THE EFFECTIVENESS OF GRADUAL RELEASE OF RESPONSIBILITY APPROACH IN IMPROVING PERFORMANCE OF STUDENTS IN MATHEMATICS

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ABSTRACT

Mathematics is fun but very challenging to teach. Several studies reported different teaching approaches that are considered effective in enhancing students' performance in Mathematics. This quasi-experimental design of the study aims to determine the effects of the Gradual Release of Responsibility (GRR) Approach in improving the performance of students in Mathematics, particularly in lesson Geometry 7. The subjects were grouped into a control group that was exposed to the Traditional Teaching Approach Employed by the School and experimental group, which was exposed to the GRR approach. Data gathered were analyzed using mean, t-test for independent sample, paired sample t-test, and ANCOVA. Results revealed that before the implementation of the approaches, both levels of proficiency of the groups are at the beginning level, which implies that they were struggling in their understanding due to lack of essential knowledge and skill on the topics. The results showed that there is an improvement in the performance of students in Mathematics after being exposed to the GRR approach and traditional teaching approach. The post-test performance of the control group found to be at the developing level of proficiency while the experimental group found to be at the approaching proficient level. Finally, the study indicated that there was a significant difference in the post-test mean scores between the control and experimental groups with pre-test mean scores covariates. The findings revealed that the GRR approach could improve the Mathematics performance of students. Based on the result of this study, the Gradual Release of Responsibility Approach is recommended to be used as an approach in teaching Mathematics.

Keywords: Mathematics, performance in Mathematics, gradual release of responsibility, quasi-experimental design, Philippines

INTRODUCTION

The continued concern of teachers on students' performance in Mathematics calls for the implementation of an innovative teaching approach that is best suited to the students. In fact, according to the International Mathematics Union (2010), one of the crucial issues in educational development is the need to strengthen Mathematics development. Unfortunately, many students continue to show incapability of performing basic Mathematics skills like solving and analyzing (Alzhanova-Ericsson, Bergman & Dinnétz, 2017). Thus, the poor performance of students in Mathematics remains to be a widespread problem today.

The low performance of students in Mathematics is also a problem for many countries like Finland, Germany, Kuwait, Netherlands, and Saudi Arabia (TIMSS, 2015). Even one of the leading countries, which is the United States of America, is experiencing a low performance in Mathematics. The report of the Programme for International Student Assessment (PISA) revealed that among the 35 members of the Organization for Economic Cooperation and Development (OECD), the US ranked 30th in Mathematics. The data provided by the reports of TIMSS (2015) and PISA (2015) concluded that there is a poor status of students' performance in Mathematics internationally.

Some of the Association of Southeast-East Asian Nation countries are also experiencing a low performance in Mathematics. For example, the PISA 2013 results for Indonesian students showed that they got the second-lowest in the OECD league table, worse than the last PISA in 2009 when Indonesia ranked 57th (PISA, 2013). Furthermore, low performance in Mathematics is also a problem in Thailand (Armstrong & Laksana, 2016; Mala, 2016) and Malaysia (World Bank, 2018; PISA, 2012).

Hence, low performance in Mathematics is also a continuous problem in some ASEAN countries. In the Philippines, low performance in Mathematics is also a concern. For instance, in the report of the 2016-2017 Global Competitiveness Report of the World Economic Forum (WEF, 2017), the Philippines was ranked 79th out of 138 countries in the quality of Mathematics education. Consequently, these records showed that the Philippines has poor performance in Mathematics.

Locally, the result of the Mathematics K to 12 Diagnostics Test conducted by the Center for Educational Measurement, Inc. in 2018 in one of the private schools in Davao del Sur showed that only about 12% of the students got above the middle 80%, which implies that there are only a few students who are above in the average range of scaled scores. Thus, these data manifested the low performance of students in Mathematics.

Many reasons lead students to perform poorly in Mathematics. However, many of the researchers claimed that it is due to teachers' poor teaching methods and qualifications (Harris & Bourne, 2017; Tshabalala & Ncube, 2016; Ali & Jameel, 2016). Moreover, Sullivian (2011) stressed that the teacher must give attention to the learning process in order for the students to perform in Mathematics.

One of the teaching approaches that can address this concern is the Gradual Release of Responsibility (GRR). In fact, many studies showed the effects of GRR in teaching English subject (Read, Landon-Hays & Martin-Rivas, 2014; Fullerton, Andrews & Robson, 2015; Stahl & Garc, 2015, Lin & Cheng, 2010) and Science and Technology Subject (Loewenstein, 2016; Whittaker, 2016; Gillies, Nichols & Burgh, 2011; Hackling, Peers & Prain, 2007). However, only a few studies were conducted for Mathematics subject, such as the studies conducted by Reyes (2019) and Saligumba and Tan (2018). The limited studies on the Gradual Release of Responsibility Approach and the possibility that it can be an effective teaching approach to improve students' performance in Mathematics are what prompted the researcher to conduct this study. Thus, the researcher conducted this study to determine if the Gradual Release of Responsibility was also an effective approach to improving the performance of students in Mathematics.

Review Related Literature

In this section, different pieces of literature and studies associated with the study were reviewed, particularly the performance of students in Mathematics and the Gradual Release of Responsibility (GRR) approach.

