

Embedding Ecological Solid Waste Management into Instruction: Extent, Effectiveness and Practical Session Guides for Sustainable School

Cristy A. Firmanes¹; Michael M. Uy²

Ph. D.²

^{1,2} Saint Louise de Marillac College of Sorsogon, Inc., Burgos Street, Talisay, Sorsogon City, Philippines

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Abstract: This study aimed to determine the extent of the integration, the level of effectiveness and the challenges encountered by teachers in integrating Ecological Solid Waste Management (ESWM) in instruction in Cabugao National High School in promoting school sustainability. Descriptive quantitative research method was employed to comprehensively determine the extent of integration. The respondents were the teachers of Cabugao National High School. Findings revealed that the extent of integration of ESWM in instruction along Teaching Strategies and Methods got a weighted mean of 3.61 (High Extent), Student Engagement and Participation got a weighted mean of 3.47 (Fair Extent), Curriculum and Planning got a weighted mean of 3.31 (Fair Extent), for Assessment a weighted mean of 3.24 (Fair Extent) and for Instructional Materials a weighted mean of 3.05 (Fair Extent). Furthermore, the perceived level of effectiveness of ESWM in instruction along Teaching Strategies and Methods got an average mean of 3.73 indicating moderately effective, Instructional Materials, Student Engagement and Participation, Assessment, and Curriculum and Planning were all classified as fairly effective with 3.55, 3.53, 3.53 and 3.13 average means respectively. Several challenges were identified which hinder effective integration, these includes; limited training, limited specific competencies, lack of instructional materials and resources, low student interest, lack of necessary infrastructure, inadequate assessment tools, and lack of funds. To address these challenges, the researcher recommends strengthening the integration of Ecological Solid Waste Management (ESWM) in instruction through curriculum enhancement, providing and utilizing instructional materials, engage students, improve infrastructure and innovates assessment. In addition, to conduct seminar and trainings to empower the teachers on ESWM concept to address the major challenge identified in the study. Finally, the researcher developed a session guides integrating ESWM concepts in other subject areas/instruction to promote sustainable schools.

Keywords: Ecological Solid Waste Management, Curriculum and Planning, Teaching Strategies and Methods, Student Engagement and Participation, Instructional Materials, Assessment, Challenges in ESWM, Sustainable Schools, Cabugao National High School

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I. INTRODUCTION

Environmental problems such as climate change, pollution and global warming have been a major issue to address with, one of the factors which contributes to this problem is waste mismanagement. The world generates 2.01 billion tons of municipal solid waste annually, with at least 33 percent of that is not managed in an environmentally safe manner and it is expected to double by 2050, a report according to World Bank (2018). According to the report, low-income countries disposed 90% of waste in unregulated dumps or openly burned. These practices are known to be

hazardous not only to human health but also to the environment. Waste when poorly managed serves as a breeding ground for disease vectors, contributes to climate change and may promote urban violence.

“Mismanagement of waste is harming human health and local environments while adding to the climate challenge,” said Laura Tuck, Vice President for Sustainable Development, World Bank (2018). “Unfortunately, it is often the poorest in society who are adversely impacted by inadequate waste management. It doesn’t have to be this way. Our resources need to be used and then reused

continuously so that they don't end up in landfills." World Bank (2018).

Statistic shows, an increased in solid waste generation was traced on population growth, urbanization and economic growth in each ASEAN countries according to ASEAN. Solid waste mismanagement from the collection, treatment and recovery, and disposal associated with environmental, technical, and governance (institution, policy, regulations) as factors. The Sustainable Development Goals Report 2022 provides a global overview of progress on the implementation of the 2030 Agenda for Sustainable Development, using the latest available data and estimates. According to the report, the interlinked crises are putting the 2030 Agenda for Sustainable Development in grave danger, along with humanity's very own survival. Issues on crises, dominated by COVID-19, climate change, and conflicts, are creating spin-off impacts on food and nutrition, health, education, the environment, and peace and security, and affecting all the Sustainable Development Goals (SDGs). One agenda tackled on this report is the responsible consumption and production. Unsustainable patterns of consumption and production are root causes of the triple planetary crises of climate change, biodiversity loss and pollution.

These crises and related environmental degradation, threaten human well-being and achievement of the SDGs. Issues on solid waste management is one of the main factors, which contributes on the environmental degradation, climate change and pollution crises across the globe. To address waste management and environmental challenges in developing countries, it is critical to integrate formal education on sustainable development at all levels of education. This has the potential to create transformative changes in society as a whole Debrah et al. (2021).

In developing countries, waste management is tied-up with other issues and realities; the most limiting factor is funding, having limited funds available to the waste service. But, improvements are not necessarily dependent on massive investments. They may use their available resources in a more efficient way. Good organizational structure and a high-quality management are two other important factors for efficient waste management. The process of waste management forces people to consider those factors; it may help to stress their importance; this is based on the report released by the International Solid Waste Association (ISWA) and the United Nations Environment Programme (2024).

The concept of zero-waste, which was coined in the 1970's by Paul Palmer, a chemist and Yale graduate and founder of the Zero Waste Institute have evolved overtime from its popular "reduce, reuse, recycle" into 5Rs: refuse, reduce, reuse, recycle, and rot, a framework by Bea Johnson, a US-based environmentalist who turned her blogs into a bestselling book and talks throughout the world. Focusing on a zero-waste approach can reduce total emissions of the waste management sector by about 84%,

according to a report by the Global Alliance for Incinerator Alternatives (GAIA), (2023).

In the Philippines, the main law governing solid waste management is Republic Act 9003, otherwise known as the "Ecological Solid Waste Management Act of 2000," it was developed to provide efficient and organized administration of waste management activities. It was enacted by the Philippine Congress on December 20, 2000 and took effect on January 26, 2001. Solid waste management in the society can be influence by various human and economic activities; another factor also can be physical geographies. In 2018, Philippines was considered as world's leading plastic polluters WWF-Philippines (2018). Philippines as a group of islands and a tourism haven should give a distinctive attention regarding this issue. This is beneficial to lessen environmental burdens and for sustainability for future generations. As a national law, RA 9003 is the main legal instrument in enforcing solid waste management programs in both national and local levels and serves as reference material for all ordinances, directives, and guidelines initiated by different government agencies and units. This gives directive on local government units as primary responsible agencies in implementing laws and regulations on solid waste management with the DENR and National Solid Waste Management Commission (NSWMC) providing the supporting role through provision of technical assistance and conduct of monitoring.

