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Gender Team-Based Learning and Performance in Mathematics: A Quasi-experimental Study

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A B S T R A C T

The main objective of this study was to find the differences in the mathematics achievement of students who were grouped according to gender – all female group, all male group, all gay-male group, and mixed group; in learning the subject of mathematics as a team. The study utilized the Pretest – Posttest Quasi–Experimental design. Before the actual experimentation began, a pretest was administered to all groups to see if there were no biases at the beginning of the experiment. Team-based method of learning was the intervention utilized in the study. After the experimentation, the posttest was administered. Using the T-test, it revealed that all groups performed better in their posttest compared to their pretest performance, concluding that team-based learning is an effective method of teaching Mathematics. ANOVA test revealed that there was a significant difference the performance of each gender team, the post hoc Scheffe's test result revealed that there was significant difference in the performance between the all male and all female groups and in the all male and all gay-male groups as well, concluding that some gender teams performed better than the other groups.

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RESUMO

O principal objetivo deste estudo foi encontrar as diferenças no desempenho em matemática dos alunos que foram agrupados de acordo com o gênero – todos do grupo feminino, todos do grupo masculino, todos do grupo gay-masculino e grupo misto; na aprendizagem da disciplina de matemática em equipe. O estudo utilizou o desenho Pré-teste – Pós-teste Quase-Experimental. Antes do início da experimentação real, um pré-teste foi administrado a todos os grupos para ver se não havia vieses no início do experimento. O método de aprendizagem baseado em equipe foi a intervenção utilizada no estudo. Após a experimentação, o pós-teste foi administrado. Usando o teste T, revelou que todos os grupos tiveram melhor desempenho em seu pós-teste em comparação com seu desempenho pré-teste, concluindo que a aprendizagem baseada em equipe é um método eficaz de ensino de matemática. O teste ANOVA revelou que houve uma diferença significativa no desempenho de cada equipe de gênero, o resultado do teste post hoc de Scheffe revelou que houve diferença significativa no desempenho entre os grupos de todos os homens e todas as mulheres e também nos grupos de todos os homens e todos os gays-homens, concluindo que algumas equipes de gênero tiveram melhor desempenho do que os outros grupos.

Keywords:
Equipes de Gênero; Grupos de Gênero; Aprendizagem baseada em equipe; aprendizagem ativa; desempenho em matemática;

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Introduction

One factor most teachers do before starting his or her lesson is knowing his/her students and identifying the appropriate teaching strategy for them. In a college like the College of Education, where students are dominated by female students and gay-male students, with very few straight male students, a teaching strategy should consider inclusivity to make them work together to develop interpersonal relationships.

The mathematics teacher and the method he or she uses to teach the subject are crucial components of the learning process. In most schools, traditional teacher-led instruction still reigns supreme. The teacher is rarely able to care for every learner throughout such education. Many students might therefore continue to perform below the expected level in mathematics, lose interest in the subject, and ultimately stop up trying to learn it. (Yeh, 2019).

Since the 1970s, team-based learning (TBL), a structured form of cooperative learning, has been used in a variety of educational settings. This approach, which was initially employed in business education, was later used with undergraduate and graduate students in a variety of health-related fields. The goal of TBL is to increase cognitive learning levels by utilizing a team's collective knowledge. (Jafari 2014)

Team-based learning (TBL), which was drawn from social-constructivist educational theory, is one of the most well-known active learning models (Hrynchak & Batty, 2012). The unique motivational context that emerges from peer interactions and social learning that occurs when teams make evidence-based decisions to solve a problem (Michaelsen, Sweet, & Parmelee, 2008) is the reason why TBL shows promising results in supporting the development of professional competencies.

