



# Impact of mathematics journaling strategy on integrating number operations with financial literacy for students with special needs

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## ABSTRACT

This study explores the impact of a mathematics journaling strategy on integrating number operations with financial literacy for students with special needs. The study adopted a quasi-experimental design. The population of this study comprised 107 junior high school class two students with special needs from the six special education schools in Benue State during the 2024/2025 academic session. The sample for this study consisted of 52 students with special needs from two intact classes in Benue State. The Number Operations Real World Financial Literacy Journal Test (NORWFLJT) has a Kuder–Richardson (K-R-20) reliability coefficient of 0.94. Research questions were answered using mean and standard deviation, while hypotheses were tested at the 0.05 level of significance using Analysis of Covariance (ANCOVA). The results of this study revealed a significant difference in financial literacy between the experimental and control groups for students with special needs (SSNs). This implies that SSNs taught number operations using a mathematics journaling strategy improve in their ability to integrate number

operations with financial literacy more than those taught using the lecturing method. The main effect of gender and the interaction effect with the mathematics journaling strategy were not significant. Therefore, one of the recommendations was that mathematics educators should encourage students with special needs to journal regularly, enabling reflective, self-regulated learning and the acquisition of number operations skills to be financially literate and able to solve real-world problems.

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## 1. Introduction

Globally, inclusivity has become a platform that supports learners, regardless of their differences and diverse needs, in learning and developing cognitive and social skills. The increase in research on inclusion education is proportionately shaping teaching pedagogy, providing a high degree of personalized learning, which is important for attending to the special needs of each learner in the class (Donkoh & Amoakwah, 2024). Though inclusive education aims to provide equal learning opportunities for students with diverse academic, social, and physical needs, students with special needs often struggle to apply mathematical concepts to real-life scenarios. There is a need to integrate mathematics learning strategies, such as mathematics journaling, in inclusive classrooms to support students with

special needs. According to Chapman (2016), mathematics journaling improves learners' mathematics skills and their real-life problem-solving. There is inadequate practical experience in managing finances, making informed decisions, and applying mathematics concepts to solving everyday financial problems. Incorporating a mathematics journaling strategy in mathematics learning can improve mathematics reasoning and performance (Borasi & Rose, 2017).

Every day, humans face difficult financial choices in various forms, such as retirement and investment plans, buying and selling transactions, budgets, and so on. The financial future of every individual is in their hands, and this requires a good knowledge and understanding of several operations. Research indicates that mathematics literacy has a significant impact on financial literacy. According to the OECD (2020), mathematical content influences

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students' financial literacy; students make better financial decisions through knowledge and understanding of mathematical concepts. Skagerlund et al. (2018) posit that the financial system is peculiar to everyone; hence, financial literacy is an important life skill for all individuals.

Despite extensive research on financial literacy and the shift from teacher-centered to student-centered learning, in Africa, there remains limited exploration of how learning strategies, such as mathematics journaling, can be used to integrate number operations with financial literacy for students with special needs. This gap highlights the need for a focused study on how these factors interact and impact learners' outcomes in solving financial problems. The purpose of this study is, therefore, to investigate the impact of mathematics journaling strategy on integrating number operations with financial literacy for students with special needs.

The findings will contribute to improving financial literacy skills and policy interventions that aim to enhance mathematical understanding and performance in special schools. This study is significant in helping mathematics educators encourage students with special needs to journal regularly, fostering reflective, self-regulated learning and the acquisition of financial literacy skills for solving real-life financial problems. This research is significant for informing policies in mathematics education, as mathematics educators, curriculum planners, and stakeholders connect and integrate the use of the mathematics journaling strategy with real-world contexts and applications in the mathematics curriculum.

## 2. Background

The OECD (2020) recognizes financial literacy as a vital life skill, driving reforms in nations such as Australia and the United Kingdom, as well as across Africa. However, many challenges persist. According to the National Financial Educators Council (NFEC, 2020), students lack financial literacy because concepts such as interest rates and taxation are inadequately taught in the United States of America. Similarly, studies in Germany, India, and China reveal gaps in understanding of mathematical concepts and compound interest, overcrowded classrooms, and a focus on assessments rather than practical application (Agarwal & Chakrabarti, 2021). These global findings show that struggles with financial literacy are not limited to Africa but are a widespread issue. Mathematics plays an important role in developing real-life problem-solving, creative, and critical reasoning skills. The importance of mathematics in real-life problem-solving is evident in its use in financial literacy. It is important for schools to implement financial literacy into mathematics education (OECD, 2019). In Indonesia's independent curriculum, financial literacy has been included, with training for teachers to implement it in mathematics by designing lessons that incorporate financial literacy (Sagita et al., 2022).

