The Effect of Explicit Mathematics Instruction on Mathematics Achievement and Motivation of Grade 9 Learners in La Trinidad Academy

John Michael D. Caraan*

johnmichaelcaraan96@gmail.com, johnmichael.caraan@tup.edu.ph

Technological University of the Philippines, Manila City, 1004, Philippines
Accomack County Public Schools, Virginia, 23396, United States of America

Abstract

This study determined the effect of Explicit Mathematics Instruction (EMI) on learners' achievement and motivation in learning Mathematics. This study also sought to bridge how the lack of attention to problem-solving skills and pattern recognition and learners' participation since a part of the strategy had learners' collaboration, mastery skills, independent learning, and motivation of the students. This study sought to answer the research problems; What is the learners' achievement in Mathematics; What is the mathematics motivation of the learners; Is there a significant difference between the pretest and post-test of the students' achievement; What is the learners' perception of explicit mathematics instruction? A mixed research method was employed in the study. The participants were Grade 9 students (n=45) in La Trinidad Academy in Imus, Cavite, Philippines. The participants were selected using convenience sampling. Four research instruments were utilized, namely: (1) EMI-based lesson plans; (2) Mathematics Motivation Questionnaire; (3) Mathematics Achievement Test (MAT); (4) Student Learning Experience Survey. Interpretation of gathered data was done quantitatively and qualitatively. Quantitative data were obtained from the validated 30-item achievement test and the adopted motivation questionnaire, while student responses to the learners' learning experience survey instrument provided qualitative data. Descriptive and inferential statistics were utilized to determine the significant difference in the achievement before and after the EMI's implementation. The results revealed significant differences in both learners' Mathematics achievement and Mathematics Motivation mean scores before and after exposure to the EMI strategy. Furthermore, the results of the survey revealed that learners' exposure to the EMI strategy was effective in facilitating significant improvements in their academic achievement and motivation in Mathematics. The results signified that the implementation of Explicit Mathematics Instructions (EMI) as a teaching-learning strategy enhanced students' achievement and motivation in Mathematics.

Keywords: Explicit Mathematics Instruction; Mathematics Achievement; Mathematics Motivation

1.1 Introduction

The field of mathematics has been significant to the development of our society in the 21st century. When a global epidemic of pneumonia struck in March 2020, the teaching-learning process in mathematics education promptly became challenging. During this period, educators are required to participate in online webinars concerning effective teaching strategies to provide students with a quality education. In the field of mathematics instruction, several studies claimed that contemporary methods have proven to be more effective and valuable as they improve students' learning. However, due to global pneumonia, teachers are obliged to shift to the new normal, where teaching strategies are new to most of them. Online classes have been a viable type of modality. In online learning environments, the effects of factors widely known to affect the caliber of education in a traditional classroom may not be the same (Fowler, 2007).

Explicit mathematics instructions have been widely used to cater to such learning modalities. Given the situation, it is also viable to conduct hybrid learning. Explicit mathematics instruction has been shown in various studies to significantly cater to different groups of learners, such as at-risk learners and with learning disabilities. It also showed in many studies that this teaching-learning strategy provided peer mentoring and extensive support to learners. This strategy had four components; teacher instruction, guided practice, collaborative practice, and independent practice. These components are systematically designed to give the learners complete, quality instructions. With that, the researcher sought to use explicit mathematics instruction to bridge the relevant gaps in this study.

In line with this, and according to Archer and Hughes (2011), it was one of the best tools accessible to educators, and it is a structured, systematic, and effective teaching style. Several studies have concluded and validated EMI to dramatically improve math achievement when used in conjunction with peer mentoring—a positive effect on creativity and an effective method for teaching critical thinking skills (Magbanua, 2018).

1.2 Theoretical Framework

Explicit Mathematics Instruction

Explicit mathematics instruction is an evidence-based strategy that provides elementary teachers with a realistic and viable framework for delivering effective and systematic instruction (Archer & Hughes, 2011; Baker, Gersten, & Lee, 2002; Gersten, et al., 2009). Explicit instruction, in particular, provides a platform for high-quality instructional interactions between teachers and learners around key arithmetic material Doabler & Fien, (2013). It also boosts the number of instructional opportunities available to at-risk learners in small-group interventions and core classes (Baker, Fien, & Baker, 2010).

Explicit mathematics instruction is one evidence-based and highly effective strategy for children with disabilities, including at-risk learners and children requiring extensive support (Spooner et al., 2018).

