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Pedagogical Effectiveness of GMRCE Learning Model in Strengthening Learning Attitude in Gas Laws

EDISON L. UY[1]
[1]Catbalogan National Comprehensive High School
Catbalogan City, Samar, Philippines
https://orcid.org/0000-0002-9154-1317

Corresponding Author: edison.uy@deped.gov.ph

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ABSTRACT

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Science education is plagued by challenges, with students complaining about the learning process and teachers expressing exhaustion among students. The study investigated the pedagogical effectiveness of the modified processes of Gamification, Modeling, Rewarding, Cognitive Teamwork, and Explicit Timing (GMRCE) Model in strengthening students' learning attitude in Gas Laws among Grade 10 Science students at Pangdan National High School during the School Year 2022-2023. The study utilized a pretest-posttest, comparison-group true-experimental design, measuring conceptual understanding through a three-tier 15-item test and assessing mathematical skills through a four-item word problem test. Descriptive-correlational research is designed to analyze personal profiles, including age, sex, academic performance, attitude toward science, proficiency level, and acceptability. Results showed that students with positive attitudes toward science achieved favorable academic performance, and the GMRCE Learning Model effectively improved students' learning attitude in Gas Laws, which was deemed moderately acceptable, indicating a high satisfaction rating. The study suggests that teachers should use strategic learning models to encourage active participation and improve academic performance. A replicated study involving a larger group of participants may be conducted in other schools, and a qualitative approach may be integrated to validate the findings.

INTRODUCTION

Science education provides students with the chance to get a greater understanding of how and why things work. Science can teach youngsters about their surroundings. Science can uncover the mechanics and explanations for complex systems ranging from human anatomy to transportation strategies. The knowledge obtained through science may be utilized to comprehend new concepts, make informed decisions, and follow a new interest (Whitcomb & Singh, 2021).

Ideally, teaching students the scientific method teaches them how to think, learn, solve issues, and make informed judgments. These abilities are essential in all aspects of a student's education and life, from kindergarten to college. However, science education has always encountered and will continue to confront problems, as students complain about the difficulties of the learning process and teachers complain about students' laziness (Karp & Frank, 2016). Because of this research, certain students may struggle to pass their scientific subjects, particularly science-related areas that rely heavily on mathematical approaches (Legner, 2013).

Consequently, an unsettling observation of Filipino pupils suggests they thrive in knowledge acquisition but do poorly in sessions demanding higher-order thinking skills (Dinglasan & Patena, 2013). Thus, Philippine students perform among the lowest in the world on the worldwide standardized test Science (Banilower et al., 2019).

The country then participated in the 2018 Program for International Student Assessment (PISA). According to Lombardelli (2023), based on the 2023 survey of the Organization for Economic Cooperation and Development (OECD) which rated 79 participant nations based on student achievement in reading, science, and math. Filipino pupils got the lowest mean reading comprehension score (340 points, below the 487-point survey average). They also finished second to worst in science (357) and math (353), with a 489-point average.

Furthermore, according to the 2019 result of Trends in International Mathematics and Science Study (TIMSS) cited by the International Association for the Evaluation of Educational Achievement (Mullis et al., 2020), the Philippines scored 297 in math and 249 in science (IEA). The TIMSS scores are interpreted using a four-level scale: Advanced International Benchmark (625), High International Benchmark (550), Intermediate International Benchmark (475), and Low International Benchmark (475). In science, 13% of Filipino pupils met the poor standard, suggesting that students have a limited comprehension of scientific ideas and mastery of core science facts. Only one percent of Filipino pupils are in the high benchmark, while five percent are in the intermediate.

The ideas presented above illustrate the considerable effect of teachers and how they do their jobs on student success in the classroom. In short, the type of teachers present in the classroom, how they manage that classroom, the type of learning experiences they provide to students, and the teaching strategies and techniques they employ to provide better learning experiences to students all have a significant impact on the type of performance that students demonstrate in tests and the classroom (Garrett, 2008).

Nonetheless, topics that require scientific conceptual understanding and mathematical skills, like the Gas Laws, have been identified as one of the least learned skills in Science 10 at Pangdan National High School since 2018. Having this said, numbers clearly express that PNHS is facing inadequate science education. This problem is a serious thing that needs to be addressed. As a result, to address the aforementioned difficulties, the researcher proposes a creatively teacher-made conceptualized approach entitled the GMRCE (Gamification, Modeling, Rewarding, Cognitive Teamwork, and Explicit Timing) Model as a pedagogical technique in teaching Gas Laws.

