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EXAMINING STUDENTS' PROCEDURAL FLUENCY AND SELF-EFFICACY THROUGH COVER-COPY-COMPARE (CCC) STRATEGY

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ABSTRACT

This study examined the effectiveness of Cover-Copy-Compare (CCC) Stretegy in exploring procedural fluency and self-efficacy in two (2) grade 11 classes in Talakag National High School for the Academic Year 2025-2026. Cover-Copy-Compare (CCC) has been conceptualized that increased practice opportunities, self-monitoring, self-evaluation, and error correction are key components of the Cover-Copy-Compare strategy. One section was exposed to the Cover-Copy-Compare (CCC) Strategy with with thirty-three (33) students, while the other section was exposed to the Non-Cover-Copy-Compare (Non-CCC) Strategy with thirty-five (35) students. This study employed a quasi-experimental research design. Procedural fluency was assessed using a validated researcher-made procedural fluency questionnaire, while self-efficacy was measured through an adopted survey questionnaire. Data was analyzed through descriptive statistics such as mean, frequency, and percentage and Analysis of Covariance (ANCOVA). Results revealed that students who are exposed to CCC showed improvement on their level of procedural fluency and non-CCC group showed progress but remained largely at a low fluency level. With regards to self-efficacy, the results revealed no significant results to both the CCC and Non-CCC. Mathematics teachers are recommended to be intentional and deliberate in activating each of these elements within their CCC-based lessons. Specifically, teachers should design activities that not only engage students in repeated practice and self-comparison but also create space for students to acknowledge their progress, articulate their confusion, and reframe difficulty as a productive stage of learning. Hence, this study provides evidence that the CCC strategy effectively enhances students' procedural fluency. While the impact on self-efficacy needs further investigation.

Keyword: Cover-Copy-Compare Strategy, Procedural Fluency, Self-Efficacy

1. INTRODUCTION

Confidence in mathematics and mastery of procedures work together to shape students' success in problem solving. Students' mathematical proficiency is crucial to the learning process and to solving mathematical problems. The National Council of Teachers of Mathematics (NCTM) identifies five key strands contributing to this proficiency: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. It is important that students possess a deep understanding of mathematical concepts and apply this knowledge effectively, particularly in procedural fluency.

Procedural fluency is the ability to perform mathematical procedures accurately, efficiently, and flexibly (NCTM, 2023). A student with strong procedural fluency cannot only possess the ability to solve problems using efficient, accurate, and correct procedures but also adapt these procedures to solve new problems. Along with procedural fluency, students' self-efficacy also plays a crucial role in how confidently and persistently they engage with mathematical tasks. Self-efficacy, on the other hand, encompasses a student's confidence toward mathematics. It refers to cognitive beliefs of competence in mathematics. Building confidence in their own ability to learn it, and persisting through challenges. Students with positive self-efficacy are more likely to be engaged learners and achieve greater success in mathematics.

Despite the importance of procedural fluency and the self-efficacy of students in learning mathematics, a lot of research indicates that it is often ignored in actual classroom practice. Students have difficulty mastering these skills, and they lack the flexibility to adapt their knowledge. This highlights a gap in their procedural fluency; they can execute steps but lack understanding of how to apply them. Ederosas (2024) and Tangcogo (2024) state that students had difficulties with procedural fluency. Aside from that, procedural fluency is not the only variable that affects students' performance in mathematics; psychological constructs such as self-efficacy, attitude, and mathematics anxiety also have a significant impact on students' mathematics performance (Saligumba & Tan, 2018). Students with low confidence may view math as irrelevant, uninteresting, or simply too difficult for them. These negative beliefs can lead to disengagement, hindering their overall mathematical achievement.

This problem is concerning because of the consistently low performance of Filipino students on the recent Program for International Student Assessment (PISA). The results revealed that the Philippines remains among the least proficient in the world in math, reading, and science (OECD, 2023). Additionally, the 2019 NAT results showed that Filipino students performed significantly below the required mean percentage score in Mathematics, indicating a low proficiency level. Learners' NAT performance has gradually declined over the last four years, placing them at poor mastery or proficiency (DepEd). In Region X, for Grade 10 NAT mean percentage score, the national mean percentage score is 44.35. The MPS of Region X is 44.32.

