

# Interplay of Green Computing Awareness, Perception, and Environmental Computing Practices

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**Abstract**— Green computing is essential in libraries as it promotes environmentally sustainable practices that reduce electronic waste. This study investigates the interplay between green computing awareness, perceptions, and the adoption of environmental practices among librarians of Misamis Oriental and Misamis Occidental, Philippines. It utilized a descriptive-correlational design. The study was participated by 75 licensed librarians. Purposive sampling was employed, allowing for intentionally selecting participants based on their professional roles and expertise. Mean, standard deviation and Canonical Correlation Analysis (CCA) were the statistical tools used in the study. Results revealed that the respondents were generally aware of key green computing principles, especially in e-waste and resource management. They also exhibited a positive attitude toward green computing, actively participating in sustainable practices like energy efficiency and responsible disposal methods in their professional roles. The results further reveal strong correlations between librarians' awareness of green computing and their participation in environmentally sustainable computing behaviors, indicating that greater knowledge contributes to better practices. These findings highlight the importance of continuous training and the development of effective policies within libraries to cultivate a culture of sustainability. By encouraging green computing initiatives, libraries can minimize their environmental footprint and strengthen their position as responsible stewards of information and resources.

**Keywords**— electronic waste, green computing, green disposal, sustainability.

## I. INTRODUCTION

The environmental concern has led libraries to become important stakeholders because they use large amounts of electronic resources and technology. The growing use of digital resources and electronic equipment in libraries has resulted in rising energy usage and e-waste production. The disposal of computers and printers and other electronic devices creates electronic waste that threatens human health and environmental sustainability by polluting soil and water (Njoku, et al., 2024). The environmental issues directly match the United Nations Sustainable Development Goals (SDGs) which include SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).

Green computing has emerged as a promising solution to address the growing environmental concerns that have developed. Green computing involves implementing strategies to enhance energy efficiency while reducing electronic waste and minimizing the environmental effects of information technology systems (Tariq & Khalid, 2023). The library implements three key practices which include using energy-efficient hardware and proper e-waste disposal and power management systems (Patel, 2024; Bagla, et al., 2022).

The green library movement has become a major international force because of its technological approach to environmental sustainability.

The international initiative supports environmental awareness in libraries through service quality maintenance which positions libraries as dual champions of environmental information and sustainable practices (Solemanpharcy & Abdul, 2023).

The movement depends entirely on librarians to actively implement green computing practices while raising their environmental awareness and perception.

Green computing maintains its increasing importance in library operations yet there is a substantial knowledge gap about how librarians understand green computing principles and their actual implementation of sustainable practices especially in developing countries like the Philippines.

Research on green computing adoption by librarians in Northern Mindanao's regional context and its influencing factors remains scarce despite previous studies about green computing in academic institutions (Soroya, et al., 2021).

