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Technology-Integrated Learning on Students' Mathematical Problem-Solving Skills

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Abstract

This study examined how San Sebastian College-Recoletos de Cavite senior high school students' ability to solve mathematical problems was affected by technology-integrated learning. The study used a posttest-only control group design with 160 students divided between traditional and technology-integrated classes, guided by constructivist learning theory. A validated normal distribution problem-solving test was given, and descriptive statistics and an independent samples t-test were used to assess the results. The findings indicate that students in the technology-integrated group outperformed those in the traditional group in terms of mean scores, demonstrating that digital tools can improve problem-solving skills when they are properly matched with pedagogy. These results highlight the need for teacher preparation, fair access, and pedagogically sound integration while confirming local and international evidence of the advantages of technology-enhanced learning. The study comes to the conclusion that technology has great potential for enhancing deeper reasoning, engagement, and 21st-century abilities in math classes when it is included in constructivist principles.

Keywords: Technology-integrated learning, senior high school, mathematical problems, constructivist learning theory, math class, digital

INTRODUCTION

Rapid advancements in digital technology in the twenty-first century have changed how educators provide lessons and how students interact with information. Scholars around the world highlight that rather than just introducing gadgets into classrooms, technology integration works best when it aligns pedagogy, content, and context (Hennessy et al., 2007; Mousoulides & Christou, 2019). Technology, in particular, allows for interactive investigation, the visualization of abstract ideas, and chances for active participation in mathematics that are not always possible with traditional methods (Ramdhane, 2024; Tuazon, n.d.). This shows how strategic, student-centered designs that seek to improve mathematical reasoning and problem-solving skills are replacing technocentric methods.

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Students must assess issues, create strategies, implement solutions, and reflect on results in order to achieve mathematical problem-solving, which is acknowledged as the fundamental goal of mathematics education (Mendoza, 2019). According to Rosli et al. (2013), traditional education frequently places a strong emphasis on exactness and memorization, which restricts students' capacity for flexible reasoning. Technology can improve engagement and conceptual understanding, both of which are necessary for successful problem-solving, according to recent meta-analyses (Sailer et al., 2024; Schweiker et al., 2023). Programming exercises and interactive simulations, for example, have been found to improve logical reasoning and adaptable thinking (Patel, 2024; Choi-Lundberg et al., 2023). All things considered, these results imply that carefully designed technology interventions are both mentally engaging and motivating.

Further evidence of this possibility can be found in the Philippine setting. According to studies, AI-powered tutors increased students' self-reliance and pre-calculus performance (Capinding, 2023), while resources helped students in Grade 7 better understand area and perimeter intuitively (Reyes, 2020). Additionally, digital literacy and higher-order modeling skills were fostered via online mathematics classes (Santos, 2021). However, there are still problems: insufficient teacher preparation may reduce the level of integration, and unequal access to digital technologies might exacerbate disparities (Zhu, 2024; Sree et al., 2024). These results demonstrate both the benefits and dangers of technology in Philippine math education.

Few studies have looked at technological integration in Cavite, especially in private Catholic institutions, despite the vastness of national and international research. Although there is a lack of thorough local evidence, Mendoza (2019) and Santos (2021) indicate regional differences in access and outcomes. It is critical to investigate whether technology-integrated learning actually improves Cavite students' problem-solving abilities as schools adapt to the demands of the twenty-first century. By focusing on senior high school students at San Sebastian College-Recoletos de Cavite, this study fills that knowledge vacuum by providing data on the effects of technology-enhanced education on mathematical problem-solving in a context that is both locally and globally relevant.

Research Objectives

The purpose of this study is to determine how students' ability to solve mathematical problems is affected by technology-integrated learning. In particular, it aims to:

1. Compare how well students solve problems in traditional and technology-integrated environments.

2. Assess for variations between the two groups that are statistically significant.

3. Make suggestions to improve institutional procedures and pedagogy.

Statement of the Problem

Main Problem: How does technology-integrated learning affect San Sebastian College-Recoletos de Cavite students' skills to solve mathematical problems?

Particular Problems:
1. What are the mean test scores of students who receive instruction via technology versus those who receive instruction using traditional means?

2. Is there a significant difference between the two groups' performance?

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3. What recommendations can be made based from the findings?

Hypothesis

H1: The technology group's mean score on mathematical problem-solving is higher than the traditional group's ($\mu tech > \mu traditional$).