Across all age groups, educators and researchers have effectively taught various mathematical concepts to learners through explicit teaching (Gersten et al., 2009; Riccomini et al., 2017; Spooner et al., 2018). Additionally, teachers have used explicit instruction to impart conceptual, procedural, and declarative mathematical knowledge (such as number sense and fundamental facts) to learners. For example, they have taught them that multiplication means having X groups of Y objects (Hudson & Miller, 2006; Miller & Hudson, 2007).

Based on Doabler et al. (2019), explicit mathematics instruction is well-known for providing scaffolded instructional interactions between teachers and learners on essential mathematics topics (Hughes, Morris, Therrien, & Benson, 2017).

Gradual Release of Responsibility Model

In the research of (Frey, 2008) the gradual release of responsibility model of education requires the teacher to transition from taking full responsibility for completing a task to a situation where the pupils believe they are solely responsible (Duke & Pearson, 2002, p. 211). To put it another way, the gradual release of responsibility stresses training that enables learners to become capable thinkers and learners when handling tasks in which they have not yet gained skills (Buehl, 2005).

The gradual release of responsibility model provides teachers with a framework for transferring knowledge from the teacher to the student's understanding and implementation. The gradual release of responsibility ensures that learners are guided through learning the necessary skills and strategies for success. It takes time to implement the model of gradual discharge of responsibilities. A teacher's time can be squandered on instructional planning. The curriculum must be vertically coordinated as part of a gradual release of responsibilities. Researchers do not want our learners to waste time on things they have already learned. Skills can only be noticed if there is a solid vertical alignment as part of the gradual transfer of responsibilities (Fisher & Frey, 2014).

Focused Instruction

In the study of Danley (2018), there are four parts to the GRR, one of which is concentrated instruction. The GRR's "I do" phase is focused on instruction. Learners will learn how a skillful thinker processes the topic under discussion, how to create a clear lesson purpose in this phase, and how to create a clear lesson purpose. Using the instructional strategies of direct explanation, modeling or showing, and think-aloud, the teacher actively focuses the student on the topic, tactics, or abilities. During this phase of the GRR, the teacher is responsible for carrying the cognitive load. Focused teaching is usually given to the entire class and lasts long enough to set the goal and provide pupils with a model to develop. Thus, this phase allows learners to work on the cognitive structures and schemata of the lesson (Panlaan, 2019). Research conducted by Aldridge et al. (2018), it is critical to set a realistic example for the kids to follow throughout this time.

Guided Instruction

The second phase of the instruction is guided by "We Do It." It consists of guided instruction as the learners work individually or in small groups. This phase is in which the instructor fields questions and clears up misunderstandings. After analyzing the student's understanding, the instructor will either return to the previous stage or proceed to the third instruction phase (Aldridge et al., 2018).

In addition to this phase, Teachers guide learners through exercises that help them better comprehend the material by promoting, questioning, facilitating, or leading them through. While this can and does happen with the entire class, the research shows that small-group instruction is required for reading education. Teachers can use guided instruction to address specific needs. It identified formative assessments and directly instructed learners in specific literacy components, skills, or strategies

Collaborative Learning

The third phase of the GRR model is "You Do It Together." The third level of the program requires pupils to accomplish a task in small groups. The study should be based on the instructor's model covered in the "think-aloud" session. One strategy is to assign each member of the group a specific task and then have them work together to produce a final result (Fisher & Frey, 2014). The level of support steadily reduces, the instructor perceives that the groups are getting along, and the learners are encouraged to collaborate.

According to Danley (2018), learners must apply the skills and knowledge they have been taught while working with 45 of their peers for assistance. Enrichment throughout the collaborative instruction is a portion of the GRR. Through peer contact, learners acquire and employ personal abilities to improve communication and leadership skills (Fisher & Frey, 2014).

Independent Learning

According to Aldridge (2018), the final phase of instruction, "You Do It Independently," provides the student with the opportunity to show what they have learned. In this phase, the student should be able to accomplish the task without help from the instructor or their peers (Fisher & Frey, 2008). Through gradual release, the idea is that the student becomes an independent learner who can demonstrate the model initiated in the focus lesson (Echevarria, Vogt, & Short, 2007).

Danley (2018) argued that the gradual release of responsibility's most crucial component is independent learning. It focuses on the student's ability to apply the skill learned. The student now bears the brunt of the cognitive burden. A common misperception concerning independent learning is that the ultimate goal of the student is to repeat what has been taught (Fisher and Frey, 2014).

