

Metacognitive Journal: An Intervention Strategy in Enhancing Low-Achieving Student's Performance in Solving Functions and Perceptions Towards Mathematics

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Abstract

This research aimed to evaluate the performance of low-achieving students in solving mathematical functions—rational, inverse, logarithmic, and exponential—and their perceptions of mathematics. It also investigated the impact of metacognitive journals on these aspects. This was conducted on the Grade 11 General Academic Strand (GAS) students at Araceli National High School, the study divided participants into two groups: with metacognitive journals and no metacognitive journals. The effectiveness of the journals was measured using a 50-item test on solving functions and a 30-item test on students' perceptions of mathematics. The findings revealed that students using metacognitive journals generally showed score improvements and better posttest performance compared to those who did not use the journals. These students also developed more positive attitudes towards mathematics, though they faced challenges such as maintaining focus and feeling peer pressure. In contrast, students without journals enjoyed peer interactions but showed a slight decrease in performance. Overall, both groups had positive perceptions of mathematics, but the experimental group's perceptions of classmates and teachers were slightly less favorable. The study concluded that metacognitive journals are beneficial for enhancing learning and performance in mathematics, recommending their integration into classroom practices and assessments.

Keywords— *metacognitive journals, no metacognitive journals, with metacognitive journals, perceptions, performance, solving functions.*

I. INTRODUCTION

The implementation of the K to 12 enhanced curriculum in the Philippines, beginning in the School Year 2012-2013, aimed to provide students with sufficient time to understand essential concepts and skills, preparing them for higher education, skill development, employment, and entrepreneurship. This curriculum includes two years of specialized upper secondary education where students can choose from various tracks such as Academic, Arts and Design, Sports, and Technical-Vocational-Livelihood (TVL). Despite these efforts, the performance of Filipino students in mathematics and science remains low, as evidenced by the 2018 Programme for International Student Assessment (PISA) and the 2019 Trends in International Mathematics and Science Study (TIMSS), where the Philippines ranked among the lowest. These results highlight a significant gap between the curriculum's goals and the actual outcomes, necessitating a deeper analysis of teaching methods and educational policies to enhance student performance in mathematics.

At Araceli National High School-Senior High School, where the researcher has taught for over six years, students have consistently struggled with solving rational, inverse, logarithmic, and exponential functions. These difficulties are often compounded by errors in mathematical operations and a negative attitude towards the subject, which has been exacerbated by disruptions in learning due to the pandemic.

Colendra (2009) found that students often made conceptual, procedural, and computational errors in basic operations with rational expressions, suggesting the need for improved instructional strategies. Akhter (2018) noted that while students were generally enthusiastic about learning mathematics, some found it tiresome and challenging, affecting their perception of the subject.

To address these issues, this study aims to evaluate the performance of low-achieving students in these areas and explore the effectiveness of using metacognitive journals as an intervention strategy. By implementing

metacognitive journals, the research seeks to improve students' understanding and performance in mathematics and assess any changes in their perceptions of the subject, providing valuable insights into the potential benefits of this reflective practice in mathematics education.

Statement of the Problem

The study aimed to investigate using a metacognitive journal as an intervention strategy in enhancing Grade 11 low-achieving students' performance in solving functions and perceptions towards mathematics. Specifically, it aimed to answer the following questions:

1. What is the performance of Grade 11 low-achieving students in solving functions before and after their exposure to two different treatments, namely:
 - a. regular class instruction with metacognitive journal; and
 - b. regular class instruction without metacognitive journal?
2. What are the perceptions of Grade 11 low-achieving students towards Mathematics before and after their exposure to two different treatments, namely:
 - a. regular class instruction with metacognitive journal; and
 - b. regular class instruction without metacognitive journal?
3. Is there a significant difference in the pretest and posttest regarding performance of the student exposed to metacognitive journal?
4. Is there a significant difference in the posttest regarding the performance of the students exposed and not exposed to the metacognitive journal?
5. Is there a significant difference in the pretest and posttest regarding the perception of the students towards mathematics exposed to metacognitive journals?
6. Is there a significant difference in the posttest regarding the perception of the students towards mathematics exposed and not exposed to metacognitive journals?

Research Hypotheses

1. There is a significant difference in the pretest and posttest regarding the performance of the student exposed to metacognitive journal.
2. There is a significant difference in the posttest regarding the performance of the students exposed and not exposed to metacognitive journal.
3. There is a significant difference in the pretest and posttest regarding perception of the students

towards mathematics exposed to metacognitive journal.

