

Awareness vs. Action: Evaluating the Waste Management Practices and Engineering Ethics of Civil Engineering Students at NEUST

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Abstract- Environmental sustainability and responsible waste management have become increasingly important in engineering education due to the growing environmental impacts associated with improper waste disposal and unsustainable development practices. This study evaluated the effectiveness of Environmental Science education in shaping the environmental knowledge, waste management practices, and ethical decision-making skills of Civil Engineering students at Nueva Ecija University of Science and Technology (NEUST). A quantitative survey-correlational research design was employed involving 228 Civil Engineering students from the second, third, and fourth year levels. Data were gathered using a researcher-developed questionnaire and analyzed using mean, standard deviation, Analysis of Variance (ANOVA), and Pearson Product-Moment Correlation Coefficient. Results revealed that the respondents demonstrated a very high level of environmental knowledge ($M = 4.43$) and ethical decision-making skills ($M = 4.45$), while waste management practices were consistently observed ($M = 4.42$). Significant positive relationships were identified between environmental knowledge and waste management practices ($r = 0.712, p < 0.05$) as well as between environmental knowledge and ethical decision-making skills ($r = 0.762, p < 0.05$). The findings indicate that Environmental Science education contributes significantly to strengthening environmental responsibility, sustainable practices, and ethical awareness among future engineers. The study highlights the importance of integrating sustainability-oriented environmental education within engineering curricula to support environmentally responsible engineering practice.

Keywords— Environmental Science, Engineering Ethics, Solid Waste Management, Sustainability Education, Environmental Knowledge, Civil Engineering Students

I. INTRODUCTION

Environmental sustainability has become a major concern in engineering practice due to increasing environmental degradation, improper waste disposal, resource depletion, and the growing demand for sustainable infrastructure development. Modern engineers are expected not only to provide technical solutions but also to consider the environmental, social, and ethical implications of engineering decisions. As environmental challenges continue to intensify, engineering education plays a critical role in developing environmentally responsible and ethically aware future professionals capable of integrating sustainability principles into engineering practice.

Environmental concepts and sustainability-related topics are commonly incorporated into engineering education to help students develop awareness of environmental issues and responsible engineering practices. Subjects such as Environmental Science provide students with foundational knowledge regarding environmental protection, waste management, and sustainability, which are relevant to engineering decision-making and professional responsibility.

Despite the inclusion of sustainability-related subjects in engineering education, the translation of environmental knowledge into actual practice remains a continuing challenge. Several studies emphasized the existence of a gap between environmental awareness and practical application, wherein individuals may possess environmental knowledge but fail to consistently implement

sustainable practices in daily activities. Within engineering education, this issue raises concerns regarding whether students are able to apply environmental principles, waste management practices, and ethical responsibility in both personal behavior and future professional decision-making.

Previous studies have shown that environmental education significantly contributes to improving environmental knowledge, waste management practices, and ethical responsibility among students. Debrah et al. (2021) emphasized that formal environmental education strengthens environmental responsibility and promotes sustainable waste management practices. Similarly, Molina and Catan (2021) reported that environmental knowledge positively influences waste segregation and disposal practices among Filipino students. In engineering education, Bielefeldt et al. (2018) highlighted the importance of integrating ethics and sustainability concepts in developing socially and environmentally responsible engineers capable of balancing infrastructure development with environmental protection.

At Nueva Ecija University of Science and Technology (NEUST), Environmental Science forms part of the Civil Engineering curriculum to promote sustainability awareness, environmental stewardship, and ethical responsibility among students. Through classroom discussions and sustainability-related activities, students are expected to develop not only technical competence but also environmentally responsible practices and ethical decision-making skills. However, limited studies have assessed whether environmental knowledge acquired through formal instruction effectively influences students' waste management practices and ethical decision-making skills in real-life situations.

Hence, this study evaluated the effectiveness of Environmental Science education in shaping the environmental knowledge, waste management practices, and engineering ethics of Civil Engineering students at NEUST. Specifically, the study assessed the students' level of environmental knowledge, waste management practices, ethical decision-making skills, and the relationships among these variables

within the context of sustainable engineering practice.

