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Technology Integration And Implementation Of Green Computing Principles Among Secondary Teachers In SDO Calaca City

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Abstract

This study examined the relationship between technology integration and the implementation of green computing principles among secondary school teachers in the Schools Division Office of Calaca City. Specifically, it assessed teachers' degree of technology integration in terms of lesson preparation and delivery, student engagement and activities, assessment and feedback, and communication and collaboration. It also determined their extent of implementation of green computing principles in terms of energy efficiency, resource conservation, and waste reduction. The findings served as the basis for developing enhancement activities to strengthen sustainable technology use in instruction.

A descriptive-correlational quantitative research design was employed. Data were gathered through a structured questionnaire administered to secondary school teachers and were analyzed using composite means and Pearson product-moment correlation coefficient. The analysis described teachers' technology integration practices, determined the extent of green computing implementation, identified related challenges, and examined the relationship between the two major variables.

Findings revealed that teachers demonstrated a moderate degree of technology integration across all instructional areas, indicating that digital tools were used in teaching but not yet fully maximized for more advanced and transformative instructional practices. The implementation of green computing principles was likewise moderate in terms of energy efficiency and resource conservation, reflecting the presence of routine sustainable practices. However, waste reduction was found to be limited, particularly in relation to formal e-waste disposal and recycling processes.

Correlation analysis showed a statistically significant moderate positive relationship between technology integration and the implementation of green computing principles. This indicates that greater use of technology in instruction is associated with stronger adoption of sustainable computing practices. However, the varying strength of relationships across domains suggests that green computing implementation depends not only on the frequency of technology use but also on how digital tools are structured, managed, and applied in specific instructional contexts.

Teachers also reported challenges related to limited infrastructure, poor internet connectivity, insufficient devices, heavy teaching workload, inadequate training, and limited institutional support. These constraints hinder the consistent implementation of green computing practices despite teachers' awareness of their importance. Based on the findings, enhancement activities were developed to strengthen teachers' competencies in advanced technology use, promote structured digital systems, improve waste management practices, and support policy development, training, and infrastructure improvement. The study underscores the need to align technology integration with environmental responsibility to promote sustainable and effective technology use in education.

Keywords:*technology integration, green computing principles, energy efficiency, resource conservation, waste reduction, sustainable technology practices.*

Introduction

Digital technologies have become central to contemporary education, shaping how teachers prepare lessons, deliver instruction, assess learning, and communicate with students. In secondary schools, the use of computers, projectors, online platforms, and other digital tools has expanded instructional possibilities and supported more flexible teaching practices. However, increased technology use also raises environmental concerns, particularly in relation to energy consumption, resource use, and electronic waste. The rapid growth of global e-waste and the continued reliance of schools on digital devices highlight the need to align technology integration with green computing principles.

Green computing emphasizes the environmentally responsible and energy-efficient use of computers and related technologies. In education, this means that technology should not only improve teaching and learning but also promote sustainable practices such as energy efficiency, resource conservation, and waste reduction. Although Philippine policies support both technology integration in education and environmental protection, the connection between classroom technology use and sustainable computing practices remains insufficiently examined. This gap is especially relevant in local school contexts where teachers serve as both implementers of digital instruction and models of responsible technology use.

This study examined the relationship between technology integration and the implementation of green computing principles among public secondary school teachers in the Schools Division Office of Calaca City during the school year 2025–2026. The findings served as the basis for proposing enhancement activities that may strengthen sustainable technology practices in classroom instruction. Specifically, the study sought to answer the following questions:

1. How do teacher-respondents assess their degree of technology integration in classroom instruction relative to lesson preparation and delivery, student engagement and activities, assessment and feedback, and communication and collaboration?
2. What is the extent of implementation of green computing principles as assessed by the respondents in terms of energy efficiency, resource conservation, and waste reduction?
3. Is there a significant relationship between the degree of technology integration and the extent of implementation of green computing principles?
4. What challenges do teachers face in implementing green computing principles?
5. Based on the results, what enhancement activities may be proposed?

