THE EFFECTIVENESS OF SELF-CORRECTION STRATEGY IN IMPROVING PRIMARY SCHOOL STUDENTS' MATHEMATICS ACHIEVEMENT

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ABSTRACT

The use of self-correction strategy helps students to detect their own mistakes and self-correct them, thereby students self-regulate their own learning processes. It is still a strategy that is rarely researched in mathematics learning, particularly at the primary level. This study attempts to fill in the gaps by determining the effectiveness self-correction strategy on primary school students' mathematics achievement. It also aims to determine the mediating roles of problem-solving self-efficacy on the relationships between the two variables. To assess the effects of self-correction strategy empirically, a Pretest-Posttest Nonequivalent Control Group design was employed. The study involved 62 primary school students. The experimental group (n=32) applied self-correction strategy during 12 mathematics lessons while the control group (n=30) did not. Achievement of both groups was measured by the mathematics test. Students' problem-solving self-efficacy was measured by the Problem-Solving Self-Efficacy Questionnaire. Results of Analysis of Covariance (ANCOVA) found that self-correction strategy was effective in improving the experimental group's mathematics achievement [$F(1, 59) = 11.00$, $p < .05$, eta square = .157]. The results of regression analysis showed that self-efficacy was a significant mediator between the use of self-correction strategy and their mathematics achievement [$F(1, 61) = 27.60$, $p = .046$, $\beta = -.201$]. Implications of the findings from the educational and research standpoints were discussed and suggestions for future research were provided in this paper.

Keywords: *Self-correction strategy, problem-solving self-efficacy, mathematics achievement, metacognitive, primary school*

INTRODUCTION

Students often struggle with mathematics problems-solving. Even when they have content knowledge to solve the problems, they often lack the ability and skills to identify when and how should a specific knowledge be applied. As a result, students make simple computational errors and give up on mathematics problem-solving (Laistner, 2016). Learning mathematics demands both domain-specific knowledge and metacognitive skills such as self-correction strategy (Katz, 2015). The use of self-correction strategy helps students to understand the question better, apply the problem-solving steps in sequence and avoid making careless mistakes. Students at all level, including primary school students should learn how to apply self-correction strategy in mathematics problems solving. Mathematics can be challenging for students, particularly at the upper primary level. During this stage, students are moving into more advance mathematical concepts. They tend to face challenges in recognizing and writing down the mathematical symbols, making errors due to misconception and lack of attention (Zarina, Abdur, & Sajjad, 2020). Research showed that students with low metacognitive skills have poor performance in mathematics (Abdullah, Rahman & Hamzah, 2017). Hence, students should be equipped with metacognitive skills to ensure that they pay attention during mathematics problem solving and avoid making careless mistakes.

Several recent pedagogical experiments proved that students' metacognitive skills can be developed through interventions (Chytrý, Říčan, Eisenmann, & Medová, 2020). The interventions aim to improve students' self-regulation from the behavioral perspective (Wang & Sperling, 2020). As such, students are taught how to practically apply strategies to plan for solutions, pay attention on task, and self-evaluate their mathematics problem-solving. Literature reviews also showed that the use of self-correction strategy will increase and sustain student learning and performance, particularly in subjects like mathematics that require constant cognitive engagement and monitoring (Mohamad Ariffin Abu Bakar, et al., 2020). Students also learn to look for errors, describe them precisely and interpret the possible causes of errors and to correct or eliminate the errors in the end (Chytrý, Říčan, Eisenmann, & Medová, 2020).

This is because the students are more capable of monitoring and correcting their own errors. They make lesser mistakes and have higher performance in mathematics problem-solving. This shows that the use of self-correction strategy could increase students' metacognitive skills and contribute positively towards their mathematics learning and performance (e.g., Mohamad Ariffin Abu Bakar, et al., 2020; Palennari, Taiyeb & Siti Saenab, 2018; Pennequin, Sorel, Nanty & Fontaine, 2010). However, most of these studies did not focus on students at the primary school level. There was also limited studies that evaluate the effectiveness of self-correction strategy in mathematics subject. In fact, most of the past studies was the application of self-correction strategy in language learning (Durdana, Shawwal, Mehwish, 2017; Marizka, 2020). There are needs to fill in the literature gaps on the effectiveness of self-correction strategy in improving primary school students' mathematics achievement.

