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Peer Instruction as a Transformative Approach for Enhanced Academic Performance in General Physics 1

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Abstract. The widespread reliance on traditional teaching methods in science education has been identified as a contributing factor to the below-standard performance of Filipino learners in both national and international assessments. This underscores the need to integrate active learning strategies into pedagogical practices. This study aimed to examine the effectiveness of peer instruction in enhancing the academic performance of Grade 12 learners in General Physics 1 during the third quarter of the school year 2023–2024. A total of 80 learners from the General Academic Strand at Gen. Tiburcio De Leon National High School in Valenzuela City participated in the study. They were equally divided (n = 40) into an experimental group, where the peer instruction approach was implemented, and a control group, where the traditional teaching method was employed. The intervention lasted three weeks and was framed within a quasi-experimental research design, utilizing a pre-test and post-test structure. The assessment tool used was expert-validated and reliability-tested. Data analysis was conducted using independent and dependent sample t-tests with IBM SPSS software, adhering to a significance threshold of $p < 0.05$. The results revealed a statistically significant improvement in academic performance within the experimental group compared to the control group, indicating that peer instruction is a more effective instructional strategy than traditional methods. The study recommends incorporating peer instruction into teaching practices, supported by comprehensive teacher upskilling programs, to foster an active learning environment.

Keywords: Academic performance; Active learning strategies; General physics 1; Peer instruction, Quasi-Experimental; Upskilling training programs.

1.0 Introduction

The main objective of science education in the Philippines is to instill in learners a thorough understanding of scientific principles, critical thinking abilities, and a profound appreciation for inquiry-based learning. However, the poor results on international and national examinations of Filipino learners demonstrate the numerous challenges science education faces. The Philippines scored 357 in science literacy in its first attempt to take part in the Programme for International Student Assessment (PISA) 2018 conducted by the Organization for Economic Co-operation and Development (OECD) for 15-year-old learners, placing the country second from the bottom, comparable to that in mathematics literacy. Out of the 7,233 Filipino learners who participated in PISA 2018, only 22% achieved the minimum level (Level 2) of competency in science literacy (Calleja et al., 2023).

Additionally, results from the PISA 2022, which were made public on December 5, 2023, indicated that Filipino learners' science, mathematics, and reading performance had not improved significantly. The Philippines was

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found to be among the countries that produced young learners with the lowest proficiency in reading, math, and science competency, ranking 77th out of 81 globally. The Philippines' average mathematics score was 355 points, much lower than the 472-point global average. The country's reading literacy score improved from 340 in PISA 2018 to 347 in PISA 2022, but it was still far below the 476-point global average. The Philippines' score in science was 356 points, placing it third from the bottom globally (Ines, 2023).

Moreover, in the Trends in International Mathematics and Science Study (TIMSS) 2019, Filipino learners in grade 4 performed poorly. In this assessment, the pupils' average score for science was 249 points, much lower than the scores of all other participating countries. While these results are disappointing, the Philippines' participation in these assessments is an important step toward addressing curriculum and learning gaps in the nation's basic education system (Barredo, 2021).

Furthermore, the results of our National Achievement Tests (NAT) in recent years are consistent with the international performance of Filipino learners. The nationwide mean percentage score (MPS) for Grade 6 learners in 2018 was just 37.44, the lowest in NAT history. This score contrasted sharply with the 70.88 obtained in 2015, which fell to 42.03 in 2016 and 39.95 in 2017. Scores for grade 10 again fell from 53.77 in 2014 to 44.08 in 2017, slightly increasing to 44.59 in 2018. These NAT results for both grade levels place them in the "low mastery" category (Tagupa, 2019).

The persistent underperformance of Filipino learners has been attributed to the widespread use of traditional lecture techniques, which are passive and fail to engage students effectively. According to Kelly (2019), lecturing is an outdated instructional method of delivering information verbally. It typically does not allow for much discussion or other forms of learner participation, does not assess learning, offers varied perspectives, differentiates instruction, or enables learners to take ownership of their learning. Traditional lectures no longer have a place in the modern teaching landscape.

