INFLUENCE OF METACOGNITIVE SELF-REGULATION LEARNING (SRL) STRATEGIES AND REGULATION OF COGNITION (ROC) ON STUDENT'S ABILITY TO SOLVE MATH PROBLEMS

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ABSTRACT

This study delved into the explicit use of metacognitive SRL strategies in Grade 10 mathematics on permutations. A 10-dayintervention cycle was followed by an analysis of pre- and post-test data. Measures relating to students' use of SRL strategies with cognitive guided tasks and MAI were quantified and analyzed. The data were tabulated and analyzed using the mean, standard deviation, and repeated measures ANOVA to investigate the influence of metacognitive SRL strategies and ROC on student's ability to solve problems. The use of SRL strategies has been proven effective as shown by an increase in students' ROC and achievement. The findings suggest that explicit instruction of SRL strategies slightly, although not significantly, affects students' ROC while explicit instruction of SRL strategies improve students' ability to problem-solve. Overall, the use of SRL strategies has been proven effective as shown by an increase in students' ROC and achievement.

Keywords: self-regulated learning strategies, regulation of cognition, problem-solving

INTRODUCTION

Metacognition has been an area of interest as it bridges various areas simultaneously and is considered as a breakthrough in the field of academic and research. Metacognition is indeed a complex construct. John Flavell, who is considered to be the father in the field of metacognition, proposed a model of cognitive monitoring wherein he identified a wide range of intellectual activities that can be monitored and processed with reference to certain actions and interactions among metacognitive knowledge, metacognitive experience, goals and actions.

Metacognition is also defined as a process of monitoring existing cognition for the purpose of controlling a person's own behavior. Existing modern researches reveal that monitoring cognition plays a crucial role in self-regulation which makes the process precise and accurate (Rhodes, 2019).

The study is framed using the research paradigm adapted from Foote (2018) on her study entitled "What About Mathematical Cognition?". The research framework shows the relationship between constructs and theories related to SLR strategies, ROC and its influence to the learners' achievement with reference to the learners' ability to solve math problems.

Panadero (2017) mentioned that self-regulated learning (SRL) strategies includes various aspects of learning including the metacognitive aspect which is being studied using extensive and integrative approaches. According

to Anthonysamy et al. (2020), SRL strategies are beneficial in assisting students to master their own learning process. Self-regulation is seen to be a very important ingredient to perform better on academic tasks.

Meanwhile, according to Foote (2018), regulation of cognition (ROC) refers to the learner's ability to take control of his or her own cognitive processes. ROC enables the learners to adjust the way they process information while utilizing cognitive and metacognitive learning strategies.

On the other hand, Tarricone (2011) mentioned that metacognition has a complex and multifaceted nature, thus, is in need of clarity of meaning and context. According to Coles (2013), as cited by Alzahrani (2017), there are very limited studies that investigate the metacognitive strategies towards enhancing metacognition.

Foote (2018) mentioned that metacognition makes use of various methods to be able to appropriately compare and regulate the skills needed for metacognition. These skills are seen to be essential for the students' learning. Logic models are used to provide a systematic review process and are said to be an effective way to identify and explore underlying processes in which the proposed solution or intervention can cause a probable effect to an individual or even larger groups (Kneale et al.,2015).

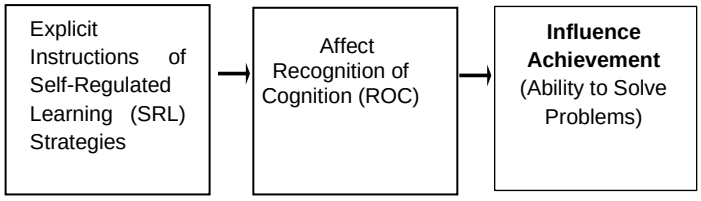

Figure 1 Logic Model

OBJECTIVES OF THE STUDY

The goal of this undertaking is to conduct a systematic investigation to contribute to the existing body of knowledge in terms of metacognitive research. More specifically, this study aims to 1) to determine how explicit instruction in metacognitive self-regulated learning (SRL) strategies influence students' regulation of cognition (ROC); 2) to determine how explicit instruction in metacognitive self-regulated learning (SRL) strategies influence students' abilities to solve problems; and 3) to determine how students' regulation of cognition (ROC) influence students' abilities to solve problems.

METHODOLOGY

The main purpose of this research is to see how explicit instruction in metacognitive SRL strategies influences students' ROC and how it affects problem-solving abilities among students. Table 1 depicts the quasi-experimental pre and post design used in this study.

Table 1
The Experimental and Control Group Pre-post Plan

Experimental Group	**Pre-test**	**Intervention**	**Post-test**
	Mathematics Achievement ROC	10 days of SRL strategies training combined with CGI tasks.	Mathematics Achievement ROC
Control Group	**Pre-test**	**Intervention**	**Post-test**
	Mathematics Achievement ROC	10 days of CGI tasks only.	Mathematics Achievement ROC

The students were selected through a purposive or judgmental sampling technique. Before and after the intervention, all students in the study were evaluated on problem-solving skill and ROC. SRL strategies were taught to the experimental group in conjunction with CGI. The control group received only CGI instruction without SRL strategies.

The study was conducted in Balanacan National High School. Balananacan, Mogpog, Marinduque, Philippines having 70 Grade 10 students. The experimental group composed of 35

Grade 10 students. The control group consisted of 35 Grade 10 students. The students were typically between the ages of 15 and 16.

This study sought permission first from the school's principal and providing informed consent from the learners' parent. The students were properly given an orientation about the scope and implementation of the study. The study utilized a blended paradigm's procedure of Pintrich's 2000. Phases Self- Regulated Learning and Polya's 1945 Self-regulation Questioning in combined with CGI tasks.

