Collaborative Learning Practices and Academic Engagement Influencing Mathematics Achievement Among Senior High School Students

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ABSTRACT

This study addressed the persistent challenge of improving Mathematics achievement among Senior High School students despite the increasing implementation of learner-centered and collaborative instructional approaches in Mathematics education. It examined the relationship between collaborative learning practices and Mathematics achievement and determined the influence of academic engagement on Mathematics achievement among Senior High School students in General Mathematics. Guided by Vygotsky's Social Constructivist Learning Theory, Johnson and Johnson's Cooperative Learning Model, and the ICAP Framework of Engagement, the study employed a quantitative descriptive-correlational research design. Grade 11 students enrolled in General Mathematics were selected through cluster sampling (n = 288). Data were collected using a validated Collaborative Learning Survey Questionnaire, a teacher-rated Academic Engagement Observation Rubric, and a pilot-tested 50-item General Mathematics Achievement Test. Descriptive statistics, Pearson's correlation coefficient, and one-way analysis of variance (ANOVA) were used to analyze the data. Results revealed that collaborative learning practices were highly evident (M = 3.82, SD = 0.09), with accountability receiving the highest rating. Interactive engagement was the predominant type (30.2%), while students demonstrated satisfactory Mathematics achievement (M = 82.10, SD = 7.73). A significant moderate positive relationship was found between collaborative learning practices and Mathematics achievement ($r = .433$, $p < .001$), with group processing exhibiting the strongest relationship ($r = .506$, $p < .001$). Mathematics achievement also differed significantly across engagement types, $F(3, 151) = 4.00$, $p = .009$, $\eta^2 = .074$, with students demonstrating interactive and constructive engagement obtaining significantly higher achievement than those demonstrating active engagement. The study concluded that collaborative learning practices and academic engagement significantly contributed to students' Mathematics achievement, highlighting the importance of strengthening collaborative learning experiences and promoting higher levels of academic engagement.

Keywords: Collaborative learning, academic engagement, Mathematics achievement, General Mathematics, Senior High School students, descriptive-correlational design

INTRODUCTION

Improving students' academic achievement in Mathematics remains a major concern, as many learners continue to struggle with conceptual understanding and problem-solving despite curriculum innovations and learner-centered strategies (Bernardo, 2020; Hernandez & Bautista, 2021; Villanueva & Cruz, 2022). Achievement is influenced not only by instructional methods but also by students' participation and engagement during learning (Fredricks et al., 2004). Collaborative learning has been widely recognized as an effective strategy for enhancing engagement and achievement (Gillies, 2016; Slavin & Lake, 2019), while academic engagement conceptualized through passive, active, constructive, and interactive modes has likewise been linked to meaningful participation and better outcomes (Chi, 2014). However, few studies have jointly examined how collaborative learning and academic engagement relate to achievement in General Mathematics among Philippine Senior High School students.

In the Philippine setting, the Enhanced Basic Education Curriculum (Republic Act No. 10533) promotes learner-centered and collaborative approaches that develop cognitive and social competencies (Department of Education, 2013), yet Filipino learners continue to perform below international benchmarks in Mathematics (Bernardo, 2020). This study is anchored on Vygotsky's (1978) Social Constructivist Learning Theory, Johnson and Johnson's (1999) Cooperative Learning Model which identifies positive interdependence, accountability, peer interaction, and group processing as the key dimensions of collaborative learning and Chi's (2014) ICAP Framework of academic engagement. Collaborative learning and academic engagement were treated as independent variables, while Mathematics achievement served as the dependent variable.

Statement of the Problem

This study determined (1) the level of collaborative learning as perceived by students in terms of positive interdependence, accountability, peer interaction, and group processing; (2) students' predominant academic engagement type; (3) the level of students' Mathematics achievement; (4) whether collaborative learning practices significantly relate to Mathematics achievement; and (5) whether academic engagement types significantly influence Mathematics achievement.

H01: There is no significant relationship between students' collaborative learning practices and their Mathematics achievement.

H02: Students' academic engagement types do not significantly influence their Mathematics achievement.

METHODS

Research Design

This study employed a quantitative descriptive-correlational research design to examine the relationship among collaborative learning, academic engagement, and Mathematics achievement in General Mathematics.

Participants and Sampling

The respondents were Grade 11 General Mathematics students of Libertad National High School, Surallah, South Cotabato (population N = 1,027). Using Slovin's formula with a 5% margin of error, a sample of 288 students was drawn through cluster sampling, with eight of the school's 22 Grade 11 sections selected as clusters and all students within those sections included as respondents.

Instruments

Three instruments were used: a student-rated Collaborative Learning Survey Questionnaire measuring positive interdependence, accountability, peer interaction, and group processing on a four-point Likert scale; a teacher-rated Academic Engagement Observation Rubric based on the ICAP Framework (Chi, 2014); and a pilot-tested 50-item General Mathematics Achievement Test developed from a Table of Specifications. Instruments were pilot-tested with 30 Grade 12 students and four Mathematics teachers to establish clarity and reliability prior to data collection.