Theoretical Framework

This study is based on Constructivist Learning Theory (Piaget; Vygotsky), which states that learners actively construct knowledge by engaging in activities, reflecting on methods, and interacting with peers. Constructivism in mathematics education requires actual problem-solving that links concepts to real-world experiences rather than rote memorization (Bruner, 1990; Brandt, 1997). Constructivist learning environments are especially well-suited to technology integration because digital tools may create dynamic scenarios in which students can test hypotheses, visualize abstract ideas, and engage in "productive struggle" (NCTM, n.d.).

Technology promotes constructivist concepts in a number of ways. First, it allows for active exploration—for example, AI programs lead learners through problem-solving procedures rather than merely providing answers (Capinding, 2023). Second, it promotes social contact, which is a crucial part of Vygotsky's sociocultural theory. Collaborative platforms, simulations, and group problem-solving activities promote discourse, peer correction, and shared meaning formulation (Ruchiyat et al., 2024). Third, technology improves metacognition by encouraging students to reflect on their strategies, compare approaches, and modify solutions, so fostering independence and critical thinking (Bermejo, 2018).

Furthermore, constructivism emphasizes the value of scaffolding and the Zone of Proximal Development (ZPD), in which teachers provide just enough assistance for students to progress. Technology promotes scaffolding by providing adaptive feedback and diverse tasks (Schweiker & Levonis, 2023). When matched with curriculum objectives, digital platforms can gradually diminish help as students develop proficiency, fostering autonomy. This demonstrates the direct relationship between theory and method: constructivism not only frames this study, but actively influences the selection of technological tools, problem-based test design, and the experimental technique to evaluating outcomes.

Thus, the theoretical framework provides a consistent justification for exploring how technology-integrated learning improves mathematical problem-solving. By grounding the study in constructivist concepts such as active engagement, collaboration, scaffolding, and reflection, the research design assures that the technology employed is not a distraction but an intentional instrument for strengthening the mathematical process.

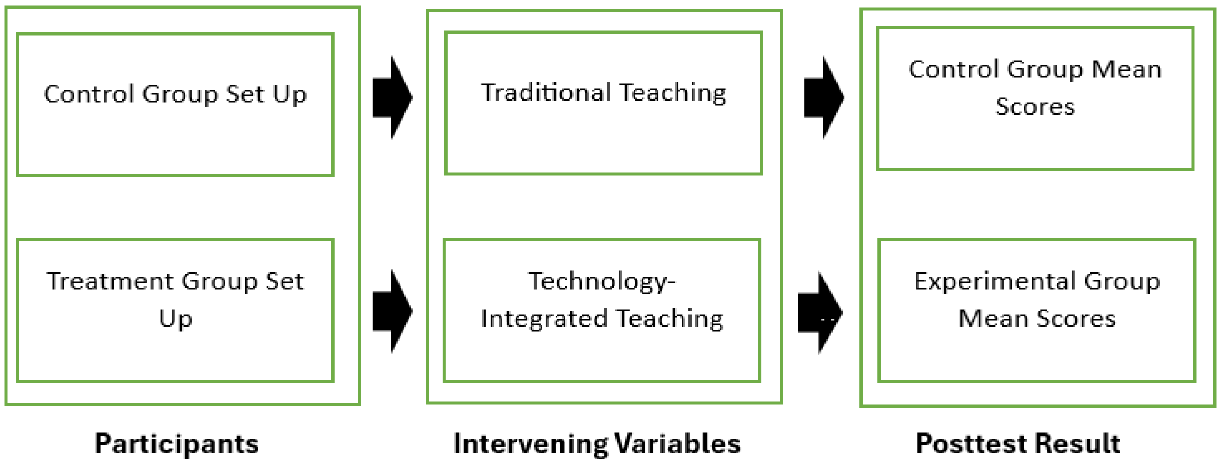

Figure 1. Conceptual Framework

Ethical Consideration

Ethical guidelines were followed throughout the study to ensure the anonymity of the student participants or respondents, informed consent, and responsible data handling. The school administration's consent was obtained before any data was gathered.

RESULTS

Table 1: Descriptive Statistics

Group	Mean	Median	Mode	Std. Deviation	Min	Max	Range	N
Control (Traditional)	19.61	20	20	2.14	15	25	10	80
Treatment (Technology)	23.96	24	23	1.90	20	28	8	80

The table showed the differences of scores between the control group and the treatment group, providing us evidence of the difference of scores. The standard deviations demonstrate that the control group has slightly more score variability.

