



TECHNOLOGY GAP AND SCIENCE LEARNING OUTCOMES AMONG JUNIOR HIGH SCHOOL STUDENTS IN TANDAG II DISTRICT, PHILIPPINES

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ABSTRACT

The integration of technology in education has transformed teaching and learning processes; however, unequal access to technological resources continues to challenge educational equity, particularly in rural communities. This study assessed the technology gap and its impact on science learning outcomes among Junior High School students in Tandag II District, Tandag City, Philippines. Specifically, the study examined the level of technology gap in terms of internet connectivity, digital literacy and ICT skills, teacher technology preparedness and integration, school technological resources, and home and environmental factors. It also determined learners' Science learning outcomes in terms of engagement and participation, concept comprehension and mastery, and academic performance, and investigated the relationship between the technology gap and Science learning outcomes. The study employed a descriptive-correlational research design and was conducted during School Year 2025–2026, with data collection and analysis completed in June 2026. Data were gathered from Junior High School students using a validated survey questionnaire. Findings revealed that the overall technology gap was rated “moderate”, with teacher technology preparedness and integration obtaining the highest assessment, while school technological resources received the lowest rating. Results further indicated that learners demonstrated a “high level of science learning outcomes” despite existing technological limitations. Statistical analysis revealed a significant positive relationship between the technology gap and Science learning outcomes, indicating that improved access to technology, enhanced digital literacy, and adequate technological resources contribute to higher levels of student engagement, concept mastery, and academic performance. The study concludes that addressing technology-related barriers through improved ICT infrastructure, enhanced digital literacy

programs, and equitable access to technological resources may significantly improve Science learning outcomes among students in rural educational settings.

Keywords: *technology gap, digital divide, science learning outcomes, digital literacy, ICT integration, junior high school students, academic performance, rural education, Philippines*

INTRODUCTION

Technology has become an essential component of contemporary education, transforming how teachers deliver instruction and how students acquire knowledge. The integration of Information and Communication Technology (ICT) has enhanced learning experiences by promoting collaboration, critical thinking, problem-solving, and access to diverse educational resources. In Science education, technology enables learners to visualize abstract concepts, conduct virtual experiments, and engage in interactive learning environments that improve understanding and retention of scientific knowledge (Timotheou et al., 2023).

Despite the recognized benefits of educational technology, disparities in access to digital resources continue to create significant challenges in achieving equitable learning opportunities. The digital divide remains evident in many developing countries, where students encounter limited internet connectivity, inadequate technological devices, and insufficient digital literacy skills. These inequalities often hinder learners' ability to participate fully in technology-enhanced learning activities and negatively affect their academic achievement (Joshi et al., 2024). Such challenges are particularly pronounced in rural communities, where technological infrastructure and educational resources are often less developed than those in urban areas. According to Auxier and Anderson (2021), learners from low-income households are more likely to experience limited access to computers and reliable internet services, placing them at a disadvantage in digital learning environments. Similarly, Reisdorf et al. (2022) reported that students who lack access to quality digital devices and stable internet connectivity often experience difficulties completing academic requirements and participating effectively in technology-supported instruction.

In the Philippines, efforts to integrate ICT into education have been strengthened through policies promoting digital transformation and 21st-century learning skills. However, many public schools continue to experience difficulties related to unstable internet access, inadequate computer facilities, and limited availability of digital learning resources. These barriers may restrict students' engagement with technology-based instruction and reduce opportunities for meaningful learning experiences in Science (Travero & Padilla, 2025). Consequently, unequal access to technology may contribute to differences in students' academic performance and learning outcomes.

Recent studies have demonstrated that technology integration positively influences students' engagement, motivation, and academic achievement when supported by adequate infrastructure and teacher preparedness. Timotheou et al. (2023)

reported that schools with stronger digital capacity tend to achieve better educational outcomes. Similarly, Ghorbani and Fattahi (2025) emphasized that access to technological resources plays a crucial role in improving educational equity and supporting learners in underserved communities. Furthermore, Derder et al. (2023) noted that schools with well-developed technological infrastructure and effective support systems are more successful in implementing digital learning initiatives and improving student outcomes. These findings suggest that reducing technology-related barriers may contribute significantly to improving student learning outcomes.

Tandag II District, located in Tandag City, Surigao del Sur, serves learners from predominantly rural communities where disparities in access to technology remain a concern. While schools have initiated efforts to integrate technology into Science instruction through digital presentations, simulations, and online learning resources, not all learners possess equal access to devices and reliable internet connectivity. These conditions highlight the need to examine how technology gaps influence students' Science learning experiences and academic performance. Therefore, this study assessed the technology gap among Junior High School students in Tandag II District and determined its relationship with Science learning outcomes in terms of engagement and participation, concept comprehension and mastery, and academic performance. The findings may provide valuable insights for educational leaders, policymakers, and stakeholders in developing interventions that promote equitable access to technology and enhance Science education in rural school settings.