The study has focused on the pedagogical effectiveness of the proposed approach covering the least-learned topics in 10 science lessons: Boyle's Law, Charles' Law, Gay Lussac's, and Combined Gas Law. This is a likely path that paved the way for the academic achievement of students in the field of science, not only for PNHS students but also for other students in Catbalogan City's Schools Division.

OBJECTIVES OF THE STUDY

The study aimed to determine the pedagogical effectiveness of a teacher-made cooperative learning model called Gamification, Modeling, Rewarding, Cognitive Teamwork, and Explicit Timing (GMRCE) in strengthening learning attitudes in Gas Laws, specifically Boyle's Law, Charles' Law, Gay Lussac's, and

Combined Gas Law among Grade 10 Science students of Pangdan National High School, enrolled during the School Year 2022-2023.

Specifically, this study measured and described the following (1) Pre-Test and Post-Test mean scores of the experimental and controlled groups on their conceptual understanding and mathematical skills on Gas Laws, (2) pre-test and post-test proficiency levels of the experimental and controlled groups on their conceptual understanding and mathematical skills on Gas Laws, (3) difference between the pre-test and post-test mean scores of the controlled group on their conceptual understanding and mathematical skills on Gas Laws, (4) difference between the pre-and post-test mean scores of the two groups, (5) difference between the pre-test mean scores of the controlled and experimental groups on their conceptual understanding and mathematical skills on Gas Laws, (6) difference between the post-test mean scores of the controlled and experimental groups on their conceptual understanding and mathematical skills on Gas Laws, and (7) level of acceptability on the GMRCE Learning Model in terms of content; presentation and organization; and learning activities.

METHODOLOGY

Research Design

This study is a quantitative type of research principally using a pretest-posttest, comparison-group true-experimental design. The representation of this research design is as follows:

Figure 1
Research Design

n	O	X	O
n	O		O

Where n is the group of participants, O is the comparison cases, and X is the treated case. In this study, the group with the treated case, the experimental group, received the treatment that uses the GMRCE Model in the instruction. In contrast, the other group received the conventional or direct instruction.

Nevertheless, this study also utilized the descriptive-correlational research design because the researcher also tried to correlate variables like personal profile in terms of age and sex, academic performance (mean of the first to third grading grades), and attitude towards science.

Participants and Research Cite

The participants of the study are students from the Grade 10 sections Lapu-Lapu and Jose Burgos classes of Pangdan National High School, Catbalogan City, enrolled during the School Year 2022-2023. A total of 40 student-participants were taken from the population, which comprises 20 (9 Males and 11 Females) students for the experimental group (section Jose Burgos) and another 20 (9 Males and 11 Females) students for the controlled group (section Lapu-Lapu).

As to the assignment of who would be the experimental group and control group, the researcher ranked all the identified student participants of the study based on their previous academic performance in Science Education. Randomization of the two groups was followed from the list. Nonetheless, Stratified Random Sampling and Simple Random Sampling, specifically the Fishbowl technique, were utilized. In the Stratified Random Sampling Method, every section had a representative sample based on its population. Under the Simple Random Sampling Method, the names of the students from the given population were written on small, rolled pieces of paper placed in a fishbowl.

Instrumentation and Validation

As stated beforehand, this study employed three sets of survey questionnaires as the main data collection tool, which were augmented by the application of documentary analysis to gather the desired data accurately. The use of the said data collection instruments and method is discussed below:

Part I. Student participants' profile includes age and sex, academic performance in science, and attitude towards science. A Set of data like age, sex, and academic performance in science was taken directly from the advisers of the student participants. In contrast, the attitude towards science was a checklist adapted from the Developing Attitude towards Science Measures of Kind (2007) with 20 indicators of their attitude toward science. Moreover, in this part of the questionnaire, the student participants were tasked to check the appropriate column of their responses using the following five-point scale: 5 for Strongly Agree, 4 for Agree, 3 for Undecided, 2 for Disagree, and 1 for Strongly Disagree.