The control and experimental groups administered pre-and-post MAI and the CGI word problem assessments for ten days. The study was conducted from March 22 to April 9 of 2021.The online data gathering of the experimental and control groups was smooth from pre-test up to post-test. The two constructs of this study were assessed using MAI and CGI Word Problem Assessment.

The Metacognitive Awareness Inventory (MAI) was used to calculate the ROC. The MAI is composed of 52 true (1) or false (0) questionnaire. The MAI was adopted from Schraw, G. & Dennison, R. S. (1994). It is adopted to address the connection between metacognition and achievement.

The task framework for CGI was created by the teacher-researcher to measure the ability of the students to solve problems. The different types of CGI word problems gave students a wide range of models and strategies to choose from, together with direct modeling, derived facts, and counting. They often necessitate the use of prior information and, most critically for this analysis, deliver an incentive to use the SRL strategy.

The data were tabulated and analyzed using the mean, standard deviation, and repeated measures ANOVA to investigate the influence of metacognitive SRL strategies and ROC on student's ability to solve problems.

RESULTS AND DISCUSSION

1. Influence of Self-regulated Learning Strategies to Student's Regulation of Cognition (ROC) and Problem-solving Skills

Regulation of Cognition (ROC). Repeated measures ANOVA was used to analyze the data, since there were two conditions for treatment (intervention versus comparison) and time (pre-test versus post-test). There was no significant main effect for Time F (1, 68) = 0.157; p = 0.693. This means that students' ROC from pre-test to post-test has not significantly improved. Further, there was no significant main effect for treatment with F (1, 68) = 0.630; p = 0.430. This shows that students' ROC did not significantly differed by treatment. On the other hand, the interaction was not significant as reflected by the F (1.68) = 0.004; p = 0.950. This suggests that there is no significant difference across treatment from pre-test to post-test, as shown in Table 2.

Table 2

Regulation of Cognition

Source	N	Pre – ROC		Post – ROC	
		Mean	SD	Mean	SD
Intervention	35	25.26	14.69	27.40	13.78
Comparison	35	24.49	16.41	26.31	12.17

Several studies have proven that SRL strategies have enhanced the students' ROC (Al-Abdullatif, 2020; Barak et al., 2016; Kim et al., 2020). However, based on the evidence gathered in this study, explicit teaching in metacognitive SRL strategies has a minimal effect on students' ROC. Students' ROC slightly increased in the treatment group as a result of explicit instruction and repeated practice in metacognitive SRL strategies. Moreover, there is a slight difference in students' ROC between the treatment group and the comparison group. This means that after the intervention period, notable improvement in students' ROC is not observed. These results are supported by the study of Foote (2018), where Grade 1 and 3 pupils' ROC have not significantly improved over a 10-day intervention. Therefore, metacognitive awareness of students on their ROC through SRL strategies was not established within the intervention period.

These results reflect the current situation of education, since distance learning is being implemented due to COVID-19 pandemic. Limited contact time of teachers and students may have affected the course of the learning success and may continually dilute effective learning outcomes. Hence, potent plan of intervention implementation must be devised in order to maximize the intervention efficacy (Yu & Jee, 2020).

Students' Problem-solving Skills. As there were two conditions for treatment (intervention versus comparison) and time (pre-test versus post-test), repeated measures ANOVA were used to analyze the data.

Table 3
Achievement

Source	N	Pre – CGI		Post - CGI	
		Mean	SD	Mean	SD
Intervention	35	7.83	4.85	10.97	2.88
Comparison	35	6.46	4.08	8.23	2.94

There is a significant main effect for Time F (1, 68) =16.474; p=0. 000. This means that there has been a noticeable change in students' performance from pre to post intervention. Treatment F (1,68) =9.425; p=0.003 had a significant effect. This shows that students' achievement significantly differs by treatment. However, the interaction was not significant with F (1, 68) = 1.283; p = 0.261. This suggests that there was no significant difference across treatment from pretest to post-test, as shown in Table 3.

On the other hand, students' ability to solve problems did improve in the treatment group as a result of explicit instruction and repeated practice in metacognitive SRL strategies. However, there is a minimal difference in the achievement of treatment and comparison groups. Nonetheless, students' improvement in solving problems is evident in their achievement, as indicated by their scores. Research suggests that SRL strategies help learners to develop metacognitive skills towards solving word problems (Eliserio, 2012; Hardings et al., 2019; Anthonysamy et al., 2020). Therefore, SRL strategies are significant for students as this might positively influence learning outcomes (Bernard et al., 2009; Kramarski & Michalsky, 2010).

CONCLUSION

Overall, this study suggests that explicit instruction of SRL strategies slightly, although not significantly, affects students' ROC while explicit instruction of SRL strategies improves students' ability to problem-solve. The use of SRL strategies has been proven effective as shown by an increase in students' ROC and achievement. It must be bear in mind that this study was only conducted on a small group of learners over a 10-day period considering the added challenge of online distance learning brought about by the COVID-19 pandemic. Further research is hence needed to extend the current study across a larger population in a longer period of time before generalized conclusions can be drawn.

RECOMMENDATION

The researchers recommend further research to explore the explicit instruction of SRL strategies and their influence on ROC and the students' ability to solve problems. A longitudinal investigation on the SRL strategies to enhance students' ROC and problem-solving skills based on contextualized materials may in the future yield different results than those found in this study.

In addition, future researchers may explore explicit instruction of SRL strategies and its influence on ROC and the students' ability to problem-solve through a qualitative lens. It may provide authentic and in-depth opportunities to examine students' awareness of cognition.

For an extension of the current study, it would be useful to delve with explicit teaching of SRL strategies and their influence on ROC and the

students' problem-solving skills across populations in examining individual levels of performance and achievement.

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