Both are revealing of low proficiency levels in the Department of Education (Escarlos et al., 2023). The decline in scores proposes potential issues in how students are applying their mathematical knowledge, and this doesn't directly assess procedural fluency. This indicates a common issue where the majority of Filipino students lack sufficient mathematical skills, including the ability to apply their knowledge flexibly. This means that Filipinos cannot go beyond simple recall (Cordova & Tan, 2018). Furthermore, there appears to be a gap in our understanding of the relationship between procedural fluency and self-efficacy. While some research suggests a positive correlation, where students with strong procedural fluency tend to have higher self-efficacy towards math, a clearer picture is needed. Understanding this relationship can inform instructional practices.

To address these problems, one of the strategies that might help to enhance procedural fluency and self-efficacy is the implementation of the Cover-Copy-Compare strategy. Cover-Copy-Compare (CCC) is a self-management strategy developed to improve students' academic performance (Nelson, 2022). It has been conceptualized that increased practice opportunities, self-monitoring, self-evaluation, and error correction are key components of the Cover-Copy-Compare intervention. A key component of Cover-Copy-Compare is having students practice math problems under self-managed conditions; therefore, students monitor their accuracy and engage in additional practice when errors occur (Nelson, 2022). Cover-copy-compare (CCC) allows students to receive immediate feedback and increase the rate of their corrective feedback (Alptekin & Sönmez, 2022). It supports independent practice, which improves students' outcomes. Thus, this research uses this strategy to examine its impact on students' procedural fluency and self-efficacy.

2. METHODOLOGY

2.1. Objectives

This study aimed to determine the effect of the Cover-Copy-Compare (CCC) strategy on students' procedural fluency and self-efficacy at Talakag National High School for the first quarter of the school year 2025-2026. Specifically, it sought to:

1. Determine the level of the students' procedural fluency as exposed to CCC and those exposed to Non-CCC Strategy in terms of:
   a. pretest,
   b. posttest, and
   c. retention test
2. Identify the level of the students' self-efficacy as exposed to CCC and those exposed to Non-CCC Strategy.
3. Ascertain if there is a significant difference in the students' procedural fluency who were exposed to CCC and to those exposed to Non-CCC Strategy in terms of:

   a. posttest, and

   b. retention test

4. Find out if there is a significant difference between students' self-efficacy as exposed to CCC and those exposed to Non-CCC.

2.2. Research Design

This study employed a quasi experimental research design. The eight sections underwent a pretest, and using a homogeneity of variance, the two sections with nearly the same pretest means were chosen as the participants in the study. The assignment of participants was determined by coin toss, designating one section as the experimental group exposed to the Cover-Copy-Compare (CCC) strategy and the other as the control group exposed to the Non-Cover-Copy-Compare (Non-CCC) strategy.

The pretests, posttests, and retention tests were administered to the two (2) intact classes: the experimental and control groups. Both sections covered the same lesson topic; however, one section was exposed to the Cover-Copy-Compare (CCC) strategy while the other was exposed to the non-CCC strategy. The goal of this research design was to determine and compare students' procedural fluency and self-efficacy in mathematics.

2.3. Locale of the Study

The study was conducted at Talakag National High School (TNHS) in Barangay San Isidro, Talakag, Bukidnon, along the Cagayan de Oro-Dominorog-Camp Kibaritan Road. Located near Sayre Highway and a short ride from the Poblacion proper of Talakag, TNHS is a public school that offers a complete Junior High School curriculum, Open High School, Alternative Learning, and various Senior High School programs, providing access to a wide range of student backgrounds and educational experiences.

Talakag National High School is an appropriate setting for this study because of its diverse student population, and it was discovered that the Grade 11 students in Mathematics classes had poor performance and negative self-efficacy, as evidenced by their overall weighted average of 50.25% last school year 2024-2025 based on the Consolidated Report on Teachers' Report Card (CMSS).