4. There is a significant difference in the posttest regarding perception of the students towards mathematics exposed and not exposed to metacognitive journal.

II. METHODS

Research Design

This study used a quantitative research design. The study employed the experimental method using the two-group pretest-post-test design to assess the effectiveness of metacognitive journals in the performance of the low-achieving students in solving functions and their perception towards mathematics subjects. Data was gathered to analyze and identify their level of performance and perception.

Respondents of the Study

The respondents of this study are mainly Grade 11 General Academic Strand (GAS) low-achieving students at Araceli National High School-Senior High School. The researcher used purposive sampling in this study because each respondent was selected purposively based on their performance/grade during the first quarter of the school year 2023-2024. There is a total of twenty (20) respondents from GAS – A (11) and GAS – B (11) coming from the lower 25% of the class.

Research Instrument

Two (2) instruments were used in this study: the 50-item mathematics test about solving functions to be given to both experimental and control groups, and the 30-item mathematics test regarding students' perceptions towards mathematics of both experimental and control groups. The students were required to have a notebook for their metacognitive journal. The metacognitive journals will be collected at the end of every session with sufficient time for the teachers to read the journals thoroughly and write a response and feedback to each journal entry

Research Procedure

First, the researcher secured a written permission from the Public Schools District Supervisor of the District of Araceli and the Principal of Araceli National High School to be allowed in conducting the said study. Second, informed consent was given to the parents and students about the information that were collected from them. Third, the researcher asked an approval through a letter to the principal of Araceli National High School to access their first quarter grades. Fourth, two instruments were constructed. A 50-item test about solving functions, and a

30-item test regarding students' perceptions towards mathematics. Lastly, upon approval, a 50-item test about solving function was given before the start of the lesson discussion to find out their knowledge of the topics and the same test was also given after the intervention—metacognitive journal writing activity. The data was gathered, was tabulated, and was consolidated afterward.

Statistical Treatment

This study used different statistical tools to analyze and interpret the data that are assumed to be normally distributed. The study was analyzed through descriptive statistics such as frequency count and mean. XLMiner Analysis Toolpak was used to get the frequencies of students regarding their performance and to get the mean in finding their perceptions towards Mathematics.

III. RESULTS

Performance of the Low-Achieving Student in Solving Functions

The scores in the pretest of the ten (10) students with metacognitive journals and ten (10) students without metacognitive journals are close to each other ranging from eleven (11) to twenty (20). On the other hand, the majority of the students with metacognitive journal scores increased while the majority of those students without metacognitive journal scores somewhat decreased. In the table, it can be seen that the performance (based on scores) of the students with metacognitive journals increased and is better than the pretest.

Pretest of Student's Perception on Mathematics of the Experimental and Control Group in terms of Subject, Classmates and Teachers

Both experimental and control groups showed positive perceptions of Mathematics, particularly regarding its usefulness and cognitive benefits. Students with metacognitive journals highlighted the subject's necessity and its role in developing thinking skills, though they reported slightly less positive attitudes compared to those without journals, who also expressed confidence in their mathematical abilities. This aligns with Tabao & Faiz (2020), who found that students recognized mathematics' practicality in daily life.

Students' perceptions of their classmates' impact on their Mathematics learning were positive in both groups. However, students with metacognitive journals reported lower focus and higher pressure when working with peers, whereas the control group expressed more positive interactions with classmates, despite some difficulties in collaborative problem-solving. This reflects Hagan et al.'s (2010) findings on the motivational impact of positive peer

perceptions. Similarly, both groups had positive views on their teachers, with the control group slightly more favorable, underscoring the importance of effective teaching strategies and clear explanations, as highlighted by Kanafiah and Jumadi (2013).

Posttest of Student's Perception on Mathematics of the Experimental and Control Group in terms of Subject, Classmates and Teachers

The posttest results showed that both experimental and control groups had positive perceptions of Mathematics, but students with metacognitive journals had a higher overall positive response. In terms of subject perception, students with journals saw Mathematics as useful and necessary, while those without journals highlighted its cognitive benefits. Regarding classmates, the experimental group showed improved focus and task performance despite some challenges, while the control group enjoyed peer interactions but faced difficulties in collaborative problem-solving. Concerning teachers, the experimental group appreciated teacher encouragement and knowledge, whereas the control group valued the use of teaching materials and felt positively about teacher support. Overall, the experimental group's perceptions improved more significantly, aligning with studies by Tabo and Faiz (2020) and Hagan et al. (2010), which emphasize that effective teaching strategies and supportive relationships enhance students' perceptions and performance in Mathematics.