Self-Correction Strategy in Mathematics Problem-Solving

Self-correction strategy can help students notice and correct their errors independently or with the cues from teachers or peers (Makino, 1993). Based on the findings of Ramdass and Zimmerman's (2008) via a quasi-experiment study, self-correction strategy was effective helping students solve mathematical problems. Students in the experimental group were taught how to use the self-monitoring checklist and solve multiplication problems based on the cues in the checklist. All students in the treatment group received similar checklist and instruction on self-correction procedures. Results from the study showed that students in the experimental group performed significantly better in posttest compare to the control group. Learning mathematics requires not only metacognitive effort but also high level of efficacious beliefs to produce the designated level of performance (Katz, 2015).

However, a large majority of students may not be equipped with adequate metacognitive skills to self-monitor and self-check their answers during mathematical problem-solving processes. Younger students particularly need guidance from teachers to engage in metacognitive activities. Past studies found that teachers' knowledge on metacognitive strategies is not high (Mohamad Ariffin Abu Bakar, et al., 2020); they may know how to promote self-correction strategy at primary level or lack the knowledge about the effectiveness of this strategy in mathematics learning. To fill in the research gaps, this study aimed to test the effectiveness of self-correction strategy on mathematics achievement among primary school students.

Self-Efficacy in Mathematics Problem-Solving

According to Bandura (2006), self-efficacy influences how a person thinks of a given task, the employment of strategy, how much efforts put and resilience ability to adversity. Self-efficacy has been proven to have strong correspondence to academic performance in past research (Kundu & Ghose, 2016; Manzano-Sanchez et. al., 2018). In mathematics and metacognitive field, self-efficacy was positively and significantly correlated with mathematical problems solving and performance of primary students (Bonne & Lawes, 2016; Haciömeroğlu, 2019). According to Ramdass and Zimmerman (2008), teachers need to monitor students' self-efficacy to optimize the application of self-correction strategy. Studies indicate that accuracy of self-judgements is important for effective metacognitive functioning and academic success (Chen & Zimmerman, 2007). Inaccuracies in self-efficacy judgment can become a barrier for children to learn mathematics and for teachers to apply pedagogical practices effectively. Studies showed that students were generally accurate in their self-efficacy judgement in mathematics and can be taught to use self-correction strategy to improve their performance (e.g., Ramdass & Zimmerman, 2008). There are needs for teachers to show students the connection between the use of self-correction strategy and how it could enhance their mathematics performance. Those who apply strategies in problem solving tend to develop higher self-efficacy in the end as they are more likely to be successful in the task compared to those who do not (Ramdass & Zimmerman, 2008). In other words, there is a relationship between the use of strategy in mathematical problem-solving, students' self-efficacy and their performance. In fact, there are literature support for the mediating roles of self-efficacy on the relationships between self-regulation, specifically the use of self-correction strategy and mathematics achievement (Fomina, 2017).

Theoretical Framework

The present study focuses on the use of self-correction strategy, which is supported by an underlying framework of Metacognitive Model (Borkowski, Chan & Nithi, 2000). The model (Figure 1) depicts students' use of self-correction strategy in problem-solving. Firstly, students are taught to employ self-correction strategy. For instance, they will learn how to use self-correction strategy to monitor, check and evaluate their own performance during mathematics problem-solving tasks. The use of self-correction strategy enhances students' executive processes such as planning for solution, focusing on task and paying attention to avoid careless mistakes. Nevertheless, students' level of competency in executive functions differ individually; some students are competent while others require more trainings.

Feedbacks provided by teachers is an important component in this model. It has a direct impact on students' self-knowledge regarding their own performance. Based on the feedbacks received, students will be able to determine the effects of strategy use on their performance. Feedback also has a direct effect on students' motivational beliefs, which is their self-efficacy. Borkowski, Chan and Nithi (2000) hypothesized that the sense of self-efficacy belief will flow from individual strategic actions and eventually return enhance the process of strategy selection and deploy, and process of monitoring and control. As students' self-efficacy improves, students will exert more efforts on the executive processes and the tasks, which lead to increase usage of correction strategy. This is because students are more confident in learning and attributed their improvement to strategy use rather than luck.