The Sangguniang Panlalawigan at the provincial level passed the Provincial Ordinance No. 05 Series of 2009 otherwise known as the "Environment Code of the Province of Sorsogon." In accordance with existing national laws, particularly Republic Act 9003 otherwise known as "Ecological Solid Waste Management Act of 2000", local government units (LGUs) are directly responsible in the implementation of integrated solid waste management. Each LGU is also required to establish their respective Integrated Solid Waste Management Committees (ISWMCs) composed of relevant sectors in the community. The primary task of ISWMCs is to develop solid waste management plans, which will serve as guide in the implementation of solid waste management program.

The City Government of Sorsogon implement a comprehensive solid waste management system for the protection and preservation of the local environment, the City Government creates the following ordinances such as City Ordinance No. 003, Series of 2005 "Sorsogon City Anti Littering Ordinance" which prohibits indiscriminate throwing of wastes. Several other ordinances were enacted such as City Ordinance No. 007, Series of 2005 or "Ecological Solid Waste Management Ordinance of the City of Sorsogon", City Ordinance No. 010, Series of 2011 or the "Sorsogon City Anti-Plastic Ordinance of 2011." The "Sorsogon City Anti-Plastic Ordinance of 2011" which classify products as wet goods and dry goods imposes penalties to establishment who are non-compliant of the policies. Furthermore, this may result to cancellation or revocation of their business permit. These ordinances are in line with the commitment of the city to the existing national

laws in promoting a proper solid waste management and disposal. It plays a great role in the attainment of goal for a quality and sustainable environment.

The City ISWM Committee formulated the Sorsogon City 10-year Solid Waste Management Plan. The Plan provides a comprehensive survey of SWM condition in the City and enumerates the corresponding interventions and programs that the City LGU implement in the period 2013-2022. The first version of the 10-Year SWM Plan (2013-2022) was submitted to the DENR EMB V and the Commission on 13 and 17 February 2014 and was subsequently given a Conditional Approval. A revised version of the Plan (2018-2027) was again submitted on 23 May 2018 but the City Government received no response from the Commission. Thus, a third version of the Plan (2021-2030) is prepared in line with the Annotated Outline issued by the Commission, updating certain sections to keep it responsive to arising needs and situation. The Plan's maximum target of 80% waste reduction, gives the emphasis on barangay capacity building through provision of logistical and technical assistance such as comprehensive Information, Education, and Communication (IEC) program; provision of waste collection vehicles such as kariton, pedicabs, etc.; assistance in the construction and operation of barangay Material Recovery Facility (MRF); and enforcement Sorsogon City SWMP 2021-2030.

At the barangay level, barangay ordinance supplements the city solid waste management ordinance as well as existing ordinances on anti-littering and dumping. It is to address the concerns in barangay level regarding on the solid waste management ordinance enacted by the city. Section 10 of RA 9003 mandates the creation of the Ecological Solid Waste Management Committee; its objective is to generate multi-sectoral interest and partnership in addressing the garbage problem in the locality. Executive Order No. 003 Series of 2024 encompasses the following; (1) Section 1. Creation and Composition of the Barangay Ecological Solid Waste Management Committee pursuant to RA 9003 and amended on DILG MC 2018-112 "Organization of the Barangay Ecological Solid Waste Management Committee". This committee shall take the lead in the successful implementation of the program in the barangay. It is composed of members from different sectors along barangay level headed by the Barangay Captain as Chairman of the Committee; (2) Section 2. Duties and Responsibilities of the Barangay Ecological Solid Waste Management Committee (BESWMC) it includes the implementation of policies and plans on Education, Engineering, Enforcement, Entrepreneurial; (3) Section 3. Functions and Responsibilities of Punong Barangay, this gives the full responsibility to the Chairman, to strictly observe the provisions of RA 9003 and related Department issuances.

School as one of the institutions and being a part of a system integrates on curricula waste management concept pursuant to RA 9512 entitled "An act to Promote Environmental Education and other Purposes." RA No. 9512 mandated schools at all levels, whether public or private to

integrate environmental education in the school curricula. The DO, 5 S 2014 – Implementing Guidelines in the integration of Gulayan sa Paaralan, Solid Waste Management, and Tree Planting under the National Greening Program (NGP) is one of the policies which support the issue on environmental sustainability. Furthermore, the Department of Education issued DepEd Order no. 52, series of 2011 entitled "Strengthening Environmental Education in Public and Private Schools". This mandates all schools to intensify lessons regarding the environment on all Science subjects, use environmental concerns as tools for classroom drills, discussions and activities, and integrate these concerns in related learning areas. Also, DepEd issued DepEd Order No. 93, series of 2011 that provided the programs, projects and activities for the Youth for Environment in Schools Organization (YES-O) which is the only recognized co-curricular environmental organization that serves as a venue for students' actions and movements towards safeguarding, protecting and conserving the environment for future generations.

It is in this context, that researcher wants to know the extent of integration of solid waste management concepts in instruction, the level of effectiveness of the integration, its challenges and the creation of a session guides that could be used to integrate Ecological Solid Waste Management concepts in instruction in several learning areas.

➤ *Problem Statement*

- What is the extent of integration of ecological solid waste management in instruction?
- What is the level of effectiveness of the integration of ecological solid waste management concepts in instruction?
- What are the challenges encountered by teachers in integrating ecological solid waste management concepts in instruction?
- What session guides can be designed to integrate ecological solid waste management concepts in other subject areas/instruction?

II. METHODOLOGY

➤ *Research Design*

The study employed a descriptive quantitative research design, which enabled the researcher to systematically collect numerical data and provide a clear description of the extent of integration of Ecological Solid Waste Management (ESWM) concepts in instruction. This design also facilitated the measurement of the level of effectiveness of ESWM integration and the identification of challenges encountered by teachers in embedding ESWM concepts into classroom instruction. By utilizing this approach, the study was able to generate objective findings that highlighted both the strengths and limitations of current instructional practices related to ESWM.