Performance of Students in Mathematics

Mathematics is one of the most important core subjects in a school curriculum. Achievement in this subject is important, and it is recognized as vital to the nation's success (Bell, 2011). Early Mathematics higher performance is an important predictor of later academic achievement and a variety of measures of adult health and economic well-being (Geary, Hoard, Nugent & Bailey, 2013; Gerardi, Goette & Meier, 2013; Jordan, Glutting & Ramineni, 2010). However, students' performance in Mathematics has been so low in the past decades (Schimdt, 2012).

One of the leading countries, the USA, is experiencing poor performance in Mathematics. Poor international mathematics achievement of American students has been documented as early as the 1960s (Mayfield & Glenn, 2018). In addition, only 40 percent of grade 4 students in 2015 scored at or above proficient on the NAEP Mathematics Assessment (National Center for Education Statistics, 2015). Significantly, Provasnik et al. (2016) showed that other countries outperformed U.S. students on the mathematics assessment by margins that reached statistical significance. Furthermore, the report of International Results in Mathematics said that Finland, Germany, Kuwait, Netherlands, and Saudi Arabia got a lower average in Mathematics performance compared to other countries (TIMSS, 2015). Thus, poor performance in Mathematics is rampant worldwide.

Low performance in Mathematics is also a problem of some countries of the Association of Southeast-East Asian Nations, like Indonesia (PISA, 2013). A similar concern was found out in Thailand. Over the past decades, Thailand had faced alarming rates of underachievement in Mathematics among students of all ages (Shaikh, 2013). On the contrary, neighboring countries like Singapore, Hong Kong, Chinese Taipei, and Japan are leading in Mathematics achievement (TIMSS, 2015). Thus, achievement in Mathematics shows a relevant effect on a certain nation.

In the Philippines, low performance in Mathematics is also a problem. For instance, in the report of the 2016-2017 Global Competitiveness Report of World Economic Forum (WEF, 2017), the Philippines got ranked 79th out of 138 countries in the quality of Mathematics and Science education. This problem is already occurring even a decade and a half ago. For example, Trends in International Mathematics and Science Study (2003) noted that the Philippines ranked 34th out of 38 countries. Additionally, the Philippine educational system underperformed among peers in other Asian countries (Cordero, 2018). Consequently, these records showed that the Philippines had a poor mathematical performance. The Department of Education (DepEd) mandated that Mathematics as a school subject must be learned comprehensively and with much seriousness (DepEd, 2013). In fact, as part of the government effort to respond to the perceived needs of the education sector, the DepEd had pushed for the implementation of the K to 12 Program (Capate & Lapinid, 2015). However, low performance in Mathematics still prevails.

Research on different types of feedback suggests that process-oriented, descriptive, and specific feedback has more positive effects (Fluckiger et al., 2010; Harks et al. 2014, Davis & Carson, 2005). Recently, several empirical researches based on large scale surveys such as TIMSS or PISA had extensively investigated the relationships between teacher characteristics and students' performance in Mathematics. For example, Kim and Ham (2014) investigated the effects of school-level variables on Korean students' non-cognitive outcomes in Mathematics using the PISA 2012 data. They found that as process variables in the classical process–product model, teacher characteristics such as student-oriented teacher behaviors and disciplinary climate of math classroom had positive effects on students' self-efficacy in Mathematics, which in turn, served as a major non-cognitive factor that drives students to higher math performance.

Lack of experience and qualification as Mathematics teachers are also the reason that leads the students to perform poorly in Mathematics (Harris & Bourne, 2017; Tshabalala & Ncube, 2016; Ali & Jameel, 2016). Furthermore, they also lack the relevant experience with classroom assessment practices as they have never previously taught or received training in the field (Campbell & Evans, 2010). This lack of experience, knowledge, and skills poses a problem to the system as these teachers are not adequately prepared to meet the diverse learning needs of students in the classroom (Akos, Cockman & Strickland, 2007). Although these teachers have undergone short term placements in secondary schools as part of their training, they are not adequately prepared to meet the learning needs of the diverse student population. This type of recruitment arrangement is one of the major contributing factors to poor standards in classroom assessment practices in Britain (Department of Education, 2012).

Flores (2016) discussed that the teacher's ability to engage in quality instruction has the greatest impact on student learning and become competent in Mathematics. Teachers must use explicit instruction (Preston, 2016; Archer & Hughes, 2011) and cooperative learning (Gupta & Pasreja, 2018; Turgut & Turgut, 2018; Ling, Ghazali & Raman, 2016). Therefore, a Mathematics teacher must consider this reason and improve their teaching performance and develop an effective teaching approach.

To ensure the students' mastery in certain Mathematical skills and perform accordingly, it is also important to let the students perform independently with the aid of teacher's feedback and let them start to become independent to improve learning (Hockings, Thomas, Ottaway & Jones, 2017; Knight, 2012). Furthermore, as discussed in the findings of McVee, Shanahan, Pearson, and Rinker (2015), if the teacher knows how to guide and learn how to release responsibility to the students, they will reflect more on their own apply the authentic task in Mathematics with full of understanding and essential skills.

Gradual Release of Responsibility (GRR)

Teachers tend to find an effective approach in teaching that suits to the students of today. As observed, students this day are in need to develop their social-conventional knowledge. Focusing on this matter, it ensembles to Pearson and

Gallagar's (1983) Gradual Release of Responsibility model of instruction. This approach has "I do—We do—You do" format in teaching (Fisher & Frey, 2008). Later, it was developed by Fisher and Frey (2013), who devised the phases into four components. Explicitly, focused instruction, guided instruction, collaborative learning, and independent learning. Thus, if teachers focus on this approach, it will be a practical approach in today's students.