1.3 Results and Discussions

The following discussions *pertained to the learners' achievement in the mathematics achievement test before* and after the implementation of Explicit Mathematics Instruction (EMI).

Table 1.

Pretest and Post-test Scores of the Learners in the Mathematics Achievement Test (n = 45)

Test	Highest Score	Lowest Score	Mean Score	SD
Pretest	21	4	13.84	3.119
Post-test	30	14	23.40	4.324

Table 1 presented the student's highest and lowest scores in the mathematics achievement test, the mean, and the standard deviation. It showed from the table above that the highest score obtained in the post-test was 30, and the lowest score was 14, while the highest and the lowest score obtained in the pretest was 21 and 4, respectively. It also illustrates that the post-test had a mean score of ($\bar{x}$=23.40), while the pretest had a mean score of ($\bar{x}$=13.84). The standard deviation of (SD=4.324) in the post-test was higher than the pretest with (SD= 3.119). Data indicated that the post-test scores were more scattered around the mean than the pretest scores. Findings implied that the learners' post-test scores improved after exposure to explicit mathematics instruction. Thus, the higher standard deviation for the post-test scores implied improvement in the achievement of the learners after the implementation of the treatment.

Table 2.

*Overall Learners' Mathematics Motivation b*efore and after the implementation of the Explicit Mathematics Instruction.

Mathematics Motivation	Intrinsic Motivation	Mastery Orientation	Performance Orientation	Expectancy	Overall Mean Score	SD
Pretest Mean Scores	2.994	3.967	2.644	2.983	3.136	.638
Post-test Mean Scores	4.306	4.489	3.822	4.067	4.171	.549

Table 2 showed the overall pretest and post-test mean, mean difference, and standard deviation of the learners' mathematics motivation before and after the implementation of explicit mathematics instruction. As illustrated in Table 5, the overall pretest mean scores and standard deviation for intrinsic motivation, mastery orientation, performance orientation, and expectancy were ($\bar{x}$ = 3.136, SD .638), respectively. Furthermore, the overall post-test mean scores and standard deviation for intrinsic motivation, mastery orientation, performance orientation, and expectancy were ($\bar{x}$ = 4.171, SD .549), respectively. It was also observed that the standard deviation of the post-test of the learners decreased. It meant the mean scores were more concentrated, directed toward the highest scores. These findings can be supported by the learners' results in mathematics motivation.

Table 3.

Paired t-test of the pretest and post-test scores of the learners in the mathematics achievement test (MAT)

Test	Mean	Standard Deviation	t-value	df	p-value	Remark
Pretest	13.84	3.119	2.015	44	1.979E-17	Significant
Post-test	23.4	4.324				

the p-value is significant at <0.05

Table 3 presents the difference between the mean of the pretest and post-test. The mean and standard deviation of the post-test ($\bar{x}$ = 23.4, SD= 4.324) were higher than the mean and standard deviation of the pretest ($\bar{x}$ = 13.84, SD= 3.119). The computed p-value (<.001) was less than the set level of significance ($p < 0.05$). The result indicated a significant difference between the pretest and post-test of the mathematics achievement of the learners. Additionally, explicit mathematics instruction has helped to improve achievement in Mathematics.

Table 4.

Paired t-test of the pretest and post-test scores of the learners in the mathematics motivation questionnaire (MMQ)

Test	Mean	Standard Deviation	t-value	df	p-value	Remark
Pretest	3.14	.609	9.99	44	1.658E-12	Significant
Post-test	4.17	.549				

the p-value is significant at <0.05

Table 4 shows the difference between the mean of the pretest and post-test. The mean and standard deviation of the post-test ($\bar{x}$ = 3.14, SD= .609) are higher than the mean and standard deviation of the pretest ($\bar{x}$ = 13.84, SD= .549). The computed p-value (<.001) is less than the set level of significance ($p < 0.05$). The result indicated that explicit mathematics instruction significantly affects their improved motivation in Mathematics.

Table 5.