Team-based learning (TBL) is a structured educational approach that requires students to acquire fundamental facts on their own before class and then use these fundamental facts in learning teams. Teams of students are formed, and it is the responsibility of the entire team to work together to find solutions to both application and factual challenges. TBL is a teacher-directed approach to supporting numerous small groups in a classroom, typically with a single teacher. (Thompson et al., 2015)

According to a 2018 essay by Das, the traditional lecture is still the most popular yet harshly criticized teaching-learning approach used in many Indian universities. In this style, the teacher shares his expertise with the class, while the pupils simply listen. The ability to reach a wide audience and the teacher's ability to manage the flow of information and the classroom atmosphere are two major benefits of the traditional lecture method. More emphasis is placed on information, content, and exam scores in traditional lectures. It frequently fails to foster conceptual growth, problem-solving abilities, analytical thought, and independent learning. The students find the lecture to be dull and boring since it is a one-way, passive learning instrument in which they are least engaged.

One of the global trends in school teaching, according to Inuwa (2012), has been a shift toward more student-centered, integrated, application modalities. Additionally, instructional techniques that encourage problem-solving and active learning are becoming more and more popular. Team-based learning (TBL) is an illustration of a method that combines elements of student-centeredness with problem-solving abilities. The approach makes use of techniques that bring the success of large-group, lecture-focused sessions into small group learning techniques like problem-based learning (PBL). Although team-based learning (TBL) can be used in both large and small classes, it typically involves multiple groups of five to seven students.

The appeal of team-based learning (TBL) among teachers and students may be attributed to a number of factors, including the fact that deep learning has been established, that it promotes self-directed learning and avoids merely memorization, and that it equips students with the problem-solving skills and encourages teamwork. Even though team-based learning (LBL) can be used with big groups, traditional lecture-based learning (LBL) is still preferred since it fosters critical thinking and encourages cooperation. Self-directed learning may be more useful than simply giving lectures to impart knowledge, according to evidence-based studies. (Salih, et. al., 2021)

Team-based learning (TBL), which Zha (2021) describes as a well-structured learning approach, has been shown in earlier research to improve students' academic achievement. TBL contains exercises for both solitary and group learning at all cognitive levels. Peer leadership has the potential to address the gender issue in class partnerships.

In light of gender inclusivity, we define gender inclusion as the belief that all gender identities and expressions should be accepted and included, and gender diversity as the understanding that diversity issues should encompass gender in all of its manifestations (Goehring, C., 2017). There are various reasons why gender inclusivity is essential. First, it increases labor diversity, which is believed to spur creativity. Diverse teams can solve problems more creatively and make better decisions because they offer a variety of viewpoints, experiences, and ideas (Chikwe, et. al., 2024). However, according to Careemdeen, J. D. (2023), the persistence of gender-based differences in school students' participation in extracurricular activities is extremely concerning. Greater equality in society is facilitated by gender equality in education. There are several instances of prejudice in academics, such as those based on ethnicity, disability, sex and gender, and LGBTQ+ status. (Tzovara, et. al., 2021).

Several studies have been conducted on TBL with two to three groups—all male, all female, and mixed groups only. Since no study has been found that includes a third gender group in TBL, this study was proposed.

It is in this light that this study was conducted and formulated the intention to find the differences in the mathematics achievement of students who are teamed differently in learning

the subject mathematics as groups, and determine answers to the following objectives; (1) find out if there is a difference in the pretest performance of the students assigned in different teams, (2) find out if there is a difference in the pretest and posttest performance of each gender team, and (3) find out if there is there a difference in the posttest performance of the students assigned in different teams.

Development

This study utilized the Pretest – Posttest Quasi-Experimental design. It tried to find the difference in the mathematics performance of differently gender-grouped students who worked as teams in learning the course concepts.

The study was conducted at Eastern Samar State University College of Education, Borongan Campus. The subjects were first-year COED students taking GenMath 111— Mathematics in the Modern World. They were grouped in threes, into different genders.

The study utilized the purposive sampling procedure to meet the required groupings of students who will be under study. Grades in their previous math subject were considered and used as a basis in determining members for each group. A similar level of performance for every member must be more or less similar in each group. From a total of 53 students, three groups of each gender groups were formed.