## Objectives of the Study

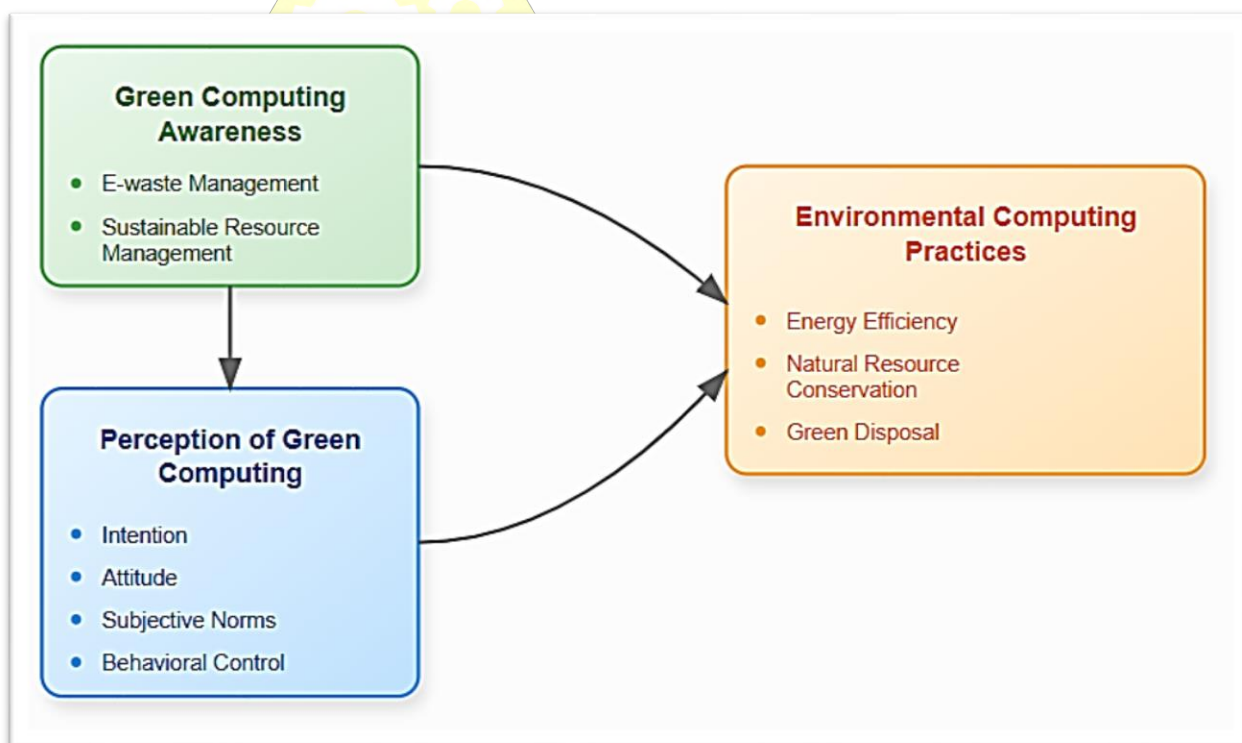
This study aims to assess the extent of librarians' awareness and perceptions regarding the adoption of green computing practices. Additionally, the researcher seeks to explore whether there is a significant relationship between librarians' green computing awareness and perception and their actual environmental computing behaviors.

## Framework

This study argues that librarians' adoption of green computing practices is shaped by their awareness, understanding, and attitudes toward environmental sustainability. This assertion is especially pertinent in Northern Mindanao, where librarians exhibit differing degrees of involvement in green computing initiatives such as energy conservation, resource preservation, and

effective e-waste management. The connection between awareness and action can be examined through two supporting theoretical frameworks: the Theory of Planned Behavior (TPB) and the Norm Activation Theory (NAT), which collectively offer a solid basis for comprehending environmentally responsible behavior in professional environments.

The Theory of Planned Behavior (TPB), developed by Icek and Ajzen in 1985, underpinned this study. According to this theory, an individual's attitude, subjective standards, and behavioral control influence their intentions, which in turn determine how likely they are to act in a certain way. Si et al. (2019) mentioned this idea, which sheds light on how TPB can be used in green consumption.



**Figure 1.** The Schematic Presentation of the Study

## Statement of the Problem

The study determined the influence of green computing awareness on librarians' green computing behavior and green computing practices. Specifically, the study will pursue to answer the following questions:

1. What is the level of librarians' green computing awareness in terms of:
  - 1.1 e-waste management; and
  - 1.2 sustainable resource management?

2. What is the librarian's perception of green computing in terms of:
  - 2.1 intention;
  - 2.2 attitude;
  - 2.3 subjective norms and
  - 2.4 behavioral control?
3. What is the librarians' level of environmental computing practices in terms of:
  - 3.1 Energy efficiency;
  - 3.2 Natural resource conservation; and

### 3.3 Green disposal?

4. Are the librarians' green computing awareness significantly associated with their perception of green computing?
5. Are the librarians' green computing awareness and their perception of green computing significantly associated with their environmental computing practices?

## III. METHODOLOGY

### Research Design

This study employed a descriptive-correlational research design to examine librarians' awareness and practices of green computing. A descriptive correlational design is a research methodology which examines the relationships or associations between two or more variables (Cooksey, 2020).