Over time, the repeatedly use of self-correction strategy helps students to master the mathematics concepts better and enhances their domain-specific knowledge on the subject. Apart from that, students' specific-strategy knowledge, which is their knowledge about strategy will also improve since they are more aware of which strategy is effective for what types of problems. The tendency of students in making careless mistakes decrease since they can detect their own mistakes and correct them during the problem-solving processes. This implies that students are self-regulating their mathematics problem-solving processes.

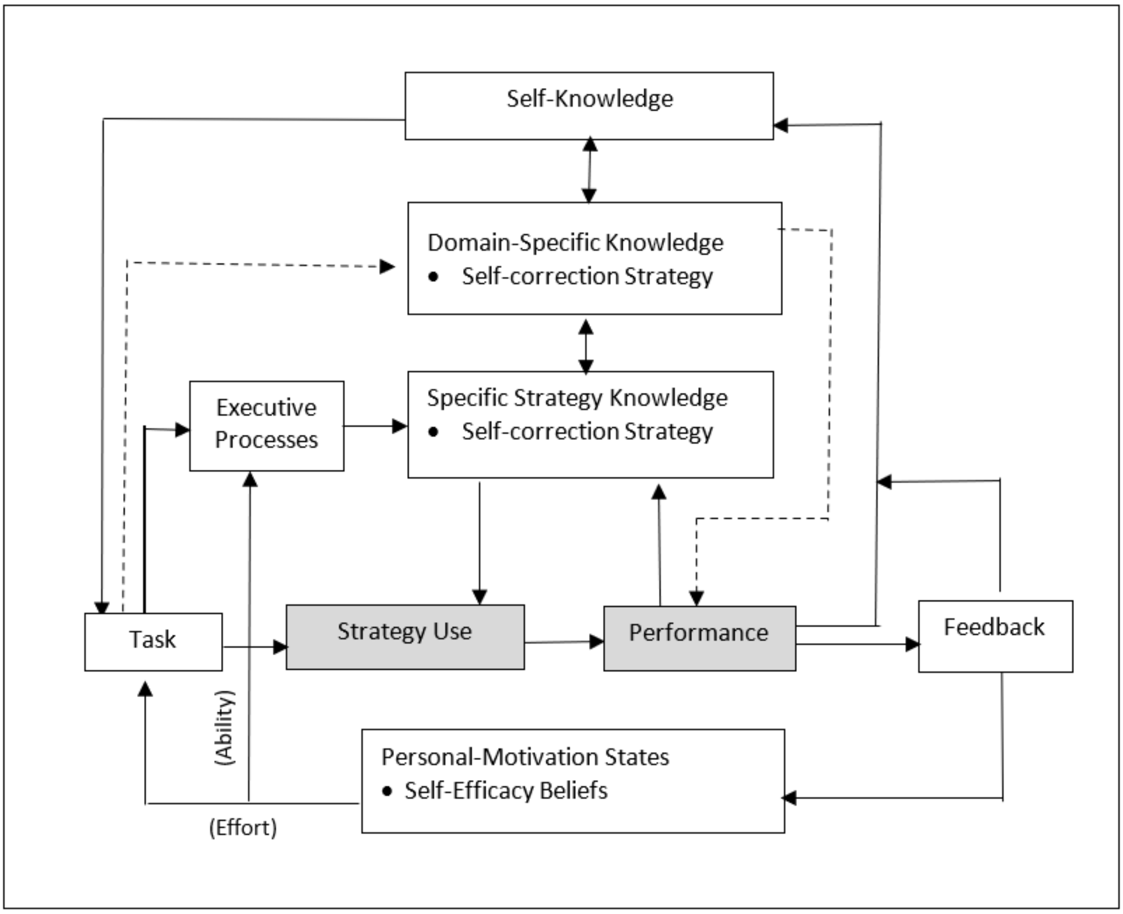

Figure 1. Theoretical Framework (Source: Adapted from Borkowski, Chan & Nithi, 2000: 10)

Even though there are literature and theoretical support on the use of self-correction strategy as an intervention to help improve students' mathematics performance, its effectiveness, and the role of self-efficacy in the process is still uncertain due to a lack of empirical study on primary school students. This study aims to fill in the gaps by determining the effectiveness self-correction strategy as an intervention on primary students' mathematics achievement. It also aims to assess the mediating roles of problem-solving self-efficacy on the relationships between the two variables. The hypothetical relationships between the three variables are depicted in Figure 2.