The study followed the following three major parts; (a) Pre-Experimental Stage: Before the actual experimentation began, the pretest was administered to all students who will be included in the different gender teams; (b) Experimental Stage: In this stage, the different group of students under study will be learning together as a group the concepts of the mathematics subject, and (c) Post Experimental Stage: After the experimentation, the posttest was administered to every member of the group under study.

The study adopted a 20 – item test from the module Mathematics in the Modern World by GenEd Math Faculty (2021) and was administered as the pretest and posttest before and after the actual experimentation

The t-test was used to determine the difference between pretest and posttest mean scores between each gender teams under study. ANOVA was utilized to find if there were differences in the pretest and posttest performances of the different gender teams under study, since found to have significant difference, the Scheffe's test was used to find specifically where the significant difference occurred.

Before the actual experiment was conducted, the researcher informed the students that they would be part of the study. The researcher provided sufficient information and assurance for them to understand and be fully informed about the study, including the risks and benefits if they partake in the study. They were given freedom about whether or not to be included in the study. Pretest and posttest scores were the only data needed from the students who were subjected to the experiment.

Results and Discussion

Table 1 is the ANOVA table presenting the pretest performance of the four gender teams with a p-value of 0.114 higher than the level of significance of 0.05 revealing that there is no significant difference in their pretest performance. Further, the computed F value of 2.10 is less than the critical value of 2.816 which falls in the acceptance region, accepting the null hypothesis – that there is no significant difference in the pretest performance. This result implies that if tests are taken individually the scores of the subjects will not differ significantly. This further implies that before the conduct of the study, the learning level of each subject are more or less similar or equal. The tables below present the results of the experimentation conducted.

Table 1

ANOVA of the Pretest Performance of the Four Gender Teams

Source of Variation	Sum of Squares	df	MSS	F	p-value	F crit	Interpretation
Between Groups	12.06	3	4.02	2.10	0.114	2.816	Not significant
Within Groups	84.42	44	1.92				
Total	96.48	47					

Table 2 revealed all significant t-test results between the pretest and posttest performances of each of the four teams. The all-male team with a pretest mean score of 2.83 and a posttest mean of 8.0 (from Table 1) shows a significant difference in the team's performance. Likewise, the all-female team who earned pretest and posttest mean scores of 3.92 and 10.833, respectively, also revealed a significant difference. Moreover, the all-gay and mixed-gender teams also revealed significant differences.

With all the p-values equal to zero, lower than the level of significance at 0.05, assuring a significant result. These results imply that learning takes place in whatever team you belong to, in whatever gender you work with. This further implies that all students learned the lessons.

Table 2

T test between the Pretest and Posttest Performances of the Four Gender Teams

	f	df	t stat	p value	t crit	Interpretation
All Male Team						
Pretest	12	11	9.672	0.000	1.796	Significant
Posttest	12					
All Female Team						
Pretest	12	11	5.304	0.000	1.796	Significant
Posttest	12					
All Gay Team						
Pretest	12	11	9.854	0.000	1.796	Significant
Posttest	12					
Mixed Gender Team						
Pretest	12	11	11.751	0.000	1.796	Significant
Posttest	12					

These results are similar with the studies of Espey, M. (2017), and Ro, H., & Choi, Y. (2011), Where all students improved their performance from the pretest to posttest.

Table 3 is the ANOVA table presenting the posttest performance of the four gender teams with the p value of 0.001 lower than the level of significance of 0.05 revealing that there is significant difference in their posttest performance between the four groups. Further, the computed F value of 6.25 is greater than the critical value 2.816 which falls in the rejection region, rejecting the null hypothesis – that there is no significant difference in the posttest performances of the four groups. This result reveals that though all subjects of the study performed better in their posttest than in their pretest, one or more teams still performed better than the other teams.