Creswell (2014) stated that, a descriptive quantitative research design is a non-experimental framework use to systematically measure, observe and describe a

phenomenon. This was utilized in the present research to acquire valid, reliable result.

The design was utilized to quantify the extent and the level of effectiveness of the integration through a structured survey questionnaire, providing measurable indicators such as curriculum and planning, teaching strategies and methods, instructional materials, student engagement and participation, and assessment. This instrument allowed the researcher to gather data from the teachers who served as the primary facilitators of instruction. The statistical tools used to facilitate the interpretation of the data collected were frequency, weighted mean and rank.

This method enabled a deeper understanding of the extent of the integration of Ecological Solid Waste Management concepts in instruction in Cabugao National High School and guided the development of session guides that may be used to promote sustainable schools. Furthermore, recommendations were formulated based on the current situation observed in the study.

➤ Respondents

The study involved the 15 teachers of Cabugao National High School, who have maximum participation in the integration of the Ecological Solid Waste Management concepts in instruction. Respondents were identified through answering respondent's profile in the survey. The respondents played a crucial role in providing valuable data

and insights that researcher analyzed and drew conclusions from. They provided meaningful insights into the extent of the integration, the level of effectiveness of the integration and the challenges in the integration of Ecological Solid Waste Management concepts in instruction. Their responses helped to gather information, understand trends, and make informed decisions based on the collected data. These individuals were essential to the research process because they provided firsthand information and points of view that provided the basis for gathering and analyzing data.

➤ Research Instrument

The researcher designed a survey questionnaire as the principal tool used in gathering the information needed in this study. The questionnaire for the teachers was divided into four parts. The first part determined the collected respondent profile information. The second part provided for the extent of the integration. The third part assessed the level of effectiveness. The fourth part provided for the challenges encountered by teachers in integrating Ecological Solid Waste Management concepts in instruction

Prior to the preparation of the questionnaire, the researcher reviewed literature and consulted with experts to create relevant questions. Upon completion of the questionnaire, it was pilot tested for clarity, then distributed to a sample of high school teachers for Data Collection Procedure.

Table 1 Numerical Range and Description for Extent of Integration

Scale	Ranges	Interpretation
5	4.60– 5.00	Highest Extent
4	3.60 – 4.59	High Extent
3	2.60 – 3.59	Fair Extent
2	1.60 – 2.59	Low Extent
1	1.00 – 1.59	Lowest Extent

Table 1 shows the numerical description employed by the researcher in interpreting the result of the survey responses regarding the extent of integration.

The data were collected using a 5-point Likert scale where 5 represents the highest extent and 1 represent the lowest extent. The scale intervals were equally distributed to

ensure consistent interpretation of the weighted mean scores. This approach is consistent with common practices in survey research Likert (1932), Creswell (2014). The study established numerical ranges where 4.60 – 5.00 = Highest Extent and 1.00 – 1.59 = Lowest Extent, such categorization provides descriptors that make the weighted mean scores more meaningful in educational contexts Alkharusi (2022).

Table 2 Numerical Range and Description for Level of Effectiveness

Scale	Ranges	Interpretation
5	4.60– 5.00	Highly Effective
4	3.60 – 4.59	Moderately Effective
3	2.60 – 3.59	Fairly Effective
2	1.60 – 2.59	Slightly Effective
1	1.00 – 1.59	Not Effective

Table 2 shows the numerical description that was used by the researcher in interpreting the result of the survey responses regarding the level of effectiveness in the integration of ESWM concepts.

The responses were analyzed using weighted mean scores to determine the overall level of effectiveness. The interpretation framework followed Warmbrod (2014), who emphasized the importance of reporting and interpreting Likert-type scale data in educational research.

To identify the challenges encountered by teachers in integrating Ecological Solid Waste Management (ESWM) concepts into instruction, the researcher included a structured checklist at the concluding section of the survey instrument. This checklist was designed to elicit specific difficulties experienced by teachers, such as limited instructional materials, time constraints, or lack of training. The use of a checklist ensured that responses were systematically gathered, allowing for quantifiable frequency counts, which were subsequently ranked to determine the relative weight of each challenge. By positioning the checklist at the end of the instrument, the researcher provided respondents with an opportunity to reflect on their experiences after completing the main survey items, enhancing the reliability of the data. This approach also served as a triangulation mechanism, complementing the Likert-scale responses with contextual information about barriers to ESWM integration.

➤ Data Collection Procedures

The researchers first designed a structured questionnaire to gather data on the integration of Ecological Solid Waste Management (ESWM) concept in instruction in Cabugao National High School. The questionnaire underwent review and validation by the research adviser, school statistician and local experts in the field were SDRRM school coordinators and school heads to ensure clarity, content relevance, and appropriateness for the intended respondents. After finalizing the research instrument, a formal request letter duly noted by the School Dean was prepared. Permission was sought to conduct the study. This letter was submitted to the Schools Division Superintendent to ensure ethical standards and proper coordination with school personnel.

Upon receiving approval, the researchers proceeded with data collection. Printed questionnaire were personally distributed to teachers. The researchers provided necessary guidance and ensured that participants answered the questionnaire voluntarily and independently. All data

gathered were treated with strict confidentiality and used solely for academic purposes.

➤ Data Analysis Method

Quantitative responses were encoded and summarized using statistical tools such as frequency, weighted mean and ranking method. The researcher interpreted the responses and organized them according to relevance to the research questions and objectives. In analyzing the responses, the results of the quantitative statistical tools were utilized and its interpretation served as guide.

➤ Statistical Analysis

To interpret the data effectively, the researchers employed the statistical treatment using the statistical tool:

• Frequency –

The researcher used frequency to determine how many times each response appeared in the survey. This helped identify the most common answers showed in the extent of the integration, level of effectiveness and which challenges in the integration of ESWM concepts were experienced by many respondents.

• Weighted Mean –

The researchers used weighted mean to determine the extent of the integration and the level of effectiveness.