Part II. It is set to measure the student-participants' conceptual understanding and mathematical skills of Gas Laws. For conceptual understanding, it focused on the concepts of gases directly connected to gas laws, such as how gases behave and relate. It was a three-tier, 15-item test with two multiple-choice choices and one explanation. In this test, the first tier comprised the item containing a question about Gas Laws with four options provided. Three options contain misconceptions, while one is the scientific notion and, therefore, the correct answer. The second tier was the reasons for the answer in the first tier; therefore, in this part, the student participants had to explain their answers based on their scientific understanding of the given concept. The third tier was a three-option part that assessed how sure the student participants were about their answers.

To determine the level of conceptual understanding, the student-participants' answers were classified using the scoring table as shown in Table 1. The classification was adopted by Phupata (2002) and Pacala (2018). The model was originally taken from Phupata (2002); however, the original application of the said scoring is to only a two-tier test. Thus, it was then modified by Pacala (2018) to meet the desired three-tiered test on the Conceptual Understanding of Momentum and Collision.

Table 1
Level of Conceptual Understanding

Level of Conceptual Understanding	Explanation	Score
Complete Understanding	The first tier is correct, the second tier is correct, and the third tier is I am sure of my answer	4
Partial Understanding with Alternative Conception	First-tier is correct, the second tier is incorrect, and the third tier is I am not sure if my answer	3
Partial Understanding with Alternative Conception	First-tier is correct, the second tier is incorrect, and the third tier is I am sure of my answer	2
	First-tier is incorrect, the second tier is correct, and the third tier is I am sure of my answer	
	First-tier is incorrect, the second tier is correct, and the third tier is I am not sure if my answer	
	First-tier is correct, the second tier is incorrect, and the third tier is I am not sure if my answer	
Alternative Conception	First-tier is incorrect, the second tier is incorrect, and the third tier is I am sure of my answer	1
	First-tier is incorrect, the second tier is incorrect, and the third tier is I am not sure if my answer	
No Understanding	First-tier is correct, the second tier is correct, and the third tier is I completely guessed my answer	0
	First-tier is correct, the second tier is incorrect, and the third tier is I completely guessed my answer	
	First-tier is incorrect, the second tier is correct, and the third tier is I completely guessed my answer	
	First-tier is incorrect, the second tier is incorrect, and the third tier is I am not sure if my answer	

Nonetheless, for student-participants' mathematical skills in Gas Laws. This part covered the following topics, to wit: Boyle's Law, Charles' Law, Gay-Lussac's Law, and Combined Gas Laws. This time, it was a four-item word problem test. In this test, the first tier was the word problem related to the topics stated earlier respectively. To determine the mathematical skills, the student-participants' answers were classified using the table as shown in Table 2. This rubric is further demonstrated by Mertler (2001) based on his template, which the researcher modified to meet its desired outcome.

Table 2
Template for Holistic Rubric

Score	Description
5	Demonstrates a complete understanding of the problem. All parts of the solution are correct.
4	Demonstrates considerable understanding of the problem. Four parts of the solution are correct.
3	Demonstrates partial understanding of the problem. Three parts of the solution are correct.
2	Demonstrates little understanding of the problem. Two parts of the solution are correct.
1	Demonstrates no understanding of the problem. One part of the solution is correct.
0	No response/task not attempted.

To identify the proficiency level of the student participants their scores in conceptual understanding and mathematical skills were summed up and used the following five-level scale based on the Department of Education (DepEd) standard and modified by the research: Advance (90 percent and above) score ranges from 72 to 80, Proficient (80 to 89 percent) score ranges from 64 to 71, Approaching Proficiency (70 to 79 percent) score ranges from 56 to 63, Developing (60 to 69 percent) score ranges from 48 to 55, and Beginning (59 percent and below) score ranges from zero to 48.

Part III. It is a checklist that is set to measure the level of acceptability in terms of content (nine items) adopted from Diongco et al. (2020), presentation and organization (seven items) adopted from Soltura (2022), and learning activities (nine items) adopted from Salcedo (2016) with nine statement indicators respectively. Moreover, the student participants were tasked to check the appropriate column of their responses using the following five-point scale: 5 for Highly Acceptable, 4 for Moderately Acceptable, 3 for Acceptable, 2 for Fairly

Acceptable, and 1 for Poorly Acceptable.

The research instruments utilized in this study were crafted accordingly with a table of specifications and validated using two types of validation procedures: 1) expert validation and 2) pilot testing.

First, the drafted research instrument by the researcher was submitted to the science teachers of PNHS who have been teaching science for the last five years for expert validation, focusing on the very content of the instruments. After this, the research instrument was re-drafted by integrating all the suggestions provided by the researcher's adviser in preparation for the second validation procedure, the pilot testing.