One effective way to address this issue is by incorporating active learning strategies into teaching practices. In contrast to traditional teaching methods, active learning engages learners as participants in the learning process. This approach prioritizes higher-order thinking, often involves group or collaborative work, and provides opportunities for meaningful academic activities that positively impact retention rates (Aji & Khan, 2019).

Active learning is a method to encourage students to do something and think about what they do. This means that instead of passively listening to the teacher's lecture, students actively participate in class activities throughout the lesson. Active learning is characterized by actively involving students in the learning process. It emphasizes learning through action based on real experiences and encourages students to move beyond passive participation. It encourages students to go beyond mere memorization and repetition of information. Furthermore, it relies on student activity with minimal assistance from the teacher (Nurbavliyev et al., 2022).

Wesolowski (2019) asserts that the primary reason for developing active learning strategies is to acknowledge students' diverse learning styles and promote the hands-on application of practical skills in both classroom and field settings. It facilitates technology integration and supports cross-cultural learning through experience-based methods. Moreover, active learning fosters student collaboration, establishes in-class learning communities, and bridges the gap between fieldwork and classroom instruction.

Active learning offers students numerous benefits. Its ability to raise student motivation and engagement levels is one of its essential advantages. Students are more likely to be engaged with and interested in the subject matter when actively participating in the learning process. This can, therefore, result in increased academic achievement and improved material retention. Critical thinking and problem-solving abilities are further fostered via active learning. Students are taught to think critically and apply their knowledge to real-world issues through group work and problem-solving. Students can develop abilities that will help them in their future academic and professional endeavors (Dogani, 2023).

Teachers can create dynamic and engaged learning environments using various active learning approaches. These include inquiry-based learning, flipped classrooms, cooperative group projects, and problem-based learning. Each

method provides unique opportunities for learners to actively create their knowledge, take part in insightful conversations, and apply ideas to actual circumstances, all of which improve learning outcomes.

In addition to the methods mentioned above, peer instruction, developed by physicist Eric Mazur in 1991, is an active learning strategy designed to address pedagogical needs. This approach departs from the traditional method of detailed presentations based on textbooks or lecture notes by focusing learners' attention on fundamental concepts. It involves a series of short presentations, followed by discussions centered around brief conceptual questions, encouraging full learner participation and interaction (Bulut, 2019). Peer instruction, with its emphasis on collaborative learning, promotes active interaction among learners, encouraging them to engage in discussions and learn from one another. Studies conducted in various educational settings show that it enhances learner engagement, comprehension, and performance more effectively than traditional methods (Budini et al., 2019).

While peer instruction has proven effective in various educational settings, a significant gap remains in the literature regarding its application in teaching General Physics 1 to senior high school learners in the Philippines, specifically focusing on Grade 12 at Gen. Tiburcio De Leon National High School in Valenzuela City. To address this gap, the researcher conducted this study to assess the effectiveness of peer instruction in enhancing the academic performance of Grade 12 learners in General Physics 1 during the third quarter of the School Year 2023-2024.

By conducting this study, teachers, school heads, curriculum planners, and policymakers can gain valuable insights into the potential of peer instruction as a transformative pedagogical strategy in senior high school science education. The findings of this study provide a foundation for proposing an upskilling training program for teachers, aiming to equip them with essential knowledge and enhanced skills for the effective implementation of peer instruction in the classroom. Such a training program has the potential to elevate the quality of science education, offering a more engaging learning experience for students. Additionally, it can serve as a model for other senior high schools in the Philippines, promoting improved academic performance and fostering a classroom environment conducive to active learning.

Moreover, this study aligns with several Sustainable Development Goals, particularly SDG 4 (Quality Education), which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. SDG 10 (Reduced Inequalities), which seeks to empower marginalized and disadvantaged groups. Furthermore, it supports SDG 9 (Industry, Innovation, and Infrastructure) by fostering a foundation in scientific literacy that encourages innovation and technological development. Ultimately, this contributes to the holistic development of learners and enhances the overall education system in the Philippines.

