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Assessing the Effect of the Gradual Release of Responsibility (GRR) Model in Teaching Science

Aileen Grace P. Fuentes[1], Leomarich F. Casinillo[2*]
[1]Hilongos National Vocational School, Hilongos Leyte, Philippines
[2]Visayas State University, Baybay City, Leyte, Philippines

*Corresponding author: leomarichcasinillo02011990@gmail.com

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Abstract

This research study is conducted to elucidate the effectiveness of the Gradual Release of Responsibility (GRR) Model in increasing students' academic performance in science class. The GRR model reflects this by scaffolding students' learning experiences, starting with teacher modeling and gradually transitioning to student-centered activities and peer collaboration. A quantitative quasi-experimental research approach was used to test the effectiveness of the said learning model. A control and experimental group with 30 students were involved in this study utilizing the Inquiry-Based Seven (7) E's Method and GRR Model, respectively. Results show that there is no significant difference between the two groups in the pretest, given the values $t(58)=0.345$ and p-value=0.731, which signifies that both groups were at low-performing levels. There is a significant difference between the two groups on the result of the post-test, given the values $t(58)=-9.309$ and p-value<0.001. The experimental group got a mean percentage score of 87.22 at the high-performing level, while the control group got 59.11 at the low-performing level. Lastly, there is a significant difference between the incremental scores of the control and experimental groups with the values $t(58)=-6.813$ and p-value<0.001. It is concluded that using the GRR Model is very effective in increasing students' academic performance with the least learned competency (i.e., Newton's Second Law Motion). Students exposed to such a model significantly improved from low-performing to high-performing levels. Hence, this article recommended that the GRR model be applied, especially in the least learned areas, since it is an effective teaching method to improve students' academic achievement. Lastly, the researchers recommend that teachers undergo training in the GRR model to become competitive.

Keywords: *Gradual Release of Responsibility, Newton's Three Laws of Motion, Academic Performance, Science 8 Students, Inquiry-Based Seven (7) E's Method*

INTRODUCTION

Teaching requires various methods and strategies for effective instructional delivery (Casinillo & Guarte, 2018). Traditionally, teachers provide worksheets and exercises to students for independent work after a series of lectures without fully considering the learning readiness of learners. According to Orhan and Beyhan (2020), teachers rarely reflect on their insufficient preparation or lack of teaching skills. They blame poor student performance on low motivation and lack of interest in school and content-area classes. In that case, teaching experience is very important since it will lead the teachers to the right strategies to enhance the student's motivation and performance (Casinillo & Casinillo, 2021). In the study of Zemanova and Knight (2021), it is portrayed that teaching methods such as exercise, drill, or practice help increase educational efficacy and efficiency and the durability of learning. Apparently, teaching methods should focus on students' preparedness before indulging in extensive independent activities. With this, one learning model that promotes students' readiness, the law of

exercise, and collaborative learning is the Gradual Release of Responsibility (GRR) Model (Dole et al., 2019). This model was first introduced in reading, allowing instruction to move from explicit modeling and instruction to guided practice and tasks that slowly permit students to become independent learners (Webb et al., 2019).

GRR model starts the lesson with a teacher-centered phase and gradually shifts to a student-centered environment. As such, there is a gradual transition of activities from the teacher doing all the tasks to students assuming all the responsibilities. To address the problem of the student's low performance of students on the least-learned competency, which is Newton's Law of Motion, the researchers utilized the Gradual Release of Responsibility Model as an intervention to increase the academic performance of students (Pearson et al., 2019) and to enhance science teaching skills. The GRR model is initially developed by Pearson and Gallagher (1983) to describe the teaching style, a structured method of pedagogy involving breaking down the responsibility within the learning process from the teacher to the eventual independence of the learner. The GRR framework reflects the intersection of several theories, such as Piaget's work on cognitive structures and schemata (Flavell, 1963), Vygotsky's work on zones of proximal development (Shabani et al., 2010), and Thorndike's law of readiness (Mowrer, 1983). Thorndike's law of readiness posits that learning depends on a learner's readiness to act when he is physically and mentally ready for it (Ahmed, 2012). The GRR model suggests that the taught task should shift progressively and purposefully from explicit modeling to joint responsibility, to independent practice and application by the learner (Pearson & Gallagher, 1983). This model of teaching has four phases such as the following: I DO, which represents the teacher modeling the lesson objective in a focus teaching; WE DO, which refers to the guided instruction with both input from the teacher and the students; YOU DO TOGETHER, portrays the collaborative learning in small groups or partners and YOU DO ALONE, refers to independent practice whereby each student will work on certain task independently (Hall et al., 2021; Skillings, 2021). A study conducted by Lin and Cheng (2010) entitled "Effects of Gradual Release of Responsibility on Language Learning" reveals that students progressed a lot in summary writing and held positive attitudes toward such instruction. They reported that using the GRR Model was effective and beneficial to students in language learning.