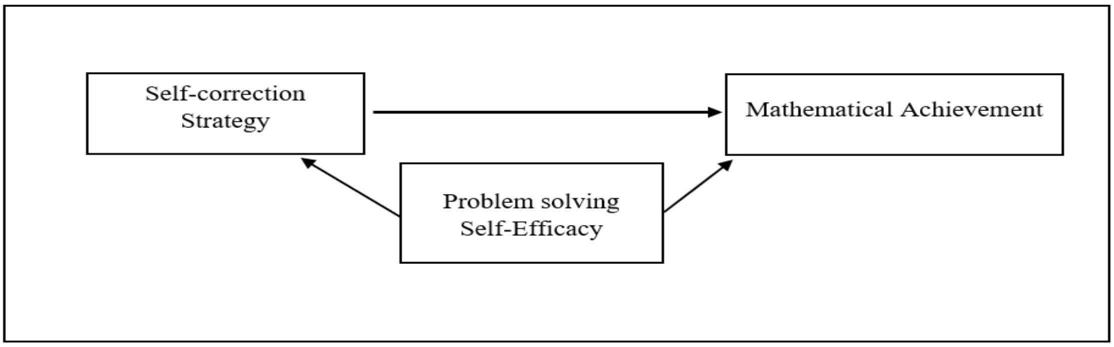

Figure 2. The Relationships between Self-Correction Strategy, Mathematics Relationship and Problem-Solving Self-Efficacy

To achieve the purpose of this study, two hypotheses were formulated :

H1: The posttest mean of experimental group's mathematics achievement is significantly higher than the control group.
H2: There is a significant mediating effect of problem-solving self-efficacy on self-correction strategy and mathematics achievement.

METHODOLOGY

Research Design

A quasi-experimental study was carried out to examine the effectiveness of self-correction strategy on primary students' mathematics performance. The subjects of this research were made up of 62 students from a primary school in the state of Penang, Malaysia. Two Year Four (10 years old) classes were randomly assigned to experimental (n=32) and control groups (n=30). The reason of selecting both experimental and control groups from a single school was to control the potential environmental and location threats. The two classes were then randomly assigned to experimental group and control group as intact groups. Though true experimental design is the most preferred experimental design in research, it could not be used in this study due to constraints in random assignment of subjects. In this study, both experimental group and control group were pretested on their mathematics achievement before the experiment began. The experimental group then received treatment of self-correction strategy for 12 lessons. Both groups were posttested on mathematics achievement and problem-solving self-efficacy after the experiments ends.

Treatment

The treatment in this study refers to the used of self-correction strategy in mathematics problem-solving. The treatment was carried out for the experimental group in a normal classroom using school curriculum. The experimental group has undergone the treatment of self-correction strategy for a duration of 12 mathematics lessons (each period = 30 minutes) while the control group received mathematics lessons without the intervention. Mathematics was chosen because problem-solving in this subject required systematic step by step procedures and demands students to engage in executive functioning to self-monitor and self-check their problem-solving. In the study, Unit 10: Shape and Space was used as the topic learnt. The students were expected to learn three subtopics from this chapter, namely solving problems that involve parameter, areas in 2D shape and volume in 3D substances. The mathematical problem-solving tasks were challenging to allow rooms for application of self-correction strategy yet attainable for Year Four students (10 years old).

The use of self-correction strategy was modeled by the teacher in mathematics lessons through step-by-step demonstration in class. During the intervention, teachers observed students' progress in using the strategy and corrected them if necessary, to ensure that every student in the experimental group understood how to use the strategy. Students in the experimental group were also given a checklist to help them self-monitor and self-check their answers during problem-solving. The checklist was adapted from Dunlap and Dunlap's (1989) checklist and was modified according to mathematics syllabuses in the local context. Students' common mistakes on the mathematics topics taught (parameters, areas in 2D shape and volume in 3D substances) were identified and listed in the form of behaviors (e.g., I underline …, I wrote… so that I could read them easily and not mistake them for other numbers). Items on the checklist ware written in the first person to help students self-check their work to avoid making common errors in problem-solving. The treatment implementer was a Mathematics teacher who thought the experimental group. The teacher had received training on self-correction strategy. A Teacher's Instruction and the teaching and learning materials (e.g., checklist) on the implementation of self-correction strategy was also provided to the teacher. The control group, on the other hand, was taught by another Mathematics teacher. Both teachers have the same amount of lesson times and were given the same mathematical problem-solving tasks.

