



## Flipped classroom with peer tutoring and academic competence of students in science: An experimental study

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### Abstract

This study aimed at investigating the effect of flipped classroom with peer tutoring strategy on the academic competence in the subject of science among 80 grade 8 students in La Fortuna National High School students during the third quarter of academic year 2022-2023. The study sample was distributed into two groups: the experimental group that consisted of 39 students, who studied under flipped classroom with peer tutoring strategy, and the control group that consisted of 40 students, who studied in the traditional method. To achieve the objectives of the study, an achievement test was prepared and its validity and reliability were checked. The study deduced that the experimental group demonstrates higher communication skills compared to the control group. Also, the experimental group demonstrates significantly higher problem-solving skills compared to the control group. In light of the findings, the study recommended the schools should conduct regular trainings on lesson planning highlighting flipped classroom model and peer tutoring programs. Funds should also target improving Learning Management System and the purchase of new technology tools. Professional development trainings for teachers about flipped classroom strategies, peer tutoring techniques, and effective ways to foster communication and problem-solving skills should also be amplified.

**Keywords:** Flipped classroom, peer tutoring, academic competence in Science, quasi-experimental

### Introduction

Flipped classroom is a learning approach where traditional classroom lectures shifted outside regular class using technology and face-to-face class time for active learning activities (Tomas, Doyle and Skamp 2019) <sup>[13]</sup>. Flipped classroom approach uses technology to provide students with active instructional and learning activities with videos and reserve class time for discussion opportunities and collaborative work. In the flipped classroom, students are engaged with learning materials, including videos and other materials outside of the classroom, to prepare for active learning activities in class (Ampera and Chalid, 2021) <sup>[2]</sup>.

Students often face common problems in understanding and applying the required competencies in science subjects. As Science subjects often involve abstract concepts, students find it difficult to visualize these concepts, making it harder for them to understand and apply them. Students struggle with applying scientific principles to real-world scenarios or analyzing experimental data to draw conclusions which impedes students' ability to communicate effectively and understand the Science subject matter. These challenges often lead to poor academic competence of students (Mikkonen, 2018) <sup>[11]</sup>. One of many educational strategies, flipped classroom model, is considered effective in providing engaging and effective learning materials outside of class and designing meaningful activities for in-class time depends on how well it aligns with the needs of the students and the goals of the course. It is an educational approach that reverses the traditional order of learning activities. The instructional content is delivered to students outside of the class, typically through pre-recorded video lectures, reading materials, or online resources (Jia *et al.*, 2023) <sup>[6]</sup>.

Olakanmi (2017) <sup>[12]</sup> in New York, in her study, revealed that the flipped instruction model facilitates a shift in students' conceptual understanding of the rate of chemical reaction in a Science subject significantly more than the control condition. She found positive significant differences on all assessments with the flipped class students performing higher on average.

In the Philippines, a study by Malto *et al.* (2018) <sup>[10]</sup> in Manila revealed that flipped classroom group of students performed better in both lower and higher order thinking skills in a Biology subject. They obtained significantly higher gain scores than traditional group. In terms of attitude, flipped classroom group gained a significantly higher level of interest and confidence in the subject matter after the intervention. A study by Cagande and Jugar (2018) <sup>[3]</sup> in the University of San Carlos showed that Test for Understanding Graphs in Kinematics gain scores in posttest and pretest were significantly higher for the experimental groups compared with the control groups. It was concluded that flipped classroom enhances students' learning of kinematics graphs by improving their level of understanding.

With the challenges posed by the pandemic which has changed the mainstream classroom setup, teachers have employed strategies in teaching. In the implementation of the K-12 curriculum, the Division of Agusan del Sur has accentuated the need for teaching strategies that can keep up with the demands of the new normal indispensable to the attainment of the vision and mission of the Department of Education. To fortify the intricacies of the new educational system under the new curriculum, there is a need to emphasize the intentional use of effective teaching approach such as the flipped classroom model. For years,

the researcher has had many experiences of teaching Science subject to students before and during pandemic. The challenges like lack of resources for teaching, time management, deficiency in content knowledge, students' inability to understand the lessons taught, lack of their students' interest in science, students' inability to understand the lessons are not new after all. The implementation of flipped classroom with peer instruction strategy and its effects on the academic competences of students as reflected in the development of the critical thinking skill, communication skill and problem solving skill in Science. This constitutes the focus of the study.