### Participants

The participants of the study were 75 librarians employed in libraries of Misamis Occidental and Misamis Oriental. Purposive sampling was employed, allowing for the intentional selection of participants based on their professional roles and expertise.

### Research Instruments

The study used a modified structured questionnaire based on Soroya et al. (2022), with three sections: green computing awareness, perceptions and attitudes, and practical environmental computing practices. The self-administered questionnaire was distributed online via Google Forms to ensure convenience and participant confidentiality.

### Ethical Considerations

The study adhered to strict ethical standards to protect participants' rights and ensure the integrity of the research. Prior to data collection, approval was obtained from the Lourdes College Research Ethics Committee. Participants were provided with detailed information about the study's purpose, procedures, and their rights through a participation letter and informed consent form, emphasizing the voluntary nature of their involvement and their right to withdraw at any time without penalty.

### Statistical Treatment

Descriptive statistics such as frequency, percentage, means and standard deviations were used to analyze the data. Canonical Correlation Analysis (CCA) was also

used to examine how librarians' perceptions and awareness of green computing influence their environmental computing practices. This analysis showed which factors have the most substantial effect on librarians' adoption of green computing practices, helping identify key areas for improving implementation in libraries.

## IV. RESULTS AND DISCUSSION

Table 1 presents the summary of librarians' level of green computing awareness. The data reveal that librarians generally have a high level of green computing awareness, particularly in sustainable resource management, with a mean score of 4.50. This indicates that the librarians have sufficient information on green computing.

They may be using recycled paper products that is beneficial to both the library and the environment. As surmised by Sun & Qamruzzaman, (2025), the library reduces its carbon footprint and operational costs, while also promoting eco-friendly practices among staff and users.

Using recycled paper products in the library helps reduce emissions by saving energy and resources, supporting a greener and healthier environment.

Hence, awareness of sustainable resource management, especially in the integration of natural resources and technological innovation, is crucial in achieving eco-friendly practices (Sembiring et.al., 2025; Erjabo et.al., 2021).

E-waste management, however, has a slightly lower mean score of 3.87, categorized as "Generally Aware." Librarians who are aware of electronic waste management will promote responsible disposal and recycling of electronic devices such as outdated computers and printers. In addition, this indicates that there is a need for green computing awareness concerning e-waste management.

As noted by Widanapathirana et. al, (2023), management of electronic waste helps in preventing environmental harm and health risks while educating the public on sustainable practices.

The overall awareness score of 4.19 suggests that, collectively, librarians possess a solid understanding of green computing principles, leaning towards a higher awareness level.

*Table 1. Summary of Librarians' Green Computing Awareness*

Variable	M	SD	Remarks
E-waste Management	3.87	0.73	Generally Aware
Sustainable Resource Management	4.50	0.47	Generally Aware
Overall Level of Awareness	4.19	0.53	Generally Aware

Scale: 4.51-5.0 (Highly Aware); 3.51-4.50 (Generally Aware); 2.51-3.50 (Moderately Aware); 1.51-2.50 (Somewhat Unaware); 1.00-1.50 (Completely Unaware)

Table 2 presents the summary of librarians' perception of green computing, indicating a positive attitude across all variables. Librarians have positive perceptions of green computing, with a total mean of 4.28. Specifically, their intention (4.49), attitude (4.44), subjective norms (3.96), and behavioral control (4.25) are all viewed positively, indicating strong motivation to adopt eco-friendly practices. This shows that librarians strongly

recognize the advantages of regularly applying green computing practices. According to Discover Sustainability (2025), the successful implementation of green computing heavily depends on the attitude of individuals who will use technologies. If users are open, supportive, and willing to adopt sustainable computing practices, the transition will be smoother and more effective.