Currently, the usual way of teaching Science is through an Inquiry-Based Approach, which starts the lesson with an activity followed by analysis, abstraction, and application. The enhanced version of this approach is the 7 E's method, which has seven phases: elicit, engage, explore, explain, elaborate, evaluate, and extend (Marfilinda et al., 2020). In this method, knowledge is constructed through discovery based on student participation in exploratory activities. On the other hand, the GRR model starts with a teacher-centered phase whereby the teacher assumes all the duties for performing a task and gradually shifts to a student-centered atmosphere where students assume all of the responsibility (Pearson et al., 2019). While many studies have been conducted on teaching methods and the gradual release of responsibility, this study is unique because it focuses on the context of science and a specific competency in which the students perform poorly. Moreover, the inquiry-based approach to the Gradual Release of Responsibility promotes comparing two teaching methods. The researchers conducted this study because there are limited studies on applying this method to specific competencies. The researchers applied the Gradual Release of Responsibility Model to effectively teach Science 8, specifically on the least-learned competencies. One of the lessons in science 8 learners find challenging to master is Newton's Law Motion. Cabucgayan National School of Arts and Trades students show low performance on the said topic, affecting the subject's mean percentage score (MPS) with 65%, which means low performance. This least-learned competency involves understanding the concepts and relationships between force, mass, and acceleration to analyze and solve computational problems. As such, the teacher-researcher adopts the GRR Model to help students achieve more in class and increase their performance on the said competency. This research aimed to determine the GRR Model's effectiveness in increasing students' performance on the least-learned competency. Specifically, it sought to answer the following objectives: (1) to measure the level of performance of the control group (students treated with Inquiry-Based Approach: 7 E's Method) and experimental group (students treated with GRR Model); and (2) to determine the significant difference between the performance of control group (students treated with Inquiry-Based Approach: 7 E's Method) and experimental group (students treated with GRR Model). The results of this study might provide informative ideas on how to enhance science teaching skills and improve students' academic performance using the GRR model. Moreover, this article might be a benchmark for other science educators and researchers and might contribute to

the literature on teaching education.

CONCEPTUAL FRAMEWORK

This study is anchored on Lev Vygotsky's theory of social constructivism, which emphasizes the importance of social interactions and collaborative learning experiences. According to this theory, learning occurs through active engagement with others and gradually acquiring knowledge and skills within a social context. The GRR model reflects this by scaffolding students' learning experiences, starting with teacher modeling and gradually transitioning to student-centered activities and peer collaboration. In addition**,** the study of Hamilton & Mosby (2022) on the Role of Cognition in the Gradual Release of Responsibility Model emphasizes the importance of the teacher's role in modeling a skill or strategy, then shifting gradually to students their own with the help of their classmates to finally doing it on their own. This process reflects the cognitive aspects of learning as students need to comprehend the basic concepts before independently applying them**.** In this study, the application of the GRR model was compared with the inquiry-based approach because this approach might not be effectively sufficient for students to grasp the concepts of Newton's Law of Motion. Therefore, the researchers deemed to apply the Gradual Release of Responsibility in the context of science, specifically on the least-learned competency in Grade 8 students of Cabucgayan National School of Arts and Trades, which showed a low performance in the particular topic, which is Newton's Law of Motion. Moreover, many students struggle to grasp science lessons, especially if they involve mathematics (Yunzal & Casinillo, 2020). With that, science teachers need an advanced strategy to enhance students' learning and improve their academic achievement. In the study by Suarez and Casinillo (2020), it is portrayed that science students need an intervention strategy, especially on the least mastered topics, to improve their comprehension, creativity, and academic performance. The study by Pearson et al. (2019) depicted that one of the effective teaching strategies is the Gradual Release of Responsibility (GRR) Model, which exhibited good student performance and developed a positive attitude toward learning. According to Clark (2014) and Reichenberg (2019), implementing the GRR model improves teaching abilities in various instructional scenarios. This implies that the GRR model has developed confidence and connection with the students as well as increased the self-efficacy of teachers and students. In this study, the GRR model was implemented to a science topic (i.e., Newton's Second Law Motion) that students were having difficulties learning, and its effectiveness was evaluated via students' academic performance. Moreover, this research study compared the relative difference in the effectiveness of the GRR model from the traditional teaching method to elucidate its impact on the teaching-learning process with the aid of a quasi-experiment.

