International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Peer Tutoring Through Flipped Classroom Approach in Meeting Students' Academic Needs and Performance in Mathematics

Regine Coronado Aranza
Laguna State Polytechnic University Sta. Cruz Laguna 4009 PHILIPPINES
Email address: julierosemendoza002@gmail.com

Abstract*—The study aimed to examine the significant effect of peer tutoring implemented through the flipped classroom approach on students' academic needs and performance in mathematics. Specifically, it sought to determine the extent of the teacher's utilization of peer tutoring within a flipped classroom setting, the level of students' academic needs in mathematics, and the students' academic performance. Moreover, the study aimed to establish the effect of peer tutoring through the flipped classroom approach on addressing students' academic needs and enhancing their performance in mathematics. A descriptive research design was employed to investigate the significant effect of peer tutoring implemented through the flipped classroom approach on students' academic needs and performance. The participants were eighty-seven (87) Grade 11 STEM students from Plaridel Integrated National High School, selected through purposive sampling. Data were collected using a researcher-made questionnaire, a mathematics written test, and a performance task. Both instruments underwent pilot testing and reliability testing to ensure their validity and reliability prior to full administration. Findings revealed a very high extent of peer tutoring utilization through the flipped classroom approach in mathematics instruction. Likewise, a very high level of students' academic needs was noted. Additionally, the results showed that students demonstrated outstanding performance in the written test and achieved a very satisfactory rating in the performance task. Lastly, the study found that using peer tutoring through a flipped classroom approach had a significant effect on students' academic needs but no significant effect on students' performance in Mathematics. Considering these findings, the second null hypothesis is accepted while the first null hypothesis is rejected. It is then recommended that the teachers and future researchers may employ and consider taking peer tutoring through flipped classroom approach into practice as it emphasizes collaborative learning in and outside the classroom.*

***Keywords*—** *Peer tutoring, academic needs, performance in Mathematics.*

I. Introduction

Learning occurs in a variety of ways, and teachers use a variety of approaches and procedures to ensure that students learn effectively. Students, on the other hand, learn well from their teachers, while some learn autonomously. Nonetheless, most pupils learn with their peers. Peers are folks who have similar abilities or are on the same level. In the classroom, a student's classmates are known as peers. Peer learning is a highly effective active learning strategy (Hansen, 2022).

Furthermore, peer-to-peer tutoring can help both pupils gain confidence. Peer tutoring is a modern method in which students help their classmates study. A struggling student gets more one-on-one instruction and feedback on their efforts and practice. Assisting students acquire confidence in their mastery of subject when they seek to educate a peer (Calderwood, 2023).

Peer tutoring includes a variety of teaching methods in which pupils collaborate in pairs or in small groups to provide mutual educational support. Moreover, there are numerous ways to integrate active learning into teaching, with the Flipped Classroom Model being one such method. The flipped or inverted classroom represents a modern and increasingly popular instructional strategy, where tasks typically performed in the classroom (such as presenting content) are shifted to home assignments, while activities usually considered homework are carried out in the classroom (Sohrabi & Iraj, 2016). The teacher may interact with students through various learning activities such as discussion, problem-solving, hands-on activities, and guidance since lectures are not the method used in the classroom to impart information to them.

Every student has a unique background, with some having more challenges than others. These individuals each have needs, regardless of background. Psychological theory states that meeting one's basic needs comes before focusing on meeting more complicated needs. This covers the demands for respect, safety, and belonging. Additionally, academic needs are the needs that every student has while they are pursuing their studies or education in general. A healthy classroom, teachers, and healthy study routine can be called the educational needs of the students. Additionally, Blankenstein (2019) stated, "Student Needs are Academic Needs," and students today frequently struggle to balance their needs, which include safety, housing, financial health, and general wellness (physical, psychological, and spiritual).

Moreover, teaching and learning Mathematics is a great concern in the educational system. Performance in mathematics refers to the level of a student's proficiency and their achievement in the subject, measured through various assessment methods such as test and quizzes scores, their academic grade, and their problem-solving activity. And on top of that, high school learners who excel in mathematics tend to succeed and perform better in their academic courses they are interested in.

Along with these matters, the researcher seeks to conduct a study where peer tutoring through flipped classroom as an

Regine Coronado Aranza, "Peer Tutoring Through Flipped Classroom Approach in Meeting Students' Academic Needs and Performance in Mathematics," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 753-760, 2025.

approach can possibly meet students' academic needs and performance in mathematics.

