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The Comparison of Grade 12 STEM on Chemistry and Physics in PHCM: A Quantitative Approach

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Abstract

Over time, the STEM strand has been the cornerstone of students who want to take course with arithmetic and science in them, but some students engage in peer-to-peer learning in order for them to understand topics that they can't comprehend. To find an answer if this type od learning is effective, the researchers conducted a study on the influence and impact of peer-to-peer interactions on students' engagement, motivation to learn, and performance. Furthermore, this quantitative research analysed the influence of peer-to-peer learning on the academic achievement of Grade 12 STEM students who took General Chemistry 2 and General Physics 2 courses. The analysis, on the other hand, showed that there is a statistically significant difference between pre and post-test scores for both subjects. The results indicate that peer-to-peer learning is influential for gaining academic achievement in STEM subjects. With this approach, students can learn from one another and share knowledge, as well as develop and use their problem-solving skills. The findings can be useful for educators and policymakers who want to improve student achievement in STEM disciplines. Educators can rethink more actively integrating peer-to-peer learning in STEM courses to not only make the lessons more interesting but also improve the overall academic performance in STEM fields. This can result in greater achievement, better motivation among students, and improved workforce readiness in STEM disciplines. In essence, the study sheds light on the role of peers.

Keywords: *Peer-to-peer learning, academic achievement, STEM students, motivation to learn, and student performance.*

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Introduction

Adolescence is a time when teenagers undergo changes and become more aware of how other people see them. In this stage students or teenagers begin to navigate a more complex academic and social environments helping them to shape their daily decisions through the influence of their peers. This is evident according to the article entitled "The Power of Peers in 2021, where it is stated that spending time with peers activates the brain's reward system making social approval feel good and boost teens to mirror the actions and values of those around them so that others will accept them. For many students, the influence becomes a silent motivator behind their study habits, attitude towards learning, and their priorities.

In school environment, we have seen it personally where peer influence can be both helpful and challenging at the same time. As nursing students at the Perpetual Help College of Manila, we have observed how seeing classmates excel in a certain subject especially the difficult one, and it somehow pushes the rest of us to try harder too. Sometimes we pushes ourselves to adjust our study strategies or seek advice from them. Even casual interactions like asking them to study together or share notes can affect one's performance and motivation towards learning. This shows that even the presence of someone hardworking can already influence how we can act. Supporting the point of Rui Pei et al. (2020), who explained that teens are indeed very sensitive to whether they feel included of left out, leading them towards a productive academic behavior or, at times, risky decision-making depending on the situation they are in.

The scientific basis for this is on how students process certain social cues. Researchers like Dr. Mary Heitzeg from the University of Michigan study this more in a deeper aspect by looking at how teenager's brain respond during the moments of social acceptance or rejection, showing that peers, school environments, and community contexts shape long-term behaviour as teens grow older. Other research also highlights hoe peer groups can affect students' learning. For instance, Kifle et al. (2023) found that when students are more engaged in classroom activities with peers their grades and performance also improve, while Daryono et al. (2024) noted that benefits of structured study groups and peer teaching promotes deeper learning among students.

Moreover, despite the growing evidence on peer-to-peer influence, there is still limitation in the attention given to senior high school students particularly those in the STEM strand, where academic workload is a bit more intense and where collaboration is often essential for a deeper comprehension. STEM subjects are known for being challenging, and students here often rely on each other to understand lessons better. However, this kind of peer-to-peer learning still isn't explored enough, especially in the local setting or here in the Phillippines.

Because of that gap, this study aims to find out how peer-to-peer learning affects the academic performance of the Grade 12 STEM students by comparing the student's scores in chemistry and physics subjects. We want to understand how learning with classmates helps students to improve, succeed in school, and adjust to difficult topics because learners are expected to meet high standards in preparation for college programs like nursing, engineering,

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and medical courses. Plus peer-to-peer learning also allows students to take turns teaching and learning from one another, which can help in building confidence, teamwork, and understanding as some still struggle with maintaining consistent performance.