Methodology

Research Design

This study employed a descriptive-correlational quantitative research design to examine the relationship between teachers' degree of technology integration and their extent of implementation of green computing principles. The design was appropriate because the study aimed to describe existing classroom technology practices, determine the implementation of green computing principles, identify related challenges, and test the significance and direction of association between the two main variables without manipulating any conditions.

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Volume 2 Issue 6 (2026)

Preliminary interviews were conducted with selected teachers who were not part of the actual respondents. These interviews were used only for item generation and refinement of the research instrument and were not treated as part of the study's final results.

Participants

The respondents were **178 public secondary school teachers** from SDO Calaca City for the School Year 2025–2026. They were selected from a total population of **319 teachers** using Slovin's formula at a 5% margin of error and proportionate stratified random sampling. This ensured representation from the participating public secondary schools and allowed the study to capture variations in teaching contexts, technology access, and sustainability practices.

Research Instrument

Researcher-made questionnaires were designed and validated by experts in educational research, technology integration, and environmental sustainability. The tool measured:

- Degree of technology integration in terms of lesson preparation and delivery, student engagement and activities, assessment and feedback, and communication and collaboration
- Extent of implementation of green computing principles in terms of energy efficiency, resource conservation, and waste reduction
- Challenges encountered by teachers in implementing green computing principles
- Bases for developing enhancement activities for sustainable technology use in instruction

The questionnaire used a **four-point Likert scale** to gather quantitative data. Semi-structured interview guide questions were also used to gather supporting insights on teachers' challenges, but these responses were not treated as a separate qualitative component and were used only to enrich the discussion of the quantitative findings.

Data Collection Procedure

Formal approval was secured from the Schools Division Superintendent of SDO Calaca City, followed by permission from the principals of the participating public secondary schools. Prior to the main data collection, the researcher conducted a pilot testing procedure to assess the clarity, comprehensibility, and reliability of the researcher-made instruments. The pilot responses were reviewed, and the results were used to refine the questionnaire before its final administration.

After validation and pilot testing, the researcher coordinated with focal persons or department heads for the administration of the questionnaires and the scheduling of interviews. Informed consent was obtained from all participants, and data were handled in accordance with the Data Privacy Act of 2012. Completed responses were checked for completeness, encoded, and prepared for statistical treatment.

Online ISSN: 3082-5121
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https://journals.aloysianpublications.com
Volume 2 Issue 6 (2026)

Data Analysis

Cronbach's alpha was used to determine the reliability and internal consistency of the researcher-made questionnaire. Mean and standard deviation were used to describe teachers' degree of technology integration, extent of green computing implementation, and challenges encountered. Pearson product-moment correlation coefficient was used to determine the significant relationship between technology integration and the implementation of green computing principles.

Results

Section 1: Technology Integration Inside of the Classroom

1.1 Lesson preparation and delivery showed a moderate degree of technology integration, with a composite mean of 2.76. Teachers most commonly used technology to create digital learning materials (WM = 3.58) and access online resources for lesson planning (WM = 3.57), indicating stronger use of basic planning tools. However, the low use of digital simulations (WM = 1.69), Learning Management Systems (WM = 1.80), and interactive EdTech tools (WM = 2.23) suggests that more advanced and interactive applications remain underutilized. Overall, technology integration in this sub-variable was evident but still limited to familiar and accessible tools.

Table 1
Degree of Integration of Technology in terms of Lesson Preparation and Delivery

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. Using a Learning Management System (LMS) to organize and share lesson materials with students.	1.80	SI	9
2. Designing lessons that use EdTech tools to develop higher-order thinking skills.	3.04	MI	4
3. Using interactive EdTech tools such as quizzes, polling, or presentation platforms during lessons.	2.23	SI	8
4. Using EdTech tools to adapt lessons based on student needs or learning pace.	2.34	SI	7
5. Selecting or creating digital learning materials that match students' interests and learning styles.	3.58	HI	1
6. Using online educational resources to support lesson planning.	3.57	HI	2
7. Using EdTech tools to plan lessons for blended or flipped classroom approaches.	2.95	MI	6
8. Using digital simulations or virtual labs to support real-world learning experiences.	1.69	SI	10
9. Using EdTech tools to organize lesson flow and manage instructional time efficiently.	2.97	MI	5
10. Using AI to generate ideas or prompts for class discussions.	3.47	MI	3
Composite Mean	**2.76**	**MI**	