2.0 Methodology

2.1 Research Design

This study adopted a quasi-experimental research design. The term "quasi," derived from Latin, means partial, incomplete, or pseudo. Bhat (2023) interprets it as signifying a degree of similarity. A quasi-experimental design resembles a true experimental design, but they are different. In this research design, the independent variable is systematically manipulated, but participants are not randomly assigned to groups. Furthermore, Thomas (2023) noted that a quasi-experimental approach does not rely on random assignment but instead uses non-random criteria to categorize participants into different groups. A quasi-experimental design is an invaluable research tool, primarily when true experiments cannot be conducted for ethical or practical reasons.

The specific quasi-experimental design that the researcher employed in this study is the pretest-posttest nonequivalent group design. This method involves carefully selecting two groups of identical participants except for the independent variable(s) being investigated. Within this framework, one group will receive the treatment or intervention, while the other will serve as a control group and remain untreated. Afterward, the two groups will be compared to determine if there are any significant differences in the outcomes.

2.2 Research Locale

The study was conducted at Gen. Tiburcio De Leon National High School, a prominent public secondary school in Valenzuela City, Metro Manila, Philippines, established in 1969. Currently, it accommodates around 6,000 learners, making it the largest public high school in Valenzuela City by population. Gen. Tiburcio De Leon National High School operates under the supervision of the Schools Division Office in Valenzuela City. The school is located at the corner of Mercado Street and Gen. T. De Leon Road, near the Torres Bugallion Bridge in Barangay Ugong, Valenzuela City.

2.3 Research Participants

Given that this study adopted a quasi-experimental design, which means that it did not involve the random assignment of participants, the researcher used the purposive sampling technique. In this sampling approach, participants were intentionally selected based on specific characteristics that aligned with the researcher's requirements for the study sample. Purposive sampling is beneficial when the researcher seeks information-rich cases or needs to maximize the use of limited resources. This selection process ensures that the chosen participants possess attributes relevant to the research focus, which enhances the study's capacity to attain its objectives effectively (Nikolopoulou, 2022).

Following this approach, the researcher purposely selected two sections of Grade 12 learners who were enrolled in and pursued the General Academic Strand at Gen. Tiburcio De Leon National High School during the School Year 2023-2024. These sections comprised a total of 80 students aged 16 to 22, with a gender distribution of 53% male and 47% female, reflecting varied prior academic performance levels. They served as the participants in the study and were classified into two groups: the experimental group, in which peer instruction was employed, and the control group, which utilized traditional teaching methods.

2.4 Research Instrument

The researcher used a teacher-made pretest-posttest questionnaire as the main instrument for gathering the data needed to answer the specific questions in this study. Specifically, this questionnaire was used to assess the performance of the Grade 12 learners before and after using traditional teaching methods for the control group and peer instruction for the experimental group. The researcher constructed the pretest-posttest questionnaire based on analyzing the least-mastered competencies of the Grade 12 General Academic Strand learners in General Physics 1 during the third quarter. It consisted of 30 multiple-choice questions based on standardized tests from the Schools Division Office and the school's test item bank. Before constructing the questionnaire, the researcher utilized a table of specifications (TOS) to ensure alignment with the intended learning outcomes. The table of specifications was validated by content experts regarding item distribution, alignment with the cognitive domain of the revised Bloom's Taxonomy, and learning competencies. Additionally, the questionnaire itself underwent a validation process.

After the validation process, the questionnaire was pilot-tested with 25 selected learners who were not included in the study but shared similar characteristics with the respondents. The Siegle Reliability Calculator assessed the reliability, resulting in a Cronbach's alpha coefficient of 0.73. This indicates an acceptable level of internal consistency.

