University of the Philippines-Diliman. She obtained her MA in Education major in Chemistry at the UP-Diliman and BSE major in Chemistry, under CHED Scholarship, graduated Cum Laude from PNU-Manila. Her research interest focuses on Education for Sustainability such as Environmental Sustainability (ESD), Ecofeminism, Rural Education, Green Chemistry, and Madrasah Education. In addition, she is the co-founder of LakbayLapis2019, committed to supporting rural agri-education stakeholders; parents, teachers and students.

COPYRIGHTS

Copyright of this article is retained by the author/s, with first publication rights granted to IIMRJ. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution – Noncommercial 4.0 International License (<http://creativecommons.org/licenses/by/4>).