Legend: *3.50-4.00 - Highly Integrated(HI) | 2.50-3.49 – Moderately Integrated(MI) | 1.50-2.49 – Slightly Integrated(SI) | 1.00-1.49 – Least Integrated(LI)*

1.2 Student engagement and activities showed a moderate degree of technology integration, with a composite mean of 3.01. Teachers most commonly used technology to review digital activity records (WM = 3.57), support peer feedback and group work (WM = 3.51), and track student participation (WM = 3.50), indicating stronger use of digital tools for monitoring and collaboration. However, the low use of video or discussion tools (WM = 2.34) and technology-based exploratory activities (WM = 2.35) suggests that more interactive, student-led, and inquiry-based applications remain underutilized. Overall, technology integration in this sub-variable was evident but remained more focused on participation tracking and structured collaboration than on independent and exploratory learning.

Table 2
Degree of Integration of Technology in terms of Student Engagement and Activities

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. Using digital quizzes or games to motivate students and review lessons.	2.90	MI	8
2. Requiring students to use video or discussion tools for participation and interaction.	2.34	SI	10
3. Designing technology-based activities that require students to actively explore and learn.	2.35	SI	9
4. Using technology to make student learning and contributions visible in real time.	3.04	MI	4
5. Using EdTech tools to ensure and track student participation during activities.	3.50	HI	3
6. Assigning digital tasks that require reflection, synthesis, or media creation.	2.93	MI	7
7. Using digital collaboration tools to support peer feedback and group work.	3.51	HI	2
8. Reviewing digital activity records to monitor student engagement.	3.57	HI	1
9. Using interactive digital spaces to support student-led and group problem-solving.	3.03	MI	5
10. Using digital tools to capture and annotate student work during or after lessons	2.97	MI	6
Composite Mean	**3.01**	**MI**	

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1.3 Assessment and Feedback showed the lowest degree of technology integration, with a composite mean of 2.47, interpreted as slightly integrated. Teachers most commonly used technology to record or track student responses (WM = 3.04), provide timely and personalized feedback (WM = 3.02), and use digital annotation tools (WM = 2.92), indicating some use of digital tools for documentation and feedback. However, the low use of LMS tools for distributing, collecting, and grading assignments (WM = 1.68), varied digital assessment formats (WM = 2.16), and digital formative tests (WM = 2.23) suggests that structured, inclusive, and real-time assessment practices remain underutilized. Overall, technology integration in this sub-variable was limited and remained focused more on basic tracking and feedback than on systematic and responsive digital assessment.

Table 3
Degree of Integration of Technology in terms of Assessment and Feedback

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. Using digital tools to collect formative assessment data during instruction.	2.26	SI	7
2. Providing timely and personalized feedback using digital platforms.	3.02	MI	2
3. Using EdTech tools to record or track student responses for assessment purposes.	3.04	MI	1
4. Using digital annotation tools to give detailed feedback on student work.	2.92	MI	3
5. Using technology to offer varied assessment formats for inclusive participation.	2.16	SI	9
6. Using LMS tools to distribute, collect, and grade assignments efficiently.	1.68	SI	10
7. Using digital formative tests to quickly check student understanding after every lesson.	2.23	SI	8
8. Aligning technology-based assessments with lesson learning objectives.	2.30	SI	4
9. Using digital records to track student participation after online sessions.	2.28	SI	6
10. Using automated or AI-assisted tools to support parts of the assessment process.	2.85	MI	5
Composite Mean	**2.47**	**SI**	