METHODS

1. Research Design

A quantitative quasi-experimental research approach has been applied to determine the GRR Model's effectiveness in students' performance on the least learned competency. Two groups of students were obtained. First, the control group was treated with the Inquiry-Based Approach: 7 E's Method, while the experimental group used the Gradual Release of Responsibility Model. Both groups took pretest and post-test, and then raw scores were analyzed statistically. By using this approach, this study aimed to provide evidence of the effectiveness of the Gradual Release of Responsibility Model in enhancing students' academic performance on the least-learned competency in science 8. Moreover, this allows for comparing outcomes between two groups of students subjected to different instructional methods.

2. Locale and Participants of the Study

This article study was conducted at the Cabucgayan National School of Arts and Trades – Libertad, Cabucgayan, Biliran, Philippines. A total of sixty (60) Grade Eight students were involved in this study

through purposive sampling. The basis for selecting participants is based on the grades, which are more or less homogeneous; they should be age 14 and a student in Cabucgayan National School of Arts and Trades. The researcher equally divided the respondents into two groups, 8-Cocoa with 30 students (Control Group) and 8- Pasta with 30 students (Experimental Group).

3. Data Collection Procedure

After seeking approval from the academic head, the school principal, and the parents of students through a letter of consent, the researchers pursued to conduct this quasi-experimental study. A thirty-item pretest was given to the 60 Grade Eight students of Cabucgayan National School of Arts and Trades – Libertad, Cabucgayan, Biliran. The control group (Section Cocoa) was treated with the Inquiry-Based Approach using 7 E's method, while the experimental group (Section Pasta) was exposed to the GRR Model. The same lesson was carried out for both groups for two weeks. The lesson was on Newton's Three Laws of Motion, which was identified as a least-learned competency in Grade 8 Science. After the lesson delivery, a post-test was given to both groups. The pretest and posttest results were statistically analyzed to determine any significant difference between the students' performances under the two different teaching methods. The following describes the two methods and instruments used to gather the necessary data for this study (See Table 1 below).

4. Gradual Release of Responsibility Model (GRR Model)

The experimental group utilized this teaching method during the period of experimentation. This method has four phases: focus lesson, guided instruction, collaborative learning, and independent practice (Aldridge, 2018).

Table 1 The Gradual Release of Responsibility (GRR) model

Stage	Teacher Activity
Focus Lesson "I Do It" Direct Instruction Teacher-centered Instruction	Establishes learning objectives Models Think-aloud models
Guided Instruction "We Do It" Guided Practice Semi-Teacher-centered instruction Substantial Teacher Assistance	 Working closely with students Whole-group/ small instruction Checking for understanding Additional modeling
Collaborative Learning "You Do It Together" Group Collaboration Semi-Student-Centered Instruction (Minimal Teacher Assistance)	 Moves from group to group Facilitates learning Provides support Clarifies
Independent Learning "You Do It Alone" Independent Assessment Student-centered instruction	 Provides feedback Evaluates understanding

5. Inquiry-Based Seven (7) E's Method

The researcher utilized the Inquiry-Based 7 E's Method in teaching the control group with the least-learned competency. This method has seven phases (Ebert, 2007).