## Methods

### Research Design

The researcher employed the two-groups quasi-experimental pretest-posttest research design was used to study the effects of an intervention on a single group of participants. In this study, the experimental group was exposed to flipped classroom strategy with peer tutoring while the control group was given the traditional way of teaching. A pretest was given to both groups to determine their level of compatibility whether they have the same learning capacity. After the intervention, a posttest was given to determine the effectiveness of the use of flipped classroom and peer tutoring on the academic competence of the students in Science.

### Research Subjects

The subjects of the study were the Grade 8 students of La Fortuna National High School, who are enrolled for the school year 2022-2023. Two sections were selected from the school. Since the students are originally grouped heterogeneously at the beginning of the school year, the researcher did not reassign the students anymore whether to stay in the experimental or control group. Hence, no section is better than the other one. As part of the study, the researcher used control and experimental groups.

### Statistical Treatment of the Data

To quantify the data for analysis, the following statistical tools will be used:

### Descriptive Statistics

Descriptive statistics was used to provide a summary of the data collected in the study. Specifically, JASP (Jeffreys's Amazing Statistics Program) was used as a statistical software tool for calculating and visualizing descriptive statistics such as means and standard deviations of the research data. Measures such as mean, median, standard deviation, and frequency distributions helped describe the characteristics of the participants and the variables under investigation.

### Mean

This will be used to measure the central tendency between the pretest and posttest mean scores in the test of the students.

### Paired t-test

The paired t-test was used to compare the mean scores of the class before and after the application of flipped classroom with peer tutoring strategy. It was used to examine whether there is a significant difference between

the pretest and posttest scores within the same group. This test evaluated the statistical significance of the changes observed.

### Analysis of Covariance (ANCOVA)

ANCOVA was used in this quasi-experimental research to control pre-existing differences between the experimental and control groups of the study. ANCOVA was used to compare posttest scores between the two groups while statistically controlling for the pretest scores as a covariate.

## Results and discussions

### Level of Communication Skills of Students during the Pretest of the control and Experimental Groups Communication Skills of the control and experimental groups during Pretest.

**Table 1:** Level of Communication Skills of the Control and Experimental Groups during Pretest

	Mean	Standard Deviation	Description	
Control	22.625	22.567	28.28%	Did Not Meet Expectations
Experimental	18.897	2.703	23.62%	Did Not Meet Expectations

It can be gleaned that both the control and experimental groups have similar means during pretest, with the control group having a mean of 22.625 and the experimental group having a mean of 18.897. The mean scores indicate that the control group has a slightly higher level of communication skills scores during the pretest. The standard deviations indicate that there is more variability in the communication skills scores within the control group which is 22.567 compared to the experimental group which is 2.703. This means that the scores in the control group are more spread out, while the scores in the experimental group were more tightly clustered together. The results imply that the mean scores provide insight into the central tendency or average performance of the control and experimental group of students in terms of their communication skills. The students in the control group have an average level of proficiency and effectiveness in communicating verbally and non-verbally in terms of speaking, listening, reading, writing, and interpersonal skills. Further, there can be interconnected factors that may contribute to the middle or typical level of communication skills of the student such as quality of the educational environment, levels of exposure to language-rich environments, student's home environment, cultural norms and values influencing communication styles, teacher influence, peer interaction, and many other unique circumstances.