Research Questions

This study aimed to assess the technology gap and its influence on Science learning outcomes among Junior High School students in Tandag II District. Specifically, it sought to answer the following questions:

1. What is the level of technology gap among Junior High School students in Tandag II District in terms of:
 - a. Internet Connectivity;
 - b. Digital Literacy and ICT Skills;
 - c. Teacher Technology Preparedness and Integration;
 - d. School Technological Resources; and
 - e. Home and Environmental Factors?
2. What is the level of Science learning outcomes among Junior High School students in terms of:
 - a. Engagement and Participation;
 - b. Concept Comprehension and Mastery; and
 - c. Academic Performance?
3. Is there a significant relationship between the technology gap and Science learning outcomes among Junior High School students in Tandag II District?
4. What challenges do students encounter regarding technology access and utilization in learning Science?

5. Based on the findings, what intervention strategies may be proposed to address the technology gap and improve Science learning outcomes among Junior High School students?

METHODOLOGY

This study employed a quantitative research approach using a descriptive-correlational design to determine the relationship between the technology gap and Science learning outcomes among Junior High School students in Tandag II District, Tandag City, Surigao del Sur. The descriptive component was utilized to assess the level of technology gap in terms of internet connectivity, digital literacy and ICT skills, teacher technology preparedness and integration, school technological resources, and home and environmental factors, as well as the level of Science learning outcomes in terms of engagement and participation, concept comprehension and mastery, and academic performance. The correlational component examined whether a significant relationship existed between the technology gap and students' Science learning outcomes. The respondents of the study were Junior High School students enrolled in the public secondary schools of Tandag II District during the School Year 2025–2026. Data were collected using a researcher-made questionnaire that underwent validation and reliability testing prior to administration. Descriptive statistics such as frequency count, percentage, weighted mean, and standard deviation were used to summarize the data, while Pearson Product-Moment Correlation Coefficient was employed to determine the significance of the relationship between the variables. Ethical considerations, including informed consent, confidentiality, anonymity, and voluntary participation, were strictly observed throughout the conduct of the study.

RESULTS

Table 1. Level of Technology Gap among Junior High School Students in Tandag II District

Dimension	Mean	Interpretation
Internet Connectivity	3.31	Moderate
Digital Literacy and ICT Skills	3.27	Moderate
Teacher Technology Preparedness and Integration	3.69	High
School Technological Resources	3.08	Moderate
Home and Environmental Factors	3.44	High
Overall Mean	3.36	Moderate

Table 2. Level of Science Learning Outcomes among Junior High School Students

Learning Outcome Dimension	Mean	Interpretation
Engagement and Participation	3.58	High

Learning Outcome Dimension	Mean	Interpretation
Concept Comprehension and Mastery	3.47	High
Academic Performance	3.41	High
Overall Mean	3.49	High

Table 3. Relationship between Technology Gap and Science Learning Outcomes

Variables	r-value	p-value	Decision	Interpretation
Technology Gap and Science Learning Outcomes	0.68	0.000	Reject H_0	Significant Positive Relationship

Table 4. Challenges Encountered by Students Regarding Technology Access and Utilization

Rank	Challenges Encountered	Mean	Interpretation
1	Unstable Internet Connectivity	3.72	Highly Experienced
2	Limited Access to Digital Devices	3.58	Highly Experienced
3	Insufficient School ICT Facilities	3.44	Experienced
4	Limited Digital Skills	3.29	Experienced
5	Lack of Technical Support at Home	3.17	Experienced
Overall Mean		3.44	Experienced

Table 5. Proposed Intervention Strategies to Address the Technology Gap

Identified Concern	Proposed Intervention
Unstable Internet Connectivity	Strengthen school internet infrastructure and establish community Wi-Fi access points.
Limited Access to Devices	Implement gadget-lending programs and seek partnerships with stakeholders for device donations.
Inadequate ICT Facilities	Upgrade and maintain computer laboratories and multimedia equipment.
Limited Digital Literacy	Conduct regular ICT skills training and digital literacy workshops for students.
Technology Integration Challenges	Provide continuous professional development programs for teachers on ICT integration.

DISCUSSION

The findings revealed that the overall technology gap among Junior High School students in Tandag II District was moderate, indicating that learners experience varying

levels of access to technological resources and digital learning opportunities. Among the dimensions assessed, teacher technology preparedness and integration obtained the highest rating, suggesting that teachers are making significant efforts to incorporate technology into Science instruction despite existing infrastructural limitations. However, school technological resources received the lowest rating, highlighting persistent challenges related to the availability and accessibility of ICT facilities. These findings support the assertion of Timotheou et al. (2023) that school digital capacity significantly influences the effectiveness of technology integration and students' learning experiences. The results further suggest that while teachers are generally prepared to use technology, insufficient resources may hinder the full realization of technology-enhanced learning.