Instruments

The instruments used to measure pretest and posttest mathematics achievement and problem-solving self-efficacy were as follows:

Pretest and Posttest

Mathematics achievement was measured by mathematics test. Both pretest and posttest were developed by experienced and qualified mathematics teacher to ensure that the coverage and content of the test was appropriate for the subjects. The tests were also verified by experts in the field of mathematics. The content of the test was made up of 12 similar mathematical problems in on Shape and Space. All the problems selected fulfilled the standard of Integrated Curriculum of Primary School laid down by the Ministry of Education (MoE). To reduce the possible pretest interaction threat, the mathematics problems chosen was non-reactive in nature and the order of mathematics problems in posttest were shuffled. The scoring for the mathematics problem was 1 for incorrect answer, 5 for partially correct answer and 10 for correct answer. The scoring of pretest and posttest were similar with the Problem-Solving Self-Efficacy Questionnaire that is also range from 1 to 10.

Problem-Solving Self-Efficacy Questionnaire

Problem solving self-efficacy was measured by the Problem-Solving Self-Efficacy Questionnaire, adapted from Bandura's (2006) guides for constructing self-efficacy scale. The instrument consists of 15 items, for example "*How sure do you feel in your capability to solve the mathematical problem?*" the ratings were from 1 to 10 where 1 represents "has no confident to do"; 5 represents "moderately can do"; 10 represents "highly confident can do". The questionnaire was pilot tested on Year Four students who were not involved in the study prior to the commencement of the experiment. The reliability of the instrument as indicated by Cronbach's alpha value was .89, indicating a high reliability. The score for self-efficacy was collected after the intervention ends as this study aimed to test its mediating roles on self-correction strategy and mathematics achievement.

FINDINGS

Descriptive Statistics

Descriptive analyses were used to describe the characteristics of the test scores. As all data were interval in nature, means were used as measure of central tendency and standard deviations as indices of variability. Table 2 shows the means and standard deviations of pretest, posttest and self-efficacy scores of experimental and control groups.

Table 2
Means and Standard Deviation of Experimental and Control Groups

Variable	Experimental Group n = 32		Control Group n = 30	
	M	SD	M	SD
Pretest -Achievement	32.81	17.48	28.80	12.37
Posttest -Achievement	70.25	33.17	44.87	26.96
Problem Solving Self-Efficacy	107.19	32.52	84.97	35.63

Note: Achievement=Mathematics achievement

The experimental group's pretest scores was M= 32.81 (SD = 17.48), while the control group's pretest score was M=28.80 (SD = 12.37). Pretest scores were treated as covariate in Analysis of Covariance (ANCOVA), whereby any effects due to differences in pretest was statistically removed before the effect of the intervention was determined. After the treatment, experimental group's posttest score was found to be M=70.25 (SD = 33.17), while control group's score in posttest was M= 44.87 (SD = 26.96). In terms of problem-solving self-efficacy, experimental group has a higher mean score of M=107.19 (SD = 32.52) while the control group's score was lower at M=84.97 (SD = 35.63).

To determine the effectiveness of the intervention effects, Analysis of Covariance (ANCOVA) was employed to analyze the data. It is a general linear model, which examines whether the population means of a dependent variable are equal across levels for a categorical variable, and at the same time controlling the effects of extraneous variables, known as covariates (Keppel, 1991). ANCOVA was used to test the first hypothesis. Before the analysis was carried out, all the relevant assumptions were fulfilled. The first few assumptions were similar with other Analysis of Variance (ANOVA), namely scale of measurement, normality, random sampling, and equal variance. Besides, there were two important assumptions specific for ANCOVA. First, covariate must be correlated with dependent variable. Second, assumption of homogeneity of regression slopes. All the assumptions were fulfilled in this study.

Effects of Self-Correction Strategy on Mathematics Achievement

Table 3 shows the results that tested the differences of posttest scores on mathematics achievement between experimental and control groups, while controlling for pretest scores as covariate. Results showed that the experimental group and control group differed significantly on posttest scores on mathematics achievement (pretest), $F(1, 59) = 11.00$, $p < .05$, eta square = .157. Therefore, hypothesis (H1) was accepted.