a. Phase 1. Elicit

The teacher determines prior knowledge: “What do you know about..?” Reviewing previous knowledge related to Newton’s Laws of Motion such as concepts about time, speed, velocity, friction, gravity, mass, and weight.

b. Phase 2. Engage

The teacher arouses student interest by using a discrepant event, telling a story, giving a demonstration, or showing an object, picture, or brief video to motivate and capture students' interest. The teacher shows pictures or videos to arouse students' interest.

c. Phase 3. Explore

The teacher lets students use manipulatives (e.g., natural objects, models) to make observations and investigate a question or phenomenon. Have students make predictions, develop hypotheses, design experiments, collect data, draw conclusions, and so forth. The teacher's role is to provide support and scaffolding. The student's role is to construct understanding through active experience.

d. Phase 4. Explain

Students report findings and discoveries to the class. The teacher allows opportunities to verbalize and clarify the concept, introduces concepts and terms, and summarizes the results of the exploration phase. Teacher explanations, texts, and media are used to guide learning. Students report and explain their findings and give answers to questions related to previous activity. Discussions about the lesson were done further.

e. Phase 5. Elaborate

The teacher lets students apply the newly learned concepts to new contexts. Pose a different (but similar) question and have students explore it using the concept.

f. Phase 6. Evaluation

The teacher uses formative assessment from the Elicit Phase and assesses, for example, the design of the investigation, the interpretation of the data, or follow-through on questions, looking for student growth. Growth is the desired change in students' understanding of key concepts, principles, and skills in a differentiated classroom. Expectations vary according to the student's beginning point. Summative assessment may be used here to measure achievement and assign a grade.

g. Phase 7. Extend

The teacher leads students to connect the concept to different contexts and transfer new learning, and the teacher assigns additional tasks.

6. Research Instrument

The researchers adopted the test questionnaire utilized by Weiss (1999) in her research entitled "The Effect of Animation and Concreteness of Visuals on Immediate Recall and Long-term Comprehension When Learning the Basic Principles and Laws of Motion" and Gokalp et. al (2013) in their research "Implementing WebQuest Based Instruction on Newton's Second Law." This 30-item standardized test was used to identify students' mastery level and determine if there is a significant difference between the 7 E's Method and the Gradual Release of Responsibility Model based on students' performance. Furthermore, before the experiment, this test questionnaire was given to a different set of students for item analysis to ensure the instrument's reliability. The researcher conducted the study within two weeks (one-hour session per day excluding Friday class), focusing on Newton's Laws of Motion. In addition, the lesson/competency was sub-tasked into three sub-competences. While every effort was made to ensure the reliability and validity of the study outcomes, several limitations should be acknowledged. Firstly, the quasi-experimental design may have limited the study's internal validity, as random assignment of participants to groups was not feasible. The study's generalizability may also be restricted due to the specific context of Grade 8 students at Cabucgayan National School of Arts and Trades

(CNSAT) in the Philippines. Furthermore, potential confounding variables, such as prior knowledge and individual differences among students, could have influenced the results.

7. Research hypotheses

Ho_1: No significant difference exists between the pretest scores of the control group (students treated with the Inquiry-Based Approach: 7 E's Method) and the experimental group (students treated with the Gradual Release of Responsibility Model).
Ho_2: There is no significant difference between the posttest scores of the control group (students treated with the Inquiry-Based 7 E's Method) and the experimental group (students treated with the Gradual Release of Responsibility Model).
Ho_3: There is no significant difference in the incremental scores between the control and experimental groups.

8. Statistical Analysis

The following were the statistical formulas used to analyze the data namely: (1) mean and (2) standard deviation. The descriptive metrics were obtained to compare the pretest and posttest results in the two strategies used in teaching Science. Base on Table 2 mean percentage score (MPS) was also used to determine the level of performance of the students based on the standard criteria set by the Department of Education (DepEd No. 73, s.2012).