Financial literacy often uses addition, subtraction, multiplication, and division number operations in mathematics. Number operations are taught from the basic level through all levels of education to ensure a solid foundation in their skills, knowledge application, and integration in solving daily financial transaction problems. Number operations constitute the integration of the numerical and analytical aspects of human knowledge, operations, and experiences in financial literacy, which all students must possess. Taylor (2021) posits that the goal of South African primary school mathematics is to enable all learners, regardless of ability or disability, to understand number operations and their applications. Despite the importance of number operations, many students, especially those with special needs, struggle to learn them, which limits their ability to solve financial literacy problems (Chand et al., 2021).

Special needs children are those who require additional support due to difficulties or disabilities that affect their learning development, or participation in educational and social activities. These needs can be physical, emotional, cognitive, or behavioral. A special needs child is an individual who requires specialized attention and care due to mental, physical, or emotional health needs (Satish, 2021). Various descriptions of the abilities of children with special needs are those with intellectual disabilities, who encounter difficulties in learning, reasoning, and problem-solving, while those with autism spectrum disorder often face challenges with social interactions and communication. Also, those with learning disabilities such as dyslexia, those with Dyscalculia who struggle with writing, and those with physical disabilities experience limitations in movement and coordination due to physical impairments. Others have sensory impairments such as visual and hearing impairments; these individuals have difficulty seeing and hearing. Due to these disabilities, special schools offer specialized education and often use assistive technologies such as braille, sign language, or hearing aids in the teaching and learning process (Ok & Kim, 2021).

### 2.1. Theoretical framework

The constructivist learning theory highlights the benefits of using mathematics journals as a teaching tool. Vygotsky (1978) posits that learners build their own understanding through active engagement with their learning environment, experiences, and social interactions. Vygotsky's social constructivist theory emphasizes the role of social interaction and mediated learning in cognitive development. Central to this theory is the concept of the Zone of Proximal Development (ZPD), which refers to the gap between what students can achieve independently and what they can achieve with guidance. This framework is relevant to the present study because it highlights how instructional support and collaborative engagement can enhance students' understanding in an inclusive classroom setting, where special needs students are taught financial literacy through writing journals. This theory also empha-

sizes scaffolding, using the journal to support self-learning and the acquisition of problem-solving skills through resilience in continuous trial and error. Also, the concept of the More Knowledgeable Other (MKO) can be beneficial, where teachers and other students serve as MKOs who can assist the student in learning mathematical ideas they do not understand, writing them in their mathematical journal, and using them to solve financial problems.

Furthermore, knowledge can be socially constructed by students as they write daily about their challenges, mistakes, misconceptions, solutions, and ideas for solving mathematical problems that are financially inclined. In the context of using mathematics journals in enabling the application of financial literacy, constructivism suggests that students learn best by exploring real-world financial scenarios, applying mathematical concepts to solve problems, and reflecting on their financial experiences. This theory supports tailored learning, focusing on meaningful engagement, active participation, and student activity such as mathematical journaling. This facilitates effective learning and demonstrates their reflective ability by connecting with personal problem-solving experiences, reflecting on problem-solving, creative writing, and applying these in real-world situations as they engage with mathematical concepts.

Students write and reflect on real-life scenarios. For example, budgeting, saving, and investing, along with the application of mathematical concepts, can enable financial literacy and metacognitive skills. For example, a student is presented with a scenario: “You have R500 to spend and save. How will you use this money and justify your decision using mathematical concepts?” Journal Entry: “I considered spending R200 out of my money. I will buy two notebooks at R100, two pens at R60, and a meat pie at R40. This will add up to R200 out of R500. The subtraction will give me a balance of R300. I will then save R300 in a savings account earning 2% interest. I used compound interest formulas to calculate interest... I chose this option because...”

Reflection: “I realized the importance of having my savings earn interest.”

This makes the learner the sole owner of their knowledge, with particularities to their experiences as they integrate this knowledge into solving real-world problems related to their financial literacy. One of the aims of mathematics education in the classroom is to integrate mathematical skills into solving real-world problems involving health, social, and economic issues, among others (Machaba, 2018).