H1: The posttest mean of experimental group's mathematics achievement is significantly higher than the control group.

The partial eta squared was .157 from the result indicates that 15.7 percent of the variance in the mathematics achievement in the posttest was explained by the treatment, which is the used of the correction strategy. According to Cohen's (1988) guidelines, .01 = small effects, .06 = moderate effects, .14 = large effects. The effects size of self-correction strategy was large. In other words, self-correction strategy had significantly improved the experimental group's mathematics achievement in posttest.

Table 3
ANCOVA on Posttest Scores of Mathematics Achievement

Source	Sum of squares	Df	Mean square	F	Sig.	Partial Eta Squared
Pretest-Achievement	20857.462	1	20857.462	35.972	.000*	.379
Posttest-Achievement	6373.518	1	6373.518	10.992	.002*	.157
Error	34210.005	59	579.831			
Total	273380.000	62				

Note: *p < .05; Achievement=Mathematics achievement

Mediating Effects of Self-Efficacy

The second hypothesis of this study was that self-efficacy has mediating effects on the relationships between self-correction strategy and mathematics achievement. Generally, a given variable is considered as a mediator to the extent that it affects the relationship between the independent and dependent variable (Judd, Yzerbyt, & Muller, 2014). There are several important assumptions in the mediation model. First, the mediator and dependent variable must be normally distributed. This assumption was tested and fulfilled. Second, the model is correctly specified. Misspecification includes incorrect causal order, incorrect causal direction and omissions of unmeasured variables that cause the variables in the mediation analysis (MacKinnon, Fairchild and Fritz 2007). This assumption was met as the model was based on past literatures. Another important assumption is no measurement error, especially measurement errors that lead to the misspecification of the model. This assumption was fulfilled as the questionnaires and tests were valid and reliable. Apart from the above assumptions, three conditions need to be fulfilled to determine whether mediation effects occur. The conditions are: the independent variable predicts dependent variable; the independent variable predicts the mediator; and the mediator predicts the dependent variables, independent variable does not predict dependent variable while controlled for mediator (Judd, Yzerbyt, & Muller, 2014).

Multiple Regression Analysis was performed to examine the first three conditions as stated above. The first regression analysis showed that self-correction strategy was a predictor of posttest mathematics achievement, $F(1, 61) = 10.87$, $p = .002$, $\beta = -.39$. The second regression analysis showed that self-correction strategy was a predictor of self-efficacy, $F(1, 61) = 6.59$, $p = .013$, $\beta = -.315$. A third regression analysis showed that self-efficacy was a predictor of posttest mathematics achievement, $F(1, 61) = 48.48$, $p = .000$, $\beta = .669$.

Table 4

Regression Coefficient of Self-Correction Strategy, Posttest Mathematics Achievement and Self-Efficacy

Predictor	Criterion Variable	Controlled for	Standardized Coefficient Beta	F	Sig
Self-correction Strategy	Self-Efficacy	-	-.392	10.870	.002*
Self-correction Strategy	Achievement	-	-.315	6.591	.013*
Self-Efficacy	Achievement	-	.699	48.483	.000*
Self-Efficacy	Achievement	Self-correction Strategy	.605	27.605	.000*
Self-correction Strategy	Achievement	Self-Efficacy	-.201	27.605	.046*

Note: *p < .05; Achievement=Mathematics achievement

In sum the pre-conditions for testing mediation were met. Multiple regressions were then run to examine the mediation effects of self-efficacy. When controlling for self-correction strategy, self-efficacy was found to predict posttest mathematics achievement significantly, $F(1, 61) = 27.60$, $p = .000$, $\beta = .605$. This means that mediation occurred. When examine for the regression analysis on self-correction strategy after controlling for mediator, the result remained significant, $F(1, 61) = 27.60$, $p = .046$, $\beta = -.201$. This result suggests that self-efficacy was a partial mediator between self-correction strategy and mathematics achievement. The second hypothesis (H2) was partially supported:

H2: There is a significant mediating effect of problem-solving self-efficacy on self-correction strategy and mathematics achievement.