II. METHODS AND PROCEDURE

This study utilized a quantitative survey-correlational research design to evaluate the effectiveness of Environmental Science education in shaping the environmental knowledge, waste management practices, and ethical decision-making skills of Civil Engineering students at Nueva Ecija University of Science and Technology (NEUST). The descriptive approach was used to determine the respondents' level of environmental knowledge, waste management practices, and ethical decision-making skills, while the correlational approach was employed to determine the relationships among these variables.

The respondents of the study consisted of second-year, third-year, and fourth-year Civil Engineering students enrolled at NEUST during the Academic Year 2025–2026. From a total population of 1,146 students, a sample size of 228 respondents was determined using Slovin's Formula with a 5% margin of error. Stratified random sampling was employed to ensure proportional representation from each year level.

A researcher-developed questionnaire served as the primary data gathering instrument. The questionnaire consisted of three sections: environmental knowledge, waste management practices, and ethical decision-making skills related to sustainable engineering scenarios. The instrument was developed based on the objectives of the study and related literature on environmental education, sustainability, and engineering ethics. Responses were measured using a 5-point Likert scale, where 5 corresponded to "Strongly Agree" or "Always" and 1 corresponded to "Strongly Disagree" or "Never."

Prior to data gathering, permission to conduct the study was secured from the College of Engineering administration. The questionnaires were distributed online through Google Forms, and respondents were informed regarding the purpose of the study and the confidentiality of their responses. The gathered data were organized, encoded, and statistically analyzed using frequency count, percentage, weighted mean,

standard deviation, Analysis of Variance (ANOVA), and Pearson Product-Moment Correlation Coefficient at a 0.05 level of significance.

III. RESULTS AND DISCUSSION

Table 1. Level of Environmental Knowledge, Waste Management Practices, and Ethical Decision-Making Skills

| Variables | Mean | SD | Interpretation |
|--------------------------------|------|------|----------------|
| Environmental Knowledge | 4.43 | 0.56 | Very High |
| Waste Management Practices | 4.42 | 0.59 | Always |
| Ethical Decision-Making Skills | 4.45 | 0.54 | Very High |

Table 1 presents the level of environmental knowledge, waste management practices, and ethical decision-making skills of the respondents. The results revealed that the respondents demonstrated a very high level of environmental knowledge (M = 4.43) and ethical decision-making skills (M = 4.45), while waste management practices were consistently observed (M = 4.42).

The findings indicate that Civil Engineering students possess strong understanding of environmental principles, sustainability concepts, and proper waste management practices. The consistently high ratings further suggest that the respondents regularly practice proper waste segregation, responsible disposal, and compliance with environmental policies within the university environment. Moreover, the high level of ethical decision-making skills reflects the students' recognition of environmental protection and sustainability considerations in engineering-related situations.

The findings support the study of Debrah et al. (2021), which emphasized that formal environmental education strengthens environmental responsibility and sustainable practices among students. Similarly, Bielefeldt et al. (2018) highlighted the importance of integrating sustainability and ethics concepts in engineering education to develop environmentally responsible future professionals.

Table 2. Most Frequently Practiced Waste Management Activities of the Respondents

| Waste Management Practices | Mean | Interpretation |
|---|------|----------------|
| Placing waste in proper bins | 4.48 | Always |
| Disposal in designated collection areas | 4.41 | Always |
| Checking waste type before disposal | 4.39 | Always |
| Proper segregation of biodegradable and non-biodegradable waste | 4.36 | Always |
| Following waste disposal instructions and regulations | 4.36 | Always |

Table 2 presents the most frequently practiced waste management activities among the respondents. Placing waste in proper bins obtained the highest mean score (M = 4.48), followed by disposal in designated collection areas (M = 4.41). Checking waste type before disposal and practicing proper segregation of biodegradable and non-biodegradable waste were likewise consistently observed among the respondents.

The findings indicate that the students regularly practice proper waste segregation and disposal measures within the university and surrounding environment. The results further demonstrate strong compliance with basic waste management procedures and environmental policies related to proper waste handling and disposal.

The findings are consistent with Molina and Catan (2021), who reported that environmental knowledge positively influences waste segregation and disposal practices among students.