2.5 Data Gathering Procedure

The researcher systematically followed a structured procedure to collect the necessary data while upholding the highest ethical standards throughout the study. The initial step involved obtaining the required permissions and approvals. The researcher drafted a formal letter to the Schools Division Superintendent of Valenzuela City to do this. After receiving the approval from the Superintendent, the researcher prepared a second formal letter addressed to the principal of Gen. Tiburcio De Leon National High School. This letter included a copy of the official approval from the Schools Division Superintendent, providing verification and authorization for the study to be conducted within the school.

To ensure the proper, effective, and efficient delivery of lessons, the researcher meticulously prepared and submitted lesson plans for General Physics 1 for validation by master teachers, who served as content experts. These lesson plans targeted the learners' least mastered competencies and provided detailed outlines of the

learning objectives, content to be covered, procedures incorporating peer instruction as the instructional strategy, assessment methods, and required teaching materials. These plans acted as a roadmap for the researcher throughout the teaching process.

With the preparatory groundwork completed, the researcher administered a pre-test to the experimental and control groups. Following the pre-test, different pedagogical approaches were applied: the traditional teaching method for the control group and the peer instruction approach for the experimental group. This instructional intervention was consistently conducted over three weeks. At the end of this period, the researcher reassessed both groups with a post-test.

2.6 Ethical Considerations

This research study adhered to ethical guidelines to ensure the integrity and welfare of all participants. To maintain transparency and uphold participant welfare, the researcher obtained informed consent from all respondents aged 18 and older. This process involved providing detailed information about the study's nature, objectives, and potential implications, ensuring that participants were well-informed and could make a voluntary and knowledgeable decision regarding their involvement. For respondents under 18 years of age, the researcher sought informed assent from the minors themselves, in addition to obtaining parental consent. This dual approach ensured that both the minors and their parents clearly understood the study's details and that the minors willingly chose to participate. Furthermore, the researcher assured all participants that their data would be handled with the utmost confidentiality and used exclusively for academic research purposes. This commitment to ethical practices protected participants' rights and reinforced the credibility and reliability of the research findings.

3.0 Results and Discussion

3.1 Pre-test Scores of the Learners

Table 1 presents the descriptive statistics and the results of the independent sample t-test for the students' pre-test mean scores prior to the intervention. The summary data on the pre-test mean scores of the control and experimental groups, as well as the results of the statistical analysis, are shown below.

Table 1. Descriptive statistics and independent sample t-test for the pre-test scores

Group	N	Lowest	Highest	Mean	Median	SD	tcal	df	p
Control	40	4	13	8.43	8.50	1.71	0.114	78	0.910
Experimental	40	4	14	8.38	8.00	2.19			

The table reveals that the descriptive statistics of the pre-test scores from both groups, each consisting of 40 respondents, indicate that the lowest score for both the control and experimental groups is 4. Meanwhile, the highest scores recorded were 13 for the control and 14 for the experimental groups. Regarding measures of central tendency, the mean and median scores for the control group were 8.43 and 8.50, respectively. In contrast, the mean and median scores for the experimental group were 8.38 and 8.00, respectively. Regarding the measure of dispersion, specifically the standard deviation, the control group exhibited a value of 1.71, while the experimental group had a standard deviation of 2.19.

The mean scores in the pre-test were compared between the control and experimental groups. A normality test was performed on the data to identify the appropriate statistical treatment. The results of the normality test indicated that the data were normally distributed. Therefore, a parametric test was employed. An independent sample t-test was conducted to compare the pre-test scores between the control and experimental groups using IBM SPSS software. Table 1 shows that the p-value associated with $t(78) = 0.114$ is 0.910, which is greater than 0.05 ($p > 0.05$), indicating that the groups are not statistically different. Consequently, no significant differences were found between the mean scores of the control and experimental groups before applying the treatment. This suggests that the groups were equivalent at the beginning of the study.