Table 2 Interval of mean percentage score (MPS) and its qualitative description

Range of MPS	Qualitative Description
86% - 100%	High Performing
66% - 85%	Average Performing
65% and below	Low Performing

Furthermore, a t-test was employed to determine the effectiveness of the GRR model. This statistical method was computed to identify if there was a significant difference in the scores obtained from the pretest, post-test, and incremental scores between the control and experimental groups. Specifically, an independent sample t-test (unpaired) was used to analyze both groups' pretest, post-test, and incremental scores and tested its significance at the standard level.

RESULTS AND DISCUSSION

1. Students' Level of Performance

Table 3 shows the mean percentage score (MPS) of the pretest and post-test between the control and experimental groups. The control group got an MPS of 25.33% in the pretest, while the experimental group got 26.11. The students in both groups were at low performing levels. In the post-test, the control group got an MPS of 59.11, while the experimental group got 87.22. The posttest result shows that students in the control group are at a low-performing level while those in the experimental group are at a high-performing level. This result shows a remarkable increase in the mean percentage score of students exposed to the GRR Model on Newton's Three Laws of Motion, identified as a least-learned competency. In a study by Aldridge (2018) entitled "The Effects of Systemic Functional Linguistics and Gradual Release of Responsibility on Student Self-efficacy and Engagement in Mathematics", student responses indicate that GRR strategies aided in building self-efficacy. Students' difficulties in communicating mathematics, the lack of understanding of math language, and low confidence levels were addressed. More so, student responses to surveys reported that GRR techniques such as think-aloud models, guided practice, and group assessments, as well as support for learning (SFL) strategies such as the word wall and journal entries, all significantly contributed to building students' self-efficacy and engagement in the classroom. Likewise, Eutsler (2022) portrayed that the GRR model is helpful for

teachers' preparation and lessons proper in which students actively participate and learn simultaneously.

Table 3 Performance level of the control group and experimental group

	Control Group MPS	Learning Level	Experimental Group MPS	Learning Level
Pretest	25.33%	Low Performing	26.11%	Low Performing
Posttest	59.11%	Low Performing	87.22%	High Performing

2. Students' Performance in Pretest

Table 4 shows that there is no significant difference between the pretest scores of the control group and the experimental group. The p-value is 0.731, which is greater than 0.05. Thus, the first null hypothesis is accepted. This result posits homogeneity of the two groups before treatment. The mean value and standard deviation of the control and experimental groups are statistically insignificant, with very little difference. In a study conducted by Çibik et al. (2008) on the "Effect of Group Works and Demonstrative Experiments Based on Conceptual Change Approach: Photosynthesis and Respiration," they likewise established the equality of concept and knowledge of the control group and experimental group by comparing their pretest scores using t-test analysis.

Table 4 Difference between the control and experimental group in the pretest result

Variable	N	Mean	SD	t-value	df	p-value
Control	30	7.60	2.54	-0.345	58	0.731
Experimental	30	7.83	2.69			

3. Students' Performance in Post-test

Table 5 shows that there is a significant difference between the post-test scores of the control group and the experimental group. The p-value is <0.001, which is less than 0.05. Thus, the second null hypothesis is rejected. This result shows better academic performance exhibited by the experimental group treated with the GRR model than the control group exposed to the Inquiry-Based Seven (7) E's Method. In a study conducted by Mostafa et al. (2018) entitled "The Science of Teaching Science: An Exploration of Science Teaching Practices in PISA 2015", they found that Teacher-directed instruction is found to be a reliable teaching strategy whose effectiveness is not sensitive to the surrounding school environment. They point out a negative association between student-reported exposure to inquiry-based Science Teaching and science performance. The study by Zemanova and Knight (2021), conducted research comparing a physics lesson with or without a tutorial and with or without a structure. They found that students who took the unstructured lesson without a prior teacher-provided tutorial performed significantly worse, while the group with a teacher-provided tutorial performed better in student achievement. In that case, students under the GRR model have exhibited a better performance in Physics than the control group indicating that the teaching approach is an effective strategy.