Table 3. Difference in Waste Management Practices and Ethical Decision-Making Skills Across Levels of Environmental Knowledge

| Variables | F-value | P-value | Interpretation |
|--------------------------------|---------|---------|----------------|
| Waste Management Practices | 96.162 | 0.000 | Significant |
| Ethical Decision-Making Skills | 126.813 | 0.000 | Significant |

Table 3 presents the Analysis of Variance (ANOVA) results on the differences in waste management practices and ethical decision-making skills across varying levels of environmental knowledge. The analysis revealed significant differences in both waste management practices ($F = 96.162, p = 0.000$) and ethical decision-making skills ($F = 126.813, p = 0.000$).

The findings indicate that respondents with higher levels of environmental knowledge demonstrated better waste management practices and stronger ethical decision-making skills compared to those with lower levels of environmental knowledge. The results suggest that environmental knowledge contributes to improved sustainability-oriented practices and environmental responsibility among Civil Engineering students.

The findings support previous studies emphasizing that environmental education significantly influences sustainable behavior and ethical responsibility among students and future engineering professionals.

Table 4. Relationship Between Environmental Knowledge, Waste Management Practices, and Ethical Decision-Making Skills

| Variables | r-value | p-value | Interpretation |
|--|---------|---------|-----------------------------------|
| Environmental Knowledge and Waste Management Practices | 0.712 | 0.000 | Significant Positive Relationship |
| Environmental Knowledge and Ethical Decision-Making Skills | 0.762 | 0.000 | Significant Positive Relationship |

Table 4 presents the relationship between environmental knowledge, waste management practices, and ethical decision-making skills of the respondents. Pearson Product-Moment Correlation analysis revealed significant positive relationships between environmental knowledge and waste management practices ($r = 0.712, p = 0.000$) as well as between environmental knowledge and ethical decision-making skills ($r = 0.762, p = 0.000$).

The results indicate that students with higher environmental knowledge are more likely to demonstrate responsible waste management behavior and stronger ethical decision-making skills related to sustainable engineering practices. The findings further suggest that environmental education plays an important role in strengthening environmental responsibility and sustainability-oriented professional values among Civil Engineering students.

Overall, the results highlight the importance of integrating Environmental Science and sustainability education within engineering curricula to support environmentally responsible engineering practice and long-term environmental stewardship.

IV. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION

The study revealed that Civil Engineering students at Nueva Ecija University of Science and Technology (NEUST) demonstrated a very high level of environmental knowledge and ethical decision-making skills, while proper waste management practices were consistently observed among the respondents. The findings indicate that students possess strong understanding of environmental principles, sustainability concepts, and responsible waste management practices relevant to engineering education and professional practice.

The respondents consistently practiced proper waste segregation, disposal, and compliance with environmental policies and waste management procedures within the university environment. Moreover, the students demonstrated strong ethical awareness regarding sustainability and environmental protection in engineering-related situations.

Statistical analysis further revealed significant differences in waste management practices and ethical decision-making skills across varying levels of environmental knowledge. Likewise, significant positive relationships were identified between environmental knowledge and waste management practices, as well as between environmental knowledge and ethical decision-making skills. These findings suggest that environmental knowledge

contributes significantly to strengthening sustainability-oriented practices and ethical responsibility among Civil Engineering students.

Overall, the study highlights the importance of integrating Environmental Science and sustainability-oriented education within engineering curricula to support environmentally responsible behavior, ethical engineering practice, and long-term environmental stewardship among future engineers.

RECOMMENDATIONS

1. Engineering educators and faculty members should continue strengthening Environmental Science and sustainability-related instruction through practical, activity-based, and problem-based learning approaches that enhance students' environmental knowledge and real-world application of sustainable practices.
2. The College of Engineering should further promote campus-based environmental programs such as waste segregation campaigns, recycling activities, and sustainability initiatives to reinforce responsible waste management practices among students.
3. Engineering curricula may incorporate additional sustainability-oriented case studies, environmental ethics discussions, and community-based environmental activities to further strengthen students' ethical decision-making skills and environmental responsibility.
4. Future researchers are encouraged to conduct similar studies involving other engineering programs and institutions to further validate the relationship between environmental education, waste management practices, and ethical decision-making skills.
5. Further studies may also include additional variables such as environmental attitudes, institutional support, community participation, and long-term behavioral practices to obtain a more comprehensive assessment of sustainability-oriented behavior among engineering students.

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