2.4. Respondents of the Study

The participants in the study were the enrolled Grade 11 students of Talakag National High School for the School Year 2025-2026. Grade 11 consisted of eight (8) sections with an average population of thirty-five (35) students per class. Two heterogeneously mixed sections were selected; one section was exposed to the Cover-Copy-Compare (CCC) strategy, which consisted of 10 males and 25 females aged around 16-17 years, while the other section was exposed to the Non-Cover-Copy-Compare (Non-CCC) strategy, which consisted of 12 males and 23 females aged around 16-17 years. The chosen sections received identical lessons, ensuring that both groups received the same educational content.

2.5. Research Instrumentation

This study employed two (2) types of instruments: a researcher-made procedural fluency test and an adopted self-efficacy survey questionnaire. The validated researcher-made test assessed students' procedural fluency specifically in the inverse of a one-to-one function, which covered topics in the first quarter.

Students' Procedural Fluency Assessment

A validated researcher-made procedural fluency questionnaire was used to assess students' procedural fluency in mathematics. This was validated by the three (3) expert panels to evaluate the questionnaire before it was used to ensure its validity. The questionnaire includes four item-solving exercises. The students' response was evaluated using an adopted modified holistic scoring rubric from Aguilar & Telese (2018), focused on students' procedural fluency.

The following scale, adopted from Andal and Andrale (2022), was used to interpret the level of students' procedural fluency:

Range of Scores	Qualitative Interpretation
17-20	High Procedural Fluency (H)
9-16	Moderate Procedural Fluency (M)
0-8	Low Procedural Fluency (L)

Students' Self-Efficacy Assessment

To assess students' self-efficacy in mathematics, a survey questionnaire was adopted from the study of Kranzler and Pajares (1997). This questionnaire consisted of 27 items and was rated using a Likert scale. It was pilot tested with a Cronbach's alpha of 0.93. The following scale, adopted from

Laranang and Bondoc (2020), was used to interpret the level of students' self-efficacy towards mathematics:

Level	Scale	Descriptive Rating	Qualitative Interpretation
5	4.50 - 5.00	Very Confident	Very High (VH)
4	3.50 - 4.49	Moderately Confident	High (H)
3	2.50 - 3.49	Neutral	Moderately High (MH)
2	1.50 - 2.49	Confident	Low (L)
1	1.00 - 1.49	Not At All Confident	Very Low (VL)

2.6. Data Gathering Procedure

The researcher obtained an Institutional Ethics Review Committee (IERC) permit from Central Mindanao University to address the ethical concerns of the study. Afterward, a written communication request addressed to the Division Schools Superintendent of the Division of Bukidnon was sent. Upon approval, the approved communication was attached to another letter request sent to the School Principal at Talakag National High School (TNHS), which permitted the researcher to conduct the study using two (2) intact Grade 11 classes as participants for six (6) weeks during the first quarter of the School Year 2025-2026.

Before the study began, a pretest and a self-efficacy questionnaire were administered. The study was conducted daily for six weeks. After all selected topics were covered, a post-test (using the same questions as the pretest) and the same self-efficacy questionnaire were administered following the intervention. Two weeks after the post-test, the same test was administered to examine the participants' retention.

Implementation of Cover-Copy-Compare (CCC) Strategy

In the Cover-Copy-Compare (CCC) strategy, the teacher will use a 5E lesson plan (Engage, Explore, Explain, Elaborate, and Evaluate), with the Cover-Copy-Compare strategy in the Evaluate phase, as part of the teacher's lesson plan, guiding students to enhance their procedural fluency in mathematics and self-efficacy towards mathematics. The classroom setup included diverse students with varying abilities and capabilities. Each phase of the CCC strategy proved useful in enhancing students' procedural fluency and self-efficacy towards mathematics. The researcher focused on the first-quarter topic of the inverse of a one-to-one function, based on the Curriculum Guide for Mathematics, outlined the learning objectives, and planned the lesson.

Engage

In this phase, the teacher began with a motivational activity to set the mood for students, capturing their attention and encouraging active participation during the discussion.

Explore/Explain

In this phase, the teacher provided direct instruction to clarify concepts and rules. Teacher-student interactions occurred throughout.

Elaborate

In this phase, students applied information from the teacher's discussion through group or individual activities. This extended students' understanding through the application of concepts in new contexts.

Evaluate

In this phase, the teacher administered a Cover-Copy-Compare strategy in enhancing students' procedural fluency and self-efficacy towards mathematics.