### Problem solving skills of the control and experimental groups during Pretest.

**Table 2:** Level of Problem Solving Skills of the Control and Experimental Groups during Pretest

	Mean	Standard Deviation	Description	
Control	9.171	1.465	35.27%	Did Not Meet Expectations
Experimental	10.205	1.609	39.25%	Did Not Meet Expectations

It can be seen in the table that the experimental group of students has a mean of 10.205 which indicates a slightly higher problem-solving skills during the pretest compared to the control group with a mean score of 9.171. Moreover, the standard deviation of the control group is 1.465 indicating that the problem-solving skills scores are relatively close to the mean. Also, in the experimental group, the standard deviation is 1.609 signifying that the problem-solving skills scores were also relatively clustered around the mean. The experimental group had a higher minimum score of 7.000 compared to the control group of 4.000 as far as the minimum and maximum values are concerned. Additionally, the experimental group had a higher maximum score of 15.000 compared to the control group of 12.000. These differences indicate that there was more variability in the problem-solving skills scores within the experimental group compared to the control group. The data reveals that the experimental group had slightly higher problem-solving skills mean scores during the pretest compared to the control group. However, the standard deviations and range of scores indicate that the problem-solving skills scores were relatively clustered around the mean in both groups, with the experimental group showing slightly more variability. In other words, the students in the experimental group may have started with a slight advantage in problem-solving abilities before the flipped classroom with peer tutoring strategy was applied. The fact that the scores were clustered around the mean indicates that most students in both groups have problem-solving skills that are close to the average. This implies that there is a level of consistency within each group in terms of problem-solving abilities. Furthermore, the slightly higher variability observed in the experimental group implies that some students had significantly higher or lower problem-solving skills compared to the average resulting in a broader range of scores. The possible reasons behind this higher variability could be various factors such as different learning approaches, individual differences, or variations in the effectiveness of the flipped classroom with peer tutoring strategy implementation.

**Level of Communication Skills of the Control and Experimental Groups during the Posttest**  
**Communication skills of the control and experimental groups during Posttest.**

**Table 3:** Level of Communication Skills of the Control and Experimental Groups during Posttest

	Mean	Standard Deviation	Description	
Control	49.125	4.201	61.40%	Did Not Meet Expectations
Experimental	68.718	6.316	85.90%	Very Satisfactory

Data revealed that the communication skills level mean score of the control group is 49.125 while the mean score of the experimental group is significantly higher at 68.718. It displays that the experimental group outperformed the control group in terms of communication skills during the posttest. This suggests that the experimental intervention called flipped classroom with peer tutoring employed by the researcher had a positive impact on the students' communication skills. As to the standard deviation, the control group has 4.201 which means that the

communication skills scores of the students during posttest were relatively close to the mean. On the other hand, the experimental group has a slightly higher standard deviation of 6.316 which suggests that the communication skills score of the students during posttest were more spread out or varied compared to the control group. This means that the individual communication skills scores within the experimental group have a wider range of values compared to the control group. In other words, there is more variability or diversity in the communication skills scores of the students in the experimental group. Simply put, the students in the experimental group have a wider range of communication skills abilities, with some scoring higher and others lower, compared to the more tightly clustered scores in the control group. Although the sample sizes for the control and experimental groups differ slightly at 40 and 39 respectively, such discrepancy in sample sizes somehow influenced the interpretation of the results. However, it can still be concluded that the experimental group had higher mean communication skills scores and slightly higher variability compared to the control group. The results imply that flipped classroom model with peer tutoring strategy has positively influenced the communication skills of the students. The tutoring sessions must have focused on improving the communication abilities of the students which provided additional knowledge, techniques and practice opportunities, giving the students an advantage over the control group. Further, the results also imply that the experimental group of students were exposed to more interactive and engaging learning strategies compared to the control group. The exercises, group discussions, or simulations actively promoted their communication skills enhancing comprehension, retention, and application of knowledge and leading to better communication outcomes. Moreover, flipped classroom with peer tutoring strategy helped improve the communication skills of the students because they received more individualized attention or personalized feedback from the teacher and peers. The personalized approach in teaching the students allows them to identify specific communication weaknesses more effectively and leads them to improve skills over time. In contrast, the control group might have had a more standardized or less personalized learning experience. The increased motivation, different instructional methods and, the time and practice also contributed to the improved communications skills of the students.