Twenty-first-century learners are in need of concrete instruction and modeling before leaving them some responsibilities. This is undeviating to the first phase of the gradual release of responsibility approach, which is the focused instruction. According to Fish and Frey (2013), this phase ensures that students understand the relevance of the lesson. This phase shows the teacher as a model in the learning process (Collet, 2015). Additionally, teachers who are careful in sequencing and connecting the lessons and approaches through focused instruction (Smith & Stein, 2011; Smith, Bill & Hughes, 2008) leads to good quality education of the students (Vic Zbar, 2014; Zakaria, 2009; Lazarowitz, Hertz, Lazarowitz & Baird, 1994). Generally, it allows students to work on cognitive structures and schemata of the lesson (Piaget, 1952). Moreover, GRR influences punitive knowledge, not only for students but also for teachers (Confrey & Maloney, 2012). Thus, focused instruction leads the way on the totality of GRR and a very important phase in students' learning.

Mastery of the lessons is needed in the learning process. In other words, the teacher must find a way so that the students can develop mastery of the lesson. Mastery in lessons and skills is more developed by scaffolding (Schukajlow, Kolter & Blum, 2015). The gradual release of responsibility's guided instruction is making scaffolding better and producing more independent students (Fish & Frey, 2013; Read, Landon-Hays & Martin-Rivas, 2014). Mastery of learner is more important in the teaching-learning process. Accordingly, to develop mastery in lessons, a gradual release approach must be employed. Through this instruction, the children tend to develop a higher mathematical idea (Daro, Mosher & Corocoran, 2011; Bakker, Smith & Wegerif, 2015).

Students are interacting with one another to build each other's learning. Outward indicators include body language and movement associated with meaningful conversations. This notion is called collaborative learning (Fish & Frey, 2013), the third phase of the gradual release of responsibility. According to O'Brien, Fielding-Wells, Makar, and Hillman (2015), interaction in Mathematics facilitates growth on mindsets. This is providing opportunities for students to engage in discourse about tasks and mathematical ideas (Huffered-Ackles, Fuson & Sherin, 2004), and using formative data to design subsequent mathematical tasks (Joyner & Muri, 2010). Moreover, students who were instructed using cooperative learning achieved significantly higher scores than students who were instructed using lecture-based teaching or traditional teaching (Tan, 2014; Zakaria, Solfitri, Daud, & Abidin, 2013; Shimazoe & Aldrich, 2010). Added by Palincsar and Herremkohl (2002), interacting with peers is learning. GRR with this phase is also proven in writing (Lee, 2013). Therefore, a gradual release approach advocated for the enactment of collaborative learning pedagogies to increase both student achievement and students' understanding of subject concepts.

Ideally, teachers want to create learners who are not dependent on other information and ideas. As such, students need to practice completing independent tasks and learning from those tasks, and this is recognized as the ultimate goal of the gradual release of responsibility (Fisher & Frey, 2013). Releasing responsibility gradually to students increases their ability and boosts their confidence (Donohoo, 2010). Moreover, self-responsible learning enhances students' Mathematics academic performance (Su, 2015).

Gradual Release of Responsibility must be utilized as an approach to teaching Mathematics subject. However, most of the published studies focus on the effect of the gradual release of responsibility approach towards performance in English, since the approach was coined for the development in language and writing (Fisher & Frey, 2011), not in Mathematics. In fact, GRR shows the effectiveness in teaching English subject (Read, Landon-Hays & Martin-Rivas, 2014; Fullerton, Andrews & Robson, 2015; Stahl & Garc, 2015, Lin & Cheng 2010). Additionally, the scaffolding approach base on GRR gives promising progress on young English learners (Fullerton, Andrews & Robson, 2015).

Some studies were conducted on the effect of GRR on Science subjects. For example, Whittaker (2016) found that scientific understanding is more developed through the use of a gradual release of responsibility model of instruction. It is also effective in other fields of Science (Loewenstein, 2016; Whittaker, 2016; Gillies, Nichols & Burgh, 2011; Hackling, Peers & Prain, 2007). Moreover, it creates better teaching practices that integrate phases for better learning in other fields of Science (Loewenstein, 2016; Whittaker, 2016; Gillies, Nichols & Burgh, 2011; Hackling, Peers & Prain, 2007). Therefore, if the GRR approach can have a positive outcome towards the other core subjects, it must also be in Mathematics.

There are only a few published studies about the implementation of the Gradual Release of Responsibility in teaching to improve the performance of students in Mathematics. For example, Saligumba and Tan (2018) state that GRR can improve the performance of students in Mathematics. It is also supported by the findings of Reyes (2019) as he found out that GRR predicts the performance of students in Mathematics. Therefore, if a teacher optimizes the Gradual Release of Responsibility Approach, then a poor performance of students in Mathematics will be lessened.

Based on the above-related literatures and studies, it can be argued that the Gradual Release of Responsibility Approach provides phases that are effective in improving the academic performance of students. Since GRR shows a positive result in other core subject areas, then it can also provide a positive result in Mathematics. The teacher should have a teaching approach that reinforces students in responsible learning because it can lessen the poor performance in Mathematics. Further, the foregoing presentation and discussion of various literatures have helped in bringing into focus the two important variables: Gradual Release of Responsibility (GRR) Approach and performance of students in Mathematics. These served as support to the results and findings of the study.