1.1 Statement of the Problem

Problem/s which were addressed by the research

The purpose of this study was to determine the effect of peer tutoring as a teaching strategy through flipped classroom approach in meeting students' academic needs and performance in Mathematics.

Specifically, it was pursued to answer the following questions:

1. What is the extent of teacher's use of peer tutoring through flipped classroom approach in terms of:
   1.1 Reciprocal Learning;
   1.2 Collaborative Interaction;
   1.3 Confidence Building; and
   1.4 Flexibility?
2. What is the level of students' academic needs in terms of:
   2.1 Individualized Learning Pattern;
   2.2 Access to Resources;
   2.3 Personalized Support; and
   2.4 Learning Goals?
3. What is the level of student's performance in mathematics as to:
   3.1 Written Test; and
   3.2 Performance Task?
4. Does peer tutoring through a flipped classroom approach have significant effect on the students' academic needs?
5. Does peer tutoring through flipped classroom approach have significant effect on the students' performance in Mathematics?

II. Methodology

A descriptive research design was employed to investigate the significant effect of peer tutoring implemented through the flipped classroom approach on students' academic needs and performance. The participants were eighty-seven (87) Grade 11 STEM students from Plaridel Integrated National High School, selected through purposive sampling. Data were collected using a researcher-made questionnaire, a mathematics written test, and a performance task. Both instruments underwent pilot testing and reliability testing to ensure their validity and reliability prior to full administration.

III. Results and Discussion

This part presents, analyzes, and interprets the data gathered that showed a significant effect of peer tutoring through a flipped classroom approach have significant effect on the academic needs of the students and performance of the students in Mathematics.

Extent of Teacher's Use of Peer Tutoring Through Flipped Classroom Approach

The extent of peer tutoring in terms of reciprocal learning, collaborative interaction, confidence building and flexibility, was treated statistically using mean and standard deviation.

Table 1 shows the extent of peer tutoring in terms of reciprocal learning. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.31) with a standard deviation (0.78) indicates that peer tutoring is utilized to a very high extent in fostering reciprocal learning among students. This implies that students strongly agree on the benefits of peer tutoring, particularly in enhancing their roles as doers and observers, developing learning strategies, improving comprehension skills, analyzing problems, and working collaboratively.

TABLE 1. Extent of Teacher's Use of Peer Tutoring in Terms of Reciprocal Learning

Peer tutoring helps me…	MEAN	SD	REMARKS
in acting as a doer and observer at the same time during class.	4.36	0.78	Strongly Agree
in developing my strategies for learning.	4.31	0.78	Strongly Agree
in accelerating my comprehensive skills.	4.30	0.73	Strongly Agree
in analyzing the problem and asking questions during classes.	4.29	0.79	Strongly Agree
in maximizing my time to work as a group and complete the task together.	4.31	0.80	Strongly Agree
Weighted Mean	4.31		
SD	0.78		
Verbal Interpretation	Very High Extent		

These findings are similar with Topping (2015), who discovered that reciprocal learning in peer tutoring boosts both cognitive and metacognitive abilities, enabling students to participate actively as both learners and instructors. His research highlighted that students gain from assuming dual roles, enhancing their understanding, problem-solving skills, and teamwork strategies.

TABLE 2. Extent of Teacher's Use of Peer Tutoring in Terms of Collaborative Interaction

Peer tutoring gives opportunity…	MEAN	SD	REMARKS
in improving my skills in collaboration and communication.	4.54	0.70	Strongly Agree
in sharing ideas and concepts with my peers.	4.39	0.67	Strongly Agree
in communicating more with my peers.	4.52	0.71	Strongly Agree
in maximizing collaborative tasks in class.	4.55	0.62	Strongly Agree
in expanding classroom time for feedback.	4.36	0.78	Strongly Agree
Weighted Mean	4.47		
SD	0.69		
Verbal Interpretation	Very High Extent		

Table 2 shows the extent of peer tutoring in terms of collaborative interaction. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.47) with a standard deviation (0.69) indicates that peer tutoring is utilized to a very high extent in fostering collaborative interaction among students. This suggests that students strongly agree on the benefits of peer tutoring, particularly in improving collaboration and communication skills, sharing ideas, maximizing group tasks, and expanding classroom time for

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feedback. These results imply that peer tutoring encourages students to engage more actively with their peers, enhancing teamwork and knowledge exchange.