Cover Phase

In this phase, the teacher allowed the student to look at the mathematics problem with the answer. Then the student covers the mathematics problem and its answer.

Copy Phase

In this phase, the teacher allowed the student to answer the mathematics problem while it was still covered.

Compare Phase

In this phase, student uncovered the mathematics problem with the answer, compared their answer to the correct one. If the answer is correct, the student will proceed to the next item. If the student is incorrect, the student crosses out the wrong response and writes the correct answer before moving on to the next item.

Implementation of Non-Cover-Copy-Compare (Non-CCC) Strategy

This group was exposed to the Non-Cover-Copy-Compare (Non-CCC) strategy. This method primarily involved a student-centered and collaborative approach. The researcher utilized the 5E lesson plan (Engage, Explore, Explain, Elaborate, and Evaluate), with activities varied based on the teacher's lesson plan.

Engage

In this phase, the teacher began with a motivational activity to set the mood for students, capturing their attention and encouraging active participation during the discussion.

Explore/Explain

In this phase, the teacher provided direct instruction to clarify concepts and rules. Teacher-student interactions occurred throughout.

Elaborate

In this phase, students applied information from the teacher's discussion through group or individual activities. This extended students' understanding through the application of concepts in new contexts.

Evaluate

In this phase, the teacher administered a written quiz or paper-and-pencil test to assess students' understanding and mastery of the concepts taught.

2.7. Ethical Considerations in the Data Collection

Ethical considerations were important and necessary to ensure the use of approved procedures. An ethical statement was provided to the School Division Superintendent, School Principal, parents of the students, and participants at Talakag National High School when requesting student involvement in the study. A note of approval was attached to the letter signed by the School Division Superintendent, School Principal, parents of the students, and participants. The adviser was also informed of the study's objectives. Additionally, a short orientation was conducted for participants regarding the intervention, when the study would start, and end. Throughout the process, student names were not disclosed to maintain confidentiality.

2.8. Statistical Tool

This research utilized descriptive statistics such as mean, frequency, and percentage to provide basic information about the level of students' procedural fluency and self-efficacy towards mathematics among those exposed to the Cover-Copy-Compare (CCC) strategy. The pretest and posttest means and percentages were used to analyze the data gathered.

To check the assumptions, the Shapiro-Wilk test (p-value of 0.086) indicated a normal data distribution, and Levene's test (p-value of 0.355) revealed comparable group variances. The researcher used Analysis of Covariance (ANCOVA) to determine the differences in students' procedural fluency and self-efficacy towards mathematics between the Cover-Copy-Compare (CCC) strategy and the Non-Cover-Copy-Compare (Non-CCC) strategy, using the pre-test as a covariate.

3. RESULTS AND DISCUSSION

The study was conducted to determine students' procedural fluency and self-efficacy towards mathematics in Grade 11 students exposed to the CCC strategy during the first quarter of the school year 2025-2026. Two intact sections, each with 33 and 35 students, were identified using the homogeneity of variance test and selected at random to participate in the study. One section was exposed to the CCC strategy, while the other was exposed to a non-CCC strategy. Moreover, this study employed a quasi-experimental research design, with quantitative instruments including an adopted survey questionnaire to measure students' self-efficacy and a researcher-made standardized and validated test to examine students' procedural fluency.

The analysis of students' procedural fluency levels shows that those exposed to the CCC strategy exhibited significant improvement from pre-test to post-test, moving from a low fluency level (100% scoring low, mean 7.49) to a moderate fluency level (overall mean 11.24), with 15.2% achieving high fluency by post-test; retention test results also maintained moderate fluency (mean 12.36) with 27.3% scoring high. In contrast, students exposed to the non-CCC strategy remained largely at a low fluency level at pretest and showed only slight gains in posttest and retention test phases, with 68.6% low fluency in post-test and 48.6% in retention test, and overall means remaining in the low procedural fluency range (7.49 pretest to 8.89 retention). This indicates that the CCC strategy was more effective in enhancing and sustaining students' procedural fluency compared to the non-CCC strategy.