Theoretical Framework

The theoretical orientation that underpins the notion of this study is Fisher and Frey's (2013) version of the Gradual Release of Responsibility Approach. It is the revised version of Person and Gallagher's (1983) GRR approach. The original approach limits the interactions to adult and child exchanges: "I do it"; "We do it"; "You do it alone." But the new version argues that this three-phase model omits a truly vital component, which is learning through collaboration with their peers. Thus, the "You do it together" phase was added.

The first phase of this approach is the "I do it." In this phase, the teacher first gives the information that allows the students to learn the concept and terms on the given topic. It was based on the concept of cognitive constructivism (Piaget, 1952). The students are expected to understand the lesson through the teacher's discussion. Thus, this phase allows students to work on cognitive structures and schemata of the lesson.

The second phase of this approach is the "We do it". In this phase, the teacher does a certain task with the students. Gradually, he/she will let the students answer or solve the question given through the guided questions and instructions. This was grounded from Wood, Bruner, and Ross' (1976) scaffold instruction. Hence, through this, teachers are slowly making students responsible enough to handle the task.

The students work on attention, retention, reproduction, and motivation through other students in order to perform better. This is the goal of the third phase, which is the "you do it together". It was coined from the notions of Social Learning Theory of Bandura (1965). Consequently, in this phase, the students will understand more in in-depth analysis of the lesson by comparing their ideas and constructing new knowledge that they acquire from their peers.

The proper invigorating of the first three phases is expectedly resulted in to drive of students to learn independently, which is the last phase of this approach, the "You do it alone" phase. Fisher and Frey (2013) argue that learning is most developed if the learners can understand, analyze, and comprehend without the help of others. Therefore, the last phase will illustrate the performance of the learners on the topic.

Objective of the Study

The study aimed to determine the effects of the Gradual Release of Responsibility Approach in improving the Mathematics performance of the Grade 7 students. Specifically, the pre-test mean scores of control and experimental groups, the post-test mean scores of control and experimental groups. It also investigated if there is a significant difference between the pre-test mean scores of control group and experimental group, if there is a significant difference between the pre-test and post-test mean scores of students in the control group, if there is a significant difference between the pre-test and post-test mean scores of students in experimental group, and if there is a significant difference in the post-test mean scores between the control and experimental groups with pre-test means scores as covariates.

Hypothesis

The null hypotheses in this study were tested at 0.05 level of significance.

HO1: There is no significant difference between the pre-test mean scores of control and experimental group.

HO2: There is no significant difference between the pre-test and post-test mean scores of students in the control group.

HO3: There is no significant difference between the pre-test and post-test mean scores of students in the experimental group.

HO4: There is no significant difference in the post-test mean scores between the control and experimental groups with pre-test mean scores covariates.

Method

This study utilized the quasi-experimental design. This research design is appropriate to use when it is not possible to randomly assign participants to control or experimental groups for comparison (Cook, Campbell & Shadish, 2002). In addition, the nonequivalent pretest-posttest control group design was used to contrast the mean scores of the control and experimental groups.

O1	X	O2
- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
O3		O4

Figure 1. *The Nonequivalent Control Group Design*

Where:			
	X	=	*Experimental Treatment*
	O1	=	*Pretest of the Experimental Group*
	O2	=	*Posttest of the Experimental Group*
	O3	=	*Pretest of the Control Group*
	O4	=	*Posttest of the Control Group*
	----------	=	*Non-randomized Selection of the Subjects*

The subjects were the intact groups of Grade 7 students in a naturally accumulated classroom setting. The study was conducted during the third grading period of the school year 2018-2019. In totality, there were 81 Grade 7 students included in the study. Of this number, 41 students were coming from Grade 7-Section E, and the other 40 students were coming from Grade 7-Section F. Both were socialized sections in which students were heterogeneously distributed. In identifying which of the two sections would be assigned as a control and experimental group, the purposive sampling technique was employed. A coin was tossed that resulted in the selection of Section E as the experimental group, while section F was assigned as a control group.

The data-gathering tool used in the study was a set of the teacher-made instrument. It was a 40-item multiple-choice type of summative test, in which seven (7) topics on Geometry were distributed as follows: (1) 5 items for Points, Lines, and Planes; (2) 6 items for Subset of a Line; (3) 5 items for Angles; (4) 6 items for Line and Angle Pairs; (5) 6 items for Polygons; (6) 6 items for Polygons focused on Triangles; and (7) 6 items for Parallel Lines Cut by Transversal Lines. The decision as to the number of items per topic was based on the competencies expected to be acquired by the students as articulated in the K-12 curriculum for Mathematics 7.

In order to establish the content validity of the instrument, expert validators and Mathematics teachers were tapped. Letters with the attached instrument were given to them, and the notes or comments made by the test evaluators were used as the basis for judging which items would be retained, improved, or removed. Results from table 1 reveal that the overall mean score is 4.39 and interpreted as to be very good. This result indicates that the content of the survey questionnaire, when tested in areas of clarity of language, presentation, or organization of topics, the suitability of items, adequacy of purpose, attainment of purpose and objectivity, passed the content validity. In addition, the test instrument was administered to 38 Grade 8 students for pilot testing. The data gathered from the pilot testing were processed and tested using Cronbach's Alpha to establish reliability and internal consistency. Tavakol and Dennick (2011) explained that Chronbach's Alpha estimates the quantity to add validity and accuracy to the interpretation of the research data. Results of the reliability statistics on table 2 show that Cronbach's Alpha was above .60, which is according to Ghazali (2008), is an acceptable value for reliability test (Tavakol & Dennick, 2011). Thus, the survey questionnaire was reliable enough to be administered.

