Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Effects of Collaborative Team Teaching on Students' Performance in High School Algebra

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This study aims to present the effectiveness of collaborative team teaching on students' performance in Secondary Algebra. The participants of the study were grade 7 students from a public school, along with the two pre-service teachers major in Mathematics who employed collaborative team teaching. The study employed a mixed-method design, utilizing one group pretest-posttest experimental design. The instruments used to collect quantitative data in the form of test scores in the Mathematics Performance Test. The qualitative data was gathered from one-on-one interviews with the two Mathematics pre-service teachers using an interview guide question to support the results of the quantitative findings. Findings revealed a significant difference between students' performance before and after the intervention, implying that collaborative team teaching is an effective teaching approach in algebra and enhances the teaching strategies of pre-service teachers. Drawing on Bandura's Social Cognitive Theory, which underscores the role of observational learning and social interaction in shaping behavior and education, it is suggested that educators, as facilitators of the teaching-learning process, should adopt innovative strategies to accommodate students' diverse learning styles and foster a positive learning environment conducive to improved academic performance in the subject.

Keywords: Algebra, Collaborative team teaching, Pre-service teachers, Students' performance.

1. Introduction

Teamteaching entails collaboration wherein two or more educators share equal responsibility for planning, teaching, and assessing the progress of all target students in the course where teamteaching is employed. Throughout this process, various agreements, disagreements, frustrations, and misunderstandings may arise among team members.However, the crucial factors contributing to successful collaboration are trust, respect, and a willingness to change, which must be observed by each member. This comparison equates collaboration to looking into a mirror heldby the teaching partner, where dialogue about observations is essential, and a spirit of give-and-take is applied throughout the team-teaching process. This dynamic

suggests that the presence of another person fosters deeper exploration, while multiple perspectives enhance instruction, encouraging reflection, discussion, and collaboration between partners, ultimately leading to professional advancement and growth for each member.

The 2022 Programme for International Student Assessment (PISA)results present a concerning scenario.Compared with the 2018 PISA results, there was an average fifteen-point drop in the mean performance in mathematics, equivalent to students losing three-quarters of a year's worth of learning [1]. This decline in mathematics performance is three times larger than any previous change recorded in PISA [2]. Given this, it falls upon Secondary Mathematics Teachers (SMTs) to ensure good quality Mathematics performance amongstudents. To achieve this, mathematics teachers must possess a thorough understanding of the concept of Algebra, which is one of the areas in mathematics where students commonly struggle to succeed [3].Therefore, SMTs must be equipped with the knowledge that contributes to effectiveness in the classroom, particularly their ability to make connections between content and pedagogy [4].

One effective teaching method is through teamteaching or collaborative teaching, wherein a group of teachers work together to plan, conduct, and evaluate learning activities for the same group of students. While team teaching can take on various formats in practice, it generally involves organizing staff into groups to enhance teaching.These teams typically comprise staff members who may represent different areas of subject expertise but share the same group of students and a common planning period to prepare for teaching.Team teaching offers unique benefits to students and teachers alike. It can deepen students' critical-thinking abilities and make classes more interesting and engaging[5]. However, to be effective, team teaching requires much more than just a common meeting time and space. Even experienced co-teachers indicate that co-teaching should only occur if both individuals participate willingly. Consequently, dedicated teachers who prioritize meeting the diverse learning needs of all students can collaboratively create an environment conducive to effective co-teaching [6].

The Scaffolding Theory of Vygotsky (1978) underscores the crucial role of social interaction in cognitive development. This theory highlights the support and guidance offered by teachers during the learning process, emphasizing that learners benefit not only from direct instruction but also from interaction with peers. The scaffolding strategy involves learners collaborating in groups to work on specific tasks and projects, enabling them to mutually support each other in achieving shared goals [7] [8].

Additionally, the Social Cognitive Theory of Albert Bandura (1989)emphasizes the significance of observational learning, modeling, and social interaction in altering individuals' behaviors and viewpoints.Within the framework of collaborative team teaching, this concept suggests that pre-service teachers learn not solely throughdirect experiences, but also by observing and interacting with their colleagues [9][10].