Data Analysis

Frequency, percentage, mean, and standard deviation were used to describe the level of collaborative learning, the distribution of engagement types, and Mathematics achievement. Pearson's r was used to test the relationship between collaborative learning and achievement, and one-way ANOVA with Eta Squared (η^2) was used to test differences in achievement across engagement types. All analyses were interpreted at the .05 level of significance.

RESULTS

Level of Collaborative Learning

Table 1. Level of Collaborative Learning in General Mathematics

Dimension	M	SD	Verbal Description
Positive Interdependence	3.83	0.11	Highly Evident
Accountability	3.86	0.08	Highly Evident
Peer Interaction	3.78	0.14	Highly Evident
Group Processing	3.79	0.20	Highly Evident
Overall Mean	3.82	0.09	Highly Evident

Collaborative learning was highly evident overall (M = 3.82, SD = 0.09), with accountability obtaining the highest rating (M = 3.86) and peer interaction the lowest (M = 3.78), though all four dimensions were rated highly evident.

Predominant Academic Engagement Type

Interactive engagement was predominant among 30.2% of students (f = 87), followed by constructive (27.4%, f = 79), active (23.3%, f = 67), and passive engagement (19.1%, f = 55), indicating that most students engaged in Mathematics through discussion, questioning, and collaborative knowledge-building rather than passive reception.

Mathematics Achievement

Students obtained an overall mean score of 82.10 (SD = 7.73), interpreted as Satisfactory. While 29.86% scored between 85.00 and 89.99 and 21.18% scored between 90.00 and 100.00, 29.51% scored below 75.00, indicating considerable variation in individual performance.

Relationship between Collaborative Learning and Achievement

Table 2. Correlation between Collaborative Learning and Mathematics Achievement

Variable	r	p	Interpretation
Positive Interdependence	.088	.136	Negligible
Accountability	.171*	.004	Weak
Peer Interaction	.236*	< .001	Weak
Group Processing	.506*	< .001	Moderate
Overall Collaborative Learning	.433*	< .001	Moderate

*p < .05. Collaborative learning practices were significantly and moderately related to Mathematics achievement (r = .433, p < .001).

Among the dimensions, group processing showed the strongest relationship (r = .506, p < .001), followed by peer interaction (r = .236, p < .001) and accountability (r = .171, p = .004); positive interdependence was not significantly related to achievement (r = .088, p = .136). H01 was therefore rejected.

Differences in Achievement by Engagement Type

Table 3. Mathematics Achievement by Predominant Academic Engagement Type

Engagement Type	n	M	SD
Interactive	87	84.30[a]	8.05

Constructive	79	82.10[a]	7.60
Passive	55	80.90[ab]	7.09
Active	67	80.20[b]	7.40

Note. $F(3, 151) = 4.00$, $p = .009$, $\eta^2 = .074$. Means sharing a superscript did not differ significantly. Mathematics achievement differed significantly across engagement types, with students demonstrating interactive and constructive engagement scoring significantly higher than those demonstrating active engagement; engagement type accounted for 7.4% of the variance in achievement. H02 was therefore rejected.

DISCUSSION OF THE FINDINGS

The highly evident level of collaborative learning suggests that students were active participants in constructing mathematical understanding rather than passive recipients of instruction, consistent with Vygotsky's (1978) view that learning develops through social interaction, and with Johnson and Johnson's (1999) model, which links shared responsibility and reflective group processing to effective collaboration. This aligns with local evidence that structured collaborative activities strengthen students' participation and conceptual understanding in Mathematics (Casinillo et al., 2023; García-Martínez et al., 2021; Hernandez & Bautista, 2021).

The predominance of interactive engagement supports Chi's (2014) ICAP Framework, which posits that engagement deepens as students move from receiving information toward co-constructing knowledge through dialogue. This is consistent with evidence that collaborative and interactive learning environments strengthen student engagement and involvement (Bond et al., 2020; Järvelä & Renninger, 2023). The satisfactory overall achievement, alongside the sizable proportion of students scoring below 75.00, echoes findings that Mathematics performance remains uneven even where instructional reforms are in place (Bernardo, 2020; Alvarez & Dalida, 2020).

Group processing emerged as the strongest correlate of achievement, suggesting that reflection on group strategies and performance rather than the mere presence of shared goals drives learning gains, a pattern also reported by Zhang et al. (2024) and Zhu and Urhahne (2020), who found that structured reflection and teacher-supported collaboration mediate the link between group work and achievement. That positive interdependence alone was not significantly related to achievement echoes Gillies (2016), who argued that collaborative learning becomes effective only when it is paired with individual accountability and genuine interaction rather than passive group membership.

Finally, the significantly higher achievement of students with interactive and constructive engagement over those with active engagement supports the ICAP premise that generative, dialogic engagement yields deeper learning than behavioral engagement alone (Li & Xue, 2023). Together, these findings suggest that Mathematics achievement is best supported not simply by grouping students, but by cultivating accountable, reflective, and interactive forms of collaboration.

CONCLUSION

The findings established that collaborative learning practices were highly evident among Grade 11 students in General Mathematics. Accountability emerged as the strongest dimension, while peer interaction obtained the lowest, although still highly evident, mean rating.