## 2.2. Empirical studies

Studies provide evidence that students with disabilities in inclusive education settings perform poorly in mathematics. Students with special needs obtain low grades in both mathematics and reading (Lenkeit et al., 2022). Many students, especially students with special needs, struggle with a mathematics phobia and obtain low grades (Mullis & Martin, 2017). Given students' poor numeracy performance, we must identify the source of the problem

to improve it. Learning can occur when teaching is successful. This can be done by teachers' use of learner-centered strategies to motivate students to learn. According to Taylor (2021), most pedagogies educators use do not align with their learners' interests, and some educators also lack subject knowledge. Donkoh and Amoakwah (2024) explain that there has been a shift from teacher-centered (traditional) pedagogy, such as the lecture method, to learner-centered pedagogy. In the lecture method, the teacher primarily uses an oral presentation to a group of learners, with little or no learner participation, resulting in low grades.

There is a need for learner-centered learning strategies that encourage students' reflection, personalized learning, cooperation, collaboration, interaction, and integration of number operations with financial literacy. According to research, a mathematics journaling strategy enables students to personalize their learning outcomes and analyze their learning (Powell, 2018). This strategy allows students to document their thoughts, insights into mathematics concepts, problem-solving approaches, and learning experiences. This journal enables the student to reflect on the learning skills acquired, clarify doubts and misconceptions, record key concepts and formulas, and track progress and set goals. It includes notes for lessons or readings, solutions to problems (indicating workings), reflections on challenges or successes, and questions or areas to explore further. It is a creative approach to reporting on one's learning experiences and problem-solving skills, which students with special needs can keep, consult, and use practically to solve real-life, daily financial problems. Researchers posit that reflection, creativity, effective communication, and the ability to solve real-world problems using a mathematics journaling strategy improve students' mathematics performance (Mullis & Martin, 2017).

Studies have shown that students are interested in learning through journals, which enable an interactive, collaborative classroom where students learn better and communicate their ideas with peers, thereby aiding their application of learned skills (McCarty & Faulkner, 2020). Studies have highlighted that the mathematics journaling strategy (MJS) can develop students' awareness of their own thought processes and learning strategies, hence building their metacognitive awareness. The Powell (2018) study shows that the use of problem-solving skills, mathematical reasoning, and comprehension of mathematical ideas of learners who use mathematics journals improved. Journaling can be used to record students' creativity, daily instructions, thoughts, ideas, knowledge discovery, problem-solving, learning experiences, and how to solve problems. It can help students think critically and reflect on their learning, identifying their strengths, weaknesses, and areas of improvement, thereby developing their metacognitive abilities in number operations and applying them to real-world problems. Studies show that mathematics journals are valuable tools learners can use to demonstrate their learning, seen as a dynamic work in progress as they apply their learning skills to problem-solving, develop a bet-

ter grasp of mathematical concepts, and boost their ability to communicate mathematics ideas effectively (McCormick & Lucas, 2020).

Numerous studies have highlighted the importance of integrating mathematical concepts with real-world applications to promote problem-solving skills, such as financial literacy skills. Studies show that writing in mathematics is an effective approach to learning that enables learners to understand concepts as they make notes in a journal, though teachers are sure to encounter diverse writing presentations from students (Chapman, 2016). Writing in mathematics is communicating mathematical ideas, such as number operations, in words to better understand and apply them in problem-solving. For example,  $25^2$  can be written as  $25 \times 25$  and, in words, can be written as twenty-five multiplied by twenty-five. The learner can have these three written in their journal for clarity on the concepts learned. With this, they can apply this knowledge to solving real-world financial problems. The learner may not be able to integrate their knowledge of  $25^2$  directly into solving real-world problems, but based on the educator's explanation, they can write it in their journal in their own words to enhance their understanding and its application. Research has shown that mathematical journaling is a strategy that helps students learn and apply their mathematical reasoning skills to solve problems. People are financially literate when they have the knowledge, understanding, and skills to tackle their personal financial challenges (Goyal & Kumar, 2021).

Researchers posit that MJS motivates students to fully participate in their own learning through journaling. According to Gorospe and Gorospe (2024), journaling is a tool for differentiation, informing the selection of instructional strategies (Gorospe & Gorospe, 2024), such as reflection and creativity, in the context of using this knowledge to make personal connections, personalized learning, and problem-solving experiences. Studies emphasize that MJS enables students to develop problem-solving skills by integrating learning into real-world experiences through reflective practice. Mathematics studies emphasize that mathematics journaling encourages inclusivity, thereby fostering reflective, self-regulated learning and attention to individual needs. Studies, such as those conducted by McCormick and Lucas (2020), have indicated that mathematics journals enable students to effectively use their mathematical ideas and communicate effectively.