The administration of the research instrument for this validation procedure was done on two separate occasions using the test-retest method. One week was allocated for the second administration of the research instrument to give the student participants involved in the try-out to settle their mindset formally. This procedure aims to check the clarity and neatness of the instructions and identify ambiguous questions or statements in the research instrument constructed by the researcher.

The results of the validation became the basis of the final rephrasing, omitting, and even constructing additional information necessary for a more reliable research output. Thus, the R-value for the correlational analysis of attitude toward science is equivalent to 0.84, which can be interpreted as a high positive correlation; for the conceptual understanding and mathematical skills, the alpha value was equivalent to 0.94, meaning the questions in the questionnaire was excellent, and the r-value for the level of acceptability was 0.92 meaning it has a very high positive correlation. Overall, the questionnaire in this study was good enough to be fielded.

Data Collection Methods

Before starting the study, the researcher trained one teacher from Pangdan National High School on how to apply the GMRCE Model in teaching Gas Laws and all the technical know-how of this study. The researcher ensured that before the study, the teacher-participant who handled the experimental group was qualified and equipped with the necessary knowledge and preparation to conduct these lessons utilizing the GMRCE Model. This strategy eliminated the internal threat to validity by not allowing the researcher to intervene in the study's outcome.

Thus, to attain the objectives of the study, the researcher observed the following steps: First, the researcher wrote a letter to the district supervisor and school heads of Pangdan National High School to ask permission to conduct the study formally. Second, after being granted, the researcher crafted the research instrument and determined the controlled and experimental groups of participants. Third, the researcher validated the instrument using two types of validation procedures: 1) expert validation and 2) pilot testing. Fourth, pilot testing was done with the randomly selected 10 Grade 10 students. Fifth, using the validated research instrument, the researcher administered the pre-test to the student participants for both experimental and controlled groups. Sixth, the researcher crafted detailed lesson plans for experimental and controlled groups used in the study. Seventh, distribute materials like notebooks, paper, pens, and plastic envelopes to the student participants. Eight, the commencement of classes based on the schedule was observed by the researcher and the other teacher concerned with the experimental groups. Ninth, a post-test was administered after the time allotted for the topics concerned. Lastly, results were finalized and computed using Microsoft Excel and SPSS by the researcher for data analysis and interpretation.

Statistical Techniques

The study employed the following descriptive and inferential statistical treatments in the analysis and interpretation of data:

Frequency count. This statistical tool was used to summarize the student participant's profiles, such as age and sex, academic performance in science, and attitude toward science, as well as the proficiency level and level of acceptability on the proposed model. Also, it was used to summarize the other relevant data.

Percentage. This descriptive statistical tool was used to present the data on age and sex, academic performance in science, and attitude toward science, as well as the proficiency level and level of acceptability as to the magnitude of occurrence.

Mean and Weighted Mean. This measure was used to determine the average scores of the four groups of participants in assessing their knowledge and skills conceptually and mathematically, the collective attitude towards science, and the level of acceptability of student participants.

Standard Deviation. This statistical measure was utilized to describe the extent to which the data vary.

Kuder-Richardson 20. This statistical tool was used to test the internal consistency of the data-gathering instrument. It was used in the test for the validity of the test instrument on students' conceptual and mathematical skills in Gas Laws.

Pearson Product-Moment Correlation Coefficient. This method was used to determine the correlation between the student participants' profile variates, academic performance, attitude toward science, and level of acceptability of the proposed intervention.

T-Test for Dependent and Independent Samples. The t-test for dependent samples was used to determine if a significant difference between the pre-test and post-test scores exists for the controlled and experimental groups. Meanwhile, the t-test for independent samples was utilized to determine if a significant difference existed between the two groups in the pre-test and post-test of the Achievement Test in Gas Laws.

RESULTS AND DISCUSSION

This part presents the findings of the study with the corresponding analysis and interpretation of data. Included herein are the following: profile of the student-participants in terms of age, sex, and academic performance; attitude toward science; pre-test and post-test mean scores of the experimental and controlled groups; pre-test and post-test proficiency level; the correlation between the profile variates and attitude toward science; the difference between pre-test and post-test mean scores of controlled and experimental groups; the difference between the pre-tests of controlled and experimental groups; the difference between the post-tests of controlled and experimental groups; level of acceptability; and even the conclusions and recommendations.