• Ranking –

The researcher used ranking to arrange data from the lowest based on the obtained frequency. In this study, ranking was applied to identify which responses or challenges were most significant based on how often they appeared in the data.

A session guide was created to improve the integration of Ecological Solid Waste Management concepts in instruction. It outlines key areas of concern, objectives, persons involved, timeline and expected outcomes. This is to promote a sustainable school for a better learning environment.

III. RESULTS AND DISCUSSION

A. Extent of Integration of Ecological Solid Waste Management in Instruction

Table 3 Extent of Integration of Ecological Solid Waste Management Along Curriculum and Planning

Indicators	Mean	Descriptive Rating
ESWM topics are integrated in the lessons	3.53	Fair Extent
The concepts of ESWM are included in the subject curriculum such as lesson on segregation, waste disposal, waste management/ classification	3.33	Fair Extent
There are specific competencies related to ESWM in the curriculum	3.26	Fair Extent
ESWM concepts are presented in lesson objectives	3.13	Fair Extent
Average	3.31	Fair Extent

➤ Curriculum and Planning

The teachers and learners give life to the curriculum. A curriculum that has been written or planned should be implemented and taught. Teacher as a facilitator of learning is obliged to implement the curriculum. The teacher as a curriculum implementer means putting into practice the written curriculum.

In pursuant to RA 9003 “Ecological Solid Waste Management Act of 2000”, mandating integration of ESWM concepts into school instruction and campus practices, and adherence to RA 9512 entitled “An act to Promote Environmental Education and other Purposes,” mandating schools at all levels, whether public or private to integrate environmental education. Schools’ integration of waste management and environmental concepts into the curriculum demonstrates responsiveness to legal mandates and societal needs.

Findings show that there is a fair extent in the integration of ESWM in instruction along Curriculum and Planning. Thus indicating that ESWM topics are being integrated into the curriculum. However, it is partially integrated across other learning areas, the same findings in the study of Akinsemulo (2025), that there is the need for integration across all disciplines. The inclusion of ESWM in the subject curriculum such as lessons on segregation, waste disposal, waste management/ classification is of fair extent, showing that teachers are integrating environmental concepts in the lesson. This was discussed in the study of Paghasian (2017), concluding that awareness on solid waste management had no influence on their practices about

disposal but their awareness had affected their practices on segregation, and the practice of 3Rs.

As to specific competencies related to ESWM in the curriculum findings suggest a fair extent meaning there is a need for inclusion of specific competencies not only on subject areas such as Science and TLE. Similarly, in the study of Prisco and Cubillas (2022), stating that schools have actively integrating ESWM. However, the results in their study also imply that less emphasis was given on the curricula integration as mandated under RA 9512 attributed to the selection of the most essential learning competencies as a response of DepEd to address the challenges posed by the pandemic. Additionally, in the study of Goswami and Ahmad (2024) indicated that most schools encountered difficulties in integrating Education for Sustainable Development (ESD) to meet the standard of green schools. Studies of Al Husban (2025), Guerra et al. and Bibi et al. (2025) highlighted the importance of embedding environmental education in the curricula. This suggest that systematic planning, continuous evaluation and modification of the curriculum is needed to a more sustained environmental education which has been a major consideration in achieving the Global Goals known as the Sustainable Development Goals (SDGs) UNESCO.

Furthermore, the Global Schools Program under the UN Sustainable Development Solutions Network (SDSN) emphasizes the integration of sustainability competencies into curricula worldwide. By training educators and embedding sustainability into lesson plans, the program demonstrates that whole-school approaches are essential for long-term ecological impact (UN SDSN, 2021).

Table 4 Extent of Integration of Ecological Solid Waste Management Along Teaching Strategies and Method

Indicators	Mean	Descriptive Rating
Teaching strategies related to ESWM such as clean-up drives, recycling project are being taught to students	3.73	High Extent
Classroom demonstration such as segregated bins and waste management disposal in the right bin is done	3.73	High Extent
Real-life examples or local community practices pertaining to waste management are taught as a strategy in teaching	3.73	High Extent
Gardening projects, Gulayan sa Paaralan, composting and maintaining MRFs in schools are present	3.53	Fair Extent
Use of multimedia, stories, cartoons in relation to waste management practices are done	3.33	Fair Extent
Average	3.61	High Extent

➤ *Teaching Strategies and Method*

Teaching Strategies is one way of exposing the learners to different methods and strategies so that they will learn different experiences. In planning lessons, teachers can choose a variety of instructional models and their corresponding strategies and methods. An instructional model is a teacher's philosophical orientation to teaching. It is related to theories of learning including behaviorism, constructivism, social interactionism and others. An instructional strategy is a teaching approach influenced by educational philosophies, while an instructional method is the specific activity that teachers and learners will be doing in the classroom. An instructional strategy is what teacher uses inside the classroom to achieve the objectives of the lesson. Such teaching strategies are categorized into: direct instruction, indirect instruction, interactive instruction, experiential learning and independent study (DepEd Order 42, s.2016). However, there is no one best method in teaching.

Results from indicators Teaching Strategies and Method signifies a high extent of integration of ESWM in instruction. There is a high extent in teaching strategies related to ESWM such as clean-up drives, recycling projects being taught in school. This finding is consistent with the study of Casinillo and Guarte (2018), which revealed that interactive and experiential methods were more effective in engaging students, and teachers who adapted strategies to student learning styles achieved better outcomes. .

Practical demonstration of segregated bins and waste management disposal as one of strategy in teaching is of high extent was observed, this practice is one way of introducing awareness and a positive environmental attitude to the learners which was also discussed in the study of Lalamonan and Comighud (2020), study revealed that there is a significant relation between the levels of awareness and

the extent of implementation of SWM practices. Similar, to the study of Rafael (2019), which outlined a practical framework for embedding ESWM within technical-vocational education. His approach emphasizes experiential learning through projects such as composting, recycling, and water purification, which not only enhance students' skills but also strengthen their engagement with community-based sustainability initiatives.