Moreover, research suggests that collaboration among the teachers in the mathematicsdepartment led to the development, implementation, and refinement of a groundbreaking equity-focused pedagogy that transformed student learning and achievement [11]. Benjamin Franklin's statement"Tell me and I forget, teach me and I remember, involve

me and I learn", underscores the importance of active involvement in the learning process for effective learning [12].

Despite its potential benefits, Collaborative team teaching is not commonly employed in Mathematics classes. Therefore, the researchers aim to investigate the effects of team teaching in Mathematics, particularly its influence on the Algebra performance of secondary students. This study also seeks to determine whether teamteaching is beneficial for Mathematics majors seeking to acquire and/or enhance their teaching skills.

2. Methodology

The study employed mixed methods of research to investigate the effects of collaborative team teaching on students' performance in algebra. Specifically, the one-group pretest-posttest experimental design was used. Quantitatively, test scores in the mathematics performance test were utilized as a source of data. Qualitatively, interview responseswith the pre-service teachers engaged in collaborative team teaching were utilized as a source of data. The study was conducted in a public high school in Marawi City, with thirty-four Grade 7 students as participants assigned to two mathematics pre-service teachers who practicedcollaborative team teaching. They were selected by the researcher because it is where basic concepts in the topic domain were being taught in junior high school.

The research instruments comprised researcher-developed mathematics performance test and interview guide questions. The mathematics performance test consisted of twenty-eight multiple-choice items. The instrument was validated(face and content validity) by the expert and pilot tested. After pilot testing, the test was checked and scored, and the reliability coefficient (Cronbach's alpha) was determined with the value of $\alpha = 0.708$.

The data gathering procedures were divided into three phases. These are the pre-intervention, intervention, and post-intervention phases.

3. Result

The study aims to present the effectiveness of collaborative team teaching on students' performance in algebra, as well as their significant differences within the eight-weeks intervention based on pretests and posttests. The results of the data gathered, and descriptive and inferential statistical tests follow.

(a)Pretest Performances of the Students before Employing the Collaborative Team Teaching between Mathematics Pre-Service Teachers

Table 1.Raw Score, Frequency, Percentage Distribution, Transmuted Grade, Qualitative Description, and Mean Score/Grade and Rating of the Student Participants' Total Scores in the Pretest

Raw Score	Frequency	Percentage	Transmuted Grade	Qualitative Description	Main Score/ Grade & Rating
6	2	5.9%	60.71	Failed	9.32/66.64 Failed
7	4	11.8%	62.50	Failed	
8	9	26.5%	64.29	Failed	

9	6	17.6%	66.07	Failed	
10	5	14.7%	67.86	Failed	
11	3	8.8%	69.64	Failed	
12	2	5.9%	71.43	Failed	
13	1	2.9%	73.21	Failed	
14	1	2.9%	75.00	Passing	
17	1	2.9%	80.36	Passing	
Total	34	100.0%			

Scaling:

Transmuted Score	Qualitative Description
98 - above	Excellent
93 - 97	Very Good
87 - 92	Good
81 - 86	Fair/Satisfactory
75 - 80	Passing
74 - below	Failed

Table 1presents the participants' scores in the pretest. It shows the frequency, percentage distribution, transmuted grade, qualitative description, and mean score/grade and rating of the participants' performance in their pretest, all derived from a twenty-eight-item test administered to the participants. Notably, the modal score during the pretest was seventeen.The participants had a qualitative description of "failed", which underscores a concerning reality: the majority of the participants fell short of achieving the passing score of fourteen. Specifically, only six out of thirty-four participants managed to pass the pretest, highlighting the widespread struggle with algebraic concepts before intervention.

The study of Sullano and Tapay[13] underscores the multifaceted nature of effective teaching. Indeed, teachers must possess a deep understanding of the subject matter and employ optimal instructional strategies to facilitate meaningful learning experiences. It is evident that the efficacy of team-teaching methods significantly influences students' learning outcomes, further emphasizing the pivotal role of teachers in shaping the educational landscape.