Pre-Test and Post-Test Mean Scores of Student-Participants

Table 3 provides information regarding the student-participants' pre-test and post-test mean scores. The test was divided into two parts: Part I, was a 15-item test measuring their conceptual understanding of Gas Laws with a total of 60, four points being the highest and zero for the lowest. Part II was a 4-item scientific word problem relative to Gas Laws with a total point of 20 or five points per problem.

Table 3

Pre-Test and Post-Test Mean Scores of Student-Participants

Group	Mean Score						Difference
	Pre-Test		Total	Post-Test		Total	
	CU	MS		CU	MS		
Controlled	16.80	4.05	20.85	32	12.90	44.90	24.05
Experimental	14.70	2.85	17.55	36.65	13.05	49.70	32.15
Difference	2.10	1.20	3.20	4.65	0.15	4.80	8.10

Table 3 reveals that the total pre-test mean score of the controlled group was 20.85 and the total post-test mean score was 44.90. The difference is equivalent to a positive 24.05. At the same time, the total pre-test mean score of the experimental group was 17.55 lower by 3.20 points compared to the controlled group and the total post-test mean score was 49.70 higher by 4.80 points compared to the controlled group. Accounting for the difference between the pre-test and post-test mean scores within and among the groups, the controlled groups garnered a difference of 24.05. In contrast, the experimental group obtained 32.15, which is significantly higher at 8.10 points. The data suggested that the student participants treated with the intervention in learning Gas Laws performed better than those left untreated.

Pre-Test and Post-Test Proficiency Level of Student-Participants

Table 4 contains the summary data on the pre-test and post-test proficiency levels on Gas Laws of the student-participants.

Table 4

Pre-Test and Post-Test Proficiency Level of Student-Participants

Level of Proficiency Scale	Controlled Group				Experimental Group				Descriptive Interpretation
	Pre-Test		Post-Test		Pre-Test		Post-Test		
	f	%	f	%	f	%	f	%	
59% & below	20	100	11	55	20	100	7	35	B
60 – 69%	0	0	3	15	0	0	7	35	D
70 – 79%	0	0	4	20	0	0	4	20	AP
80 – 89%	0	0	1	5	0	0	1	5	P
90% & above	0	0	1	5	0	0	1	5	A
Total	20	100	20	100	20	100	20	100	-

Legends:	Scale	Score	Interpretation	Initials
	59% & below	0 – 47	Beginning	(B)
	60 – 69%	48 – 55	Developing	(D)
	70 – 79%	56 – 63	Approaching Proficiency	(AP)
	80 – 89%	64 – 71	Proficient	(P)
	90% & above	72 – 80	Advanced	(A)

Table 4 revealed that, on the pre-test, all the student participants both in the controlled and experimental groups obtained scores of 59% and below or

47 points below meaning all of the student participants were classified at the beginning level.

Additionally, for post-test results, the majority of the controlled group was classified at the beginning level that is 11 or 55 percent, followed by three or 15 percent at developing, four (4) or 20 percent at approaching proficiency, and both proficient and advanced levels gain one (1) student-participant respectively. The majority of the experimental group was classified as beginning and developing levels, that is, seven (7) or 35 percent correspondingly, followed by four (4) or 20 percent at approaching proficiency, and both proficient and advanced levels gain one (1) student-participant separately. These data imply a significant improvement and mobility in the proficiency level of the student participants on Gas Laws.

Difference between the Pre-Test and Post-Test of the Controlled Group

Table 5 encompasses the results of the difference between the pre-test and post-test scores of the controlled group on their conceptual understanding and mathematical skills on Gas Laws.

Table 5

Difference between the Pre-Test and Post-Test of the Controlled Group

Variates	n	Mean	SD	t-Value	p-Value	Evaluation	Decision
Pre-Test	20	20.85	6.83	-5.73	0.00	Significant	Reject H_o
Post-Test	20	44.90	15.80				

In connecting the difference between the pre-test and post-test scores of the controlled group, the coefficient of correlation yielded a t-value of -5.73 with a p-value equal to 0.00. The generated data revealed that the p-value was lesser than the 0.05 significance level, signifying that the difference between the variables was significant. This meant that the post-test scores of the control group were significantly better than their pre-test scores. Thus, the corresponding null hypothesis to this effect was rejected.

Difference between the Pre-Test and Post-Test of the Experimental Group

Table 6 comprehends the outcomes of the difference between the pre-test and post-test scores of the experimental group on their conceptual understanding and mathematical skills on Gas Laws.