The findings were parallel to the earlier results of the research results by Sotto Perez et al. (2019). The analysis revealed no significant difference when comparing the two groups' pre-test scores. In other words, the control and experimental groups performed similarly on the inventory test before implementing peer instruction to understand electric circuit concepts. Additionally, this finding aligns with the study on peer instruction by Alfadda et al. (2022), which indicated that the control and experimental groups were equal during the pre-test

regarding their knowledge of language and information about the topics presented throughout the course. Maguate and Rabacal (2023) similarly discovered that there was no significant difference in the results of the pre-tests between the experimental and control groups regarding the science performance of Grade 8 students. Furthermore, their study revealed that neither group had any prior knowledge of the topics before the implementation of the intervention, as evidenced by the low pre-test mean scores for both groups. Additionally, both groups demonstrated the same level of science skills prior to the intervention.

In line with the above research findings, Pagtulon-an and Tan (2018) suggested that the low pre-test scores of students may be related to inadequate conceptual understanding or a lack of foundational knowledge of the evaluated topics. Similarly, the study by Lantajo and Tipolo (2019) revealed that the absence of a significant difference in pre-test mean scores before the intervention indicated that the knowledge and skills of the control and experimental groups in physics were comparable. Thus, the validity of the study was strengthened by the balanced performance of the respondents at the beginning of the experiment.

Since both groups exhibited equivalent knowledge and skills before the intervention, educators should prioritize building foundational knowledge before implementing peer instruction. Recommended actions include conducting diagnostic assessments to identify weaknesses and offering targeted interventions to address those gaps.

3.2 Post-test Scores of the Learners after the Intervention

Table 2 presents the descriptive statistics and the results of the independent sample t-test for the post-test mean scores of the students after the experiment. The summary data on the post-test mean scores for both the control and experimental groups, along with the statistical analysis results, are shown below.

Table 2. Descriptive statistics and independent sample t-test for the post-test scores

Group	N	Lowest	Highest	Mean	Median	SD	tcal	df	p	Cohen's d
Control	40	9	22	16.95	17.00	3.32	-6.219	78	.000	1.39
Experimental	40	13	29	22.03	23.00	3.95				

The table displays the descriptive statistics of the post-test scores, indicating that the lowest scores for the control and experimental groups are 9 and 13, respectively, while the highest scores are 22 and 29. In terms of mean and median scores, the control group obtained 16.95 and 17.00, respectively. On the other hand, the mean and median scores of the experimental group are 22.03 and 23.00, respectively. The standard deviation of the control group is 3.32, while that of the experimental group is 3.95.

The mean scores in the post-test were compared between the control and experimental groups. A normality test was conducted on the data to determine the appropriate statistical approach, confirming that it followed a normal distribution. Consequently, a parametric test was employed. An independent sample t-test was conducted to compare the post-test scores of the control and experimental groups following peer instruction. Table 2 shows that the p-value associated with $t(78) = -6.219$ is 0.000, which is less than 0.01 ($p < 0.01$) and is interpreted as highly significant. The results indicate that the two groups are statistically different. Accordingly, significant differences were found between the control and experimental groups after the intervention's implementation, with the experimental group's mean score being statistically higher than that of the control group following the utilization of peer instruction. Furthermore, the difference between the post-test scores of the control and experimental groups is very large based on Cohen's formula ($d = 1.39$).

The comparison of post-test scores between the two groups implies that students exposed to the intervention benefited substantially from peer instruction, leading to a noteworthy improvement in their academic performance compared to those in the control group. Furthermore, it can be gleaned from the table that there is a significant difference in test results before and after the peer instruction session. From getting low performance in the pre-test, students demonstrated a deepened understanding of concepts through collaborative discussion with peers with minimal teacher intervention, resulting in remarkably higher performance in the post-test. The significant increase in post-test mean scores among students in the experimental group underscores the effectiveness of this learning approach. These results prove that peer instruction is highly conducive to student learning.

These findings mirrored the results of the study conducted by Ande (2019) on the effectiveness of peer instruction in statics. The post-test scores clearly showed that most students gained advantages from peer instruction. Similarly, the research by Ragmac and Lubos (2019) from Bukidnon State University, which evaluated the academic performance and engagement in physics, particularly in, electricity and magnetism, of Grade 10 learners taught using the discrepant event approach through peer instruction, revealed that the learners' scores increased in the post-test. The increase in post-test scores demonstrated that the learners performed better after being taught using the peer instruction approach.