Based on the result,educators must embrace collaborative teaching approaches and customize instructional strategies to cater to the diverse learning needs of students. By fostering collaborative learning environments and leveraging innovative teaching techniques, teachers can cultivate a supportive atmosphere conducive to academic success in mathematics education. Moreover, the provision of professional development opportunities is crucial for empowering teachers to refine their pedagogical practices and adapt to evolving educational paradigms. Ultimately, byembracing collaborative teaching methodologies, educational institutions can foster a culture of excellence and ensure the holistic growth and achievement of students in mathematics education.

(b)Posttest Performances of the students Before Employing the Collaborative Team Teaching between Mathematics Pre-Service Teachers

Table 2.Raw Score, Frequency, Percentage Distribution, Transmuted Grade, Qualitative Description, and Mean Score/Grade and Rating of the Student Participants' Total Scores in the Posttest

Raw Score	Frequency	Percentage	Transmuted Grade	Qualitative Description	Main Score/ Grade & Rating
15	2	5.9%	76.79	Passing	19.71/85.19

16	1	2.9%	78.57	Passing	Fair/Satisfactory
17	3	8.8%	80.36	Passing	
18	3	8.8%	82.14	Fair/Satisfactory	
19	7	20.6%	83.93	Fair/Satisfactory	
20	6	17.6%	85.71	Fair/Satisfactory	
21	7	20.6%	87.50	Good	
22	1	2.9%	89.29	Good	
23	2	5.9%	91.07	Good	
24	1	2.9%	92.86	Good	
27	1	2.9%	98.21	Excellent	
Total	34	100.0%			

Scaling:

Transmuted Score	Qualitative Description
98 - above	Excellent
93 - 97	Very Good
87 - 92	Good
81 - 86	Fair/Satisfactory
75 - 80	Passing
74 - below	Failed

Table 2 shows the frequency, percentage distribution, transmuted grade, qualitative description, and mean score/grade and rating in the participants, and performance in their posttest, all derived from the administered twenty-eight-item test.

During the posttest, the modal score remained at seventeen, indicating a common benchmark of achievement among the participants. Notably, the qualitative description shifted to "fair/satisfactory," signifying that all participants successfully passed the posttest. This remarkable improvement underscores the efficacy of the collaborative team-teaching intervention in enhancing students' understanding and mastery of algebraic concepts.

The significant progress observed in students' performance aligns with the primary goal of the pre-service teachers: to facilitate meaningful learning experiences and promote academic success among their students. This outcome validates the notion that effective teaching, characterized by high content knowledge and strategic instructional practices, positively impacts student learning outcomes.

These findings resonate with previous research, which underscores the correlation between teacher expertise and student performance. The results of this study reaffirm that students taught by teachers with advanced content knowledge exhibit improved academic performance, as evidenced by their enhanced proficiency in algebra [14]. This implies that the positive outcomes observed in the participants' performance underscore the transformative potential of collaborative team teaching in fostering student success in mathematics education.

(c)Comparison of Students' Performance Test Mean Score Before and After Intervention

Table 3.t-test and p-value on the Comparison of Student's Performance Test Mean Score Before and After Intervention

Score	Mean	Transmuted Grade	t-value	p -value	Interpretation	Analysis Taken
Pot-test Score	19.71	85.19	22.831	0.00	Significant	H_0 is rejected
Pre-test Score	9.32	66.64				

Table 3 presents a comparative analysis of the participants' pretest and posttest scores, revealing a substantial difference between their performance before and after the intervention. The mean score for the posttest was 19.71, significantly higher than the mean score of 9.32 for the pretest. These findings provide compelling evidence that the intervention activities effectively contributed to the marked improvement in participants' performance in high school algebra.

This implies that there is sufficient evidence to indicate that there is a significant difference between the pretest and posttest scores of the participants which means that the improved performance of the participants in the posttest can be attributed to the intervention activities. Findings suggest that academic performance refers to how students deal with their studies and how they cope with or accomplish different tasks given to them by the teacher. Some students performed well while some may not.Some will perform according to their needs in the classroom. [15][16].