Interactive engagement was the predominant academic engagement type, followed by constructive, active, and passive engagement. Students attained a satisfactory level of Mathematics achievement, although considerable variation existed in individual performance.

Collaborative learning practices demonstrated a significant relationship with Mathematics achievement. Accountability, peer interaction, group processing, and overall collaborative learning practices showed significant positive relationships with achievement, with group processing demonstrating the strongest

association. Positive interdependence, however, did not show a significant relationship with Mathematics achievement.

Finally, Mathematics achievement differed significantly according to predominant academic engagement type. Students exhibiting interactive and constructive engagement attained significantly higher achievement than those exhibiting active engagement.

RECOMMENDATIONS

Based on the findings, Mathematics teachers may strengthen collaborative learning through structured approaches such as the jigsaw method, peer tutoring, think-pair-share, and structured group problem-solving. These activities may particularly strengthen peer interaction, which obtained the lowest mean among the collaborative learning dimensions.

Teachers may also incorporate strategies that encourage interactive and constructive participation, including peer questioning, student-led explanations, collaborative problem-solving, error analysis, and group reflection.

Schools may strengthen academic support programs through targeted Mathematics interventions, regular progress monitoring, peer tutoring, and small-group remediation for students who obtain grades below 75.00.

Structured collaborative activities may also assign individual and group responsibilities through rotating roles, peer tutoring assignments, and group performance tasks with individual accountability components.

Future researchers may conduct comparative studies across other subject areas and replicate the study across multiple schools and regions. More advanced statistical techniques, such as regression analysis or structural equation modeling, may also be employed, together with triangulation through interviews, classroom observations, and performance portfolios.

Ethical Considerations

This study involved human respondents (Grade 11 students) and was conducted in accordance with accepted ethical standards for research involving human participants. Ethical approval was obtained from the appropriate institutional research ethics review body prior to data collection, and informed consent including parental/guardian consent for minor participants was secured, with confidentiality and anonymity maintained throughout.

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and ethical restrictions associated with the participation of minor respondents.

REFERENCES

1. Alvarez, M. T., & Dalida, R. M. (2020). Collaborative learning and mathematics performance among senior high school students. Asia Pacific Journal of Multidisciplinary Research, 8(4), 45–53.
2. Bernardo, A. B. I. (2020). Socio-emotional skills and Filipino students' mathematics achievement: Insights from international large-scale assessments. Philippine Journal of Psychology, 53(2), 123–145.
3. Bernardo, A. B. I. (2021). Factors influencing mathematics achievement among Filipino students: The role of engagement and collaborative learning. Asia-Pacific Education Researcher, 30(4), 1–12.

4. Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020). Mapping research in student engagement and educational outcomes: A systematic review. Educational Research Review, 30, 100327.
5. Casinillo, L. F., Lacandula, M. J., & Zanoria, M. J. (2023). Collaborative learning and mathematics achievement among Grade 7 students. Philippine Journal of Education Research Press.
6. Chi, M. T. H. (2014). Active-constructive-interactive: A conceptual framework for differentiating learning activities. Topics in Cognitive Science, 6(1), 219–234.
7. Department of Education. (2013). Implementing rules and regulations of Republic Act No. 10533 (Enhanced Basic Education Act of 2013).
8. Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept and state of the evidence. Review of Educational Research, 74(1), 59–109.
9. García-Martínez, J. A., et al. (2021). Cooperative learning strategies in mathematics classrooms and their impact on academic achievement. Journal of Educational Research and Practice, 11(2), 45–60.
10. Gillies, R. M. (2016). Cooperative learning: Review of research and practice. Australian Journal of Teacher Education, 41(3), 39–54.
11. Hernandez, J. P., & Bautista, L. R. (2021). Collaborative learning strategies and students' mathematics achievement in senior high school. International Journal of Instruction, 14(2), 789–804.
12. Johnson, D. W., & Johnson, R. T. (1999). Learning together and alone: Cooperative, competitive, and individualistic learning (5th ed.). Allyn & Bacon.
13. Järvelä, S., & Renninger, K. A. (2023). Engagement in collaborative learning environments: Processes and outcomes. Learning and Instruction, 83, 101712.
14. Li, Y., & Xue, H. (2023). The mediating role of student engagement in collaborative learning and academic achievement. Computers & Education, 190, 104625.
15. Slavin, R. E., & Lake, C. (2019). Effective programs in elementary mathematics: A best-evidence synthesis. Review of Educational Research, 89(4), 613–651.
16. Villanueva, M. L., & Cruz, E. P. (2022). Emotional intelligence and collaborative learning outcomes in secondary mathematics education. Journal of Educational Research and Practice, 12(1), 95–110.
17. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.
18. Zhang, L., Wang, X., & Liu, Y. (2024). Direct and indirect effects of collaborative learning on academic achievement: The mediating role of engagement. Studies in Educational Evaluation, 79, 101294.
19. Zhu, M., & Urhahne, D. (2020). Teacher support and collaborative learning in mathematics classrooms. Learning and Instruction, 65, 101245.