Contradict to the study of Debrah et al. (2021) which revealed that students have a positive environmental attitude and high awareness but there is a lack of practical education of teachers to guide students to put SWM into practice. Also, a high extent with regards to real-life examples or local community practices pertaining to waste management being taught as a strategy in teaching, giving importance to the study of Bajaj (2024), underscoring the approach of experiential learning in environmental education. Same idea in the study of Kong (2021), who highlighted experiential learning resulted in developing and improve classroom engagement. However, with regards to gardening projects, Gulayan sa Paaralan, composting and maintaining MRFs in school findings suggest a fair extent giving an idea that, knowledge does not always lead to practice, this may be due to several factors which hinder implementation.

Meanwhile, strategies in classroom instruction that utilize multimedia, stories, and cartoons related to waste management resulted in a fair extent of effectiveness. This suggests that there is a need for further exploration and improvement, as the integration of technology can make learning more engaging and meaningful. A similar concept was emphasized in the studies of Aina (2023) and Casinillo & Guarte (2018), which highlighted the importance of technology in fostering a collaborative and constructive approach to teaching and learning.

Table 5 Extent of Integration of Ecological Solid Waste Management Along Instrurctional Materials

Indicators	Mean	Descriptive Rating
Instructional materials such as videos, modules, books and other reading materials focusing on ESWM are accessible and utilized in instruction	3.13	Fair Extent
Contextualized instructional materials related to ESWM are present in the school for teaching and learning purposes	3.13	Fair Extent
Color-coded bins for biodegradable, non-biodegradable and recyclables are accessible and clearly labeled	3.06	Fair Extent
Environmental set-ups like compost pit and school garden are observed, maintained and integrated into school activities	2.86	Fair Extent
Average	3.05	Fair Extent

➤ Instructional Materials

In order to address individual differences, teachers should employ varied teaching methodologies and provide diverse instructional materials that cater to different learning styles. Effective teaching and learning must be supported by appropriate and well-designed instructional materials, ensuring that learners are engaged and that concepts are delivered in ways that suits them well.

In this study, the use of instructional materials in the extent of integration is of fair extent though materials and facilities are present in school, such as videos, modules, books and other reading materials focusing on ESWM there is a need for full utilization. Also, contextualized instructional materials related to ESWM are present in school making the lesson more meaningful. The accessibility of color coded bins for biodegradable, non-

biodegradable and recyclables shows a fair extent, this is somehow related to the study of Diestro (2022), who revealed that students have adequate knowledge however, there is a need for further clarification and information drive with regards to proper waste handling, violation and penalties, proper waste disposal and color codes of waste bins.

Moreover, the findings reveal that accessibility of environmental set-ups like compost pit and school garden should be given importance, continuous monitoring and evaluation. Also, teachers must be resourceful in order to improve the ways in which students learn and apply concept of ESWM. The study of Aina (2023) highlighted that teachers need to be resourceful in many different ways by utilizing varied learning materials and using all the materials available to improve ways in which students learn.

Table 6 Extent of Integration of Ecological Solid Waste Management Along Student Engagement and Participation

Indicators	Mean	Descriptive Rating
Students participate in school-wide ESWM activities and programs such as clean-up drives and culminating programs on ESWM	3.53	Fair Extent
Students are involved in the school activities pertaining to ESWM such as, composting, waste segregation and recycling	3.40	Fair Extent
Average	3.47	Fair Extent

➤ Student Engagement and Participation

Student engagement and participation is vital in the integration and implementation of concepts of ESWM. The involvement of students gives them a sense of responsibility and pride. Findings reveal that there is a high extent in the integration of ESWM with regards to Student Engagement and Participation. It shows that involvement of students in activities pertaining to ESWM is a great way for developing environmental awareness.

Students participating in school-wide ESWM activities and programs such as clean-up drives and culminating programs on ESWM and the student's involvement on ESWM activities pertaining to ESWM such as composting, waste segregation and recycling is at fair extent. Similar study, cited that student engagement is one of the important constructs that is used to understand the behavior of the student towards the teaching-learning process Delfino (2019). This is also cited in the study of Morales and Oco (2020), who claimed that attitude especially on shared

responsibility can influence the achievement of the goal of SWM program. Additionally, the study of Prisco and Cubillas (2022), highlighted the importance of cooperation between stakeholders for environmental awareness and sustainability.

This shows that schools provide opportunities for students to engage in hands-on environmental activities that promotes ESWM concepts fostering environmental sustainability, however, further enhancement in the implementation of these activities is needed to make it more engaging, consistent and meaningful.

Table 7 Extent of Integration of Ecological Solid Waste Management Along Assessment

Indicators	Mean	Descriptive Rating
Search for cleanest classrooms and most practicing ESWM classroom and the like are done	3.86	High Extent
Concepts of ESWM and understanding are part of quizzes, exams and assessment	3.00	Fair Extent
Performance tasks related to practice of ESWM such as recycling, segregation and composting are observed	2.86	Fair Extent
Average	3.24	Fair Extent

➤ *Assessment*

Assessment of learning is an evaluation process that tells whether the intended learning outcomes, have been converted into achieved learning outcome. These learning outcomes can be measured through various assessment tools.

The finding reveals that assessment was utilized into fair extent in the integration of ESWM in instruction. Furthermore, assessment such as search for cleanest classrooms and most practicing ESWM is of high extent suggesting that activities which promotes collaboration foster active participation, teamwork, and real-world application was implore.

In this study, concept of ESWM and understanding are part of quizzes, exams and assessment is of fair extent indicating a fair use. Performance tasks such as recycling, segregation and composting is also of fair extent The study which was conducted by Bercasio et al., (2021), showed that varied assessment techniques address students' diversity and authentic assessment tasks encourage students' participation. It is in this context, that varied assessment must be use to achieve a desired learning outcome, considering diverse learner.