**Problem solving skills of the control and experimental groups during Posttest.**

**Table 4:** Level of Problem Solving Skills of the Control and Experimental Groups during Posttest

	Mean	Standard Deviation	Description	
Control	18.732	1.898	72.04%	Did Not Meet Expectations
Experimental	23.154	1.829	89.05%	Very Satisfactory

Data revealed that the experimental group has a higher mean score of 23.154 compared to the control group of 18.732 during posttest. This suggests that, on average, the students in the experimental group have higher problem-solving skills compared to those in the control group. The standard deviation for the control group is 1.898, while the

experimental group has a standard deviation of 1.829. Both groups have relatively similar standard deviations, indicating that the measures of variability within both groups are comparable or close to each other.

Based on the above data on the mean scores, it can be gleaned that the experimental group has a higher level of problem-solving skills compared to the control group. The higher mean score in the experimental group suggests that, on average, the students in this group performed better in problem-solving tasks compared to the students in the control group although the mean score may not capture the complete picture of problem-solving skills of students in the study.

**Significant Difference Between Gained Scores of the Control and Experimental Groups Students**  
**Significant difference in communication skills of the control and experimental groups.**

**Table 5:** Significant Difference in Communication Skills of the Control and Experimental Groups

Independent Samples T-Test			
	T	df	P
Problem Solving – Posttest	-10.604	78	<0.001

The data show that the t-value is -16.273 which indicates the magnitude and direction of the difference between the control and experimental groups of the study. The negative t-value signifies that the control group of the study has lower communication skills compared to the experimental group. There are also 77 degrees of freedom. It means that there were 77 independent observations available for the comparison of communication skills between the control and experimental groups.

The p-value of <0.001 suggests that the p-value is very small which is considered statistically significant. The data presents that the p-value being less than 0.001 suggesting that the observed difference in communication skills between the control and experimental groups of students is highly unlikely to have occurred by chance alone. It can also be observed that Levene's test is significant with a p-value less than 0.05, indicating a violation of the equal variance assumption which means that the assumption of equal variances between the control and experimental groups of students may not hold. Considering the potential impact on the validity of the t-test, other tests like Welch's or non-parametric one may also be employed for analyzing the data and determining the significance of the difference in communication skills between the control and experimental groups of students of the study. Overall, there is a significant difference in the communication skills of students between the control and experimental groups based on the independent samples t-test results above. Hence, the results reject the null hypothesis of the study. The results of this study imply that students who underwent a flipped classroom with peer tutoring have better communication skills because they were given more opportunities to engage in collaborative learning activities with their peers. It is because working together on projects, discussing concepts, and providing feedback to one another enhances communication skills. The act of explaining concepts to peers requires students to articulate their understanding clearly, fostering effective communication.

Moreover, the flipped classroom model encourages active learning, where students take an active role in their education. Peer tutoring reinforces this active learning by providing students with the opportunity to teach and explain concepts to their peers. Teaching others requires a deep understanding of the subject matter and the ability to communicate complex ideas in a simplified manner.

**Significant Difference in Problem-Solving Skills of the control and experimental groups.**

**Table 7:** Significant Difference of Problem-Solving Skills of the Control and Experimental Groups

Independent Samples T-Test			
	T	df	P
Problem Solving – Posttest	-10.604	78	<0.001

The data revealed that the t-value is -10.604 which indicates the magnitude and direction of the difference between the students in control and experimental groups of the study. The negative t-value suggests that the control group has lower problem-solving skills compared to the experimental group. There are also 78 degrees of freedom. It means that there were 78 independent observations available for the comparison of problem-solving skills between the control and experimental groups.

Furthermore, the probability value of <0.001 suggests that it is very small and considered statistically significant. Thus, the p-value being less than 0.001 suggests that the observed difference in problem-solving skills between the control and experimental groups is highly unlikely to have occurred by chance alone. Therefore, based on these results, we can confidently conclude that there is a significant and meaningful difference in the problem-solving skills of students between the control and experimental groups. The experimental group demonstrates significantly higher problem-solving skills compared to the control group. The results imply that the flipped classroom with peer tutoring strategy applied to the experimental group of students had an impact on their problem-solving abilities compared to those in the control group. This flipped classroom approach allows students to engage with the content at their own pace and provides them with more control over their learning. The peer tutoring strategy with it involves students teaching and supporting each other's learning which apparently fosters communication and collaboration skills. Such collaborative problem-solving activities encourage teamwork, as students work together, share ideas, and explore different perspectives. All are but essential skills in real-world problem-solving scenarios.