*Table 2. Level of Librarians' Perception of Green Computing*

Variable	M	SD	Remarks
Intention	4.49	0.50	Positive
Attitude	4.44	0.56	Positive
Subjective Norms	3.96	0.65	Positive
Behavioral Control	4.25	0.56	Positive
Overall Level of Perception	4.28	0.49	Positive

Scale: 4.51-5.0 (Very Highly Positive); 3.51-4.50 (Positive); 2.51-3.50 (Moderately Positive); 1.51-2.50 (Slightly Negative); 1.00-1.50 (Strongly Negative)

Table 3 shows that librarians' engagement in environmental computing practices is highly positive, with an overall mean score of 4.43. Among the variables, natural resource conservation has the highest mean of 4.46, indicating a strong commitment to sustainable practices. This implies that librarians strongly recognize the importance of minimizing paper waste, demonstrating an effective strategy for natural resource conservation. Reusing paper reduces paper consumption and waste, conserving trees and lowering energy in paper production. Using soft copies of documents minimizes the need for printed materials, further reducing paper waste and supporting digital platforms. The improper use of natural resources can lead to harmful side effects, including air and water pollution, destruction of habitats, and climate change. (Tang et.al., 2024). Green disposal has the lowest mean of 4.44, yet still reflects a positive implementation. These findings suggest that librarians are actively

involved in environmentally friendly computing activities, which can foster further adoption and promotion of green initiatives within their libraries. Overall, the high levels of environmental computing practices provide a solid foundation for enhancing sustainable behaviors in the library setting. This implies that librarians are highly proactive in implementing energy-saving practices by ensuring that they unplug devices when not in use. This reflects a strong commitment to reducing energy waste and promoting sustainability within their library environments. When components are powered off, the system sleeps automatically to save the power. (Anayat, S., 2020). Allowing systems to enter sleep mode or entirely shut down and unplug equipment when not in use helps conserve electricity and extends the lifespan of devices. These small changes contribute to a larger goal of minimizing the library's carbon footprint and supporting sustainable operations.

*Table 3. Level of Environmental Computing Practices*

Variable	M	SD	Remarks
Energy Efficiency	4.38	0.50	High Adoption
Natural Resource Conservation	4.46	0.51	High Adoption



<b>Green Disposal</b>	4.44	0.53	High Adoption
<b>Overall Level of Environmental Computing Practices</b>	4.43	0.46	High Adoption

Scale: 4.51-5.0 (Very High Adoption); 3.51-4.50 (High Adoption); 2.51-3.50 (Neutral); 1.51-2.50 (Low Adoption); 1.00-1.50 (Very Low Adoption)

Table 4 presents the Canonical Correlation Analysis (CCA) summary between Librarians' Green Computing Awareness and their Perception. The relationship between the two variables is strong, where 53 percent of the variation of the perception is explained by their awareness. The e-waste management (loading=-0.79) and sustainable resource management (loading=-0.94) have a negative correlation with their canonical variate Green Computing Awareness. Similarly, the intention (loading=-0.92), attitude (loading=-0.88), subjective norms (loading=-0.88), and behavioral control

(loading=-0.70) have negative correlation with their canonical variate Green Computing Perception. This suggests that increased green computing awareness is positively associated with more favorable perceptions toward environmentally sustainable practices. Consistent with Soroya et al. (2021), which indicated that heightened awareness plays a crucial role in fostering sustainable behaviors, this study reinforces the idea that enhancing awareness directly encourages organizations and libraries to adopt more environmentally responsible actions.

**Table 4.** Canonical Correlation Analysis Summary Between Librarians' Green Computing Awareness and their Perception

Canonical Loading				Rc	Rc <sup>2</sup>	F	Df1	Df2	p
Green Computing Awareness		Green Computing Perception		.73	.53	8.16*	8	138	<.001
E-waste Management	-.79	Intention	-.92						
Sustainable Resource Management	-.94	Attitude	-.88						
		Subjective Norms	-.88						
		Behavioral Control	-.70						
*Significant at .01 level									

Table 5 presents the Canonical Correlation Analysis (CCA) summary between Librarians' Green Computing Awareness, Perception and their Environmental Computing Practices. The results show a significant canonical correlation between librarians' green computing awareness and their environmental computing practices, with  $R_c = 0.44$  and  $R_c^2 = 0.19$ ,  $F(6,140) = 8.16$ ,  $p = 0.014$ . This indicates a statistically significant relationship between the two canonical variates. The strength of the relationship between the two variables is moderately strong, where 19 percent of the variability of the environmental computing practices is explained by their green computing awareness. The e-waste management (loading=-0.46) and sustainable resource management (loading=-0.99) have a negative correlation with their canonical variate Green Computing Awareness. Similarly, energy efficiency (loading=-0.93), natural resource conservation (loading=-0.95), and green disposal (loading=-0.80) have a negative correlation with their canonical variate Environmental Computing Practices. This implies that higher green computing awareness tends to have better environmental computing practices. (Soroya et.al., 2021)