These findings are similar with Gillies (2016), who discovered that structured peer collaboration enhances pupils' communication and teamwork abilities. Her research stressed that collaborative learning environments help students to express themselves, engage in meaningful debates, and build problem-solving abilities.

TABLE 3. Extent of Teacher's Use of Peer Tutoring in Terms of Confidence Building

Peer tutoring helps me…	MEAN	SD	REMARKS
in gaining confidence in my abilities.	4.24	0.71	Strongly Agree
in feeling comfortable in asking questions.	4.33	0.77	Strongly Agree
in collaborating confidently with my peers.	4.43	0.77	Strongly Agree
in empowering active learning.	4.30	0.88	Strongly Agree
in gaining confidence to correct my mistakes.	4.38	0.74	Strongly Agree
Weighted Mean	4.34		
SD	0.77		
Verbal Interpretation	Very High Extent		

Table 3 shows the extent of peer tutoring in terms of confidence building. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.34) with a standard deviation (0.77) indicates that peer tutoring is utilized to a very high extent in fostering confidence building among students. This suggests that students strongly agree on the benefits of peer tutoring, particularly in gaining confidence in their abilities, feeling comfortable asking questions, collaborating with peers, engaging in active learning, and correcting their mistakes. These results imply that peer tutoring creates a supportive learning environment where students feel encouraged to participate actively and take ownership of their learning process.

These findings are similar with Vygotsky's Social Development Theory, as discussed by Schunk (2016). This highlights the importance of social interactions within learning settings in fostering confidence and self-efficacy. The research demonstrated that students boost their confidence when participating in peer-assisted learning, as they benefit from prompt feedback, support, and chances to solidify their comprehension through conversations.

Table 4 shows the extent of peer tutoring in terms of flexibility. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.34) with a standard deviation (0.76) indicates that peer tutoring is utilized to a very high extent in fostering flexibility in learning. This suggests that students strongly agree on the benefits of peer tutoring, particularly in minimizing homework, maximizing access to learning resources, improving time management, engaging with various learning materials, and learning at their own pace. These results imply that peer tutoring allows students to have greater control over their learning process, making it more adaptable to their individual needs and preferences.

TABLE 4. Extent of Teacher's Use of Peer Tutoring in Terms of Flexibility

Peer tutoring helps me…	MEAN	SD	REMARKS
in minimizing my homework and other taken-home tasks.	4.41	0.72	Strongly Agree
in maximizing opportunities to browse more learning resources.	4.25	0.77	Strongly Agree
in practicing time management in learning.	4.20	0.90	Agree
in maximizing my engagement in various learning materials.	4.34	0.71	Strongly Agree
in learning at my own pace and take control of my learning styles.	4.49	0.70	Strongly Agree
Weighted Mean	4.34		
SD	0.76		
Verbal Interpretation	Very High Extent		

These findings are similar with Hung (2015), who found out that Flexible learning settings, including flipped classrooms and peer tutoring, allow students to manage their own learning preferences and speed. His research highlighted that when students are given the freedom to explore learning resources in a well-organized but adaptable environment, they tend to show increased involvement and better academic results.

Overall, the results highlight the significant role of peer tutoring in fostering reciprocal learning, collaboration, confidence, and flexibility. With consistently high ratings across all dimensions, peer tutoring enhances active engagement, critical thinking, and self-efficacy. It promotes effective communication, problem-solving, and personalized learning, allowing students to take ownership of their academic growth and improve overall performance.

Level of Students' Academic Needs

The level of students' academic needs in terms of individualized learning pattern, access to resources, personalized support and learning goals, was treated statistically using mean and standard deviation.

TABLE 5. Level of Students' Academic Needs in Terms of Individualized Learning Pattern

I learned to…	MEAN	SD	REMARKS
take responsibility for my learning.	4.39	0.70	Strongly Agree
monitor my individual learning process.	4.39	0.78	Strongly Agree
develop learning strategies with my different interests and abilities.	4.16	1.01	Agree
pursue self-paced learning and personally ask questions when needed.	4.22	0.83	Strongly Agree
come prepared for classroom learning.	4.10	0.84	Agree
Weighted Mean	4.25		
SD	0.83		
Verbal Interpretation	Very High		

Table 5 shows the level of students' academic needs in terms of individualized learning patterns. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.25) with a standard deviation (0.83) indicates that students highly recognize the

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importance of individualized learning. This suggests that students strongly agree on the need to take responsibility for their learning, monitor their progress, and pursue self-paced learning. Additionally, while students generally agree on developing learning strategies and coming prepared for class, these areas show slightly lower ratings, indicating opportunities for improvement.