Table 1. Paired Sample T-Test for the Significant Difference in the Performance of the Grade 11 Low-Achieving Students in Solving Functions

	t - value	p-value	remarks
Pretest (WMJ) and Posttest (WMJ) in Solving Functions	1.833113	0.001569	Significant Difference

The results in Table 1 implied that the pretest of the low-achieving student's performance in solving functions was significantly different from the posttest since the p-value of 0.001569 is less than the significance level of 0.05.

Table 2. Paired Sample T-Test for the Significant Difference in the Posttest Towards the Performance of the Grade 11 Low-Achieving Students in Solving Functions

	t - value	p-value	remarks
Posttest (WMJ & NMJ) on the Student's Performance in Solving Functions	1.833113	0.000539	Significantly Different

The results in Table 2 implied that the posttest towards the performance of the Grade 11 Low-Achieving Students in Solving Functions exposed and not exposed to

metacognitive journals are significantly different from each other since the p-value of 0.000539 is less than the significance level of 0.05.

Table 3a. Sample T-Test for the Significant Difference in the Perceptions of the Grade 11 Low-Achieving Students Towards Mathematics Exposed to Metacognitive Journals (Subjects)

	t - value	p-value	remarks
Pretest and Posttest in Perception of Students Exposed to Metacognitive Journal	1.833113	0.40428	Not Significantly Different

The results in Table 3.a above implied that the pretest and posttest towards the perceptions of the Grade 11 Low-Achieving Students in Solving Functions exposed to metacognitive journals are not significantly different from each other since the p-value of 0.40428 is greater than the significance level of 0.05.

Table 3b. Sample T-Test for the Significant Difference in the Perceptions of the Grade 11 Low-Achieving Students Towards Mathematics Exposed to Metacognitive Journals (Classmates)

	t - value	p-value	remarks
Pretest and Posttest in Perception of Students Exposed to Metacognitive Journal	1.833113	0.243021	Not Significantly Different

The results in Table 3b. implied that the pretest and posttest towards the perceptions of the Grade 11 Low-Achieving Students in Solving Functions exposed to metacognitive journals are not significantly different from each other since the p-value of 0.243021 is greater than the significance level of 0.05.

Table 3c. Sample T-Test for the Significant Difference in the Perceptions of the Grade 11 Low-Achieving Students Towards Mathematics Exposed to Metacognitive Journals (Teacher)

	t - value	p-value	remarks
Pretest and Posttest in Perception of Students Exposed to Metacognitive Journal	1.833113	0.276477	Not Significantly Different

The results in Table 3c. implied that the pretest and posttest towards the perceptions of the Grade 11 Low-Achieving Students in Solving Functions exposed to metacognitive journals are not significantly different from each other since the p-value of 0.276477 is greater than the significance level of 0.05.

Table 4a. Sample T-Test for the Significant Difference in the Perceptions of the Grade 11 Low-Achieving Students Towards Mathematics Exposed and Not Exposed to Metacognitive Journals (Subject)

	t - value	p-value	remarks
Posttest in Perception of Students Exposed and Not Exposed to Metacognitive Journal	1.833113	0.069384	Not Significantly Different

The results in Table 4a. implied that the posttest towards the perceptions of the Grade 11 Low-Achieving Students in Solving Functions exposed and not exposed to metacognitive journals are not significantly different from each other since the p-value of 0.069384 is greater than the significance level of 0.05.

Table 4b. Sample T-Test for the Significant Difference in the Perceptions of the Grade 11 Low-Achieving Students Towards Mathematics Exposed and Not Exposed to Metacognitive Journals (Classmates)

	t - value	p-value	remarks
Posttest in Perception of Students Exposed and Not Exposed to Metacognitive Journal	1.833113	0.252045	Not Significantly Different

The results in Table 4b implied that the posttest towards the perceptions of Grade 11 Low-Achieving Students in Solving Functions exposed and not exposed to metacognitive journals are not significantly different from each other since the p-value of 0.252045 is greater than the significance level of 0.05.