**Discussions**  
**Communication Skills of the control and experimental groups during Pretest.**

The results suggest that both the control and experimental group have almost the same performance in terms of their communication skills. The students in the control group have an average level of proficiency and effectiveness in communicating verbally and non-verbally in terms of speaking, listening, reading, writing, and interpersonal skills. Further, there are many factors affecting this result such as quality of the educational environment that the teachers are doing better in facilitating learning specifically

in the use of the English language since it is the medium of instruction. The students are exposed to language-rich environments such as their interaction with their peers and their classmates and school mates.

This is in line with the study of Abdel-Basset *et al.* (2019) [1] which asserted that the quality of the educational environment has a significant impact on learning outcomes and the overall development of students. A conducive and supportive learning environment can enhance students' academic performance, social skills, and emotional well-being. A positive and engaging classroom atmosphere fosters active participation and enthusiasm among students. Highly qualified and motivated teachers also play a crucial role in shaping students' learning experiences. The physical surroundings of the school, including classrooms, libraries, and recreational areas, can impact learning as it can promote concentration, reduce distractions, and provide resources that facilitate learning.

This is in accordance with the idea of Long (2023) [9] who said that exposure to language-rich environments has a profound and positive impact on students' cognitive, linguistic, social, and academic development. Language-rich environments offer students varied and meaningful language experiences that include reading, conversations, storytelling, and interactive activities. Regular exposure to diverse language experiences helps students expand their vocabulary, grasp grammar rules, and improve their overall language skills. Students exposed to language-rich environments tend to perform better academically. Further, a language-rich environment supports reading acquisition and comprehension through exposure to books, stories, and written materials that enhances literacy skills and fosters a love for reading.

#### **Communication skills of the control and experimental groups during Posttest.**

During the posttest, the communication skills level mean score of the control group is inferior while the mean score of the experimental group is significantly higher. The result signifies that there is an increase of the performance of the experimental group that their scores during posttest are more spread out or varied compared to the control group.

#### **Problem solving skills of the control and experimental groups during Pretest.**

During the pretest, the experimental group performs a little higher than that of the control group, but the result signifies that both groups have almost the same performance. In other words, before the experimentation both groups received the same learning specifically on the development of problem solving skills. They are very compatible for studying.

According to Kwangmuang *et al.* (2021) [7], the average problem-solving skills of students in science subjects can be influenced by a wide range of factors, including individual, social, and educational aspects. Students with a strong foundation in science concepts and a natural aptitude for problem-solving may find it easier to excel in science subjects. The effectiveness of science teachers in conveying complex concepts, providing guidance, and encouraging critical thinking can significantly influence students' problem-solving abilities. A positive and supportive learning environment that fosters curiosity, experimentation, and collaboration can enhance problem-solving skills. The availability of comprehensive and well-designed science

curricula, textbooks, and supplementary materials can facilitate problem-solving abilities.

#### **Problem solving skills of the control and experimental groups during Posttest.**

During the posttest, the experimental group has a higher mean score compared to the control group which suggests that the students in the experimental group have higher problem-solving skills compared to those in the control group. Both groups have relatively similar standard deviations, indicating that the measures of variability within both groups are comparable or close to each other.

The result conforms with the study of Huang *et al.* (2022) [5] who concluded that the flipped classroom model contributes to higher problem-solving skills in students due to several key advantages it offers over traditional teaching methods. They asserted that flipped classroom promotes active learning during class time. Students could engage with the course content at their own pace outside of class. If students encounter difficulties or have questions while engaging with the pre-class material, they can seek clarification during the in-class sessions. The teacher takes on the role of a facilitator rather than a lecturer in providing guidance, address queries, and support students' problem-solving processes, encouraging active thinking and exploration. It also incorporates group activities and discussions, which encourage collaborative problem-solving. Interacting with peers allows students to learn from different perspectives and enhances their problem-solving skills.