B. Level of Effectiveness of the Integration of Ecological Solid Waste Management Concepts in Instruction

Table 8 Level of Effectiveness of the Integration of Ecological Solid Waste Management Along Curriculum and Planning

Indicators	Mean	Descriptive Rating
The ESWM competencies found in the curriculum enhance waste segregation and recycling skills of learners	3.26	Fairly Effective
The lesson objectives with the integration of ESWM provides direction in achieving both the content and performance standards on environmental education	3.20	Fairly Effective
The integration of ESWM concepts in the curriculum supports the development of core competencies such as environmental literacy and civic responsibility	2.93	Fairly Effective
Average	3.13	Fairly Effective

➤ Curriculum and Planning

On the level of effectiveness of the integration of ESWM concepts in instruction all indicators are fairly effective, which suggest that continuous modification of curriculum is necessary to provide direction in achieving both the content and performance. Additionally, integrating concepts of ESWM for the development of core competencies such as environmental literacy and civic responsibility should be given emphasis to be more effective.

This signifies the study of Al Husban (2025), advocating for improvements in the curriculum to improved environmental awareness which can later improve behavior. By highlighting the significance of Environmental Education (EE) and embedding it within their curricula or programs, educational institutions can contribute to a more sustainable future while strengthening their image as socially responsible organizations UNESCO (2024). Additionally, they can establish sustainability-oriented policies and practices that benefit both the environment and the broader community.

Furthermore, in the study of Duran and Mariñas (2024), giving the importance of educators' attitudes and institutional support in shaping sustainability integration in curricula. The inclusion is supported by the studies of Al Husban (2025), Guerra et al. and Bibi et al. (2025) in order

to have a strong impact on the level of effectiveness of the integration of ESWM in instruction.

Tilbury (2011) pushed for transformative pedagogy and systemic redesign. Similarly, Sterling (2016) advocated for “whole-system redesign” in schools, embedding ecological principles into both curriculum and operations, thus giving importance on curriculum enhancement for instruction is a practical approach on schools sustainability. Wals (2010) advanced participatory and problem-solving approaches to sustainability education, urging schools to embed ESWM practices into daily instruction. Similarly, Hopkins (2015) has shaped global frameworks for education toward sustainability, putting emphasis on waste reduction and ecological responsibility as integral components of school curricula.

Integrating environmental education into the school curriculum involves embedding environmental topics into various subjects, creating dedicated programs, or restructuring the entire school to be environmentally focused. This integration aims to develop students' knowledge and skills, foster positive attitudes toward the environment, and encourage them to become responsible citizens who can address environmental challenges through critical thinking, decision-making, and hands-on activities like conservation projects.

Table 9 Level of Effectiveness of the Integration of Ecological Solid Waste Management Along Teaching Strategies and Method

Indicators	Mean	Descriptive Rating
Making use of real-life examples or local community practices pertaining to segregation between biodegradable, non-biodegradable, recyclables and special waste are observed by learners that result in better understanding of waste disposal	4.00	Moderately Effective
The use of gardening projects, Gulayan sa Paaralan, composting and maintaining MRFs in schools enhances learners' awareness of ESWM and usefulness of waste materials	3.93	Moderately Effective
Teaching strategies related to ESWM develop community responsiveness like clean-up drives and recycling project from learners	3.66	Moderately Effective
The use of learning resources themed with ESWM results in students understanding of proper waste disposal	3.60	Moderately Effective
Classroom demonstration on ESWM concepts develop skills on segregation of waste and waste management disposal among learner	3.46	Fairly Effective
Average	3.73	Moderately Effective

➤ Teaching Strategies and Method

Along with Teaching Strategies and Method on the level of effectiveness of the integration of ESWM indicates moderate effectiveness. These are the teaching strategies and methods which uses real-life examples, gardening projects, Gulayan sa Paaralan, composting and maintaining MRFs, teaching strategies related to ESWM like clean-up drives and recycling project, which resulted in better understanding of the concept. However, classroom demonstration on ESWM concepts develop skills on segregation of waste and waste management indicates fair effectiveness and this should be look into.

In the study of Casinillo and Guarte (2018), the following teaching strategies such as modeling, teaching demo, oral recitation and reporting are effective for both teachers and student. This was also believed in the study of

Zhou (2015) who stated that classroom instruction, which is a key responsibility of subject teachers, can effectively cultivate awareness and lead to practice. Thus, highlighting a holistic approach, touching both the mind and the heart in teaching concepts focusing on environmental awareness. Zafar (2024) highlighted that environmental education is essential to instill values of conserving the environment. .

Overall, the results suggest that experiential learning is effective in promoting concepts of environmental awareness and civic responsibility. Similar findings in the study of Gupta et al. (2024), Bajaj (2024) and Kong (2021), underscored experiential learning as an effective approach in achieving the goal of environmental education. The active participation of learners enhances their understanding and retention of the ESWM concepts that will then be applied.

Table 10 Level of Effectiveness of the Integration of Ecological Solid Waste Management Along Instrurctional Materials

Indicators	Mean	Descriptive Rating
The use of instructional materials such as videos, modules, books and other reading materials focusing on ESWM increased awareness of learners for ESWM practices	3.73	Moderately Effective
Accessible color-coded bins for biodegradable, non-biodegradable and recyclables encouraged the learners to learn and practice ESWM in school	3.53	Fairly Effective
The use of environmental set-ups like compost pit and school garden are observed to make understanding of ESWM realistic	3.53	Fairly Effective
Present contextualized instructional materials related to ESWM enhanced the learners understanding of ESWM provisions and rules	3.40	Fairly Effective
Average	3.55	Fairly Effective

➤ Instructional Materials

Along Instructional Materials, the level of effectiveness is fairly effective. Highlighting, the use of instructional materials such as videos, modules, books and other reading materials focusing on ESWM increased awareness of learners for ESWM practices. The results imply that learners are more engaged on lesson which include videos and reading materials. These instructional materials capture learners' attention and enhance engagement on lessons pertaining to ESWM making it more effective. Teachers can improve how they work as educators by utilizing the varied materials at their disposal. Teachers that are considered resourceful display traits that demonstrate how they maximize the benefits of using all of the resources available to them Aina (2023).

The accessibility of color-coded bins, the use of compost pit and school garden, and the contextualized materials was seen to be fairly effective. Hence, in the study

of Casinillio and Guarte (2021) highlighted the use of computer assisted lessons, modeling and teaching demo as an effective teaching.