Research shows that financial literacy in mathematics class is restricted to financial contexts or knowledge. According to Sagita et al. (2022), a financial literacy learning environment shows mathematics teachers the need to use suitable materials in teaching mathematics and financial literacy. Financial literacy, as measured by mathematics, can be improved for both males and females through MJS. Gender is seen as a factor affecting students' mathematics performance, but research suggests that journal-based learning does not show a significant difference in scores between male and female students. Afful et al. (2024) suggest that journal writing enhances specific mathematical

skills and contributes to students' overall academic success irrespective of gender. Writing to learn in mathematics journals fosters collaborative learning and communication among male and female students, enabling the sharing of problems and solutions. Research shows that collaborative learning enabled by learner-centered strategies shows no gender bias. According to Ugo and Oliweh (2024), collaborative learning fosters improved performance and problem-solving skills for both males and females. Studies indicate that there are no significant differences by gender in students' achievement in mathematics concepts when set theory is taught using student-centered learning approaches (Abaver & Imoko, 2023; Abaver et al., 2024). A mathematics journal is a student-centered tool that allows learners to document their problem-solving approaches and mathematical reasoning.

### 2.3. Statement of the problem

The literature needs studies investigating strategies that demonstrate knowledge acquisition by learners without the use of examinations, which can be integrated into solving real-world problems. However, empirical research on strategies of learning mathematics education remains limited. Despite recognition of the potential of mathematical journaling, there remains a significant gap in research on its introduction to students with special needs (SSNs) and its use for integrating number operation skills and financial literacy. Despite evidence that mathematical skills and students' academic success can be fostered through journaling (Afful et al., 2024), many mathematics teachers still use a lecture-based approach to teach these skills and financial literacy, leaving students with special needs struggling to learn (Chand et al., 2021).

In this context, this study will investigate the ability of students with special needs to create a mathematics journal that integrates number operations into financial literacy, focusing on the basics of solving real-world financial problems. The study is underscored by Vygotsky's (1978) social constructivist theory concepts of Zone of Proximal Development, scaffolding, and More Knowledgeable Other, which emphasizes social interaction among students with special needs while solving mathematical problems relating to financial literacy by means of assisting others who do not know how to solve such problems well. The study provides empirical evidence to guide students' development, curriculum design, and educational policy, promoting the use of self-instructional strategies that encourage student interaction and collaboration with peers with special needs while learning and practicing mathematics skills through journaling.

### 2.4. Significance of the study

It was important to investigate whether effective strategies, such as mathematics journaling, could be used to integrate number operations with real-world financial

problem-solving. This was intended to encourage students with special needs to reflect on their mathematics learning by looking inward and recognizing their abilities through metacognition, thereby helping them achieve the educator's learning goals and enabling special needs students to be efficient with technical gadgets such as Android phones, laptops, notepads, and other devices, including social media platforms and the internet, for resources on operations, and to be taught to write their mathematical ideas and experiences in real-world financial problem-solving.

## 2.5. Purpose of the study

This investigation examined the impact of a mathematical journaling strategy on integrating number operations with financial literacy for students with special needs in junior high class two, with the aim of integrating these skills into real-world financial problem-solving. Students with special needs from junior high class two from two schools participated. The findings can be applied to similar schools, but further research across a broader range of schools is needed to confirm their applicability to all schools.

## 2.6. Research questions

The study was guided by the following research questions:

1. What is the mean difference between the financial literacy scores of students with special needs taught number operations using the mathematical journaling strategy and those taught using lecture methods?
2. What is the mean difference in financial literacy scores between male and female students with special needs taught number operations using a mathematical journaling strategy?

## 2.7. Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

1. There is no significant difference between the financial literacy scores of students with special needs taught number operations using mathematical journaling strategies and those taught using lecture methods.
2. There is no significant mean difference in financial literacy scores between male and female students with special needs taught number operations using a mathematical journaling strategy.

## 3. Methodology

The researcher adopted a pre-test and post-test quasi-experimental control-group design. The design is appropriate because schools did not want their schedules to be disrupted. The research was carried out in two schools. In each school, an intact class of students with similar performance levels and cognitive abilities was randomly selected. The study design was used to establish the effects of a mathematics journaling strategy on the integration of number

operations with financial literacy in real-world problem-solving among students with special needs, compared with those taught through lecture methods. The choice of a quasi-experimental design with a non-equivalent pre-test and post-test control group enabled the researcher to collect pre-test and post-test data that can be used by students with special needs. Thus, intact classes were randomly assigned to either the experimental or the control group.

The population of this study comprised 107 junior high school class two students with special needs from the six special needs secondary schools in Benue State during the 2024/2025 academic session.