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1.4 Communication and collaboration showed a moderate degree of technology integration, with a composite mean of 3.24. Teachers most commonly used school digital platforms for announcements (WM = 3.61), guided students in using digital tools for communication and collaboration (WM = 3.61), and participated in online platforms or webinars for professional exchange (WM = 3.60), indicating strong use of technology for information sharing and professional engagement. However, the low use of video conferencing tools for parent communication (WM = 2.12) and school technical support systems (WM = 2.25) suggests that synchronous communication and formal support mechanisms remain underutilized. Overall, technology integration in this sub-variable was evident but remained stronger in routine communication than in real-time stakeholder interaction and structured technical support.

Table 4

Degree of Integration of Technology in terms of Communication and Collaboration

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. Using school digital platforms to post announcements and share information.	3.61	HI	1.5
2. Using video conferencing tools to meet with parents or guardians.	2.12	SI	10
3. Guiding students on how to use digital tools for collaboration and communication.	3.61	HI	1.5
4. Sharing teaching materials with colleagues through shared digital platforms.	3.05	MI	8
5. Using digital tools to communicate regularly with parents about student progress.	3.54	HI	6
6. Participating in online platforms or webinars to exchange assessment practices.	3.60	HI	4
7. Using EdTech tools to engage in professional discussions about teaching practices.	3.48	MI	7
8. Sending personalized digital messages or feedback to students outside class hours.	3.56	HI	5
9. Using school technical support systems when experiencing technology issues.	2.25	SI	9
10. Checking students' messages, comments, and online discussion posts to see who is participating.	3.57	HI	3
Composite Mean	**3.24**	**MI**	

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Volume 2 Issue 6 (2026)

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Section 2: Implementation of Green Computing Principle

2.1 Energy efficiency showed a moderate extent of green computing implementation, with a composite mean of 2.97. Teachers most commonly practiced turning off devices when not in use (WM = 3.74), ensuring proper ventilation to prevent overheating (WM = 3.64), and supporting renewable energy use when available (WM = 3.62), indicating stronger engagement in basic and visible energy-saving practices. However, the low ratings for checking energy-heavy applications (WM = 2.28), awareness of classroom device electricity consumption (WM = 2.32), and use of power-saving features or lightweight applications (WM = 2.35) suggest that more technical energy management practices remain underutilized. Overall, energy efficiency was evident but was practiced more through routine habits than through systematic monitoring and technical optimization.

Table 5

Implementation of Green Computing Principles in terms of Energy Efficiency

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. Turning off computers, projectors, and other devices when not in use.	3.74	HI	**1**
2. Using power-saving hardware features during regular device operation.	2.35	SI	**7.5**
3. Being aware of how much electricity classroom devices consume.	2.32	SI	**9**
4. Checking which applications or programs use more energy and limiting their use when possible.	2.28	SI	**10**
5. Choosing energy-efficient devices (e.g., low-power laptops) when given options.	3.24	MI	**4**
6. Using cloud storage for their energy efficiency benefits.	3.07	MI	**6**
7. Ensuring proper ventilation around devices to prevent overheating.	3.64	HI	**2**
8. Ensuring unused devices automatically power down after working hours.	3.12	MI	**5**
9. Using lightweight applications that require less processing power.	2.35	SI	**7.5**
10. Supporting the use of renewable energy in school (e.g., solar power, wind energy) when such systems are available.	3.62	HI	**3**
Composite Mean	2.97	MI	

Legend: *3.50-4.00 - Highly Implemented | 2.50-3.49 – Moderately Implemented | 1.50-2.49 – Slightly Implemented | 1.00-1.49 – Least Implemented*

2.2 Resource conservation showed a moderate extent of green computing implementation, with a composite mean of 2.97. Teachers most commonly practiced sharing existing equipment instead of purchasing new hardware (WM = 3.60) and using email or school platforms instead of paper memos (WM = 3.58), indicating stronger use of practical resource-saving strategies. However, the low use of digital signatures (WM = 1.76) and digital systems for submitting reports and forms (WM = 2.32) suggests that formal paperless processes remain underutilized. Overall, resource conservation was evident but was practiced more through equipment sharing and digital communication than through fully institutionalized paperless systems.