The following are the procedural steps observed in executing this quasi-experimental design study: first, letter seeking permission to conduct the experiment was sent to the office of the Principal for approval. Second, the selection on which of the two sections would be the control or experimental group was determined by the tossing of a coin. After the toss coin, it was determined that Grade 7-F would be the control group, and Grade 7-E will be the experimental group. Third, prior to the start of the actual teaching, a pre-test was administered for both control and experimental groups. Fourth, before the first day of actual teaching, the topics included in the study were presented and referred from the learning competencies in the syllabus. Fifth, after the orientation of classes, the experiment started. Sixth, the researcher used the Gradual Release of Responsibility approach in teaching the experimental group employing the activities developed by the researcher. 7. For the control group, the researcher used the traditional teaching approach employed by the school. This approach is anchored on Social Constructivism theorized and popularized by Lev Vygotsky (1986). Eight, after the delivery of the seven lessons, post-tests were administered to both the control and experimental groups. Ninth, the Pre-test and Post-test results were scored and transmuted (60%) using the Transmutation Table and qualitative description, as shown in table 1 adopted from the Department of Education Grading System pursuant to DepEd Order No. 73 s. 2012. Lastly, data were analyzed using the most appropriate statistical tools.

Table 1. Table for Interpretation of Pre-test and Post-test Scores

Initial Mean Percentage Score	Level of Proficiency	Indicators
35 – 40	Advanced	Student exceeds core requirements in terms of knowledge, skills and core understanding; can transfer them automatically and flexibly through authentic tasks.
32 – 34.9	Proficient	Student develops fundamental knowledge, skills and core understanding; can transfer them independently through authentic tasks.
28-31.9	Approaching Proficiency	Student develops fundamental knowledge, skills and core understanding; with little guidance can transfer understanding through authentic tasks.
24 – 27.9	Developing	Student possesses the minimum knowledge and skills but needs help throughout the performance of authentic tasks.
Below, 23.9	Beginning	Student is struggling with his/her understanding due to lack of essential knowledge and skills.

In identifying the result of the study, the following statistical tools were used: First, mean was used to identify the mean scores of the subjects in the control and experimental groups. Second, the T-test for Independent Samples was utilized to find the significant difference between the pre-test mean scores of students in the control and experimental groups (Heeren & D'Agostino, 1987). Third, the Paired Sample T-test was employed to analyze if there exist significant differences between pre-test and post-test scores in the control and experimental groups (Mee & Chua, 1991). Finally, Analysis of Variance (ANCOVA) was employed to answer used to detect the difference between the means scores of the groups while controlling for scale covariant (Rutherford, 2011). The researcher employed ANCOVA since the homogeneity of the variance of the groups in terms of the level of their Mathematics performance is not determined because of the heterogeneous sectioning of the subjects. Thus, it was used to determine the significant difference between the post-test scores of control and experimental groups while controlling the pre-test scores.

Results

The results presented into six clusters with tales based on the six statements of the problem.

The Pre-Test Mean Scores of Control and Experimental Groups

Table 2 presents the pre-test mean scores of the control and experimental groups on the topics of Grade 7 Geometry: (1) Points, Line and Plane, (2) Subset of the Line, (3) Angles, (4) Line and Angle Pairs, (5) Polygons, (6) Polygons Focused on Triangles and (7) Parallel Lines Cut by Transversal Line.

The pre-test mean scores of the students in the control group, as reflected in Table 2, were between 1.33 and 2.08. The results revealed that of all the topics measured, the students were found to be weakest on the topic Angles with a mean score of 1.33 and described as being at the beginning level. Although, the students got a higher mean score of 2.08 on topic Points, Line, and Plane, still, the level of proficiency was at the beginning level. The overall pre-test means score of the students in the control group is 11.28, which indicates that the students in the control group are said to be at the beginning level of proficiency in all the specified topics on Grade 7 Geometry. Thus, the students in the control group at this level indicate a lack of essential knowledge and skills in the said topics.

Also, as presented in Table 2, the students in the experimental group were able to attain the mean scores between 1.37 and 2.05. The results revealed that of all the topics measured, the students in the experimental group were found to be weakest on the topic Subset of the Line with a mean score of 1.37 and described as being at the beginning level. Though the students got a higher mean score of 2.05 on topic Points, Line and Plane, still, the level of proficiency is at the beginning level. The over-all pre-test means score is 11.20, which indicates that the students in the experimental group are said to be at the beginning level of proficiency in all the specified topics on Grade 7 Geometry. Thus, the students in the experimental group at this level indicate a lack of essential knowledge and skills in the said topics.

Table 2. The Pre-test Mean Scores of Students in the Experimental and Control Group

TOPICS	Control Group		Experimental Group	
	Mean	Level of Proficiency	Mean	Level of Proficiency
Points, Line, and Plane	2.08	Beginning	2.05	Beginning
Subset of the Line	1.63	Beginning	1.37	Beginning
Angles	1.33	Beginning	1.90	Beginning
Line and Angle Pairs	1.68	Beginning	1.54	Beginning
Polygons	1.38	Beginning	1.51	Beginning
Polygons Focused on Triangles	1.53	Beginning	1.44	Beginning
Parallel Line Cut by Transversal Line	1.68	Beginning	1.39	Beginning
All Topics	**11.28**	**Beginning**	**11.20**	**Beginning**

In looking at the pre-test mean scores of both groups, it can be said that the two groups do not differ in their level of performance in all the topics that were measured. Both levels of proficiency of the groups were at the beginning level, which implies that in general, the students were struggling in their understanding due to a lack of essential knowledge and skills on the topics.

