



Peer Collaboration Mastery of Standard Deviation Lessons Among Second-Year College Students of Kolehiyo ng Lungsod ng Lipa AY 2025-2026

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Abstract

Statistics is a core subject in college curricula, yet many students struggle with lessons on standard deviation due to reliance on rote memorization and difficulty in computation and interpretation. Peer collaboration offers a student-centered approach that may address these challenges.

This study aims to determine the effectiveness of peer collaboration among the second-year college students at Kolehiyo ng Lungsod ng Lipa, Brgy. Marawoy, Lipa City, Batangas, in enhancing their mastery of the lessons on the Standard Deviation, during the 2nd semester of the Academic Year 2025-2026. The participants in peer collaboration activities are the 60 students on the second-year college level.

A mixed-methods design was employed, combining quantitative and qualitative approaches. Sixty second-year students participated through purposive sampling. Quantitative data were gathered using pre-tests and post-tests to measure academic performance, and survey questionnaires to assess the level of engagement. Qualitative data were collected through focus group discussions to identify challenges encountered in learning standard deviation.

Findings revealed that peer collaboration improved students' performance in measures of central tendency (grouped and ungrouped data) and data analysis. Students demonstrated higher engagement in classroom activities, increased confidence in solving statistical problems, and a deeper understanding of computation steps. Students faced cognitive difficulties in grasping the lesson, along with emotional frustration and behavioral responses, which were mitigated through peer teaching, role rotation, and collaborative activities.

Peer collaboration is an effective intervention in mastering standard deviation lessons. It fosters active participation, critical thinking, and confidence, while addressing persistent learning gaps in statistics. The study highlights its significance for administrators, teachers, and students as a pedagogical innovation that strengthens statistical literacy and prepares learners for future professional endeavors.

Keywords: *Peer collaboration, Standard deviation, Student engagement, Academic performance, Statistics education*

Introduction

The Statistics program in the college curriculum equips future statisticians with skills and ethical values for evidence-based decision-making and community betterment. It develops critical thinking, data literacy, and decision-making skills, as noted by Ben-Zvi & Garfield (2021). The measure of dispersion, particularly standard deviation, is the foundation of data analysis, research, and professional practice, helping address learning gaps and variability in student performance.

Students often find Statistics challenging, especially standard deviation, due to computation, interpretation, and reliance on rote memorization, which leads to low mastery and reduced confidence. Bello (2021) and Adetunji (2020) emphasized peer collaboration as a student-centered approach that fosters active engagement, shared problem-solving, and deeper comprehension.

Peer collaboration in standard deviation lessons moves learning beyond mechanical computation. Activities such as think-pair-share, peer-teaching, group problem-solving, role rotation, and technology integration strengthen understanding, confidence, and critical thinking. Real-world contexts like sports statistics and test scores make learning engaging and relevant. Springer (2023), Van Leeuwen & Janssen (2023), Nwala & Grenn (2023), and Achor (2020) highlighted peer collaboration as effective for mastery, participation, and positive outcomes.

Second-year college students are chosen for this study as they are developmentally ready for collaborative learning and at a stage where Statistics is introduced as a core subject. Mastery of measures of dispersion ensures readiness for advanced applications of data analysis and professional practice.

The study addresses persistent learning gaps in understanding standard deviation of grouped data, moving beyond rote memorization toward meaningful application. Peer collaboration enhances comprehension, confidence, and problem-solving, contributing to pedagogical innovation and supporting broader educational goals such as critical thinking, collaborative skills, and academic success..

Studies revealed that many students performed below mastery in NAT and ranked low in PISA, showing gaps in mathematics, science, and language. Weak teacher training, overcrowded classrooms, and limited resources contributed to low academic performance. Collaborative learning, peer collaboration, cooperative learning, and peer tutoring improved academic performance, engagement, confidence, and critical thinking. Activities such as brainstorming, group reporting, role play, and group discussions encouraged active learning and creativity. Challenges included weak foundation, difficulty in computation, abstract ideas, limited interaction, low motivation, and reliance on rote memorization. Interventions like peer teaching, teamwork, role rotation, and collaborative strategies helped students overcome difficulties, sustain interest, and achieve better results in mathematics and statistics, especially in standard deviation lessons..

Research Questions

This study assessed the effectiveness of integrating peer-collaboration strategies in strengthening retention and mastery among second-year college students.