Students' self-efficacy levels exposed to both the CCC and Non-CCC strategies are generally low, with pre-test and posttest mean scores remaining within the low qualitative interpretation range. For the CCC group, the mean self-efficacy increased slightly from 2.18 (low) in the pre-test to 2.35 (still low) in the posttest, with some indicators, such as using a scientific calculator and setting a monthly budget, showing moderate-high confidence. The non-CCC group started slightly higher with a pre-test mean of 2.45 (low) and improved marginally to 2.51 (still low) post-test, with a few task indicators reaching moderate-high levels, such as material estimation and travel time calculation. Despite small gains, neither strategy led to a substantial shift from low to high self-efficacy, indicating that self-confidence in handling math-related real-world tasks remained relatively limited across both groups.

Students exposed to the CCC strategy demonstrated significantly higher procedural fluency than those in the non-CCC group in both the post-test and retention test. In the post-test, the CCC group had a mean score of 11.24 compared to 7.49 for the non-CCC group, with the difference being statistically significant ($F(1,65) = 10.032$, $p = 0.002$) and a moderate effect size (partial eta squared = 0.134). Similarly, in the retention test, the CCC group maintained a higher mean score of 12.36 compared with 8.89 for the non-CCC group, with a significant group effect ($F(1,65) = 5.006$, $p = 0.029$) and a moderate effect size (partial eta squared = 0.072). Pretest scores showed no significant difference, indicating that these improvements are attributable to the strategy, confirming that the CCC strategy is more effective in both immediate learning and long-term retention of procedural fluency.

Students' self-efficacy does not differ significantly between those exposed to the CCC and non-CCC strategies after controlling for pretest scores, as indicated by the non-significant group effect ($F(1,65) = 0.188$, $p = 0.666$). However, the pretest self-efficacy scores showed a significant covariate effect ($F(1,65) = 5.752$, $p = 0.019$), meaning initial self-efficacy levels influenced the posttest results regardless of the strategy used. This suggests that while students started with varying confidence levels, neither the CCC nor the non-CCC strategy produced a significantly different impact on their self-efficacy after the intervention.

4. CONCLUSION

Based on the findings of the study, the following conclusions are drawn.

Both the CCC and non-CCC groups began the study on equal footing, with all students falling under the Low procedural fluency level during the pre-test, confirming that neither group had prior mastery of the inverse function-solving process before instruction commenced. Following the intervention, the CCC group demonstrated consistent, progressive improvement, successfully reaching the Moderate level of procedural fluency on both the post-test and retention test. The non-CCC group, while showing marginal gains, remained at the Low level throughout the entire study. This divergence in performance courses, particularly the CCC group's ability to sustain and even improve upon its gains in the retention test, establishes that the Cover-Copy-Compare strategy is markedly more effective in developing and maintaining students' procedural fluency than the non-CCC strategy.

With regard to self-efficacy, both groups continued to register generally low levels of mathematical confidence across most task indicators even after instruction. The CCC group has both groups remaining at the Low level throughout. Only a handful of practical indicators, such as using a scientific calculator and setting up a monthly budget, reached Moderately High ratings, while the majority of indicators, especially those involving complex mathematical reasoning, remained stubbornly low for both groups. This pattern leads to the conclusion that procedurally-focused strategy, regardless of its effectiveness in building technical skill, is insufficient on its own to produce meaningful gains in students' mathematical self-efficacy. Addressing self-efficacy requires a more deliberate, sustained, and affectively oriented approach that reaches beyond the boundaries of procedural skill development.

The ANCOVA analysis on posttest scores revealed a statistically significant difference in procedural fluency between the CCC and Non-CCC groups, with the CCC group demonstrating a substantially higher mean score than the non-CCC group. The moderate effect size further affirms the practical significance of this difference, indicating that the structured cycle of studying, covering, reproducing, and comparing that defines the CCC strategy was directly and meaningfully responsible for the superior performance of the CCC group. Given that pretest scores confirmed the comparability of both groups prior to instruction, this significant post-test advantage is confidently attributable to the effectiveness of the CCC strategy itself, establishing it as a significantly superior approach to improving procedural fluency in the immediate outcome of instruction.