These findings is comparable with Zimmerman (2015). He emphasized that the importance of self-regulated learning in boosting academic performance was underscored, as it motivates students to own their educational journey, establish learning objectives, and assess their performance. The research revealed that students who participate actively in self-directed learning and develop strategies tend to achieve higher academic success and greater adaptability.

TABLE 6. Level of Students' Academic Needs in Terms of Access to Resources

The learning approach…	MEAN	SD	REMARKS
…provides enough learning resources.	4.34	0.73	Strongly Agree
…allows me to use various e-learning resources.	4.21	0.88	Strongly Agree
…gives opportunities to browse more learning resources.	4.43	0.73	Strongly Agree
…allows students to access the provided learning resources.	4.32	0.84	Strongly Agree
…maximizes time to browse learning resources.	4.40	0.75	Strongly Agree
Weighted Mean	4.34		
SD	0.79		
Verbal Interpretation	Very High		

Table 6 shows the level of students' academic needs in terms of access to resources. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.34) with a standard deviation (0.79) indicates that students highly value access to various learning resources. This suggests that students strongly agree on the importance of having sufficient learning materials, utilizing e-learning platforms, and maximizing opportunities to explore additional resources. The results imply that providing diverse and easily accessible educational materials enhances students' ability to reinforce learning and deepen their understanding of concepts.

These findings align with Sun and Rueda (2015), who emphasized that access to digital and print resources has a substantial impact on student engagement and academic accomplishment. According to their findings, kids who have free access to and use a variety of learning materials have improved comprehension, self-regulation, and information-seeking behaviors.

Table 7 shows the level of students' academic needs in terms of personalized support. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.34) with a standard deviation (0.82) indicates that students perceive personalized support as highly essential in their learning process. The results suggest that students strongly agree that the learning approach helps address individual needs, strengthens sensitivity to academic difficulties, and provides opportunities to connect with peers. However, slightly lower ratings on speaking up in class indicate that some students may still require encouragement to express their thoughts and ideas.

TABLE 7. Level of Students' Academic Needs in Terms of Personalized Support

The learning approach…	MEAN	SD	REMARKS
provides solutions to meet individual needs.	4.44	0.81	Strongly Agree
allows me to speak up my ideas and suggestions in our classroom.	4.18	0.93	Agree
maximizes the time to summarize what was learned each day.	4.23	0.89	Strongly Agree
gives opportunity to get to know our peers.	4.46	0.74	Strongly Agree
strengthen sensitivity to one's difficulty of the lesson.	4.41	0.74	Strongly Agree
Weighted Mean	4.34		
SD	0.82		
Verbal Interpretation	Very High		

These findings is comparable with Tomlinson (2017), who gives emphasis to that the individualized assistance in education enables students to receive customized instruction that caters to their specific needs, promoting enhanced engagement and academic achievement. Her research pointed out that when students perceive their difficulties are recognized and addressed, they tend to become more motivated and self-assured in their learning experience.

TABLE 8. Level of Students' Academic needs in Terms of Learning Goals

I learned to…	MEAN	SD	REMARKS
monitor my learning process.	4.37	0.76	Strongly Agree
utilize my interests and abilities in my learning strategies.	4.37	0.70	Strongly Agree
explain and summarize topics that we cover in class.	4.08	0.93	Agree
keep myself motivated to learn.	4.38	0.82	Strongly Agree
stay focused on what we are learning to ensure my learning goals.	4.56	0.66	Strongly Agree
Weighted Mean	4.35		
SD	0.78		
Verbal Interpretation	Very High		

Table 8 shows the level of students' academic needs in terms of learning goals. The table presents various statements, along with their corresponding mean, standard deviation, and remarks.

The computed weighted mean (4.35) with a standard deviation (0.78) indicates that students highly recognize the importance of setting and maintaining learning goals. The results suggest that students strongly agree on the need to stay motivated, monitor their learning progress, and align their learning strategies with their interests and abilities. However, the slightly lower rating on explaining and summarizing topics suggests that some students may still need additional support in articulating what they have learned.