The Post-Test Mean Scores of Control and Experimental Groups

Table 3 reveals the post-test mean scores of the control group and experimental group on specified topics of Grade 7 Mathematics on lesson Geometry, namely; (1) Points, Line and Plane, (2) Subset of the Line, (3) Angles, (4) Line and Angle Pairs, (5) Polygons, (6) Polygons Focused on Triangles and (7) Parallel Lines Cut by Transversal Line.

As presented in Table 3, the students belonging to the control group were said to be already in the advanced level of proficiency in terms of the topic Angles with a post-test mean score of 4.23. This indicates that the students at this topic exceed core requirements in terms of knowledge, skills, and core understanding. Moreover, they got a mean score of 3.98 in the topic Point, Line, and Plane, which designated that they are proficient in this topic and can already transfer their fundamental knowledge, skills, and core understanding independently through authentic tasks. For the topics Subset of the Line, Line and Angle Pairs, Polygons, Polygons Focused on Triangles and Parallel Line Cut by Transversal Line, the students are said to be at the developing level of proficiency with 3.80, 3.55, 3.80, 3.78 and 3.83 post-test mean scores respectively which means that the students still possess the minimum knowledge and skills on these topics.

Table 3. The Post-test Mean Scores of Students in the Experimental and Control Group

TOPICS	Control Group		Experimental Group	
	Mean	**Level of Proficiency**	**Mean**	**Level of Proficiency**
Points, Line, and Plane	3.98	Proficient	4.29	Advanced
Subset of the Line	3.80	Developing	4.05	Developing
Angles	4.23	Advanced	4.78	Advanced
Line and Angle Pairs	3.55	Developing	3.88	Developing
Polygons	3.80	Developing	3.80	Developing
Polygons Focused on Triangles	3.78	Developing	3.98	Developing
Parallel Line Cut by Transversal Line	3.83	Developing	4.41	Approaching Proficiency
All Topics	**27.05**	**Developing**	**29.20**	**Approaching Proficiency**

Overall, it can be said that although the control group obtained an overall post-test mean score of 27.05, described as already in the developing level, the said students only possess the minimum knowledge and skills on Grade 7 Geometry and need help and support throughout the performance of authentic tasks.

In looking at the post-test mean scores of the students in the experimental group, they were able to attain mean scores of 4.29 for topic Points, Line and Plane, and 4.78 for topic Angles. These denote that they exceed core requirements in terms of knowledge, skills, and core understanding of these topics. Furthermore, they got a mean score of 4.41 in the topic Parallel Line cut by Transversal Line which indicates that they are already at the level of approaching proficiency in this topic and with a little guidance, they can already transfer their fundamental knowledge, skills, and core understanding independently through authentic tasks. For the topics Subset of the Line, Line and Angle Pairs, Polygons, and Polygons Focused on Triangles, the students are said to be developing the level of proficiency with 4.05, 3.88 3.80 and 3.98 as post-test mean scores respectively. This means that the students still possess the minimum knowledge and skills on these topics.

The results in Table 3 also show that the overall post-test mean score of the students in the experimental groups is 29.20, which is described as already at the approaching proficiency level. Thus, it can be claimed that the students at this level already developed fundamental knowledge, skills, and core understanding and, with little guidance, can already transfer their fundamental knowledge, skills, and core understanding independently through authentic tasks.

Significant Difference between the Pre-test Mean Scores of Control and Experimental Groups

In this study, the researcher tried to determine if there is a significant difference between the pre-test mean scores of students in the control group and the experimental group. In order to answer the research problem, a T-test for Independent Sample was utilized.

As observed in Table 4, the t value for the topic Angles is -2.328 with a “sig” value of .022. This indicates that there is a significant difference between the pre-test scores of control and experimental groups on the said topic with the experimental group (m=1.90) showing a higher level of performance as compared to the control group (m=1.33). Meanwhile, the “sig” values of the topics Point Line and Plane, Subsets of a Line, Line and Angle Pairs, Polygons, Polygons focused on Triangle and Parallel Lines Cut by Transversal Lines are .924, .264, .480, .564, .712 and .154 respectively. These values were all above the 0.05 level of significance set for this study and indicate that the differences in the mean scores between the control group and the experimental group on the said topics were not significant.

Table 4. Significant Difference in the Pre-test Scores of the Students in Experimental and Control Groups

TOPICS	Mean		T	Sig. (2-tailed)	Remarks
	CG	EG			
Point Line and Plane	2.08	2.05	0.096	.924	Not Significant
Subsets of a Line	1.63	1.37	1.125	.264	Not Significant
Angles	1.33	1.90	-2.328	.022	Significant
Line and Angle Pairs	1.68	1.54	.705	.480	Not Significant
Polygons	1.38	1.51	-.580	.564	Not Significant
Polygons focused on Triangle	1.53	1.44	.371	.712	Not Significant
Parallel Lines Cut by Transversal Line	1.68	1.39	1.440	.154	Not Significant
ALL TOPICS	**11.28**	**11.20**	**.107**	**.915**	**Not Significant**

LEGEND: CG = Control Group, : EG = Experimental Group

Table 4 also shows that when an attempt to determine whether there exists an overall difference in the mean scores when all topics are included, the overall significance value of 0.915 is found to be higher than the 0.05 level of significance set for this study. It designates that the study failed to reject the null hypothesis, which is there is no significant difference in the pre-test scores of the students in experimental and control groups. Thus, the difference between the mean scores of the two groups during the pre-test was found to be nearly the same.