The significant advantage of the CCC group was further confirmed at the retention test stage, where the ANCOVA results again yielded a statistically significant difference between the two groups. More compellingly, the CCC group's mean score increased from the posttest to the retention test, while the non-CCC group's mean remained low with no comparable trajectory of growth. This upward trend in the CCC group's retention scores speaks to the durability and depth of the learning facilitated by the strategy. It is therefore concluded that the CCC strategy does not merely produce immediate gains in procedural fluency but cultivates the kind of deeply encoded procedural knowledge that strengthens over time, making it a highly effective strategy for fostering long-term mathematical competence.

When pretest self-efficacy scores were controlled as a covariate, the ANCOVA analysis revealed no statistically significant difference in self-efficacy between the CCC and Non-CCC groups, with a negligible effect size. In contrast, the pretest itself emerged as a significant predictor of post-instruction self-efficacy, revealing that students' initial beliefs about their own mathematical capability were far more determinative of their post-instruction confidence than the type of instructional strategy they experienced. This finding affirms that mathematical self-efficacy is a deeply entrenched and slow-developing construct and that short-term instructional interventions, however skillfully designed, are unlikely to produce statistically significant shifts in students' fundamental self-beliefs within a limited period. Improving mathematical self-efficacy demands long-term, multi-dimensional, and effectively targeted efforts that extend well beyond any single instructional episode.

5. RECOMMENDATION

Based on the summary, findings, and conclusions of the study, the following recommendations are given:

In light of the finding that students exposed to the CCC strategy consistently reached and maintained Moderate Procedural Fluency while the non-CCC group remained at the Low level throughout the study, mathematics teachers are strongly encouraged to adopt the Cover-Copy-Compare strategy as a primary instructional strategy when teaching procedural topics in mathematics, particularly those involving sequential and multi-step processes such as solving inverse functions. Teachers should deliberately sequence their lessons to provide multiple structured opportunities for students to practice the same process repeatedly, such as writing, reviewing, and re-solving, so that procedural fluency is built progressively and reliably across all learners, including those who begin instruction at the lowest levels of competency.

Given that both groups remained at generally low self-efficacy levels after instruction, suggesting that procedural skill development alone is insufficient to raise students' mathematical confidence, school administrators and curriculum developers are urged to design and implement school-wide or program-level initiatives that specifically target the affective dimensions of mathematics learning. These may include structured confidence-building programs, mathematics anxiety reduction workshops, and the integration of self-efficacy scaffolds such as reflective journaling, effort-recognition activities, and growth-oriented feedback into the broader mathematics curriculum. Addressing self-efficacy must be treated as a deliberate and sustained instructional goal, not an incidental by-product of content instruction.

In view of the statistically significant post-test advantage demonstrated by the CCC group, the curriculum developers are recommended to consider the formal integration of the CCC strategy into the official mathematics curriculum and instructional guides at the secondary level. The strategy structured cycle of studying, covering, reproducing, and self-comparing provides a replicable and evidence-based framework for improving procedural fluency that can be embedded into existing learning materials and lesson exemplars for teachers to apply across diverse classroom contexts.

In view of the finding that the CCC group's procedural fluency not only remained significant at the retention test stage but further improved from post-test to retention test even without additional instruction, mathematics teachers and school administrators are encouraged to recognize and advocate for the value of spaced and distributed practice in mathematics instruction. Schools should allocate sufficient instructional time for review and retention activities within the mathematics program, ensuring that students are given regular opportunities to return to previously learned material. This practice of revisiting content is not redundant instruction but a strategically essential condition for the development of durable and transferable procedural knowledge.

Given that the ANCOVA revealed no statistically significant difference in self-efficacy between the CCC and Non-CCC groups, and that students' initial self-efficacy levels proved to be the stronger predictor of post-instruction confidence, future researchers are encouraged to conduct longitudinal studies that implement the CCC strategy over a longer instructional period, spanning one full school year or more, to determine whether sustained exposure to the strategy eventually produces statistically significant and lasting shifts in students' mathematical self-efficacy. Additionally, future studies may explore an enhanced version of the CCC strategy that explicitly integrates self-efficacy-building components such as mastery goal setting, peer modeling, structured self-reflection, and anxiety-coping strategies alongside its procedural framework, so that both cognitive and affective dimensions of mathematical development are addressed with equal intentionality.

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