#### **Significant difference in communication skills of the control and experimental groups.**

Based on the data, it can be gleaned that the experimental group has a higher level of communication skills compared to the control group. There is a significant difference in the communication skills of students between the control and experimental groups based on the independent samples t-test results above. Hence, the results reject the null hypothesis of the study.

The findings are in congruence with the study of Jdaitawi (2019) [5] which revealed that students have higher level of communication skills are influenced by significant factors. The experimental group should have received an intervention aimed at improving communication skills like training programs, workshops, or educational materials designed to enhance their communication abilities. The experimental group were more motivated or engaged in the study, leading them to put more effort into improving their communication skills compared to the control group. There is also a more conducive learning environment or teaching methods that fostered the development of communication skills effectively.

#### **Significant difference in problem solving skills of the control and experimental groups.**

The experimental group demonstrates significantly higher problem-solving skills compared to the control group. The results imply that the flipped classroom with peer tutoring strategy applied to the experimental group of students had an impact on their problem-solving abilities compared to those in the control group.

In an experimental study conducted by Lin (2019), the results revealed that students have higher level of problem-solving skills they received a specific intervention at

improving problem-solving skills like a new teaching method or an educational tool designed to enhance problem-solving abilities. In such study, participants were typically randomly assigned to either the experimental or control group ensuring that any differences between the two groups are due to the intervention or treatment. The results also showed that larger sample sizes generally lead to more reliable conclusions. Since the experimental group was larger, any differences in problem-solving skills were more evident. The experimental group also had more opportunities to practice and develop their problem-solving skills due to the intervention they received considering that increased practice can lead to improved performance.

### Conclusions and recommendations

Based on the foregoing results of the study, the mean score in the communication skills test of the experimental group is significantly higher than that of the control group. It can be concluded that the flipped classroom with peer tutoring applied to the experimental group has had a positive impact on their communication skills. The statistically significant difference in mean scores provides strong evidence to support this conclusion.

Moreover, the experimental group, which was exposed to flipped classroom with peer tutoring strategy, achieved a higher mean score level in the problem-solving skills test compared to the control group. I can conclude that the intervention had a positive impact on enhancing problem-solving abilities among the participants. The higher mean score level implies that the experimental group displayed improved problem-solving skills, potentially due to the flipped classroom with peer tutoring they received.

The study conducted on the problem-solving skills of students between the control and experimental groups demonstrates a significant and meaningful difference. The findings indicate that flipped classroom with peer tutoring applied to the experimental group had a noticeable impact on enhancing their problem-solving abilities compared to the control group. It can be concluded that specific strategies and techniques implemented in the experimental group positively influenced their problem-solving skills.

### Recommendations

The significant impact of flipped classroom with peer tutoring to the communication and problem-solving skills has led to the following recommendations:

1. The schools should conduct regular training on lesson planning highlighting flipped classroom model and peer tutoring programs. Teachers should be taught how to incorporate flipped classroom models into their science teaching methodologies. Flipped classrooms encourage students to engage with the learning materials before class, allowing for more interactive and collaborative activities during class time.
2. The school heads should draft comprehensive plans which include training on selecting appropriate classroom activities that encourage collaboration among students. Group projects, discussions, and problem-solving tasks can enhance communication skills, as students learn to express their ideas, listen actively to others, and work together to find solutions. These activities can be integrated into both in-class and out-of-class components of the flipped classroom approach.

3. The school administration should allocate funds to improve the Learning Management System and the purchase of new technology tools. The school should amplify the use of technology tools that facilitate communication and collaboration, such as online discussion boards, video conferencing, and collaborative document sharing platforms. These tools can enhance student interactions, enabling them to communicate and solve problems together, even when not physically present in the same location.
4. Classroom assessments should specifically evaluate communication and problem-solving skills within the flipped classroom context. Students can be assessed through presentations, group projects, case studies, or reflective assignments. By assessing these skills, teachers can identify areas for improvement and provide targeted feedback to enhance students' abilities.
5. Professional development opportunities like seminars or trainings for teachers to learn about flipped classroom strategies, peer tutoring techniques, and effective ways to foster communication and problem-solving skills. This will enable teachers to effectively implement these methodologies and support students in developing these essential skills.

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