Significant Difference Between the Pre-test and Post-test Mean Scores of Students in Control Group

The study also aimed to determine whether the traditional teaching approach employed by the school is effective in improving Mathematics performance. The level of mean scores of Mathematics performance was determined before and after the implementation of the teaching approach. Mean scores were calculated, and a Paired-sample t-test was used in order to establish whether there is a significant difference in the performance of students in Mathematics before and after the teaching approach was employed.

Table 5. Significant Difference between the Pre-test Scores and Post-test of the Students in Control Groups

TOPICS	Mean Scores		T	*d*	Sig. (2-tailed)	Remarks
	Before	After				
Point Line and Plane	2.08	3.98	-10.250	1.62	.000	Significant
Subsets of a Line	1.63	3.80	-9.618	1.52	.000	Significant
Angles	1.33	4.23	-14.363	2.27	.000	Significant
Line and Angle Pairs	1.68	3.55	-8.564	1.28	.000	Significant
Polygons	1.38	3.80	-10.109	1.59	.000	Significant
Polygons focused on Triangle	1.53	3.78	-11.152	1.76	.000	Significant
Parallel Lines Cut by Transversal Line	1.68	3.83	-9.315	1.47	.000	Significant
ALL TOPICS	**11.28**	**27.05**	**-20.921**	**3.31**	**.000**	**Significant**

As observed in Table 5, the performances of students in the specified topics have increased after the implementation of the traditional teaching approach. The most apparent result is the topic Angles, whereby the mean score increased from 1.33 to 4.23 or from the beginning level to advance level. Another interesting result is the topic polygons, whereby the mean score has increased from 1.38 to 3.80. Interestingly, results in Table 5 indicate that the performance of students in the post-test in all topics has significantly increased as manifested by sig. (2-tailed) valued of 0.000, which are all below the 0.5 level of significance. In addition, the effect size (d) of all the topics is above 1.0 with the overall d value of 3.31, which implies that the effect size is large and the results' differences are consequential. Furthermore, the results also indicate that when looking at the overall performance of students involving all topics, the value of the sig. (2-tailed) which is equal to 0.000, with a T-value of -20.921, reveals that there is a significant improvement in their performance in the specified topics.

Significant Difference Between Pre-test scores and Post-test Mean Scores of Students in Experimental Group

Another aim of this study was to determine whether the gradual release of responsibility approach is effective in improving Mathematics performance. The level of mean scores of Mathematics performance was determined before and after the teaching approach. Mean scores were calculated, and a Paired-sample t-test was employed in order to find whether there is a significant difference in the Mathematics performance of students in the treated group before and after the teaching approach was implemented.

Table 6. Significant Difference between the Pre-test Scores and Post-test of the Students in Experimental Groups

TOPICS	Mean Scores		T	*d*	Sig. (2-tailed)	Remarks
	Before	After				
Point Line and Plane	2.05	4.29	-13.768	2.15	.000	Significant
Subsets of a Line	1.37	4.05	-13.702	2.14	.000	Significant
Angles	1.90	4.78	-17.112	2.67	.000	Significant
Line and Angle Pairs	1.54	3.88	-12.535	2.67	.000	Significant
Polygons	1.51	3.80	-10.101	1.95	.000	Significant
Polygons focused on Triangle	1.44	3.98	-13.025	1.58	.000	Significant
Parallel Lines Cut by Transversal Line	1.39	4.41	-15.194	2.38	.000	Significant
ALL TOPICS	**11.20**	**29.20**	**-25.333**	**3.96**	**.000**	**Significant**

As observed in Table 6, the performances of the students in the specified topics had increased after the implementation of the gradual release of responsibility approach. The most outward result is on the topic Parallel Lines Cut by Transversal Lines, whereby the mean score has increased from 1.39 to 4.41 or from the beginning level to approaching proficiency level. Another interesting result is on the topic Polygon Focused on Triangle, whereby the mean score has increased from 1.44 to 3.98. Interestingly, results in table 6 indicate that the performance of students in the post-test in all the topics has significantly increased as manifested by sig. (2-tailed) values of 0.000, which are all below the 0.05 level of significance set for this study. In addition, the effect size (d) of all the topics is above 1.0 with the overall d value of 3.96, which implies that the effect size is large, and the results' differences are consequential as regards to its topics. Furthermore, the results also indicate that when looking at the overall performance of the students involving all topics, the value of the sig. (2-tailed) which is equal to 0.000 with a T-value of -25.333, reveals that there is a significant improvement in their performance in the specified topics.

Significant Difference in the Post-test Scores between the Control and Experimental Groups with Pre-Test Mean Scores as Covariates

This study correspondingly attempted to determine if there is a significant difference between post-test scores of students in the control group and students in the experimental group while controlling the pre-test scores. In order to answer the research problem, ANCOVA was employed.