The study also found that students demonstrated a high level of science learning outcomes in terms of engagement and participation, concept comprehension and mastery, and academic performance. This finding implies that learners remain capable of achieving satisfactory academic outcomes despite experiencing moderate technology-related challenges. A possible explanation is that teachers have adopted adaptive instructional strategies that compensate for technological limitations. This observation is consistent with the findings of Traverro and Padilla (2025), who emphasized that effective technology integration, when supported by appropriate pedagogical practices, enhances student engagement and facilitates meaningful learning experiences. Likewise, Emma (2025) reported that technology-supported instruction contributes positively to learners' motivation and academic achievement when implemented effectively.

Furthermore, the results revealed a significant positive relationship between the technology gap and Science learning outcomes. This indicates that students who experience better access to technological resources, stronger digital literacy skills, and supportive learning environments tend to demonstrate higher levels of engagement, conceptual understanding, and academic performance. The finding supports the study of Joshi et al. (2024), which found that access to technology and digital engagement significantly influence students' academic success. Similarly, Ma and Cheng (2022) observed that students with greater access to digital resources are more likely to benefit academically because they can utilize technology for educational purposes and skill development. These findings underscore the importance of ensuring equitable access to technology as a means of improving educational outcomes.

The challenges identified by students, particularly unstable internet connectivity and limited access to digital devices, further emphasize the continuing presence of the digital divide in rural educational settings. Such barriers restrict learners' opportunities to access online learning materials, participate in technology-based activities, and develop essential digital competencies. These results corroborate the findings of Udeogalanya (2022), who reported that inadequate technological infrastructure and limited access to digital devices remain significant obstacles to effective learning. Moreover, the UNESCO (2023) Global Education Monitoring Report highlighted that unequal access to digital technologies continues to widen educational disparities worldwide, particularly among learners in disadvantaged and rural communities. In the Philippine context, these challenges are often more pronounced in geographically isolated and economically

disadvantaged communities, where educational institutions face difficulties in providing adequate technological support.

Overall, the findings suggest that reducing the technology gap through improved ICT infrastructure, enhanced digital literacy programs, increased access to learning devices, and strengthened technology integration initiatives may significantly improve Science learning outcomes among Junior High School students. Addressing these concerns is essential to ensuring equitable educational opportunities and promoting quality Science education in rural schools.

Conclusions

Based on the findings of the study, it was concluded that Junior High School students in Tandag II District experience a moderate level of technology gap in learning Science. While teacher technology preparedness and integration were assessed at a high level, limitations in school technological resources, internet connectivity, and digital literacy continue to affect students' access to technology-enhanced learning opportunities. Despite these challenges, students demonstrated high levels of engagement and participation, concept comprehension and mastery, and academic performance in Science.

Furthermore, the study established a significant positive relationship between the technology gap and Science learning outcomes. This indicates that improvements in technology access, digital literacy, ICT infrastructure, and supportive learning environments contribute positively to students' engagement, understanding of scientific concepts, and academic achievement. The findings affirm that technology plays a vital role in enhancing Science education and that reducing technology-related barriers can promote more equitable and effective learning experiences. Therefore, addressing technological disparities remains essential in improving Science learning outcomes among students in rural educational settings.

Recommendations

In light of the findings and conclusions of the study, the following recommendations are proposed:

1. School Administrators should prioritize the improvement of technological infrastructure by expanding internet connectivity, upgrading computer laboratories, and providing sufficient digital learning resources to support Science instruction.
2. Teachers should continue strengthening technology integration in classroom instruction through the use of interactive digital tools, simulations, virtual laboratories, and other learner-centered teaching strategies.
3. Students should be encouraged to participate in digital literacy and ICT skills development programs to enhance their ability to effectively utilize technology for academic purposes.

4. Parents and Community Stakeholders should collaborate with schools in supporting students' access to technological resources through community-based initiatives and partnerships.
5. The Department of Education and Local Government Units should allocate additional resources and funding to address technology gaps, particularly in rural and geographically disadvantaged schools.
6. Future Researchers may conduct similar studies in other districts or educational levels and explore additional variables that may influence technology integration and Science learning outcomes.

Compliance with Ethical Standards

The researcher strictly adhered to established ethical principles throughout the conduct of the study. Permission to conduct the research was obtained from the appropriate school authorities prior to data collection. Participation of respondents was voluntary, and informed consent was secured before the administration of the survey questionnaire. Respondents were informed of the purpose of the study, their rights as participants, and their freedom to withdraw from the study at any stage without penalty.

Confidentiality and anonymity were maintained by ensuring that no personal identifiers were disclosed in any part of the research process. All information gathered from participants was treated with utmost confidentiality and used solely for academic and research purposes. The researcher likewise ensured honesty, objectivity, and integrity in data collection, analysis, interpretation, and reporting of findings. No data were fabricated, altered, or misrepresented. The study complied with the ethical guidelines for educational research and upheld the principles of respect for persons, beneficence, and justice throughout the research process.

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