Overall Student-*Participants' Experience in Explicit Mathematics Instruction in* Terms of Percentage

Themes	%
1) Positive Learning Experience	60
2) Adaptation and Perseverance	15
3) Mixed Feelings	13
4) Time Management and Scheduling Challenges	7
5) Appreciation for the Teacher	5

Table 5 shows the computed percentage of the overall Experience based on the themes after the analysis of the responses of the student participants. Positive Learning Experience got the highest percentage of 60%. Data only confirmed that the learners enjoyed and had positive feedback after the exposure to explicit mathematics instruction. Student participants said that “I would describe it fun and successful. I learned a lot, though most times at first, I didn't understand.”, “The overall experience is fun, though I don't understand in the early quarter but in the end I understand it very well.”, “I learned how to get the angles, sides, and more. After I understand the lesson, I enjoy to solve it.”, “It was a great help because it helps me to understand the lesson more.”, “A fun, interactive educational experience.”, “Overall, it was good and quite fun especially the collaborative practice because I was able to help out my groupmates in the assignment.”, “the overall experience is very good because I learned a lot about math or our topic.”, “My overall learning experience is fun because the teacher uses real-life examples and he explains the lesson well. He also gives different examples and activities, which helps us understand the lesson more.”

1.4 Summary of Findings

This study ascertained the effect of the use of Explicit Mathematics Instruction on the Mathematics Achievement and Motivation of the Grade 9 learners of La Trinidad Academy. The findings of the study are as follows:

1. The mean of the pretest in the mathematics achievement test was 13.84, while the mean for the post-test was 23.40. Data indicated an increase in the learners' overall achievement in Mathematics after exposure of the learners to explicit mathematics instruction.

2. The mean of the pretest in mathematics motivation was 3.136, while the mean for the post-test was 4.171. Data indicated a gain in the mathematics motivation of the learners.

3. The difference between the means of the pretest and post-test had a gain of 9.56. The computed p-value of $p < .05$ associated with the t-value of 2.015 was less than the .05 level of significance. There appeared to be a significant difference between the pretest and post-test mean scores of the learners in the Mathematics Achievement Test before and after their exposure to explicit mathematics instruction.

4. The difference between the means of the pretest and post-test had a gain of 1.035. The computed p-value of $p < .05$ associated with the t-value of 9.99 was less than the .05 level of significance. It appeared that there was a significant difference between the pretest and post-test mean scores of the learners in mathematics motivation before and after their exposure to explicit mathematics instruction.

5. The overall learning experience of the learner-participants with the theme of positive learning experience got 60%. Section headings

1.5 Conclusions

Based on the findings of the study, the following conclusions were developed:

1. The explicit mathematics instruction was effective as an instructional strategy for the learners. Moreover, being exposed to different examples also helped the learners to solve word problems,
2. The explicit mathematics instruction had an overall positive contribution across the components of mathematics motivation. Learners had a new way of learning where they had some fun with their classmates through teamwork and cooperation and enhanced their communication skills.
3. The explicit mathematics instruction ameliorated the mathematics achievement. Explicit mathematics instruction exposed the learners to different word problems and step-by-step instructions that led to improvement in understanding the topics in mathematics.
4. Since the learners experienced a sense of accomplishment, responsibility, and independence in doing some work, explicit mathematics instruction boosted their mathematics motivation.
5. The overall learners' positive responses to explicit mathematics instruction were evident during the implementation of the study. Since explicit mathematics instruction is a full-blast instructional strategy, the learners experienced getting validations from the teacher through teacher instruction and guided practice and support from their classmates through collaborative practice.

1.6 Recommendations

Based on the summary of findings and conclusion, the following recommendations by the researchers were put forward:

1. Teachers are encouraged to use explicit mathematics instruction as an instructional strategy to help the learners improve both collaborative and independent practices.
2. Future research on explicit mathematics instruction on both face-to-face and hybrid modalities to support more results for the enhancement of mathematics motivation and achievement should be conducted.
3. Conduct further studies about explicit mathematics instruction on a more extensive scope across the grade level and learning areas in public schools to learn more about the benefits of it further.
4. Follow-up research on explicit mathematics instruction considering other variables such as engagement and self-efficacy should be conducted.
5. Follow-up studies about mathematics motivation across its components and explicit mathematics instruction.

References

Aldridge, J. D. (2018). The effects of systemic functional linguistics and gradual release of responsibility on students' self-efficacy and engagement in mathematics.

Archer, A. L., & Hughes, C. A. (2011). Explicit instruction: Effective and efficient teaching. New York, NY: Guilford Press.

Baker, S., Fien, H., & Baker, D. (2010). Robust reading instruction in the early grades: Conceptual and practical issues in the integration and evaluation of Tier 1 and Tier 2 instructional supports. Focus on Exceptional Children, 42(9), 1–20.