Table 3

ANOVA of the Posttest Performance of the Four Gender Teams

Source of Variation	Sum of Squares	df	MSS	F	P-value	F crit	interpretation
Between Groups	56.23	3	18.74	6.25	0.001	2.816	significant
Within Groups	143.25	44	3.26				
Total	199.48	47					

To determine which team or teams performed better than the other/s, Scheffe's Test was performed, and it is presented in Table 4.1. Scheffe's Test, also known as Scheffe's Method, is a post-hoc test used when after computing ANOVA and got a significant F-statistic, to find which pairs of Mean are significant.

Table 3.1

SCHEFFE'S TEST on the Posttest Performance of the Four Gender Teams

TEAMS		Mean Difference	F	F crit	Interpretation
All Male	All Female	2.833	17.336	7.932	Significant
	All Gay	2.083	9.373		Significant
	Mixed Gender	1.833	7.258		Not Significant
All Female	All Gay	0.750	1.215		Not Significant
	Mixed Gender	1.000	2.160		Not Significant
All Gay	Mixed Gender	0.250	0.135		Not Significant

The table above is Table 3.1. This presents the Scheffe's Test Result. This test is performed since ANOVA in Table 3 revealed a significant difference. This test revealed a significant difference between the posttest performance of the all-male team and the all-female team, revealing an F-statistic of 17.336, way higher than the F critical value of 7.932. These results are in consonance with the findings of Espey, M. (2017) in his study entitled Diversity,

Effort, and Cooperation in Team-based Learning, where the female group performed better than the male group.

But these results are in contradiction to Ro, H., & Choi, Y. (2011) in their study "Student Team Project: Gender Differences in Team Project Experience and Attitudes Toward Team-Based Work" and Hirshfield, L. & Koretsky, M. D. (2018) in his study "Gender and Participation in Engineering Problem-Based Learning Environment" where both female groups of students did not show any statistically significant differences in their performance than that male group of students.

These results are also in contradiction with the study of Beroíza-Valenzuela, F., Salas-Guzmán, N., & Huepe, D. (2025) in their study "Bridging Gaps: The Role of Gender and Team Composition in Collective Intelligence within STEM Education" where teams with a majority of men achieved higher average scores than those with a majority of women group. This implies that the all-female group performed better as compared to the all-male group.

Another significant difference was revealed between the all-male team and the all-gay team, giving an F-statistic of 9.373, still higher than the critical F value of 7.932, implying that the all-gay team performed better than the all-male team. This result can be supported by the study of Nkrumah, C.F. (2021) in his study "Effects of Collaborative Learning and Mathematics Achievement on Gender Groupings of Colleges of Education in Ghana," where the all-female group performed the highest, followed by the mixed group, and the all-male group is at the bottom. This implies, therefore, that the all-gay group performed significantly over the all-male group.

All other pairs of means revealed no significant difference, with all F-statistics falling below the critical F value.

Conclusions

Based on the findings, though the four gender teams obtained different means in their pretests, the differences were very minimal, negligible enough to say that all students under study performed similarly when working individually. In the result of the comparison between the pretest and posttest of each gender team, it can be concluded that all subjects under study improved in their performance from their pretest to posttest, suggesting that learning took place. When ANOVA was conducted, it showed a significant difference in the four gender teams post-test, expressing that one or more gender teams performed better than another, and when the post hoc test was conducted, it revealed that all-female and all-gay groups performed better than the all-male group, implying that when all male students worked together as a team, less learning and low performance was obtained.

Based on statistics, the following conclusions were formulated: (1) there was no significant difference in the pretest scores obtained by the four gender teams, because the students under study have similar abilities when working individually, and at the beginning of the study, the subjects have a more or less equal level of knowledge; (2) the pretest and posttest of each group revealed significant differences and expressing that as long as there is teaching, learning will definitely take place, and (3) in the posttest performance of the four gender teams, it varied significantly due to the effect of the team who the subjects were studying and working with. Significant differences resulted in all-female and all-male groups, as well as in all-gay and all-male groups, implying that all-female and all-gay groups performed significantly as compared to the all-male group.

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