In this era, where most schools highlights individual achievement, learning is also something that happens within a group. Students grow through their own effort, but also through the support and encouragement of their peers and mentors. Therefore the present research aims to examine how the influence of peer-to-peer learning is in students' academic achievement happens. The findings may offer insights for teachers, advisers, school administrators, and students on how to strengthen collaborative learning environments that could build both competence and confidence among the students. Ultimately, we also hope to show through this study that when students study together and help one another, they don't just share knowledge but they uplift each other and achieve more than they could alone.

Statement of the Problem

This study quantitatively assessed the influence of peer-to-peer learning on students' engagement, academic performance, and motivation be comparing their physics and chemistry subjects. Specifically, it seeks to address the following:

Research Questions:

1. Do students in General Chemistry 2 achieve the same results as those in General Physics 2 after undergoing peer-to-peer learning as an intervention?
2. Does the effect of peer-to-peer learning on academic achievement persist over time, as measured by a delayed post-test administered one week after the pre-test and intervention?
3. What is the influence of peer-to-peer learning on the academic performance of Senior High School STEM students, as reflected in changes in their academic scores in General Physics 2 and General Chemistry 2?

Research Methodology

Study Design

This study utilized a quantitative comparative research design to determine the influence of peer to peer learning on the academic performance of Grade 12 STEM students. The design allowed the researchers to compare the academic outcomes of students before and after the intervention. A pretest and a posttest were used to measure changes in performance and to evaluate the effectiveness of the peer to peer learning sessions. This design was selected because it supports systematic measurement, objective analysis, and clear interpretation of student progress across the intervention period.

Participants and Settings

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The participants of the study were thirty five Grade 12 STEM students enrolled at Perpetual Help College of Manila. These students were selected because they were currently taking subjects that aligned with the academic focus of the research. Participation was voluntary, and all students were informed about the purpose and procedures of the study through consent forms. Only students who provided signed approval were included in the data collection. The group size was considered appropriate for obtaining reliable and meaningful results for the comparative analysis.

Data Collection

Two major instruments were used for data collection. The first instrument was the pretest, which served as the initial assessment of the students academic performance before the intervention. The second instrument was the posttest, which measured changes in performance after participation in the peer to peer learning sessions. Both instruments were created to reflect the competencies expected in the Grade 12 STEM curriculum.

The test items covered key areas that the students were expected to learn in their academic subjects. The instruments were reviewed by the subject professor to ensure accuracy, clarity, and alignment with the study objectives. Classroom activity scores gathered during the intervention period were also collected to provide additional insight into student progress and participation.

In addition the researchers first refined the study title, statement of the problem, and research instrument with the guidance of the subject professor. Permission to conduct the study was requested through formal letters submitted to the Research Coordinator, which were later endorsed to the Dean and the Assistant Principal. Consent forms were distributed to inform the Grade 12 STEM student about the purpose and voluntary nature of the study.

Once approvals were secured, the researchers administered the pretest to the thirty five participants to establish baseline performance. The peer to peer learning intervention was conducted afterward, followed by a second session one week later. Immediately after the intervention, the posttest was administered. Scores from related classroom activities during the sessions were also collected to support the findings.

All gathered data were organized and handled with confidentiality, and ethical guidelines were observed throughout the process.

Data Analysis

After the data were collected, the researchers organized and tabulated the pretest scores, posttest scores, and classroom activity results. The mean and percentage scores were computed to describe the students level of performance before and after the intervention. A comparative analysis was conducted to determine whether improvements occurred following the peer to peer learning sessions.

The pretest and posttest results were examined closely to identify any changes in academic performance, while the scores from the classroom activities provided additional evidence of the

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student's progress during the intervention period. These analyses helped the researchers determine the overall effect of peer to peer learning on the academic achievement of the Grade 12 STEM students.

Results and Discussion

Results

The data for this study were obtained from the administered pre-tests and post-tests in General Chemistry 2 and General Physics 2 on how affects the academic performance of Grade 12 STEM students at Perpetual Help College of Manila and were analyzed through both descriptive and inferential statistical procedures. To see if the learning method helps improve student's scores in General Chemistry 2 and General Physics 2, the results are organized according to the research questions, using inferential and descriptive statistics before and after Peer-to-Peer Learning. Moreover, in order to draw out important information and significant points about the influence of peer-to-peer learning on the academic achievement of Grade 12 STEM students, the results are shown in tables and interpretation to help understand the findings clearly.