Specifically, it seeks to answer the following questions:



1. How may peer collaboration techniques improve students' academic performance before and after mastering the standard deviation lessons in terms of:
 - 1.1 Measures of Central Tendency (Grouped Data);
 - 1.2 Measures of Central Tendency (Ungrouped Data);
 - 1.3 Data Analysis
2. To what extent does peer collaboration enhance students' engagement in learning through Standard Deviation lessons based on the above-mentioned questions:
3. How effective is peer collaboration technique in enhancing the mastery of Standard Deviation lessons among the students relative to:
 - 3.1 Learning content
 - 3.2 Classroom activities
 - 3.3 Assessment task?
4. What challenges are encountered by the students when learning Standard Deviation lessons through peer collaboration?
5. Based on the analysis, what enhancement activities may be proposed?

Methodology

Research Design

A mixed-methods design was employed, combining quantitative (pre-test, post-test, survey questionnaires) determine the students' academic performance before and after the implementation of peer collaborative activities, and a survey questionnaire to assess students' level of engagement and qualitative (focus group discussions) approaches to identify the challenges that students encounter when learning standard deviation through peer collaboration.

Participants

The study involved 60 purposively selected second-year college students from Kolehiyo ng Lungsod ng Lipa during the 2nd semester of AY 2025–2026.

Research Instruments

The researcher-made test is used to measure students' academic performance before and after the implementation of peer collaboration activities, which consists of 40 multiple-choice items. On the other hand, a 10-item questionnaire using a 4-point Likert scale is used to assess the level of engagement using



peer collaboration in the standard deviation lesson. For the focus group discussion, the researcher uses guide questions that will be conducted with the 10 selected participants to identify the challenges encountered when learning standard deviation through peer collaboration.

Data Collection Procedure

The researcher followed procedures by preparing a request letter to the College Administrator, which permitted the conduct and validation of the study, including the section, activity, schedule of intervention, and instrument used. Assistance was secured from the class adviser and subject teacher to explain the goal, research design, and conduct of the activity, and permission was granted to implement the intervention with second-year college students.

An assent form was provided, confirming respondents' agreement and willingness to participate. With consent obtained, the researcher administered the pre-test, implemented the intervention, conducted the post-test, and collected survey questionnaires and feedback forms. The responses were tallied, tabulated, and analyzed with the assistance of a statistician to ensure precision in computation and decision-making.

Data Analysis

Frequency. This determined the number of respondents who fall within a score range. This determined the performance before and after the implementation of the peer collaboration to measure the initial level of mastery of second-year college students in solving problems involving the standard deviation of grouped data.

Percentage. This determined the proportion of students in each mastery level. This determined the performance before and after the implementation of the peer collaboration to measure the initial level of mastery of second-year college students in solving problems involving the standard deviation of grouped data.

Mean. This determined the scale for the student level of engagement.

Composite Mean. This determined the average score on the students' level of engagement. This also determined the scale for the student level of engagement

Thematic Analysis. This analyzed the responses of the participants in the focus group discussion to determine the challenges met. The participants' answers were recorded and transcribed verbatim. The researchers then analyzed to identify different codes, which are words or phrases that were repeated in the participants' responses. The codes are grouped based on common themes that emerged from the data.

Results

1. Academic Performance of the Students in Pre-test Scores

Table 1 below shows the results of 40 multiple-choice pre-test items of the respondents to measure the initial level of mastery among second-year college students. Twenty (20) out of 60 students

(33.33%) fell within the Developing, and 13 (21.67%) within Needs Improvement. The mean pre-test score was 23.88, which corresponds to the Developing level when the pre-test was administered.

Table 1. Frequency and Percentage Distribution of Respondents' Academic Performance (Pre-Test)

Scores	Level of Mastery	Frequency	Percentage
36 - 40	Advanced Mastery	7	11.67%
30 - 35	Proficient	9	15.00%
24 - 29	Basic Understanding	13	21.67%
18 - 23	Developing	20	33.33%
0 - 17	Needs Improvement	11	18.33%
Total		60	100%

Academic Performance of the Students in Post-Test Scores

In Table 2, the post-test results, which determine the level of mastery after the implementation of peer collaboration. Thirty-five (35) of the respondents (58.33%) achieved the Advanced Mastery, with a mean post-test score of 33.78, corresponding to the Advanced Mastery.

Table 2. Frequency and Percentage Distribution of Respondents' Academic Performance (Post-Test)

Scores	Level of Mastery	Frequency	Percentage
36 - 40	Advanced Mastery	35	58.33%
30 - 35	Proficient	15	25.00%
24 - 29	Basic Understanding	3	5.00%
18 - 23	Developing	6	10.00%
0 - 17	Needs Improvement	1	1.67%
Total		60	100%

The data was obviously higher than the pre-test after implementing the peer-collaboration, from Developing and Needs Improvement to Proficient and Advanced Mastery. This implies that the students demonstrate the effectiveness of peer collaboration in enhancing students' academic performance.