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Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 6 (2026)

Table 6
Implementation of Green Computing Principles in terms of Resource Conservation

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. Using digital documents instead of paper records.	3.05	MI	**7.5**
2. Reducing printing through controlled and limited printing practices.	3.07	MI	**6**
3. Using digital signatures to avoid printing documents for approval.	1.76	SI	**10**
4. Submitting reports and forms through digital systems.	2.32	SI	**9**
5. Using cloud storage to reduce the need for physical storage devices	3.05	MI	**7.5**
6. Sharing existing equipment instead of purchasing new hardware.	3.60	HI	**1**
7. Choosing digital or cloud-based tools instead of additional physical technology equipment when possible.	3.13	MI	**3**
8. Communicating through email or school platforms instead of paper memos.	3.58	HI	**2**
9. Using apps or programs that take up less storage space and use less electricity.	3.09	MI	**5**
10. Regularly deleting unnecessary data to conserve digital storage.	3.10	MI	**4**
Composite Mean	**2.97**	MI	

Legend: *3.50-4.00 - Highly Implemented | 2.50-3.49 – Moderately Implemented | 1.50-2.49 – Slightly Implemented | 1.00-1.49 – Least Implemented*

2.3 Waste reduction showed a slight extent of green computing implementation, with a composite mean of 2.27. Teachers most commonly practiced repairing and reusing devices before replacement (WM = 3.74) and supported the use of reusable or recyclable devices (WM = 3.15), indicating stronger engagement in practical reuse-related behaviors. However, the low implementation of leasing or service-based device models (WM = 1.80), proper disposal through authorized recyclers (WM = 1.81), battery recycling (WM = 1.82), and device disposal recordkeeping (WM = 1.84) suggests that formal e-waste management practices remain limited. Overall, waste reduction was evident mainly through repair and reuse, but systematic recycling, disposal, and documentation processes were underutilized.

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 6 (2026)

Table 7
Implementation of Green Computing Principles in terms of Waste Reduction

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. Participating in proper disposal of old electronic devices through authorized recyclers.	1.81	SI	**9**
2. Using leasing or service-based device models to extend equipment lifespan.	1.80	SI	**10**
3. Repairing and reusing devices before replacing them.	3.74	HI	**1**
4. Supporting the school's use of devices designed to be reused or recycled (e.g., refurbished PCs, recyclable laptops).	3.15	MI	**2**
5. Following school guidelines on electronic waste disposal.	1.90	SI	**6**
6. Supporting school initiatives related to Bring Your Own Device (BYOD) programs to reduce hardware demand.	1.93	SI	**5**
7. Reusing parts from old equipment for less demanding tasks.	2.35	SI	**4**
8. Using software updates that help older devices run longer.	2.39	SI	**3**
9. Properly removing and recycling batteries from retired devices.	1.82	SI	**8**
10. Helping maintain accurate records of school device use and disposal.	1.84	SI	**7**
Composite Mean	**2.27**	**SI**	

Legend: *3.50-4.00 - Highly Implemented | 2.50-3.49 – Moderately Implemented | 1.50-2.49 – Slightly Implemented | 1.00-1.49 – Least Implemented*

Section 3: Relationship Between Technology Integration and Implementation of Green Computing Principles

The overall relationship between technology integration and green computing implementation was moderate, positive, and statistically significant, as shown by the Pearson r value of .531 and p-value of .000. This indicates that teachers who reported higher integration of technology in classroom instruction also tended to demonstrate stronger implementation of green computing principles. The result suggests that effective technology use may support more sustainable ICT practices, particularly when digital tools are applied intentionally to reduce resource consumption, improve instructional efficiency, and promote environmentally responsible routines. However, the relationship also implies that technology integration alone is not enough; sustainable outcomes still depend on structured systems, clear policies, and purposeful application of green computing practices.