Table 6
Difference between the Pre-Test and Post-Test of the Experimental Group

Variates	n	Mean	SD	t-Value	p-Value	Evaluation	Decision
Pre-Test	20	17.55	5.73	-10.75	0.00	Significant	Reject H_o
Post-Test	20	49.70	11.06				

In connecting the difference between the pre-test and post-test scores of the experimental group, the coefficient of correlation yielded a t-value of -10.75 with a p-value equal to 0.00. The generated data revealed that the p-value was lesser than the 0.05 significance level, which signified that the difference between the aforesaid variables was significant. This meant that the post-test scores of the experimental group were significantly better than their pre-test scores. Thus, the corresponding null hypothesis to this effect was rejected.

Difference between the Pre-Tests of the Controlled and Experimental Groups

Table 7 encompasses the results of the difference between the pre-test scores of the controlled and experimental groups on their conceptual understanding and mathematical skills on Gas Laws.

Table 7
Difference between the Pre-Tests of the Controlled and Experimental Groups

Group	n	Mean	SD	t-Value	p-Value	Evaluation	Decision
Controlled	20	20.85	6.83	1.65	0.11	Not Significant	Accept H_o
Experimental	20	17.55	1.28				
Mean Difference				3.30 points			

In connecting the difference between the pre-test scores of the controlled and experimental groups, the correlation coefficient yielded a t-value of 1.65 with a p-value equal to 0.11. The generated data revealed that the p-value was greater than the 0.05 significance level, signifying that the difference between the aforementioned variables was insignificant. This meant that the pre-test score of the experimental group did not significantly influence the pre-test score of the control group. Yet, the control group's mean score was significantly higher at 3.30 points. Thus, the corresponding null hypothesis to this effect was rejected.

Difference between the Post-Tests of the Controlled and Experimental Groups

Table 8 encompasses the results of the difference between the post-test scores of the controlled and experimental groups on their conceptual understanding and mathematical skills on Gas Laws.

Table 8

Difference between the Post-Tests of the Controlled and Experimental Groups

Group	n	Mean	SD	t-Value	p-Value	Evaluation	Decision
Controlled	20	44.90	15.80	-1.11	0.06	Not Significant	Accept H_o
Experimental	20	49.70	11.06				
Mean Difference					4.80 points		

In connecting the difference between the pre-test scores of the controlled and experimental groups, the coefficient of correlation yielded a t-value of -1.11 with a p-value equal to 0.06. The generated data revealed that the p-value was greater than the 0.05 significance level, signifying that the difference between the aforementioned variables was insignificant. This meant that the experimental group's post-test score did not significantly influence the post-test score of the control group. Yet, the experimental group's mean score was significantly higher at 4.80 points. Thus, the corresponding null hypothesis to this effect was rejected.

The Level of Acceptability on the GMRCE Model of Student-Participants

Table 9 appraises the attitude of student participants toward science education. There were 20 attitudinal statements considered in this study.

Consequently, table 13 establishes that in all the 25 statements relative to the level of acceptability, the student-participants expressed that the intervention used in this study was "Moderately Acceptable," with equivalent mean values that range from 2.60 to 4.50. Statement number 2, under content, was rated the highest, saying, "Engage and motivate learners," and statement number 7, under presentation and organization, was rated the least, stating, "Are parallel with the objectives and activities."

Table 9

The Level of Acceptability on the GMRCE Model of Student-Participants

Statement		Mean
A. Content		3.48
1.	Are associated and appropriate to the lesson or concept being learned	4.45
2.	Engage and motivate learners	4.50
3.	Are interactive and interesting	4.25
4.	Present ideas in a comprehensive language	3.20

5.	Are sufficient to support learning	2.75
6.	Are appropriate for the learners' level of comprehension	2.65
7.	Are parallel with the objectives and activities	2.60
8.	Are sufficient to allow the learners to learn independently	3.75
9.	Provide a range of learners' interests and preferences	3.20
B. Presentation and Organization		3.71
1.	Clarity of presentation of the concepts	3.15
2.	Clarity of instructions	3.85
3.	Orderly presentation of the content	3.95
4.	Adequacy of the content	4.25
5.	Application of appropriate learning strategies	3.75
6.	Compatibility of the lessons to the allotted time frame	3.60
7.	Provisions for interactive teaching-learning	3.45
C. Learning Activities		3.64
1.	The activities were developed to enhance the understanding of the concepts	3.60
2.	The activities were distributed fairly from simple to complex	3.40
3.	The activities were presented in an organized manner	3.85
4.	The activities were linked logically to other topics	3.85
5.	The activities were created to stimulate distinctive interest in learning	3.60
6.	The activities were arranged accordingly to develop critical thinking	3.85
7.	The activities were applied to real-life situations	3.50
8.	Activities were suited appropriately to the needs of the group in the class	3.50
9.	The activities can be understood easily	3.65
Grand Mean		3.61
SD		0.19