Source	Post-test Mean Scores		d	F-Value	P-value	Remarks
	Control	Experimental				
Group	*27.05*	*29.20*	*0.46*	*5.56*	*0.021*	*Significant*
Pre-Test				*17.20*	*0.000*	

Table 10 shows the analysis of covariance (ANCOVA) of post-test results between treatments. As observed in Table 10, the pre-test with an F-value of 17.20 was used as a covariate to statistically equate dissimilar prognostic variables that may have an effect on the analysis. In addition, the results specify that when looking for the significant difference between the post-test mean scores between the groups with pre-test mean scores as covariates, the F-value between groups is 5.56 with a probability value of 0.021 ($p<0.05$) indicating a significant difference; thus there is a difference in the post-test scores between the control and experimental groups with pre-test mean scores as covariates. This implies that the experimental group with a mean score of 29.20 performed better than the control group with a mean score of 27.05. Moreover, the size effect (d) of 0.46 was identified, which means that the effect size of the two groups is medium and consider approaching consequential. Therefore, the students exposed in the Gradual Release of Responsibility Approach perform better than the students exposed in the Traditional Teaching Approach employed by the School.

Discussion

Teaching Mathematics continues to be a posing challenge for teachers. The results of this study could help them to improve students' performance in Mathematics. Thus, they would have a teaching approach that is essential for teachers and effective for students.

As to Mathematics teaching, results revealed that before the implementation of the approaches, both levels of proficiency of the groups are at the beginning level, which implies that they were struggling in their understanding due to lack of essential knowledge and skill on the topics. But after the implementation of both approaches, the results showed that there is an improvement in the performance of students in Mathematics after being exposed to the GRR approach and traditional teaching approach.

The difference between the mean scores of the two groups during the pre-test was found to be nearly the same. This is nearly similar to the study conducted by Reyes (2019) involving students' pre-test Mathematics performance before using Team-Pair-Solo Approach patterned in Gradual Release of Responsibility Instruction for the experimental group and Traditional Method (Lecture-Discussion) for the control group. Reyes discovered that there is also no significant difference between the pre-test mean scores of the students in control and experimental groups.

The traditional teaching approach employed by the school demonstrates positive outcomes towards students' academic performance in Mathematics. This result confirms what Diab and Abdel (2016) also discovered in their study involving the effectiveness of flipped classroom instruction anchored in Vygotsky's social constructivism theory on students' achievement in Mathematics. Diab and Abdel found that learners' performance in Geometry topics that were taught and exposed to social constructivism significantly increased. Thus, Vygotsky and Cole (2018) argued that this approach should be practiced in students' early learning years.

Students exposed in the Gradual Release of Responsibility Approach perform better than the students exposed in the Traditional Teaching Approach employed by the School. This conformed by Caligumba and Tan (2018) and Reyes (2019), wherein they found out that there is a significant difference between pre-test mean scores of control and experimental group with pre-test mean scores as covariates. Caligumba, Tan, and Reyes found that the students exposed to the approach patterned in the Gradual Release of Responsibility Approach perform better in Mathematics than the students who are not exposed to the said approach. In addition, the results also confirm what Ciubal and Tan (2018) also discovered in their study involving students exposed to Mathematics Communication Strategies (MCS), which was also utilized by the researcher in the phases of Gradual Release of Responsibility Approach. Ciubal and Tan (2018) found out that the students exposed to the said approach are significantly different from those who are non-exposed while controlling their pre-test mean scores. Thus, Fisher and Frey (2013) argued that students perform better in any subject area after being exposed to the Gradual Release of Responsibility approach than other approaches.

Conclusions

In the light of the objectives of the study, the statistical analysis, and findings of the study, the following conclusions were drawn: first, it found out that there is a problem in the performance of the students in Mathematics. The pre-test mean scores of the students were both found to be at the beginning proficiency level. Hence, the level of Mathematics performance of the Grade 7 students before they were exposed to different approaches was concluded as low. Second, after the application of the traditional teaching approach employed by the school, a significant increase in the performance of the students had been found, although it only improved the developing level. Thus, the effects of such an approach had been recognized. Third, after the implementation of the Gradual Release of Responsibility (GRR) Approach, a significant increase in the performance of the students has been found. Specifically, the performance of students has improved from the beginning level to approaching proficiency level. Finally, it was concluded that those students who had been exposed to the Gradual Release of Responsibility Approach performed significantly better than those students in the traditional teaching approach. Therefore, the Gradual Release of Responsibility Approach is more effective than the traditional teaching approach employed by the school in improving the performance of students in Mathematics.

Recommendations

In the light of the findings and conclusions of the study, the following recommendations were offered: Mathematics teacher is encouraged to improve the performance of their students through the use of Gradual Release of Responsibility (GRR) Approach since it is noted in this study that there is a significant increase in the performance of the students after the implementation of the said approach. Also, in teaching Mathematics, the teachers should gradually release the students to learn independently. It would help them to enhance their learning and understanding of the concepts in Mathematics by following the four phases of the GRR approach. Then the school administrators should employ the usage of the Gradual Release of Responsibility Approach as an approach in teaching Mathematics from the elementary level to a higher level of education. They should also develop a program that will facilitate the training of Mathematics teachers in acquiring the skills on how to use the Gradual Release of Responsibility Approach. The program may contain different activities based on the phases of GRR. For example, in phase 1, there will be training for effective, focused discussion; in Phase 2, training for effective guided instructions; in Phase 3, training for effective collaborative learning and in Phase 4, training for effective individual and responsible learning. Also, the findings of the study may serve as a basis in conducting a more profound study, specifically pertaining to the Gradual Release of Responsibility (GRR) approach. Moreover, the findings should be used as one of the references testing the validity of other related findings needed and useful in designing an effective and Mathematics curriculum.

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