Table 5 Difference between the control and experimental groups in the post-test result

Variable	N	Mean	SD	t-value	df	p-value
Control	30	17.73	3.91	-9.309	58	<0.001
Experimental	30	26.16	3.05			

4. Difference in Incremental Scores

Table 6 shows the mean percentage score of the control group (8-Cocoa) exposed with the Inquiry-Based 7 E's Method, from 25.33% (pretest) to 59.1% (posttest) with a difference (incremental score) of 33.77. This shows that after lesson delivery, students in this group were still classified as low performing. On the other hand, the experimental group utilizing the GRR Model had 26.11% in the pretest, increasing to 87.2% in the posttest, with a difference (incremental score) of 61.09. This shows

that after lesson delivery, students of this group were at a high-performing level. The difference in the incremental scores of the two groups was 27.32, which is a big difference. This implies that students' performance under the GRR model has improved as opposed to those under the control group.

Table 6 Incremental scores of the control and experimental groups based on pretest and posttest MPS results

Variable	N	Pretest	Posttest	Incremental Score	Learning Level
Control Group	30	25.33	59.1%	33.77	Low Performing
Experimental Group	30	26.11%	87.2%	61.09	Low Performing to High Performing

Table 6 shows that there is a significant difference between the incremental scores of the control group and the experimental group. Given the t-value of -6.813, the p-value is <0.001, less than 0.01. This implies that the experimental group scores are significantly higher than the control group scores. Thus, the third null hypothesis is rejected. In that case, it is sufficient to say that the GRR model is an effective teaching tool to enhance students' academic performance. The above-mentioned results are congruent with the study conducted by Row (2022) and Namsaeng (2023) on the Effects of the Gradual Release of Responsibility Model on Language Learning. It has been found that the GRR model is a conducive, effective, and beneficial model for students' learning. Furthermore, students develop positive attitudes, especially while working with peers, which yields better independent learning results. According to Trinh and Nguyen (2020) and Wu et al. (2023), the GRR Model is a key dimension for instruction in transactional strategies. Using such instruction, students showed a significant performance in standardized tests, interpretive abilities, and knowledge and use of strategies. Several studies proved that teacher-led instruction contributes to greater student achievement than an Inquiry-Based Approach, and a pure teacher-centered atmosphere enables students to experience less motivation, negative attitudes towards the subject being learned, and little or no use of collaboration and communication skills (Guerrero & Bautista, 2023; Machado & Nahar, 2023). The GRR model bridges the gap between a teacher-centered and a student-centered atmosphere. Anchored on Piaget's work on the cognitive structure and Thorndike's law of readiness, the GRR model allows greater time for students' conditioning as a prerequisite to learning (Dole et al., 2019; Pearson et al., 2019; Webb et al., 2019).

Table 7 Difference between the incremental scores of the control group and the experimental group

Variable	N	Mean	SD	t-value	df	p-value
Control Group	30	10.13	4.61	-6.813	58	<0.001
Experimental Group	30	18.33	4.70			

CONCLUSION

This study assessed the effectiveness of the Gradual Release of Responsibility (GRR) Model in increasing students' academic performance on the least-learned competency, specifically on Newton's Law of Motion in Science 8. It was found that the control group (treated with an inquiry-based approach) and the experimental group (treated with the GRR Model) showed improvements in their pretest to posttest. However, the experimental group showed notably higher average performance than the control group. Moreover, there is a significant difference between the control and experimental groups in terms of pretest and posttest and incremental scores; the result showed that the GRR model was more effective in increasing the students' academic performance on Newton's Law of Motion compared to the Inquiry-Based Approach. This study contributes to the field of education by providing evidence of the effectiveness of the GRR model in the Science concept. The findings show the importance of innovative pedagogical approaches in addressing the challenges associated with least-learned competencies and improving students' academic performance. Based on the findings, teachers may consider adopting the GRR Model as one of the effective instructional methods in teaching the least-learned competencies, especially in science subjects. The teachers and school administrators

should explore opportunities to integrate the GRR model into their teaching practices. Future researchers can conduct further research about the GRR model to validate its effectiveness across learning areas, and future researchers can also conduct longitudinal studies to investigate the long-term impact of the GRR model on students' academic performance.

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DATA AVAILABILITY STATEMENT

The research data collected that support the results of this current study are available on request from the authors.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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