Margate and Padilla (2024), in their study recommended leveraging online platforms and practical instructional resources to bridge the gap between awareness and practice. Implicating that instructional material must not only inform but also provide hands-on, practice-oriented activities to ensure knowledge translates into sustainable habits. In the study of Uddin (2023), in the conduct of the project 10-day 3Rs Program (Reduce, Reuse, Recycle), pupils showed significant improvement in waste management practices. Structured interventions and localized instructional materials (bins, sacks, guides) reinforce ESWM concepts. Signifying that instructional materials should be integrated into curriculum frameworks to ensure consistency and long-term adoption Englis et al. (2023).

Table 11 Level of Effectiveness of the Integration of Ecological Solid Waste Management Along Student Engagement and Participation

Indicators	Mean	Descriptive Rating
Students participate in school-wide ESWM activities and programs such as clean-up drives and culminating programs on ESWM results in better understanding of concepts integrated in the curriculum that protects environment	3.66	Moderately Effective
Students are involved in the school activities pertaining to ESWM such as, composting; waste segregation and recycling enhance understanding of content on environmental awareness	3.40	Fairly Effective
Average	3.53	Fairly Effective

➤ *Students Engagement and Participation*

Student engagement has three dimension, which are behavioral, emotional, and cognitive. Behavioral engagement refers to student's participation in academic and extracurricular activities. Emotional engagement refers to student's positive and negative reaction to peers, teachers and school. While cognitive engagement talks about student's thoughtfulness and willingness to master difficult skills Fredericks, et al. (2004). Delfino (2019) highlighted that student engagement is one of the important constructs that is used to understand the behavior of the student towards the teaching-learning process.

The overall responses along Students Engagement and Participation on the level of effectiveness of the integration of ESWM concepts in instruction indicates fairly effective. Students' involvement in the schools pertaining to ESWM such as composting, waste segregation and recycling resulted in fair effectiveness. However, students' participation in school-wide ESWM activities and programs such as clean-up drives and culminating programs on ESWM is described as moderately effective.

The results imply that collective activities pertaining to ESWM concepts is seen to be more engaging, shows visible impact and give a deeper sense of community rather than task-oriented activities such as composting and recycling. Closely, related to the study of Gupta et al. (2024), stated that participation on environmental education programs showed environmental awareness and a positive behavioral change. Moreover, it was found out that behavioral, emotional and cognitive engagements were positively

correlated to the academic performance of the students. The teacher, the school, and the parents should have strong collaboration to provide more opportunities for students to maximize their engagement.

In the study of Columna (2023), Pillai and Anonuevo (2023), highlighted that a positive and inclusive environment fosters participation. Giving insights that engagement in ESWM related activities is enhanced when studenta feel valued, respected and supportive through collaborative learning.

Molina et al. (2025) though focused on social and emotional learning, findings show that student engagement and participation increase when interventions are culturally responsive and contextualized.

Table 12 Level of Effectiveness of the Integration of Ecological Solid Waste Management Along Assessment

Indicators	Mean	Descriptive Rating
Search for cleanest classrooms and most practicing ESWM classroom and the like are done that shows support of performance standards in environment related to instructions	3.93	Moderately Effective
Performance tasks related to practice of ESWM such recycling, segregation and composting are observed to manifest application of content in the curriculum about environment	3.53	Fairly Effective
Concepts of ESWM and understanding are part of quizzes, exams and assessment that lead to better understanding of importance of environment	3.13	Fairly Effective
Average	3.53	Fairly Effective

➤ Assessment

On the level of effectiveness of the integration of ESWM concepts in instruction on the use of Assessment, resulted in fair effectiveness. The search for cleanest classrooms and most practicing ESWM classroom indicates moderately effectiveness. Meanwhile, performance tasks related to practice of ESWM such as recycling, segregation and composting indicates fair effectiveness same with concepts and understanding as part of the quizzes, exams and assessment. The results imply that students are more engaged in activities that give them a sense of pride and collective efforts unlike performance task such as recycling, segregation and composting that may lack of motivational and collaborative elements. Similarly, in the study of Morales and Oco (2020), claimed that attitude especially on shared responsibility can greatly influence the success of the ESWM program and collaborative efforts is essential in achieving goals for better environment and sustainability.

The use of paper and pen assessment indicated fairly effective, as this assessment may fail to connect with the students' real-world experiences as supported by the findings of Bajaj (2024). Findings in the study of Morales and Oco (2020), revealed that there is a significant relation on the knowledge capacity of the students and implementation of ESWM. This lack of understanding can lead to complacency and hinder the effectiveness of waste management programs Benosa (2021).

In the study of Bautista (2022), findings revealed that most schools relied on traditional written assessment, which measured awareness but not actual practice. The study recommended performance-based assessments (e.g., project outputs, recycling initiatives, composting activities) to capture both cognitive and behavioral dimensions of ESWM learning, highlighting the importance of giving an authentic assessment tool to evaluate whether students actually apply ESWM concepts in practice.

C. Challenges Encountered by Teachers in Integrating Ecological Solid Waste Management Concepts in Instruction

Table 13 Challenges Encountered by Teachers in Integrating Ecological Solid Waste Management Concepts in Instruction

Challenges	Frequency	Rank
Limited training on ESWM making it difficult to teach the concepts	13	1
There are limited competencies related to ESWM in the curriculum	11	3.5
Lack of instructional materials and resources specifically tailored to ESWM concepts	11	3.5
Students show little interest in ESWM concepts	11	3.5
Schools lack of necessary infrastructure to practically apply ESWM such as bins, compost pit and school-based MRF	11	3.5
Assessment task such as poster making, recycling that may require materials and resources are not readily available to all students	10	6.5
Lack of funds to finance the actual conduct of performance tasks reflecting the integration of ESWM	10	6.5
There is a cultural and behavioral barrier that influence student's attitude	9	8
Time constraints to teach and add more topics on ESWM	7	9.5
Activities and programs pertaining to ESWM are not the priority of the school	7	9.5
It is difficult to integrate the ESWM topics in the lesson	5	11

There were several challenges encountered by teachers in integrating ecological solid waste management concepts in instruction and the top most concern is the limited training on ESWM, despite the inclusion of ESWM in the curriculum proper training for teachers should be given priority hence they are the one giving instruction same finding in the study of Yarkandi et al. (2012). The need of training for teacher will give them confidence in teaching the concept which will result to better understanding. In the study of Corpuz, et al. (2022), Esa (2010), indicated that teachers are prepared to pursue the integration however there is a need for them to be equip. Teachers also encountered challenges when looking at the specific competencies related to ESWM in the curriculum especially teachers which does not teach Science and TLE this is the same challenge presented by Akinsemolu (2025), Bibi et. al (2025), to improve the curriculum.