DISCUSSION

Self-correction strategy is a metacognitive strategy that is used in many learning areas and was found to have significant effects in improving students' academic performance (Ramdass & Zimmerman, 2008; Marizka, 2020). However, its effect on mathematics achievement of primary school students were seldom tested. The effectiveness of self-correction strategy in improving the primary school students' mathematics achievement was tested. The mean score of experimental group (M = 70.25, SD = 33.17) was higher than the control group (M = 44.87, SD = 26.96) in posttest. The finding suggests that the experimental group performed significantly better than the control group on mathematics achievement after controlling for pretest achievement, $F(1, 59) = 11.00$, $p < .05$, eta square = .157. The magnitude of intervention effects was considered large (eta squared = .157) according to Cohen's (1998) guidelines, as 15.7 % of the variance in achievement were due to the employment of self-correction strategy.

Self-correction strategy was found to be effective in enhancing students' mathematics achievement. The result is supported by Ramdass and Zimmerman's (2008) study that self-correction strategy has positive effects on students' mathematics performance. As Ramdass and Zimmerman's (2008) study provide evidence for the effects of self-correction strategy on middle school students, the current research filled in the gaps by offering insights on the effectiveness of self-correction strategy on primary school students' mathematics achievement. The use of self-correction strategy could help students to monitor their cognitive processes when solving mathematical problems (Kolić-Vehovec, 2002). During the application of self-correction strategy, students would monitor their solution steps-by-steps and check their answers using a self-monitoring checklist. The checklist has provided substantial opportunities for the students to monitor their cognitive strategies and help them making fewer careless mistakes when solving the mathematical problems. Study has proven that the more monitoring process involved, the better the performance (Peschon, 2020).

In terms of mediation effects of self-efficacy on self-correction strategy and mathematics achievement, the results of multiple regression analysis proved that self-efficacy has partial effects on mathematics achievement. The result is slightly differed from Coutinho's (2008) finding as he found a full mediation of self-efficacy between metacognition and performance while the current finding found a partial mediation effect. This may be due to the level of difficulty of the test between the two studies were differ. Researcher of present study had included challenging items in mathematics test, this invariably could have increased the difficulties of the assessment. According to Bandura (1997)-replace with updated source when investigating the relationship between self-efficacy and performance, the complexity, or level of difficulties of the task should be taken into consideration. In most cases, it is assumed that when complex task is involved, the magnitude of self-efficacy needs to be higher. Even though some of the mathematics problems were challenging, they were attainable based on the students' ability and background knowledge on the topics. The results of this study suggest that self-efficacy had helped students in solving mathematical problems. As explained by Bandura (1997), with a strong self-efficacy, a person is likely to act, even if he or she believed that the action may not necessarily lead to a desirable outcome. In fact, the partial mediating role of self-efficacy has shed lights on the reasons why some findings on the effects of strategy used and students' performance was inconsistent (Akamatsu, Nakaya & Koizumi, 2019; Katz, 2015). There are possibilities that the samples have different level of self-efficacy.

Current study draws a few implications on education. First, metacognitive strategy such as self-correction strategy is applicable in classroom settings, in specific mathematics lesson. Teacher can explain the meaning of metacognition and model the use of self-correction strategy during lesson. Teacher could scaffold primary school students to apply self-correction strategy to help them monitor and check answers. According to An and Cao (2014), metacognitive scaffolding is important to help student monitor their progress in problem solving. Secondly, this study has demonstrated the importance of cues in scaffolding as hypothesized by social cognitive theory (Moon & Ryuu, 2021). Self-correction strategy though exists in many forms in different learning domains, the main feature of it is teacher provides relevant cues or hints to students during problem-solving processes. The cues given were important in this study as it helped students to retrieve their prior knowledge from long-term memory to understand and solve problems (Tok, 2013).-Researchers point out that it is important for teacher not to correct students' errors or give answer to students directly, as an alternate, teachers may provide cues or hints so that the students can correct their own errors by activating prior knowledge (Malone, 2015) or to get new information for the correction. Thirdly, the present study shows that students are capable of self-correct their works with some helps from the teachers (e.g., prepare a self-monitoring checklist and teach them how to use). However, students do not automatically activate the use of self-correction strategy. They need to be guided and constantly prompted by the teacher. Therefore, teacher plays important roles in development primary students' metacognitive skill, by giving them adequate thinking time to ponder and check their answers using self-monitoring checklist and find new solutions if they have made mistakes. Fourthly, as current study revealed that self-efficacy has partial mediating effects on the relationships between self-correction strategy and mathematics performance, teachers need to constantly examine students' self-efficacy when teaching students using self-correction strategies. In addition, teacher provide positive reinforcement and feedbacks for those who manage to apply the strategy in problem-solving. By seeing the connection between strategies use, self-efficacy and performance, student will value the strategy more in learning.