These findings is comparable with Locke and Latham (2019), who stressed that setting goals in education boosts student motivation, self-regulation, and overall academic

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achievement. Their research indicated that when learners create specific learning objectives, they tend to remain engaged, persevere through difficulties, and take initiative in their educational journey.

Overall, the results highlight the significant role of academic support in fostering individualized learning, resource accessibility, personalized assistance, and setting individual learning goals. With consistently high ratings across all dimensions, students recognize the importance of self-regulation, motivation, and tailored learning experiences. According to Rahman (2019), learning needs are the gaps or challenges that students face in acquiring the knowledge, skills, and attitudes required for a specific learning outcome. When students' basic needs aren't met, it often results in academic struggles. In addition to this, with proper support and encouragement, students will naturally build positive attitudes to diverse resources, structured support, and clear learning goals that enhances engagement, adaptability, and academic performance, allowing students to take ownership of their learning and achieve greater success.

Level of Student's Performance in Mathematics

The level of student's performance in mathematics as to written test and performance task was treated statistically using the frequency and percentage.

TABLE 9. Level of Student's Performance in Mathematics as to Written Test

Scores	Frequency	Percentage	Verbal Interpretation
33-40	54	50.00%	Outstanding
25-32	27	43.18%	Very Satisfactory
17-24	6	2.27%	Satisfactory
9-16	0	0.00%	Fairly Satisfactory
0-8	0	0.00%	Did Not Meet Expectation
Total	87	100%	

Weighted Mean = 32.84
SD=5.25

Table 9 presents the level of students' mathematical skills based on their written test performance. It includes the score ranges, frequency, percentage, and corresponding remarks.

Out of the 87 respondents, the majority (54 students or 50.00%) scored between 33-40, which falls under the Outstanding category. This was followed by 27 students (43.18%) who scored between 25-32, classified as Very Satisfactory. Meanwhile, 6 students (2.27%) attained scores between 17-24, which is considered Satisfactory. Notably, no student scored in the lower ranges of 0-16, meaning none were classified under Fairly Satisfactory or Did Not Meet Expectation.

The overall weighted mean score was 32.84, with a standard deviation of 5.25. These results suggest that most students demonstrated an Outstanding level of mathematical proficiency in the written test, with relatively high performance among the respondents.

These findings is in congruent with the study of Hattie (2015), who emphasized that high-achieving kids in mathematics frequently demonstrate good conceptual knowledge and problem-solving abilities, resulting in continuous success on written tests. His research found that controlled learning environments and excellent teaching tactics help students achieve greater marks on mathematics assessments.

TABLE 10. Level of Student's Performance in Mathematics as to Performance Task

Criteria	Mean	SD	Verbal Interpretation
Creativity and Neatness	3.32	0.80	Satisfactory
Logic	3.16	0.70	Satisfactory
Accuracy	4.93	0.37	Outstanding
Punctuality	4.83	0.59	Outstanding
Overall	4.06	0.61	Very Satisfactory

Table 10 shows the level of student's performance in mathematics as to performance task. The table also shows the mean, standard deviation and remarks.

In terms of Creativity and Neatness, most of the respondents got scores of five (3), "Somewhat creative and neat," with a mean of 3.32 and a standard deviation of 0.80, and were remarked as Satisfactory. Secondly, in terms of Logic, most of the respondents got scores of five (3), "Somewhat Reasonable and Coherent" with a mean of 3.16 and a standard deviation of 0.70, and were remarked as Satisfactory. Third, in terms of Accuracy, most of the respondents got scores of five (5), "Reasonably accurate" with a mean of 4.93 and a standard deviation of 0.37, and were remarked as Outstanding. Lastly, in terms of Punctuality, most of the respondents got scores of five (5), "Submits before the deadline" with a mean of 4.83 and a standard deviation of 0.59, and were remarked as Outstanding.

Overall, the level of student's performance in mathematics as to performance task attained the weighted mean of 4.06 and standard deviation of 0.61 and was remarked as very satisfactory among respondents.

This implies that while students performed exceptionally well in Accuracy and Punctuality, there is room for improvement in Creativity, Neatness, and Logic. Enhancing these areas could further elevate their overall performance in mathematics-related tasks.

These findings is in congruent with those of Brookhart (2015), who emphasized that performance-based assessments assist measure not only students' accuracy in solving mathematical problems, but also their ability to use logical reasoning and keep creativity in their work. Her research found that while students frequently succeed at accuracy, skills such as problem-solving inventiveness and structured reasoning require further reinforcement.