(d) Mathematics Pre-Service Teachers' Perception on Collaborative Team Teaching in Teaching Mathematics

This further implies that the use of collaborative teaching positively influenced the performance of the students. According to one of the mathematicspre-service teacher participants: "In our collaborative endeavor of team-teaching, alignment on various aspects becomes imperative. Our journey commenced with a unanimous decision on our class schedule, which thankfully, posed no hindrance as we had already completed the majority of our subjects. Interestingly, we found ourselves entrusted with a Grade 7 class, reputed to be challenging to manage according to our critic teacher. However, undeterred by this reputation, my pre-service co-teacher and I embraced the opportunity wholeheartedly. Despite the perceived difficulties, we viewed it as an enriching experience to not only impart knowledge but also to explore the dynamics of co-teaching. We were determined to demonstrate the effectiveness of collaborative teaching, turning what could be seen as a challenge into a valuable opportunity for professional growth and pedagogical innovation".

Thus, this could lead to success in the team-teaching process. This is true since the other pre-service teacher participant said "One of the most gratifying aspects of engaging in teamteaching collaboration, from my perspective, is the realization that I wasn't solely focused on teaching; I was actively engaged in the process of learning myself. This collaborative team-teaching allowed me to not only share knowledge but also to absorb new insights and perspectives from my teaching partner and the students. It fostered a dynamic environment where ideas were exchanged freely, enhancing not only my teaching efficacy but also my personal growth as an educator. It underscored the reciprocal nature of teaching and learning, reaffirming the notion that in education, the teacher is also a perpetual student, continuously evolving and expanding their understanding of the subject matter and teaching methodologies.". The use of collaborative teaching methodologies emerges as a key factor in driving the positive outcomes observed in this study. As articulated by the teacher participant, the collaborative approach fostered effective communication and mutual agreement on teaching strategies, ultimately creating a conducive learning environment even in challenging classroom settings.

Furthermore, the testimonies of the pre-service teachers highlight the professional and

personal growth experienced through team-teaching collaboration. The reciprocal learning process not only benefitted the students but also enriched the teaching experience for educators, underscoring the transformative potential of collaborative teaching approaches.

These results underscore the importance of collaborative teaching in promoting student success and professional development among educators. By embracing teamteaching methodologies, educators can enhance student engagement, promote academic achievement, and cultivate a supportive and enriching learning environment.

Moreover, the findings suggest that teamteaching can alleviate stress and increase motivation among teachers, leading to a more enjoyable and fulfilling teaching experience. This positive impact on teacher well-being further reinforces the value of collaborative teaching approaches in enhancing both student outcomes and teacher satisfaction.

4. Conclusion

This study introduces aninnovative approach to classroom instruction through the implementation of the Collaborative Team-Teaching Method, which represents a departure from traditional learning environments typically encountered by students in Grade 7. The findings of this study underscore the transformative impact of this pedagogical approach, revealing a positive change in students' academic performance.

The empirical evidence presented in this study lends support to Vygotsky's Scaffolding Theory, which emphasizes the critical role of social interaction in cognitive development. The observed improvement in students' performance following the team-teaching intervention highlights the efficacy of collaborative learning environments facilitated by teachers with high content knowledge. By engaging in collaborative teaching practices, educators not only provide direct instruction but also foster peer interaction, creating a supportive framework for students to scaffold their learning and achieve academic success.

Moreover, Bandura's Social Cognitive Theory underscores the role of observational learning and social interaction in shaping behavior and learning, it is suggested that educators, as facilitators of the teaching-learning process, should adopt innovative strategies to accommodate students' diverse learning styles and foster a positive learning environment conducive to improved academic performance in the Algebra.

The significant gains observed from the pretest to posttest scores further substantiate the effectiveness of the Collaborative Team-Teaching Method in teaching algebra. It is evident from the findings of this study that the classroom should not be viewed as an isolated and monotonous space for learning. Instead, educators should embrace the principles of active learning and collaboration, recognizing the inherent value of hands-on, experiential learning experiences. By fostering a culture of cooperation and inquiry, educators can empower students to take ownership of their learning and cultivate a deeper understanding of algebraic concepts.

The results of this study highlight the importance of a collaborative team teaching approach in promoting student success and fostering a vibrant and inclusive learning environment. It encourages educators to continue exploring innovative teaching approaches and leverage the

power of collaboration to maximize student engagement and achievement in mathematics education.

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