2. Student Level of Engagement in Learning through Standard Deviation Lessons

Table 3 presents the respondents' level of engagement with a composite mean of 3.49, which is verbally interpreted as Engaged. Among the indicators, five statements reached the Very Engaged level, each with a mean range from 3.52 to 3.53. Although the composite mean is still classified as Engaged, this is very close to the "Very Engaged" range (3.50-4.00).

Table 3. Mean and Composite Mean Distribution of Respondents' Level of Engagement

Indicators	Mean	Verbal Interpretation
I enjoy performing activities with my groupmates and guided activities with my professor.	3.52	Very Engaged
I am excited to share my knowledge and skills with my peers and with my professor.	3.42	Engaged
I am motivated to answer when working with my group and when encouraged by my professor.	3.42	Engaged
I actively listen to the ideas of my groupmates and the explanations of my instructor during discussions.	3.53	Very Engaged
I contribute suggestions and solutions when my group is solving problems, while also considering my professor's feedback.	3.48	Engaged
I respect and value the opinions of my peers and the guidance of my professor, even if they differ from mine.	3.53	Very Engaged
I feel more confident when collaborating with classmates and receiving support from my professor compared to working alone.	3.43	Engaged
I willingly help groupmates who struggle with a task or topic, and seek clarification from my professor when needed.	3.47	Engaged
I believe teamwork with my peers and guidance from my professor helps me understand lessons better.	3.53	Very Engaged
I enjoy celebrating group achievements together and acknowledging the teacher's role in our success.	3.53	Very Engaged
Composite Mean	3.49	Engaged

3. Effectiveness of Peer Collaboration Relative to Learning Content, Classroom Activities, and Assessment Tasks

Learning Content. Table 1 shows the improvement of the mean score from 23.88 to Table 2 with 33.78, which shows the enhanced mastery of the Standard Deviation Lessons.

Classrooms Activities. The result of the level of engagement in Table 3 provides positive participation and the enjoyment level of the students inside the classroom, despite having the same level of challenges that have been noted.

Assessment Tasks. The post-test results confirm the measurable improvement, with a significant increase in students achieving Proficient and Advanced Mastery.

Peer collaboration was an effective intervention and can be recommended as a teaching strategy for the students, not only improving their test performance but also reported having a positive experience in classroom activities and learning content mastery.

4. Challenges Encountered by the Students when Learning Standard Deviation Lessons through Peer Collaboration

Theme 1: Cognitive Difficulties in Understanding the Standard Deviation Lessons

Thematic Chart A

Participants	Responses
P2,P3,P4,P6,P7,P8,P10	Encountered difficulties in distinguishing between the population vs sample
P1,P3,P7,P10	Struggled in remembering the step-by-step in computing the standard deviation
P1,P4,P6,P8,P9	Found it confusing to understand the purpose of squaring deviations and taking the square roots

As seen from Thematic Chart A, many of the participants encountered challenges when learning the Standard Deviation lessons. Some participants get confused in using n and $n-1$ from one another, and the reason behind the use of one over the other. Several participants found it challenging in terms of recalling the step-by-step process, which has led to missed calculations. While others found it confusing to understand the real purpose of squaring and getting the square roots. These difficulties were particularly noticeable when participants were initially introduced to the lesson, which reflects the cognitive effort required to become familiar with the lessons of standard deviations.

The following quotes illustrate these challenges:

“The $n-1$ cause it's hard to understand.”

“I sometimes find it hard to remember the exact order of steps, especially why we need to square the differences and then take the square root at the end. It also confuses me when to divide by n versus $n-1$ and what the difference really means.”

“The main hurdles are grasping why we square each and then take the square root.”

“The difficulty I encounter in understanding the standard deviation formula is remembering the correct order of the steps, such as subtracting the mean from each value, squaring the result, finding the average, and then taking the square root. Sometimes it is also confusing to know when to divide by n or $n-1$. Because of the many steps, it is easy to make small calculation mistakes.”