Baker, S. K., Gersten, R. M., & Lee, D.-S. (2002). A synthesis of empirical research on teaching mathematics to low-achieving students. Elementary School Journal, 103, 51–73. doi:10.1086/499715

Buehl, D, “Scaffolding,” Reading Room, 2005, <www.weac.org/News/2005-06/sept05/readingroomoct05.htm> (November 11, 2006).

Danley, E. H. (2018). The Impact of the Gradual Release of Responsibility Professional Development on Teacher Self-Efficacy. ProQuest Dissertations and Theses, 185. http://ezproxy.lib.gla.ac.uk/login?url=https://www.proquest.com/dissertations-theses/impact-gradual-release-responsibility/docview/2385294914/se-2?accountid=14540%0Ahttp://eleanor.lib.gla.ac.uk:4550/resserv?genre=dissertations+%26+theses&issn=&title=The+I

Doabler, C. T., & Fien, H. (2013). Explicit Mathematics Instruction: What Teachers Can Do for Teaching Students With Mathematics Difficulties. Intervention in School and Clinic, 48(5), 276–285. https://doi.org/10.1177/1053451212473151

Doabler, C. T., Stoolmiller, M., Kennedy, P. C., Nelson, N. J., Clarke, B., Gearin, B., Fien, H., Smolkowski, K., & Baker, S. K. (2019). Do Components of Explicit Instruction Explain the Differential Effectiveness of a Core Mathematics Program for Kindergarten Students With Mathematics Difficulties? A Mediated Moderation Analysis. Assessment for Effective Intervention, 44(3), 197–211. https://doi.org/10.1177/1534508418758364

Duke, N. K., & Pearson, P. (2002). Effective practices for developing reading comprehension. In Alan E. Farstrup & S. Jay Samuels (Eds.), What Research Has to Say About Reading Instruction (3rd ed., pp. 205-242). Newark, DE: International Reading Association, Inc.

Echevarria, Jana, Mary Ellen Vogt, and Deborah Short. Making Content Accessible for English Learners: The SIOP Model. 3rd ed. Boston: Allyn, 2007.

Fisher, D., & Frey, N. (2014). Better learning through structured teaching: A framework for the gradual release of responsibility. Alexandria, VA: Association for Supervision and Curriculum Development.

Fowler, S. (2007). THE MOTIVATION TO LEARN ONLINE QUESTIONNAIRE by SHAWN FOWLER (Under the Direction of Shawn Glynn). 57.

Frey, D. (2008). Effective Use of Gradual Release of Responsibility Model. October. https://www.mheonline.com/_treasures/pdf/douglas_fisher.pdf

Gersten, R., Chard, D. J., Jayanthi, M., Baker, S., Mophy, P., & Flojo, J. (2009). Mathematics instruction for students with learning disabilities: A meta-analysis of instructional components. Review of Educational Research, 79(3), 1202–1242. https://doi.org/10.3102/ 0034654309334431

Hudson, P., & Miller, S. P. (2006). Designing and implementing mathematics instruction for students with diverse learning needs. Allyn & Bacon.

Hughes, C. A., Morris, J. R., Therrien, W. J., & Benson, S. K. (2017). Explicit instruction: Historical and contemporary contexts. Learning Disabilities Research & Practice, 32, 140–148. doi:10.1111/ldrp.12142

Magbanua, M. U. (2018). Explicit Instruction in Problem-Solving Skills, Creative and Critical Thinking Skills of the Elementary Education Students. 5(6).

Miller, S. P., & Hudson, P. J. (2007). Using evidence-based practices to build mathematics competence related to conceptual, procedural, and declarative knowledge. Learning Disabilities Research & Practice, 22(1), 45–57. https://doi.org/10.1111/j.1540-5826.2007.00230.x

Panlaan, J. M. (2019). the Effectiveness of Gradual Release of Responsibility Approach in Improving Performance of Students in Mathematics. Slongan, 4(December), 38–63. https://120.28.24.52/index.php/slongan/article/view/20

Riccomini, P. J., Morano, S., & Hughes, C. A. (2017). Big ideas in special education: Specially designed instruction, high-leverage practices, explicit instruction, and intensive instruction. Teaching Exceptional Children, 50(1), 20–27. https://doi.org/10.1177/ 0040059917724412

Spooner, F., Root, J. R., Saunders, A. F., & Browder, D. M. (2018). An updated evidence-based practice review on teaching mathematics to students with moderate to severe developmental disabilities. Remedial and Special Education, 40(3), 150–165. https://doi.org/ 10.117771074193251775105