Similar to the study of Cruz-Ocampo (2020) highlighted the challenges and opportunities of environmental education in Philippine schools resulted in gaps in teacher training and curriculum while advocating for systemic approaches that embed ESWM practices into instruction.

The inadequate instructional materials and resources specifically tailored to ESWM concepts is also perceived as challenge. Given the advancement of technology there is a limited resources for instructional materials which discusses ESWM concepts. Teachers pointed out that students show little interest in ESWM concepts and schools lack of necessary infrastructure to practically apply ESWM, which was also seen as challenge in the study of Cruz (2024).

Assessment task such as poster making, recycling that may require materials, resources and lack of funds to finance the actual conduct of performance tasks reflecting the integration was observed. The cultural and behavioral barriers, time constraints, activities and programs pertaining to ESWM were also seen, same challenges stated in the study of Yarkandi (2012) et al. However, difficulty to integrate the ESWM topics in the lesson is the last in rank, indicating that teachers are capable and willing to integrate ESWM in the lesson. Suggesting that integration of ESWM is not a major challenge compared to other challenges.

Understanding these challenges faced by teachers is essential to provide insights that can guide the school community for effective integration of ESWM concepts in instruction. This study seeks to address these challenges and contribute to the continuous improvement of effective environmental education and sustainability.

D. Proposed Session Guides Integrating Ecological Solid Waste Management Concepts in Other Subject areas/Instruction

Integrating Ecological Solid Waste Management (ESWM) concepts across subject areas is an essential step in promoting toward sustainable schools and environmentally responsible learners. Education plays a significant role in developing learner's values, knowledge, and practices that address environmental concern. Incorporating ESWM principles, into other subject areas foster a holistic approach to sustainability. This interdisciplinary integration not only strengthens students' academic competencies but also develops their sense of responsibility, critical thinking, and problem-solving skills in real-life context.

Moreover, the alignment of ESWM with instructional practices supports the objectives of the Ecological Solid Waste Management Act (RA 9003), which highlights the role of communities and institutions in promoting waste reduction and management. Through carefully designed session guides, teachers can translate these policy mandates into meaningful classroom experiences that are engaging, practical, and transformative. Integrating ESWM concepts into instruction ensures that learners are not only academically proficient but also active contributors to environmental preservation and sustainable development.

Ultimately, the proposed session guides could address the current gap and ensure that integration of ESWM concepts in instruction across subject areas is possible and an effective way towards sustainable schools.

IV. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

➤ *Findings*

- The extent of integration of ESWM in instruction are the following: Teaching Strategies and Methods got a weighted mean of 3.61 indicating a high extent, Student Engagement and Participation got a weighted mean of 3.47 indicating a fair extent, Curriculum and planning

got a weighted mean of 3.31 indicating a fair extent, for Assessment a weighted mean of 3.24 indicating a fair extent and for Instructional Materials a weighted mean of 3.05 indicating a fair extent.

- The level of effectiveness of ESWM in instruction are the following: Teaching Strategies and Methods got an average mean of 3.73 indicates moderately effective, Instructional Materials, Student Engagement and Participation, Assessment, and Curriculum and Planning are all classified as fairly effective with an average mean of 3.55, 3.53, 3.53, and 3.13 respectively.
- There are several challenges encountered by teachers in integrating ecological solid waste management concepts in instruction on rank 1 is the limited training of the integration of ESWM making it difficult to teach the concepts. All tied up at rank 3.5 are the following; limited specific competencies related to ESWM in the curriculum, lack of instructional materials and resources specifically tailored to ESWM concepts, students show little interest in ESWM concepts, schools lack of necessary infrastructure to practically apply ESWM. On rank 6.5, both challenges have the same rank; assessment task that may require materials and resources are not readily available to all students and lack of funds to finance the actual conduct of performance tasks reflecting the integration of ESWM.
- The proposed session guides on the integration of the ESWM concept in several learning areas include the topics: Technology and Livelihood Economics (TLE): Types of Hazards in Agriculture, Science: Digestive System Processes, English: Transitional Devices, Mathematics: Data Presentation, Araling Panlipunan: Mga Isyung Pangkapaligiran at Ekonomiya: Suliranin sa Solid Waste, Filipino: Tekstong ekspositori batay sa estruktura nito: Sanhi at Bunga, MAPEH: Community and Environmental Health, Edukasyon sa Pagpapakatao: Pangangalaga sa Kalikasan, General Academic Strand (GAS): Filipino sa Piling Larang- Dokumentasyon sa Paggawa ng isang bagay/ produkto, Technical-Vocational-Livelihood (TVL) - Horticulture: Prepare Composting Area and Raw Materials

➤ *Conclusions*

- Teaching strategies are of high extent, but improvements are needed in curriculum and planning, student engagement, assessment, and instructional materials.
- Teaching strategies are moderately effective, but improvements are needed in curriculum and planning, student engagement, assessment, and instructional materials.
- The challenges encountered by teachers in integrating ecological solid waste management are limited trainings, competencies, resources, student's interest, infrastructure, assessment tools, and funding.
- The proposed session guides aim to integrate the ESWM concept in instruction, to guide teachers on how to integrate ESWM concept without compromising the content standard.

➤ Recommendations

- ESWM integration be strengthened, through improved curriculum, student engagement, assessment and instructional materials.
- ESWM integration be effectively implemented by enhancing the curriculum, improving students' engagement and assessment, and providing instructional materials.
- To address these challenges, teachers training, curriculum enhancement, instructional materials and resources, student engagement, improved infrastructure, assessment and funding are necessary.
- The researcher recommends that the session guide developed for integrating ESWM concepts across subject areas must undergo validation and pilot testing prior to implementation.

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