Online ISSN: 3082-5121
Aloysian Interdisciplinary Journal
of Social Sciences, Education, and Allied Fields
https://journals.aloysianpublications.com
Volume 2 Issue 6 (2026)

Table 8
Relationship between the Teacher-respondents' assessment of their degree of integration of technology and Extent of Implementation of Green Computing Principles

Variable	Pearson r Value	p-value	Decision on H_o	Interpretation
Significant Relationship between the Teacher-respondents' assessment of their degree of integration of technology and Extent of Implementation of Green Computing	.531	.000	Reject H_o	Significant

$p < 0.05$ Significant

Section 4: Teacher Challenges in Implementing Green Computing Principles

Table 9
Teacher challenges in Implementing Green Computing Principles

Indicators	Weighted Mean	Verbal Interpretation	Ranks
1. My school has limited access to energy-efficient devices (e.g., low-power computers), making sustainable practices difficult.	**3.09**	**A**	**8**
2. I experience difficulty managing energy-saving settings and basic device maintenance due to limited technical support or training.	**3.40**	**A**	**7**
3. The demands of my teaching schedule limit my ability to consider environmental impacts when using digital technology in class.	**3.46**	**A**	**2**
4. Poor internet or not enough devices (e.g., slow Wi-Fi or few computers) makes it hard to regularly use eco-friendly digital tools in my classroom.	**3.55**	**SA**	**1**
5. My school lacks clear and accessible systems for the proper disposal and recycling of electronic waste.	**3.44**	**A**	**4**
6. Efforts to reduce energy consumption at the	**3.43**	**A**	**5**

classroom level feel limited in impact due to broader institutional constraints.			
7. I have not received sufficient hands-on training focused on practical strategies for green computing and sustainable digital resource management.	**3.45**	**A**	**3**
8. I find it challenging to integrate explanations about the environmental impact of digital technology due to limited instructional guidance or materials.	**3.42**	**A**	**6**
9. I find it difficult to design and implement green computing practices that remain inclusive and fair given varying levels of student access to digital technology.	**2.87**	**A**	**9**
10. I receive limited encouragement from school administrators to practice energy conservation and responsible use of technology.	**2.84**	**A**	**10**
Composite Mean	**3.29**	**A**	

Legend: *3.50-4.00 - Highly Implemented | 2.50-3.49 – Moderately Implemented | 1.50-2.49 – Slightly Implemented | 1.00-1.49 – Least Implemented*

Teacher challenges in implementing green computing principles were generally evident, with a composite mean of 3.29, interpreted as Agree. The most prominent challenges were poor internet connectivity or insufficient devices (WM = 3.55), heavy teaching workload (WM = 3.46), and lack of hands-on training on green computing and sustainable digital resource management (WM = 3.45), indicating that infrastructure, workload, and preparedness strongly affect implementation. Meanwhile, the lowest-rated challenges were limited administrative encouragement (WM = 2.84), difficulty ensuring inclusive green computing practices due to unequal student access (WM = 2.87), and limited access to energy-efficient devices (WM = 3.09). Overall, the findings suggest that teachers recognize the value of green computing, but consistent implementation is constrained by resource limitations, insufficient training, workload demands, and weak institutional support systems.

Section 5: Enhancement Activities

The matrix presents a structured set of **enhancement activities for strengthening green computing implementation in technology-supported instruction**. It is organized into key components: **activities, proposal/objective, procedure, persons involved, time of implementation, budgetary requirements, and budget source**. The activities include seminar-workshops on ICT integration, school-based training on paperless workflow systems, energy-efficiency orientation and optimization, e-waste management and disposal, development of school green ICT guidelines and monitoring tools, technical assistance and peer coaching, integration of green computing principles in lesson planning, and monitoring/evaluation with recognition of green ICT practices. Overall, the matrix shows a complete implementation plan because it identifies what activity will be done, why it is needed, how it will be implemented, who will be responsible, when it will be conducted, what resources are required, and where the budget may come from.