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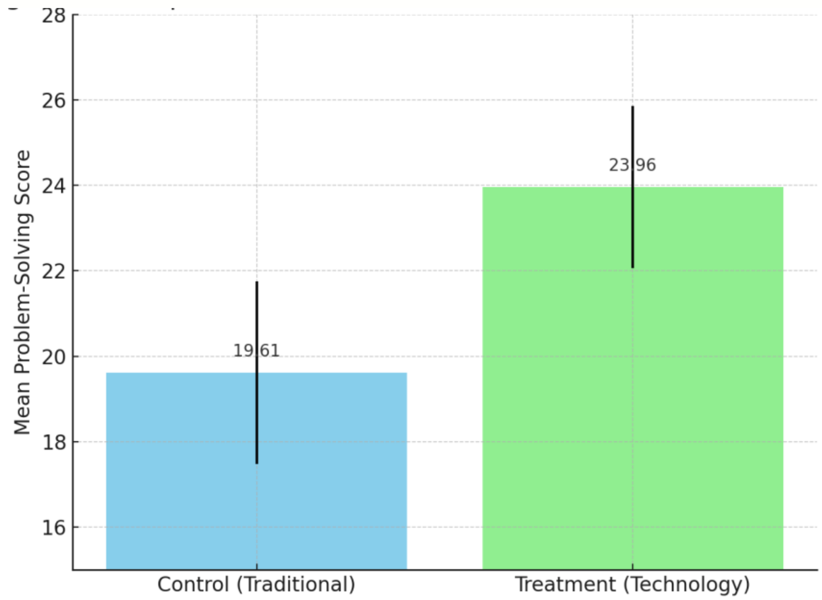

Figure 2. Comparative Mean Scores of Control and Treatment Groups

The control group had a mean score of 19.61, but the treatment group had a considerably higher average of 23.96.

Statistic	Value
Mean (Control)	19.61
Mean (Treatment)	23.96
df	156
t-statistic	-13.59
p-value (one-tailed)	1.53×10^{-28}

Table 2. Inferential Statistics

The independent samples t-test showed a significant difference between the two groups (p-value < 0.001), rejecting the null hypothesis. Students exposed to technology-integrated learning did much better than those in traditional environments. Students that were exposed to technology-integrated learning outperformed the traditional group in terms of mathematics problem solving.

DISCUSSION

The findings indicate that technology-integrated learning greatly improves students' mathematical problem-solving abilities when compared to traditional teaching. Previous research has found favorable relationships between utilization of technology and learner engagement, motivation, and accomplishment (Sailer et al., 2024; Schweiker & Levonis, 2023).

The study, which aligns with Constructivist Learning Theory, demonstrates how interactive platforms enable knowledge production through problem-centered activities, peer cooperation, and reflective involvement. Students in the treatment group benefited not just from exposure to digital tools, but also from teaching practices that linked technology use to genuine mathematical settings.

The findings further emphasize the need of attentive instructional design. When effectively integrated, technology does more than just support learning; it actively affects how students engage with mathematical concepts. This conclusion is consistent with research demonstrating that successful technology integration enhances higher-order thinking abilities and learner autonomy (Capinding, 2023; Patel, 2024).

Nonetheless, the study highlights problems raised in previous research, such as the potential of worsening inequalities caused by unequal access to digital resources (Zhu, 2024). While this study was done at a private institution with excellent resources, wider adoption in public or rural schools may encounter structural challenges that require policy and institutional assistance.

Conclusion

This study proved that technology-integrated learning notably improves senior high school students' mathematics problem-solving skills compared to traditional instructional techniques. Learners' ability to evaluate, strategize, and solve mathematical problems improved when digital tools were aligned with constructivist concepts. The findings provide localized data to both Philippine and worldwide conversations about 21st-century mathematics education, suggesting that when used carefully, technology promotes deeper thinking, engagement, and academic accomplishment.

However, the study emphasizes that technology's performance is dependent on pedagogical fit, teacher preparedness, and fair access. Without these, the digital gap may persist, and the full potential of technology may go unrealized.