Moreover, the post-test results of the present study substantiated the notable findings of numerous other research studies. This increasing consensus is supported by the earlier work of Alvarez-Alvarado et al. (2019), Carstensen et al. (2020), Macale et al. (2021), and Kaymak (2022), all of which indicated a significant difference between the control and experimental groups after the intervention. This important difference suggests that the peer instruction approach has a substantial impact on improving students' academic performance. Notably, the observed differences favored the experimental group's post-test results, confirming the effectiveness of the peer instruction technique in promoting enhanced learning outcomes.

Furthermore, the computed effect size of the difference between the post-tests of the control and experimental groups, determined through Cohen's formula and described as "very large," provided strong evidence of a significant difference in academic performance between the two groups before and after the intervention. This analysis demonstrated that the experimental group outperformed the control group, indicating that peer instruction was a more effective and impactful teaching strategy than the traditional method. Lastly, this present study contradicted the findings of Bulut (2019), which indicated that although the experimental group achieved higher post-test scores than the control group, the difference did not reach statistical significance.

To build on peer instruction's positive outcomes, educators should implement peer instruction strategies more broadly across the curriculum. This involves training teachers in effective peer instruction techniques and developing collaborative learning modules that foster student interaction. Regular assessments should also be conducted to monitor student progress and ensure the sustainability of these improved learning outcomes.

3.3 Difference between the Pre-test and Post-test Scores of the Learners

The researcher compared students' pre-test and post-test scores to test the hypothesis. The differences in scores underwent a normality test using IBM SPSS software to determine the most suitable statistical approach. The results of this analysis indicated that the data exhibited a normal distribution, confirming that the assumptions necessary for parametric testing were met. Consequently, it was concluded that a paired sample t-test would be the most appropriate statistical method for further analysis. The details of the IBM SPSS output, summarizing the findings of the paired samples t-test, are presented in Table 3.

Table 3. Paired sample t-test comparing the pre-test post-test scores

Groups	t	df	p	Interpretation	Cohen's d
Control Post – Pre-test Scores	17.458	39	.000	Highly Significant	2.76
Experimental Post – Pre-test Scores	21.529	39	.000	Highly Significant	3.40

A paired sample t-test was conducted on the data to compare the pre-test and post-test scores of the respondents. This test was chosen to evaluate the mean differences between two related groups—in this case, the same group of students before and after the intervention. The results in the table reveal that the calculated t for both the control and experimental groups is highly significant, as the p-values were both less than 0.01. For the control group, there was a significant increase in scores from the pre-test (mean = 8.43) to the post-test (mean = 16.95), with $t(39) = 17.458$, $p < .01$. This increase is very large based on Cohen's effect size formula ($d = 2.76$), with a mean increase of 8.52. Similarly, for the experimental group, there was a significant increase in scores from the pre-test (mean = 8.38) to the post-test (mean = 22.03), with $t(39) = 21.529$, $p < .01$. This increase is also very large according to Cohen's effect size formula ($d = 3.40$), with a mean increase of 13.65. Notably, the mean increase in scores for the experimental group is much higher than that of the control group.

While both effect sizes are similarly very large, the significantly higher mean increase in scores observed in the experimental group compared to the control group indicates a substantial difference in performance before and after the intervention. This observation clearly illustrates that the peer instruction approach is significantly more effective than the traditional teaching method in enhancing the academic performance of students in General Physics 1.

Similar results were found in the study by Sotto Perez et al. (2019). They assessed the effect of peer instruction on learning and examined the differences in the pretest and posttest results within each group. After the pedagogical intervention, they observed a significant improvement in the learners' scores. Moreover, the experimental group exhibited a greater effect size, indicating a possible difference in performance between the two groups following the intervention, even though both groups displayed moderate to high effect sizes. The post-test scores of the experimental group were found to be significantly higher than those of the control group. Accordingly, they concluded that using peer instruction approach is beneficial and effective in improving student academic performance in an electric circuit analysis course.