Discussion

The findings indicate that secondary school teachers in SDO Calaca City demonstrated a moderate degree of technology integration in classroom instruction. This suggests that teachers regularly use digital tools for lesson preparation, student engagement, assessment, and communication, but their integration remains largely functional rather than advanced or transformative. While commonly accessible tools are already embedded in teaching practices, the limited use of simulations, learning management systems, structured assessment platforms, and synchronous collaboration tools shows that technology integration has not yet been fully maximized. This finding supports Serrano and Torres (2023), who noted that many schools continue to experience limitations in infrastructure, teacher training, and readiness for more advanced forms of educational technology use.

The teachers' moderate implementation of green computing principles in energy efficiency and resource conservation suggests an emerging awareness of environmentally responsible technology use. Basic practices such as proper device use, equipment sharing, and reduced material consumption are already evident. However, these practices appear to be informal and dependent on individual teacher initiative rather than on systematic school-based mechanisms. This aligns with Masters and Hsu (2023), who emphasized that modern technological systems should not only improve efficiency but also support sustainable and energy-conscious practices. Similarly, Moaveni (2023) stressed that responsible energy use and sustainable technologies are necessary in reducing environmental harm.

However, the slight implementation of waste reduction reveals a critical gap in the teachers' green computing practices. Although teachers may repair, reuse, or extend the life of devices when possible, their limited participation in formal disposal, recycling, and e-waste management indicates that waste reduction requires stronger institutional systems. This result suggests that responsible technology use cannot rely solely on individual awareness; it also requires clear policies, disposal protocols, monitoring mechanisms, and access to recycling support. This finding is consistent with the Global E-waste Monitor 2024, which reported the continuing increase in global e-waste generation and the relatively low rate of formal collection and recycling (UNITAR, 2024).

The significant positive relationship between technology integration and green computing implementation shows that teachers who integrate technology more effectively also tend to demonstrate stronger sustainable technology practices. This suggests that technology integration and environmental responsibility are interconnected when digital tools are used with intentionality, efficiency, and resource-conscious planning. However, the varied strength of relationships across the dimensions indicates that not all forms of technology use automatically promote green computing. For instance, routine communication or basic digital use may not directly contribute to waste reduction unless supported by deliberate policies and structured sustainability practices. This reinforces Hepburn et al.'s (2023) view that technology can support sustainability, but it may also produce environmental consequences when its full life cycle is not responsibly managed.

The teacher-reported challenges further explain why green computing implementation remains uneven. Limited infrastructure, insufficient devices, poor connectivity, lack of training, heavy workload, and weak institutional support constrain teachers' capacity to practice green computing consistently. These challenges show that sustainable technology use is not merely a matter of teacher willingness, but also of organizational readiness and resource availability. This supports Education Profiles Philippines (2024), which noted a disconnect between teachers' growing technology proficiency and their limited understanding of the environmental implications of digital technology use.

Overall, the results justify the development of enhancement activities designed to strengthen green computing implementation in technology-supported instruction. Since the weakest area was waste reduction and the major barriers involved infrastructure, training, and institutional support, the proposed activities are appropriate in addressing both practice-based and system-level gaps. Through targeted training, structured digital systems, responsible device use, e-waste awareness, and school-supported sustainability mechanisms, the enhancement activities can help align technology integration with environmentally responsible teaching practices. Thus, the study affirms that effective technology integration should not only improve instruction but also promote sustainable and responsible digital behavior in schools.

Conclusion

This study concluded that Senior High School students in SDO Calaca City had limited AI literacy and research competence, with notable gaps in evaluating AI-generated content and applying research conventions. The significant positive relationship between the two variables indicates that stronger AI literacy is associated with higher research competence. However, unclear AI policies, technological constraints, reduced teacher-student interaction, and heavy teacher workloads hinder the development of these competencies. Thus, the proposed AI-Augmented Research Toolkit provides structured instructional support for promoting ethical AI use and strengthening students' research competence.

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