Legends:	Scale	Interpretations	Initials
	4.51 – 5.00	Highly Acceptable	(HA)
	3.51 – 4.50	Moderately Acceptable	(MA)
	2.51 – 3.50	Acceptable	(A)
	1.51 – 2.50	Fairly Acceptable	(FA)
	1.00 – 1.50	Poorly Acceptable	(PA)

Taken as a whole, the student-participants expressed that they found the intervention “Moderately Acceptable,” which can be inferred that they were very satisfied with the model, as is shown by the statements being indicated with the grand mean of 3.61 and an SD value of 0.19.

CONCLUSION

The students were at the age which indicated that they relatively met the qualifying standard set by the Department of Education for Grade 10 students, and female dominance existed among them. Moreover, the majority of the students fairly satisfactorily perform in science. This is because they have been negatively influenced by their previous experiences, which has built an undesirable learning attitude toward the subject. The study by Hacieminoglu (2016) supported the idea that traditional teaching and over-dependence on textbooks could be responsible for the increasing negative student attitudes about science. Teachers should be aware of students’ differences to improve students’ academic performance and attitude toward science.

It was also found in the study that the students have less interest in learning and understanding science, which might have a detrimental effect on their performance. That attitude has been identified as an important measure for assessing science teaching, which is related to students’ performance in learning science and their retention of what they have learned in science (Fulmer et al., 2019). Thus, students with positive attitudes towards science reflect on their ability to demonstrate the knowledge they have learned and tend to have higher scores in tests, quizzes, presentations, and final examinations; hence, students with negative attitudes towards science may obtain otherwise (Perera, 2014).

Consequently, based on the student’s assessment performance, both groups had a nominal idea of the concepts and skills of Gas Laws. Nevertheless, both groups obtained a significant increase in their knowledge and understanding of the lesson, yet the experimental group performed better than the control groups, garnering a significant difference. The comparison results between the two groups showed that the control group obtained a 24.05 mean score while the experimental group obtained 32.15, significantly higher at 8.10 points. This is due to the impact of the cooperative learning intervention used to improve their learning attitude and performance in teaching gas laws because students were involved in relevant, inquiry-based, active learning experiences. This finding is consistent with that of Jayapraba (2013), who claimed that cooperative learning increases achievement for all ability levels, fosters critical thinking, leads to deeper understandings, fosters positive peer relationships, improves students’ social skills and helps them support their peers more socially, and raises self-esteem.

In addition, as it is observed, teachers teach their students how to be a part of a productive group and manage conflict; teachers also learn those social skills and can use them with their colleagues. Thus, cooperative learning promotes higher achievement than competitive or individual learning experiences (Gillies & Boyle, 2010).

TRANSLATIONAL RESEARCH

As it was discovered that still, some teachers were still using the traditional way of teaching science, there is a need to conduct training on the different teaching strategies promoting cooperative learning or other relevant pedagogies that could elicit active participation and improve learning attitudes toward the subject.

As was disclosed in the study, a significant number of students do not have a positive attitude toward science, which negatively impacts their academic performance; teachers should facilitate the proper acquisition of essential knowledge and skills to learn and appreciate the importance of science. Also, teachers should be made aware of the powerful relationship between meaningful learning through professional development on pedagogy, instruction, and content.

Likewise, teachers should strengthen their delivery of instruction and conduct remedial teaching or follow-up sessions whenever necessary to improve the student's learning attitude toward science. Also, students should be given in-depth instruction in knowledge and skills, including opportunities for hands-on activities, peer-teaching, and discussion of ideas and concepts, as well as inquiry-based active learning experiences in the content area related specifically to the concepts being learned.

Nevertheless, a replicated study may be conducted in other schools involving a larger group of participants and integrate a relevant qualitative approach to validate the findings of this study.

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