The present findings align with the study conducted by Eremina and Tandi (2021), which compared the pre-test and post-test achievement values of students in an experimental group using peer instruction with those in a control group receiving traditional instruction. Their results demonstrated significant mean differences, indicating that students taught through peer instruction experienced a greater increase in academic achievement than those in the control group. This suggests that peer instruction has a substantial positive impact on students' academic performance. Additionally, the study reported a high partial eta squared value, reflecting a strong effect size.

Furthermore, in his study on the impact of peer instruction strategies on the attitudes toward trigonometry and mathematics achievement of Grade 9 students, Kaymak (2022) found similar outcomes. The results indicated that, following the implementation of peer instruction, the average mathematical achievement score of students in the experimental group was significantly higher than their scores prior to the intervention. This led to the conclusion that peer instruction substantially enhances students' academic performance.

Finally, the results of this study contrast with the findings of research conducted in Kazakhstan by Balta et al. (2021), which concluded that peer instruction did not enhance student performance or learning outcomes. Therefore, this study represents a significant contribution to the existing body of research, demonstrating the effectiveness of the peer instruction approach in improving students' test scores, conceptual problem-solving skills, participation, and overall comprehension.

Given these findings, it is recommended that educators integrate peer instruction strategies more extensively into their teaching practices. Establishing professional development programs will be crucial for equipping teachers with the necessary skills to implement peer instruction effectively. Furthermore, additional research should investigate the long-term effects of peer instruction on student engagement and conceptual understanding. Such studies could provide deeper insights into the benefits of this approach across various subjects and educational contexts.

4.0 Conclusion

In light of the findings, several key conclusions can be drawn. Firstly, both the control and experimental groups exhibited equivalent levels of knowledge and skills at the outset of the study, enhancing the credibility and validity of the research by minimizing potential biases. A significant improvement in post-test scores was observed in the experimental group, which utilized peer instruction, compared to the control group that did not receive this intervention. This suggests that peer instruction is effective in enhancing academic performance. Moreover, notable score increases were recorded in both groups from pre-test to post-test, indicating that both teaching strategies led to meaningful learning outcomes. However, peer instruction proved to be more advantageous, as evidenced by the significantly higher mean increase in test performance within the experimental group. This advantage was particularly evident in topics such as interpreting displacement and velocity as areas under velocity vs. time and acceleration vs. time curves, understanding velocity and acceleration as slopes of position vs. time and velocity vs. time graphs, and solving for unknown quantities in equations involving one-

dimensional uniformly accelerated motion, including free fall. Students also excelled in calculating the range, time of flight, and maximum heights of projectiles. Consequently, a teacher upskilling training program is proposed to expand and refine the implementation of peer instruction. This initiative aims to establish a systematic and effective approach to teacher development, ultimately leading to improved student learning outcomes.

Based on the findings and conclusions outlined, several recommendations are proposed. Curriculum planners should integrate the peer instruction strategy into the General Physics 1 curriculum, given the significant improvements observed in the experimental group's post-test results. This incorporation can enhance student engagement and comprehension. Science teachers are encouraged to adopt peer instruction, as it has consistently demonstrated its effectiveness in improving learning outcomes and fostering active participation in the classroom. Moreover, educators across various subjects can benefit from implementing peer instruction, which promotes collaboration and active learning, thereby enhancing both subject-specific knowledge and essential skills such as communication and teamwork. Additionally, school leaders and policymakers should organize professional development initiatives, including upskilling training sessions, to familiarize teachers with the principles and practices of peer instruction. Providing ongoing support, teaching materials, and technological resources will further ensure the successful implementation of this approach. Finally, future researchers could explore the effects of peer instruction across different subjects, diverse student populations, and varying grade levels, while considering necessary adjustments to better address the unique needs of both teachers and students.

5.0 Contributions of Authors

The author independently conceptualized and executed this study, taking sole responsibility for every phase of the research process.

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7.0 Conflict of Interests

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

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