Overall, the results highlight the strong performance of students in mathematics, particularly in accuracy, punctuality, and problem-solving. With consistently high scores in both written tests and performance tasks, students demonstrate proficiency in computational skills and mathematical reasoning. However, areas such as creativity, neatness, and logical reasoning present opportunities for improvement. Strengthening these aspects through structured guidance and enhanced learning strategies can further elevate overall mathematical competence and academic success.

Test of Significant Effect of Peer Tutoring through a Flipped Classroom Approach on the Students' Academic Needs

To test the significant effect of peer tutoring through a flipped classroom approach on the academic needs of the students in terms of individualized learning pattern, access to resources, personalized support and learning goals, was treated statistically using Jamovi 2.3.28 using the regression analysis.

Table 11 presents the results of multiple regression analyses examining the significant effect of peer tutoring through a flipped classroom approach on students' academic needs across four dimensions: Individualized Learning Pattern, Access to Resources, Personalized Support, and Learning Goals.

For individualized learning patterns, the regression model was statistically significant, $F(4, 82) = 53.61$, $p < .001$, accounting for 72.3% of the variance ($R^2 = .723$). Among the predictor variables, reciprocal learning ($B = 0.52$, $SE = 0.11$, $t = 4.55$, $p < .001$) and flexibility ($B = 0.34$, $SE = 0.11$, $t = 3.09$, $p = .003$) were significant positive predictors, indicating that greater reciprocal learning and flexibility were associated with stronger individualized learning patterns. However, collaborative interaction ($B = -0.04$, $SE = 0.12$, $t = -0.32$, $p = .750$) and confidence building ($B = 0.18$, $SE = 0.12$, $t = 1.44$, $p = .150$) were not significant predictors.

TABLE 11. Significant Effect of Peer Tutoring through a Flipped Classroom Approach on the Students' Academic Needs

Individualized Learning Pattern				
Predictor Variables	B	SE B	t	p
(Constant)	-0.07	0.35	-0.21	0.833
Reciprocal learning	0.52	0.11	4.55	<.001***
Collaborative interaction	-0.04	0.12	-0.32	0.750
Confidence building	0.18	0.12	1.44	0.15
Flexibility	0.34	0.11	3.09	0.003**
Note. $R^2 = .723$, $F(4, 82) = 53.61$, $p = .000$. *p < .05, **p < .01, ***p < .001.				
Access to Resources				
Predictor Variables	B	SE B	t	p
(Constant)	-0.29	0.30	-0.97	0.333
Reciprocal learning	0.33	0.10	3.38	<.001***
Collaborative interaction	0.29	0.10	2.78	0.007**
Confidence building	-0.07	0.10	-0.66	0.510
Flexibility	0.51	0.09	5.38	<.001***
Note. $R^2 = .783$, $F(4, 82) = 73.89$, $p = .000$, *p < .05, **p < .01, ***p < .001.				
Personalized Support				
Predictor Variables	B	SE B	t	p
(Constant)	0.13	0.44	0.30	0.762
Reciprocal learning	0.22	0.14	1.53	0.131
Collaborative interaction	0.42	0.15	2.70	0.009**
Confidence building	-0.00	0.16	-0.00	0.999
Flexibility	0.32	0.14	2.29	0.025**
Note. $R^2 = .547$, $F(4, 82) = 24.74$, $p = .000$, *p < .05, **p < .01, ***p < .001.				
Learning Goals				
Predictor Variables	B	SE B	t	p
(Constant)	-0.02	0.30	-0.07	0.941
Reciprocal learning	0.18	0.10	1.79	0.077
Collaborative interaction	0.10	0.11	0.97	0.335
Confidence building	0.21	0.11	5.32	0.052
Flexibility	0.51	0.10	5.32	<.001***
Note. $R^2 = .760$, $F(4, 82) = 64.79$, $p = .0.000$, *p < .05, **p < .01, ***p < .001.				

These findings are similar with with Lai and Hwang (2016), who concluded that self-regulated flipped classrooms improve personalized learning styles by enabling students to modify their learning speed and foster independence. Their research highlighted that mutual learning and adaptability in teaching approaches result in enhanced self-regulation and greater involvement with educational resources.