Table 4c. Sample T-Test for the Significant Difference in the Perceptions of the Grade 11 Low-Achieving Students Towards Mathematics Exposed and Not Exposed to Metacognitive Journals (Teachers)

	t - value	p-value	Remarks
Posttest in Perception of Students Exposed and Not Exposed to Metacognitive Journal	1.833113	0.373259	Not Significantly Different

The results in Table 4c (in the preceding page) implied that the posttest towards the perceptions of the Grade 11 Low-Achieving Students in Solving Functions exposed to metacognitive journals are not significantly different from each other since the p-value of 0.373259 is greater than the significance level of 0.05.

IV. DISCUSSION

The following findings were obtained from the results of this study.

The pretest scores for both groups of students, with and without metacognitive journals, range from eleven (11) to twenty (20) and are quite close to each other. However, the majority of students with metacognitive journals showed score increases, while most without showed decreases. Notably, students with metacognitive journals exhibited improved posttest scores, indicating enhanced performance compared to their pretest scores.

The perceptions of Grade 11 low-achieving students towards Mathematics were examined before and after exposure to two different treatments: regular class instruction with a metacognitive journal, and regular class instruction without a metacognitive journal. In the experimental group, students with metacognitive journals displayed positive attitudes towards Mathematics, emphasizing its utility and benefits for cognitive development. However, their perception of Mathematics in relation to classmates and teachers was slightly less positive compared to the control group. Despite this, both groups exhibited overall positive attitudes towards Mathematics.

Specifically, students with metacognitive journals acknowledged the support of their classmates and teachers but also reported difficulties in maintaining focus and feeling pressure when working with peers. Conversely, students without metacognitive journals expressed enjoyment in sharing solutions with classmates and appreciation for teacher support. Additionally, both groups demonstrated positive perceptions of Mathematics itself, with the experimental group displaying a slightly higher mean score in terms of subject perception. However, the pretest and posttest perceptions within the experimental group did not differ significantly, indicating consistent attitudes towards Mathematics over time. Overall, while both groups showed positive attitudes towards Mathematics, the experimental group's perceptions were slightly less favorable in relation to classmates and teachers, despite demonstrating similar perceptions of Mathematics itself.

The analysis of pretest and posttest perceptions of Grade 11 Low-Achieving Students in Solving Functions exposed to metacognitive journals reveals no significant difference between the two assessments.

The results in Table 3a, 3b, and 3c implied that the perceptions of students exposed to metacognitive journals do not differ greatly at all, their perceptions towards mathematics are somehow similar from the beginning of the quarter to the end of the quarter. Parallel to the study of blythe111 (2019), students' perception towards mathematics varies depending on how complex or simple the given problem to them was.

The analysis of posttest perceptions regarding Mathematics exposure to metacognitive journals among Grade 11 Low-Achieving Students in Solving Functions reveals no significant difference between the groups. The results in Tables 4a, 4b, and 4c implied that students' perception towards mathematics was quite the same even with or without the implementation of metacognitive journals in the learning process. However, just like what Kunwar (2021) said in his study, the use of intervention strategies can improve student's perception of mathematics. Further studies need to be conducted so that this may be achieved to further analyze the perception of the students exposed and not exposed to any intervention strategies.

V. CONCLUSION

In conclusions, the majority of students with metacognitive journals showed score increases, while most without showed decreases. Notably, students with metacognitive journals exhibited improved posttest scores, indicating enhanced performance compared to their pretest scores; students with metacognitive journals displayed positive attitudes toward Mathematics, emphasizing its utility and benefits for cognitive development.; Students with metacognitive journals acknowledged the support of their classmates and teachers but also reported difficulties in maintaining focus and feeling pressure when working with peers. Conversely, students without metacognitive journals expressed enjoyment in sharing solutions with classmates and appreciation for teacher support. Additionally, both groups demonstrated positive perceptions of Mathematics itself, with the experimental group displaying a slightly higher mean score in terms of subject perception. Overall, while both groups showed positive attitudes towards Mathematics, the experimental group's perceptions were slightly less favorable about classmates and teachers, despite demonstrating similar perceptions of Mathematics itself; there is a significant difference between the pretest and posttest performance of low-achieving students in solving functions; there is a significant difference between the posttest performance of Grade 11 Low-Achieving Students in Solving Functions who were exposed to metacognitive journals and those who were not; the exposure to metacognitive journals did not significantly alter the perceptions of Grade 11 Low-Achieving Students in Solving Functions regarding Mathematics from the pretest to the posttest assessments; and lastly, the exposure to metacognitive journals did not significantly impact posttest perceptions of Grade 11 Low-Achieving Students in Solving Functions regarding Mathematics compared to those not exposed to such journals.

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