Theme 2: Emotional Challenges When Learning Standard Deviation Lessons

Thematic Chart B

Participants	Responses
P2, P3, P8, P9	Felt anxious and nervous when applying standard deviation to large or messy datasets
P1, P4, P6, P7	Experienced frustration and hopelessness when making errors in computation
P6, P7, P10	Reported increased confidence and satisfaction when steps were understood clearly

As seen from Thematic Chart B, many participants expressed emotional challenges associated with learning the standard deviation lesson using peer collaboration. These challenges were primarily emotional responses in handling real-life data, most especially from the large datasets having complex values. Wrong calculations usually lead to frustrations and feelings of hopelessness. These emotional factors can significantly impact students' motivation, engagement, and overall learning experience, especially when dealing with new lessons or unfamiliar activities.

The following quotes highlight some of the emotional struggles encountered by the students:

"I feel nervous and unsure, especially with large data."

"If my calculations are wrong, I feel hopeless."

"I feel a bit anxious because real data is often messy and has many numbers, which makes the calculations long and tiring. The fear of making a mistake in arithmetic also makes me less confident when solving problems."

"I sometimes feel overwhelmed and unsure if I am doing the process correctly, especially with larger data sets. It can be stressful because one mistake can affect the final answer."

"I feel a bit overwhelmed and unsure when applying it to real-life data because the numbers can be more complicated. Sometimes I feel anxious about making mistakes, especially in long computations."

"Practice and understanding the rationale behind these steps can boost confidence."

"I have a higher confidence when I know the right solution or formula in computing SD, and anything in general, it gives me the feeling of being on the right path and washes away my worries."

Theme 3: Behavioral Responses in Learning Standard Deviation Lessons

Thematic Chart C

Participants	Responses
P1, P2, P4, P8	Preferred working collaboratively, learned better from peers
P3, P4, P6, P7, P8, P9, P10	Reported that collaboration with peers enhanced motivation, engagement, and comprehension

As seen from the Thematic Chart C, many participants encountered behavioral shifts from being stressed, anxious, nervous, and frustrated to becoming expressive about how it feels when peer collaboration has been introduced during the discussions. The participants shared that collaboration with



peers helped them enhance motivation and comprehension of the lesson. With the help of the intervention, this clarifies confusing steps, lessens emotional stress, and provides practical examples, which deepen the comprehension.

The following quotes highlighted some of the positive behavioral attitudes encountered by the students:

“Individually, I have only my opinion, but in collaboration, there are many suggestions and recommendations.”

“Working with others helps me understand better, while alone I get stuck easily.”

“Collaboration makes it easier for me to learn and improves my confidence.”

“Working with my classmates helps me feel more motivated and makes it easier for me to understand standard deviation because we can share ideas and help each other.”

“Working alone helps me focus, but I can get stuck easily. Working with others is more motivating because we can discuss and explain ideas to each other, which helps me understand the concepts better and makes learning more enjoyable.”

“I learned better with peers because we can explain steps to each other.”

“Working with others helps me gain insights from others.”

“Working with my classmates helps me feel more motivated and makes it easier for me to understand standard deviation because we can share ideas and help each other.”

Discussion

Based on the findings of the study, it was concluded that students' academic performance significantly improved with the integration of peer collaboration, shifting from Developing and Needs Improvement in the pre-test to Advanced Mastery in the post-test. Students also demonstrated a high level of engagement when peer collaboration was implemented, though they encountered cognitive, emotional, and behavioral challenges in learning the Standard Deviation lessons. Peer collaboration proved effective in enhancing learning content, classroom activities, and assessment tasks, and it significantly improved mastery of standard deviation lessons, aligning with previous studies that emphasize the benefits of cooperative learning. Students became more confident, participative, and resilient in handling complex datasets, supporting earlier research (Santos et al., 2023; Cruz et al., 2023) that collaborative learning enhances achievement and engagement. Similar to Villanueva & Mendoza (2022), peer tutoring boosted active participation and confidence.

Teachers may adopt peer collaboration strategies to improve mastery in statistics, administrators can integrate collaborative approaches into curriculum design, and policy makers may consider peer-based interventions to address persistent learning gaps. The study was limited to standard deviation lessons and second-year students in one institution, so results may not generalize to other statistical concepts or student populations.



Conclusion

1. The adoption of peer collaboration in classroom instruction for statistical lessons may be conducted by college teachers.
2. Peer collaboration activities, which reinforce mastery while helping others, may be actively participated by the college students.
3. The utilization of the student-made problem creation: A Group Mentoring and Collaboration (GMC) approach to Standard Deviation Mastery may be applied to further enhance the effectiveness of peer collaboration.
4. For future researchers, they may explore the effectiveness of peer collaboration in other statistical lessons and investigate its long-term impact.

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