For access to resources, the regression model was also statistically significant, $F(4, 82) = 73.89$, $p < .001$, explaining 78.3% of the variance ($R^2 = .783$). Significant positive predictors included reciprocal learning ($B = 0.33$, $SE = 0.10$, $t = 3.38$, $p < .001$), collaborative interaction ($B = 0.29$, $SE = 0.10$, $t = 2.78$, $p = .007$), and flexibility ($B = 0.51$, $SE = 0.09$, $t = 5.38$, $p < .001$), indicating that these factors contributed positively to students' access to learning resources. However, confidence building ($B = -0.07$, $SE = 0.10$, $t = -0.66$, $p = .510$) was not a significant predictor.

These results are similar with Hao (2016), who discovered that flipped learning enhances students' resource accessibility by offering interactive and flexible learning materials. His research highlighted that mutual learning and cooperative interaction improves engagement with course material, enabling students to use resources more efficiently.

For personalized support, the regression model was statistically significant, $F(4, 82) = 24.74$, $p < .001$, explaining 54.7% of the variance ($R^2 = .547$). Collaborative interaction ($B = 0.42$, $SE = 0.15$, $t = 2.70$, $p = .009$) and flexibility ($B = 0.32$, $SE = 0.14$, $t = 2.29$, $p = .025$) were significant positive predictors, indicating that higher levels of collaborative interaction and flexibility were associated with greater personalized support. However, reciprocal learning ($B = 0.22$, $SE = 0.14$, $t = 1.53$, $p = .131$) and confidence building ($B = -0.00$, $SE = 0.16$, $t = -0.00$, $p = .999$) were not significant predictors.

These results are comparable with the work of Sun, Wu, and Lee (2018), which indicated that flipped classrooms improve personalized assistance by enabling students to participate in collaborative interactions and flexible learning experiences. Their research highlighted that cooperation among peers and adaptability in educational design foster greater individualized support and guidance from teachers.

For learning goals, the regression model was statistically significant, $F(4, 82) = 64.79$, $p < .001$, accounting for 76.0% of the variance ($R^2 = .760$). Among the predictor variables, flexibility ($B = 0.51$, $SE = 0.10$, $t = 5.32$, $p < .001$) was the only significant positive predictor, indicating that greater flexibility contributed to the achievement of learning goals. However, reciprocal learning ($B = 0.18$, $SE = 0.10$, $t = 1.79$, $p = .077$), collaborative interaction ($B = 0.10$, $SE = 0.11$, $t = 0.97$, $p = .335$), and confidence building ($B = 0.21$, $SE = 0.11$, $t = 5.32$, $p = .052$) were not statistically significant predictors.

These results correspond with Hung (2015), who discovered that adaptability in flipped learning settings greatly improves students' capacity to establish and attain their learning objectives. His research highlighted that when students can manage their learning speed and instructional materials, they tend to become more self-driven and focused on their goals.

Overall, the findings indicate that reciprocal learning, collaborative interaction, and flexibility positively influence different aspects of students' academic needs. Reciprocal learning significantly contributed to individualized learning

Regine Coronado Aranza, "Peer Tutoring Through Flipped Classroom Approach in Meeting Students' Academic Needs and Performance in Mathematics," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 753-760, 2025.

patterns and access to resources, while collaborative interaction was particularly important for access to resources and personalized support. Flexibility emerged as a strong predictor across all models, emphasizing its role in facilitating individualized learning, access to resources, personalized support, and learning goal attainment. Confidence building, however, did not have a significant effect on any of the academic needs. This result shows that peer tutoring through a flipped classroom approach can effectively enhance academic support, particularly when flexibility and collaboration are emphasized.

These findings are similar with Lo, Hew, and Chen (2017). They discovered that reciprocal learning, collaborative contact, and flexibility are critical components in increasing students' academic engagement and support in flipped classroom settings. Their research found that when students actively participate in peer tutoring and flexible learning activities, they have better access to resources and individualized academic aid, which improves their overall learning experience.

Test of Significant Effect of Peer Tutoring Through Flipped Classroom Approach on the Students' Performance in Mathematics

To test the significant effect of peer tutoring through flipped classroom approach on the performance of students in mathematics in terms of written test and performance task was treated statistically using Jamovi 2.3.28 using the regression analysis.

Table 12 presents the results of regression analysis which was conducted to examine whether reciprocal learning, collaborative interaction, confidence building, and flexibility predict students' performance in mathematics, measured through written tests and performance tasks in a peer tutoring setting using the flipped classroom approach.