Recommendations

1. Strengthen Teacher Training - Provide ongoing professional development to prepare teachers to build constructivist, technology-integrated curriculum.
2.
   2. Address the Digital Divide by implementing initiatives that provide access to devices and connection, guaranteeing parity in learning possibilities.
3. Align Technology and Pedagogy - Use assessment frameworks to ensure that technologies help students solve problems rather than distract them.
4. Secure Data Privacy - Develop procedures to secure student and instructor information as digital technologies become more prevalent in education.
5. Encourage Local Research Replication - Encourage more research across grade levels and circumstances in Cavite to validate and expand upon these findings.

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REFERENCES

Accelerate Learning. (n.d.). Constructivist Teaching. Retrieved from https://info.acceleratelearning.com/constructivist-teaching

Begornia, E., & Doronio, R. (n.d.). *TRADITIONAL AND INSTRUCTIONAL APPROACHES IN TEACHING MATHEMATICS: AN EXPERIMENTAL STUDY*. *11*, 2025. Retrieved July 31, 2025, from https://ijariie.com/AdminUploadPdf/TRADITIONAL_AND_INSTRUCTIONAL_APPROACHES_IN_TEACHING_MATHEMATICS__AN_EXPERIMENTAL_STUDY_ijariie27062.pdf

Bermejo, F. (2018). *A Constructivist Intervention Program for the Improvement of Mathematical Performance Based on Empiric Developmental Results (PEIM)*. Frontiers in Psychology. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2020.582805/full

Brandt, R. (1997). *How does learning happen? Constructivism in the Classroom*. ASCD.

Bruner, J. S. (1990). *Acts of meaning*. Harvard University Press.

Capinding, A. T. (2023). Revolutionizing Pre-Calculus Education: Photomath's AI-Powered Mathematics Tutorship. *Problems of Education in the 21st Century*, *81*(6), 758–775. https://eric.ed.gov/?q=self-reliance&ff1=eduHigh+Schools&id=EJ1409630

Chandraja, Ajayan, T., Ruskin, S., & George, M. (2024). *INNOVATIVE PEDAGOGIES: ADAPTING TEACHING STRATEGIES FOR MODERN LEARNING ENVIRONMENTS*. https://www.iipseries.org/assets/docupload/rsl2024AFB362D7F2D6F33.pdf

Choi-Lundberg, D., Butler-Henderson, K., Harman, K., & Crawford, J. (2023). A systematic review of digital innovations in technology-enhanced learning designs in higher education. *Australasian Journal of Educational Technology*. https://ajet.org.au/index.php/AJET/article/view/7615.

Choueiry, G. (2022). *Posttest-Only Control Group Design: An Introduction – Quantifying Health*. Quantifying Health. https://quantifyinghealth.com/posttest-only-control-group-design/

Daniela, L. (2021). Smart Pedagogy as a Driving Wheel for Technology-Enhanced Learning. *Technology, Knowledge and Learning*, 26, 711 - 718. https://link.springer.com/article/10.1007/s10758-021-09536-z

Duterte, J. (2024). Technology-Enhanced Learning Environments: Improving Engagement and Learning. *International Journal of Research and Innovation in Social Science*. https://rsisinternational.org/journals/ijriss/articles/technology-enhanced-learning-environments-improving-engagement-and-learning/

Effect of a Constructivist Approach on Students' Problem-Solving Skills in Mathematics. (n.d.). Journals Place. Retrieved from https://journals.journalsplace.org/index.php/JEDA/article/viewFile/662/565

Hennessy, S., Wishart, J., Whitelock, D., Deaney, R., Brawn, R., Velle, L. la, McFarlane, A., Ruthven, K., & Winterbottom, M. (2007). Pedagogical approaches for technology-integrated science teaching. *Computers & Education*, *48*(1), 137–152. https://www.educ.cam.ac.uk/research/programmes/istl/PedScT.pdf

Indonesian Educational Research Journal. (n.d.). *Improving Problem-Solving Ability through a Constructivist Approach in Learning Mathematics for Grade X High School Students*. Retrieved from https://journal.id-sre.org/index.php/ierj/article/download/18/10/86

International Journal of Education and Social Science Research (IJESSR). (n.d.). *Applying Constructivist Theory in Teaching Mathematics at Grade 2*. Retrieved from https://ijessr.com/uploads2023/ijessr_06_762.pdf

Kissane, B. (2009). *Teaching, learning and technology in the Philippines*. https://researchrepository.murdoch.edu.au/id/eprint/6250/

Mendoza, A. L. (2019). The effects of technology-enhanced instruction on the mathematics performance of Filipino high school students. *Philippine Journal of Education and Teaching*, 96(2), 45-56

Mousoulides, N., & Christou, C. (2019). Technology-enhanced learning of mathematics: Approaches, outcomes, and challenges. *ZDM Mathematics Education, 51*(1), 1-12.