The presentation of the findings in this chapter follows a sequential order. Table 1 shows the average score for General Chemistry 2 and General Physics 2 after having the Peer-to-Peer Learning as an intervention. Based on the result, before the intervention, General Chemistry 2 students had a mean pre-test score of 5.11 with a standard deviation of 1.530, while General Physics 2 students scored higher, with a mean pre-test score of 8.86 and a standard deviation of 3.040.

After the intervention, the mean post-test score for General Chemistry 2 increased significantly to 13.43 with a standard deviation of 5.101, whereas General Physics 2 students had a mean post-test score of 11.11 with a standard deviation of 2.988. This indicates that although both groups demonstrated progress, the degree of improvement differed between the two subjects.

Table 1. Mean Scores and Standard Deviation

Subjects	Mean Score	Standard Deviation
General Chemical 2 Pre-Test Score	5.11	1.530
General Chemistry 2 Post-Test Score	13.43	5.101
General Physics 2 Pre-Test Score	8.86	3.040
General Physics 2 Post-Test Score	11.11	2.988

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The results in Table 2 shows that there is a decrease in the pre-test and post-test scores of students in General Chemistry 2 and General Physics 2. For Chemistry, the p-value ($p = 0.000$) is lower than the 0.05 significance level, and we thus reject the null hypothesis. We conclude that there is a significant increase in student performance of General Chemistry 2, and the change is likely caused by the intervention. The test statistic is significant and far from 0, which indicates the change in pre-test score to post-test score is significant and not random. The p-value of General Physics 2 ($p = 0.000$) is also lower than the significance level, so we reject the null hypothesis. We can conclude that post-intervention, the students performed significantly better in Physics. The level of improvement may not be the same as the level of Chemistry. However, the results are statistically significant, and we can conclude that the intervention was effective in improving student performance in all subjects.

The test results of the paired sample t-test illustrate the effect of the intervention on student performance. The results are statically validated and measurable. We can conclude that the intervention helped in improvement of student learning, revealed the gaps in the learning, and helped to overcome the gaps learned in different science subjects.

Table 2. Paired Sample T-Test Results

Variable Trend	Test Statistics	p-value	Interpretation	Decision
Chemistry Pre–Post Test Sore	-9.649	0.000	Reject Ho	Significant
Physics Pre–Post Test Sore	-4.335	0.000	Reject Ho	Significant

Scores Based on T-Test Findings

Codes	Themes
CODE 1: Noticeable improvement after intervention	THEME 1: Students exhibited measurable learning gains in both subject
CODE 2: Strong statistical evidence	THEME 2: P-value confirm significant changes from pre-test to post-test
CODE 3: Effectiveness of intervention	THEME 3: Intervention produced consistent improvement to the groups

Table 3 presents the relationship between students' pre-test and post-test scores for General Chemistry 2 and General Physics 2. In the case of General Physics 2, since the obtained p-value is below the 0.05 level of significance ($p = 0.004$), the researcher fails to reject the null

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hypothesis. This serves to confirm that there is no significant relationship between the pre-test and post-test scores of Physics. That is, students' initial level of performance in Physics was not a strong predictor of the extent of gain after the intervention. This would therefore suggest that any gains realized in Physics may be more related to the effectiveness of the intervention per se rather than to prior knowledge or initial competence. It also means that those with relatively low initial performance were as capable of making these gains as those with higher initial scores, which is a way of closing performance gaps among learners.

For the General Chemistry 2 results, however, a different pattern emerges. The p-value obtained herein is $p = 0.384$, which is greater than 0.05, and hence the null hypothesis is rejected. This implies a significant association between pre-test and post-test scores for Chemistry. In essence, students' performance in Chemistry is significantly influenced by their initial performance. Those who began with better pre-test scores tended to also show relatively better performance post-test. This relationship would suggest that the intervention supported students in learning but may have been more easily maximized by those who already had higher baseline understanding of the subject.