Likewise, a significant result was found between Green Computing Perception and Environmental Computing Practices, with  $R_c = 0.66$  and  $R_c^2 = 0.44$ ,  $F(12,180) = 4.02$ ,  $p < 0.001$ . This indicates a statistically significant relationship between the two canonical variates. Because this correlation is significant, the null hypothesis three ( $H_{o3}$ ) is rejected.

The strength of the relationship between the two variables is strong where 44 percent of the variability of the environmental computing practices is explained by their green computing perception.

The intention (loading=-0.80), attitude (loading=-0.74), subjective norms (loading=-0.71), and behavioral control (loading=-0.96) have negative correlation with their canonical variate Green Computing Perception. Also, the energy efficiency (loading=-0.99), natural resource conservation (loading=-0.82), and green disposal (loading=-0.72) have negative correlation with their canonical variate Environmental Computing Practices. This implies that higher green computing perception tends to have better environmental computing practices.

**Table 5.** Canonical Correlation Analysis Summary Between Librarians' Green Computing Awareness and their Perception, and Environmental Computing Practices

Canonical Loading				R <sub>c</sub>	R <sub>c</sub> <sup>2</sup>	F	Df <sub>1</sub>	Df <sub>2</sub>	p
<b>Green Computing Awareness</b>		<b>Environmental Computing Practices</b>		.44	.19	2.79*	6	140	.014
E-waste Management	.46	Energy Efficiency	.93						
Sustainable Resource Management	.99	Natural Resource Conservation	.95						
		Green Disposal	.80						
<b>Green Computing Perception</b>		<b>Environmental Computing Practices</b>		.66	.44	4.02**	12	180	<.001
Intention	.80	Energy Efficiency	.99						
Attitude	.74	Natural Resource Conservation	.82						
Subjective Norms	.71	Green Disposal	.72						
Behavioral Control	.96								

\*Significant at .05 level. \*\*Significant at .01 level.

## V. CONCLUSION

Based on the findings of the study, it can be inferred that librarian's awareness and perception of green computing are antecedents of their environmental computing practices. The assumptions advanced in this study is confirmed which points out that the higher librarians' awareness, the greater is their tendency to practice green computing in their respective libraries.

The findings support the Theory of Planned Behavior (TPB), confirming that positive perceptions influence environmentally responsible behaviors among librarians. The data imply that increasing awareness and fostering positive attitudes can effectively promote sustainable practices in library environments.

Finally, statistical analysis revealed significant relationships between green computing awareness and perception, as well as between these factors and environmental computing practices. This suggests that librarians who are more aware and hold positive perceptions are more likely to engage in environmentally sustainable computing behaviors.

## VI. RECOMMENDATION

Based on the findings and conclusions of the study, the following recommendations are drawn:

1. That librarians in Misamis Occidental and Misamis Oriental may:

1.1 implement ongoing training and workshops for librarians focused on green computing practices. This can include topics such as e-waste management, energy efficiency, and sustainable resource management to enhance their understanding and implementation of these practices;

1.2 establish clear policies and guidelines regarding the adoption of green computing practices. These documents should outline steps for efficient e-waste disposal, energy conservation measures, and best practices for resource management, ensuring that all staff members are informed and engaged; and

1.3 strengthen the integration of green principles into their operations, such as reducing paper usage, utilizing energy-efficient technologies, and implementing recycling programs. This approach not only demonstrates a robust commitment to sustainability but also sets a positive example for patrons.

2. Library administrators may allocate sufficient funding and resources towards renewable technologies and sustainable practices. Investment in eco-friendly equipment and resources can significantly reduce environmental footprints.

3. Future researchers may study on green computing awareness in another contexts with more number of participants.

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