National Council of Teachers of Mathematics (NCTM). (n.d.). *Constructivist Learning and Teaching*. Retrieved from https://www.nctm.org/Handlers/AttachmentHandler.ashx?attachmentID=wVxezpSpZG0%3D

Patel, A. (2024). Impact of Technology Integration on Math Achievement in Middle School Classrooms in India. *American Journal of Education and Practice*, *8*(3), 1–12. https://ajpojournals.org/journals/index.php/AJEP/article/view/1904

Payadnya, I. P. A. A., Putri, G. A. M. A., Suwija, I. K., Saelee, S., & Jayantika, I. G. A. N. T. (2024). Cultural integration in AI-enhanced mathematics education: insights from Southeast Asian educators. *Journal for Multicultural Education*. https://www.emerald.com/jme/article-abstract/19/1/58/1245391/Cultural-integration-in-AI-enhanced-mathematics?redirectedFrom=fulltext

Ramdhane, K. (2024). *Teachers Engagement in the Digital Transformation Era: An Analysis of Challenges, Opportunities, and Best*. *ResearchGate*, *09*(2602-6368), 713–730. https://www.researchgate.net/publication/387477485_Teachers_Engagement_in_the_Digital_Transformation_Era_An_Analysis_of_Challenges_Opportunities_and_Best_Practices

Reyes, M. J. (2020). Exploring the impact of interactive math tools on learners' performance in Cavite private schools. *Journal of Philippine Education Research*, 5(1), 23-31.

Rosli, R., Goldsby, D., & Capraro, M. M. (2013). Assessing Students' Mathematical Problem-Solving and Problem-Posing Skills. *Asian Social Science*, *9*(16). Retrieved from https://www.researchgate.net/publication/269519904_Assessing_Students%27_Mathematical_Problem-Solving_and_Problem-Posing_Skills

Ruchiyat, A., Haryadi, R., & Widyanti, N. (2024). *The Effect of Constructivist Approach on Students' Mathematical Problem-Solving Ability and Self-Concept*. Jurnal Pendidikan Matematika dan Sains, 8(1).

Sailer, M., Maier, R., Berger, S., Kastorff, T., & Stegmann, K. (2024). Learning activities in technology-enhanced learning: A systematic review of meta-analyses and second-order meta-analysis in higher education. *Learning and Individual Differences*. https://www.sciencedirect.com/science/article/pii/S1041608024000396?via%3Dihub.

Santos, E. G. (2021). E-learning and student engagement in mathematics: A case study of a Cavite-based college. *Luzon Academic Review*, 12(4), 67-78.

Schweiker, S., & Levonis, S. (2023). Enhancing chemistry education through technology-enhanced learning: Impact on student outcomes. *ASCILITE Publications*. https://publications.ascilite.org/index.php/APUB/article/view/463.

Sree, S., Ankarao, M., Thejeswini, B., & Narmada, A. (2024). Global Significance of Technology Enhanced Learning and Teaching. *Power System Technology*. https://powertechjournal.com/index.php/journal/article/view/873.

The Impact of Constructivist Methods on Students' Mathematical Problem-Solving. (n.d.). ResearchGate. Retrieved from https://www.researchgate.net/publication/390698352_The_impact_of_constructivist_methods_on_students'_mathematical_problem-solving

Tuazon, M. L. (n.d.). *Publications The integration of technology in education: Transforming learning landscapes.* Retrieved June 29, 2025, from https://www.depedbataan.com/wp-content/uploads/2023/12/THE-INTEGRATION-OF-TECHNOLOGY-IN-EDUCATION-TRANSFORMING-LEARNING-LANDSCAPES.pdf

Wekerle, C., Daumiller, M., Janke, S., Dickhäuser, O., Dresel, M., & Kollar, I. (2024). Putting ICAP to the test: how technology-enhanced learning activities are related to cognitive and affective-motivational learning outcomes in higher education. *Scientific Reports*, 14. https://www.nature.com/articles/s41598-024-66069-y

Zhu, H. (2024). Enhancing Mathematical Learning Through Technology Integration. *Proceedings of the 3rd International Conference on Education, Language and Art (ICELA 2023)*, 766–771. https://www.atlantis-press.com/proceedings/icela-23/125998563