Overall, the mixed findings give evidence that student learning was influenced differently by the intervention across subjects. Whereas improvement in Physics was more uniform and independent of prior knowledge, learning gains in Chemistry remained linked to students' initial level of understanding. These results show the importance of designing interventions that take into consideration varying levels of readiness; these may guide future instructional adjustments aimed at assuring more equitable learning outcomes across subjects.

Table 3. Pearson R Correlation Results

Variable Trend	Test Statistics	p-value	Interpretation	Decision
Chemistry Pre–Post Test Sore	0.152	0.384	Reject Ho	Significant
Physics Pre–Post Test Sore	0.478	0.004	Fail to Reject Ho	Not Significant

Based on Correlation Findings

Codes	Themes
CODE 1: Week relationship in Chemistry	THEME 1: Chemistry scores show a limited association between pre-test and post-test performances
CODE 2: Moderate	THEME 2: Physics scores indicate a measurable

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relationship in Physics	correlation after the intervention
CODE 3: Variation across subjects	THEME 3: The influence of the intervention differed between Chemistry and Physics

Discussion

The findings of the study revealed that the peer-to-peer learning had clearly helped to improve the academic performance of Grade 12 STEM students in both subjects which are the General Chemistry 2 and General Physics 2. The result shows noticeable gains in the test scores of the students after the intervention were the average score of Chemistry from 5.11 to 13.43 and Physics students' score from 8.86 to 11.11 that clearly shows improvement statistically significant. These results show that the learning approach had helped the students understand their lessons better.

In physics, the improvement does not show any clear link of how the student performed even before the study that shows peer-to-peer method worked well regardless whether students began at a high or low level. On the other hand, in Chemistry, there are significant improvements in student's test scores showing that the students benefited from peer collaboration.

The findings highlight that peer-to-peer learning helps the students to improve their learning through the gap between their test scores before and after the intervention. In essence, this research shows that peer-to-peer learning not only boosts student performance but also helps reveal and address learning gaps. While its impact can vary by subject and initial skill, it offers a promising way to make STEM education more effective and inclusive.

Conclusion

COMPARISON OF PRE-TES & POST-TEST

	Chemistry 2	**Physics 2**
Mean Pre-test Score	5.11	8.86
Mean Post-test Score	13.43	11.11
Paired T-test p-value Interpretation	0.000 Significant	0.000 Significant

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Pearson r p-value Interpretation	0.384 Not Significant	0.004 Significant

The study's findings indicate that students in both General Chemistry 2 and General Physics 2 improved greatly following the intervention. This was really noticeable in their post-test results. Students showed an improvement by their average grade from 5.11 to 13.43 in Chemistry 2, while the result in Physics 2 showed an improvement from 8.86 to 11.11. Although both subjects benefited, the extent of improvement depends on the two subjects.

The t-test results showed that there was a significant change between the two pre-test and post-test scores for both subjects, with p-values of 0.000. To put it simply, the intervention that was used has helped the student to have an improvement in their academic performance in both Chemistry 2 and Physics 2 subjects. Lastly, the patterns of their performance did not match when the relation between the pre-test and post-test scores was looked at.

The correlation data shows the line of difference. Physics showed an important connection between pre-test and post-test scores ($p = 0.004$), indicating that students who did better at first showed higher improvement. On the opposite side, Chemistry did not show a significant relationship ($p = 0.384$), demonstrating that factors aside from the students' starting performance may have influenced their improvements. Overall, the table reveals that while the intervention was helpful for both groups, its effect differed based on the subject and how students responded to the learning activities.

Recommendations

The following recommendations are based on the conclusions drawn from the study:

1. Further research must investigate various factors that could have contributed to the improvement in post-test scores among General Chemistry 2 students, such as approaches to teaching, learning styles, or other tools for learning.

2. Considering the significant difference among pre-test and post-test results, instructors should use similar interventions or instructional techniques to promote student learning in both General Chemistry 2 and General Physics 2.

3. More research with a larger sample size could be conducted to strengthen the findings and ensure the consistency of the conclusion.

4. Further research could look into how different instructional materials or teaching approaches improve students' understanding and retention of topics in the two courses.

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