In addition, this study also contributes to the theoretical and research realm in a few ways. It supported Borkowski, Chan and Nithi (2000)'s hypothesis that the learning of metacognitive strategy can enhance students' self-efficacy, which in turn improve their academic performance even primary school students. As such, the teaching of metacognitive strategy shall be emphasized by teachers. The findings of this study also supported the importance of self-efficacy in learning and performance, as proposed by Social Cognitive Theory (Bandura. 1997). The mediation effect of self-efficacy as found in this study was supported by past study (Coutinho, 2008). Given this finding, future researchers who study the effect of self-correction strategy on performance must include self-efficacy as a controlled variable. The importance of scaffolding in helping students to learn strategy step-by-step was also evident in this study (Vygotsky, 1987). This study also found that the use of self-correction strategy can be effective on students' performance if teachers model how the strategies are applied in problem-solving and provide cues and learning tool (e.g., checklist) to help students self-monitor more effectively.

The present study acknowledges two limitations. Firstly, a quasi-experimental design instead of a pure experimental study was carried out. This implies that there was no random sampling of subjects and the study may expose to some threats (Gay, et. al., 2009). Nevertheless, the researchers have taken measures to ensure that treatment was the only difference between experimental and control groups. Both groups were comparable in terms of prior mathematics performance. Furthermore, ANCOVA was carried out to remove potential confounding effects from pretest achievement scores. Self-efficacy was not included as a control variable in ANCOVA as its mediating effects was still uncertain before the intervention was carried out. Mixed findings were found in the literatures. The second limitation the content or subject tested. The findings of this study could only be generalized to mathematics. The scope of mathematics test in this study was limited to a specific unit in the syllabus. This was done to control the potential differences in prior knowledge of control and experimental group.

CONCLUSION

In conclusion, this study found that primary school students' mathematics achievement has improved significantly after they have learned to apply self-correction strategy in mathematics problem-solving. The finding shows that self-correction strategy can be taught to primary school students as a metacognitive skill to help them improve their mathematics performance. In view that it was beyond the scope of this study to measure the retention of self-correction strategy after the experiment ends, the sustainability of this strategy was uncertain. A delayed posttest can be designed in future studies to evaluate whether the effects of self-correction strategy can be sustained after the intervention ends and how long it could last. The results will offer crucial information on whether the use of self-correction strategy will continue even without the scaffolding of the teacher. In other words, will students continue to practice and use self-correction strategy in mathematics problem solving on their own. To become effective in metacognitive and self-regulation processes, students are expected to use of the strategy independently without close supervision from the teacher.

In view that this study has tested the effects of self-correction strategy on mathematics subjects. Future studies can be carried out to determine whether the same positive effects of self-correction strategy can be attained for other STEM subjects such as science, which also involved many problem-solving tasks. In addition, this study also found that students' self-efficacy has mediated the use of self-correction strategy and mathematics achievement. This shows that self-efficacy is an important motivation factor that have to be taken into consideration, as supported by The Metacognitive Model (Borkowski, Chan & Nithi, 2000). The level and complexities of the mathematics tasks were not being investigated in this study. Future studies can be carried out to assess whether level of tasks complexities affect students' self-efficacy and how students use self-correction strategy in mathematics problem-solving. This is because there is a possibility that the relationships between self-efficacy and performance is also influenced by the level of task complexities (Street, Malmberg, & Stylianides, 2017; Tian, Fang, & Li, 2018). Overall, the findings of this empirical study lend support to the teaching of self-correction strategy in mathematics lesson. It is an effective intervention to improve primary school students' mathematics problem-solving and their performance in the subject. To attain a positive impact, teachers should take into consideration students' self-efficacy and provide positive feedbacks to increase their confidence in using self-correction strategy.

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