For the written test, the regression model was not statistically significant, $F(4, 82) = 1.58$, $p = .187 > p = 0.05$, indicating that the predictor variables did not significantly explain the variance in students' scores.

TABLE 12. Significant Effect of Peer Tutoring Through Flipped Classroom Approach on the Students' Performance in Mathematics

Written Test				
Predictor Variables	B	SE B	t	p
(Constant)	3.73	0.57	6.56	0.000
Reciprocal learning	0.35	0.19	1.87	0.065
Collaborative interaction	0.14	0.20	0.67	0.503
Confidence building	0.04	0.20	0.18	0.855
Flexibility	-0.34	0.18	-1.87	0.065
Note. $R^2 = .072$, $F(4, 82) = 1.58$, $p = .187$. *p < .05, **p < .01, **p < .001.				
Performance Task				
Predictor Variables	B	SE B	t	p
(Constant)	6.10	4.79	1.27	0.207
Reciprocal learning	0.95	1.58	0.60	0.548
Collaborative interaction	-3.76	1.69	-2.23	0.029*
Confidence building	3.29	1.71	1.93	0.057
Flexibility	-0.613	1.53	-0.40	0.689

Note. $R^2 = .081$, $F(4, 82) = 1.82$, $p = .0.1343$. *p < .05, **p < .01, **p < .001.

These findings align with Lo, Hew, and Chen (2017), who discovered that while flipped learning improves student engagement and conceptual understanding, its direct impact on writing exam performance is frequently minimal. Their findings suggested that flipped classroom practices are more helpful at fostering higher-order thinking skills than increasing traditional exam results.

For the performance task, the regression model was also not statistically significant, $F(4, 82) = 1.82$, $p = .134 > p = 0.05$, accounting for 8.1% of the variance ($R^2 = .081$).

These findings are in congruent with Kirschner, Sweller, and Clark's (2016) discovery that excessive collaboration without sufficient framework might have a negative influence on individual performance in complicated tasks. Their research found that unstructured collaborative learning can lead to cognitive overload, limiting the usefulness of performance-based assessments.

Overall, the results showing that none of the predictor variables significantly explained variance in written test scores, and only collaborative interaction significantly negatively predicted performance task scores. This implies that higher levels of collaborative interaction were associated with lower performance task scores, which may warrant further investigation. These results indicates that peer tutoring through the flipped classroom approach may not have a strong effect on students' written test or performance task scores based on the given predictors.

These findings is comparable with those of Chen, Wang, and Lin (2016), who discovered that, while flipped learning increases student engagement and conceptual understanding, it does not always lead to improved assessment performance. Their findings revealed that collaborative contact might occasionally lead to distractions or unequal participation, which can have a negative impact on individual task performance.

IV. Conclusion and Recommendations

Among the indicators of peer tutoring implemented through the flipped classroom approach, it was found that half demonstrated a significant effect on the indicators of students' academic needs. As a result, the first null hypothesis was partially rejected. This finding concludes that the flipped classroom model, when integrated with peer tutoring, can effectively enhance academic support for students. In particular, the improvement was most evident when flexibility in learning and collaborative interaction among students were prioritized.

Similarly, the study found that peer tutoring through the flipped classroom approach did not exhibit a significant effect on students' performance in the written test. Additionally, among the predictors of peer tutoring, only collaborative interaction showed a significant effect on students' performance in terms of the performance task. Given these findings, the second null hypothesis was accepted. These results indicate that while collaborative interaction plays a crucial role in enhancing students' performance on applied tasks, peer tutoring through the flipped classroom approach may not directly influence students' outcomes in traditional written assessments.

In the formulated conclusions from the findings, it was recommended that:

Regine Coronado Aranza, "Peer Tutoring Through Flipped Classroom Approach in Meeting Students' Academic Needs and Performance in Mathematics," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 753-760, 2025.

Learners may encourage to participate in peer tutoring to develop collaboration with peers and accountability to self-learning process.

Teachers and School Administrators may employ and consider taking peer tutoring through flipped classroom approach into practice as it emphasizes collaborative learning in and outside the classroom.

Future researchers, as well as curriculum developers may conduct studies regarding the utilization of peer tutoring through flipped classroom approach to further develop and create more engaging and effective activities that would enhance and nurture learners' performance in mathematics and meet their academic needs.

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Regine Coronado Aranza, "Peer Tutoring Through Flipped Classroom Approach in Meeting Students' Academic Needs and Performance in Mathematics," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 753-760, 2025.