The sample for this study consisted of fifty-two students (30 males and 22 females). The study's sample comprised students with special needs from two schools in Benue State and two intact classes. The sample size was selected using a multi-stage sampling procedure. In the first stage, stratified random sampling was used. This was intended to divide the population into two strata to ensure each subgroup is represented in the sample. These strata cover urban and rural geographical areas of Benue State. The use of the two strata ensured balance in the representation, precision, and control of the population for reliable results. In the second stage, simple random sampling was used to select from each stratum. One school was selected from each of the two strata, for a total of 2 special needs schools. In each of the two schools, a junior high class, two intact classes were used.

The research was conducted in intact classes with students of similar performance levels and cognitive ability. This was because there is only one junior high class, amounting to two in both special education schools. In the third stage, a simple random sampling technique using the 'bucket and draw' method without replacement was used. The researcher wrote out the names of the two sampled schools on paper, folded them, and dropped them in a bucket. The first school drawn without replacement was randomly assigned to the experimental group. The school was selected and taught and assessed using a mathematics journaling strategy (MJS), while the remaining one in the bucket was selected as the control group, which was taught and assessed using the lecture method (LM).

The criterion for selecting a multi-stage sampling procedure was to ensure that the selected elements met the research requirements. The use of intact classes was intended to avoid reorganizing them during studies. Junior high class two students were selected because it will enable them to develop essential financial habits early and equip them with basic financial concepts, such as saving, spending, and documenting their financial experiences in a journal. Financial literacy is a significant aspect of daily real-world problem-solving, requiring everyone to have a skillful knowledge of number operations.

In this study, the Number Operations Real World Financial Literacy Journal Test (NORWFLJT) was used. The instrument NORWFLJT was made up of 4 sections with 5 multiple-choice questions with answer options lettered

A-D. These questions covered number operations for addition, subtraction, multiplication, and division, constructed by the researcher. The NORWFLJT was scored as over 100 percent using a marking guide; five marks were awarded for the selection of the correct option, and a zero mark was awarded for the incorrect answer option. After the pre-test, the experimental group was taught number operations using five lesson plans with a mathematics journaling strategy, while the control group was taught using the lecture method. This treatment lasted for five weeks. Thereafter, the students in both groups were given a post-test. However, a reshuffled version of the items was administered as a post-test.

#### **Number Operations Real World Financial Literacy Journal Test development and operation procedure:**

The instrument Number Operations Real World Financial Literacy Journal Test (NORWFLJT) was constructed by the researcher using number operations for addition, subtraction, multiplication, and division, covering household purchasing and saving arithmetic numeration topics in the junior high class two-level mathematics curriculum. Each test item in the instrument consists of multiple-choice questions with four response modes. Each question consists of one correct option and three distractors. The sample NORWFLJT includes, for each number of operations, four levels of writing: first, problem-solving reflection, in which the learner describes a mathematical financial problem, solves it, and indicates the challenges encountered and the number of operations used; secondly, the ability to relate a mathematical error recently made on a similar problem; thirdly, the ability to explain what was learned from the error/mistake; and fourthly, the ability state how to avoid similar errors or mistakes in the future.

The educator sets clear expectations by establishing guidelines for journal entries, including the content, mathematics, communication skills, and the integration of real-world financial problem-solving and application, encouraging reflection of mathematical ideas by prompting students to reflect on their problem-solving processes, highlighting successes, challenges, and areas of improvement. Also, it emphasizes the importance of persistence, continuous effort, and learning from mistakes. Furthermore, this incorporates mathematical journaling into the curriculum, ensuring it aligns with several operations, including learning objectives and outcomes, and can be integrated into real-world financial literacy applications. The researcher provided research assistants, who were educators, with professional development opportunities to learn about mathematical journaling and its implementation.

The Number Operations Real World Financial Literacy Journal Test (NORWFLJT) was used to collect data. Section 'A' collected students' biodata, while section 'B' had twenty questions each for number operations, with four multiple responses for each question to test students' ability to gain number operations content knowledge and mathematics communication skills and integrate

number operation skills into solving financial problems. It also had a section 'C' where the student constructs two mathematics questions using number operations, solves them, and indicates their implications for financial literacy. NORWFLJT—section B was validated and trial-tested with a reliability coefficient of 0.94, determined by using the Kuder–Richardson 20 (K-R-20) formula to ascertain the internal consistency of the items. Consequently, since the test items differ in difficulty and in skills such as understanding, interpretation, and problem-solving, K-R-20 was an appropriate coefficient to use. Section C was used to determine the students' journaling and problem-solving skills. The instruments were considered reliable for this study, as Emaikwu (2015) stated that an instrument with a reliability coefficient of 0.50 or higher is considered reliable.

The students' mathematics journal was assessed using a rubric adapted from Guiriba (n.d.) upload of Rubrics for Reflective Journal by the researcher, using four criteria instead of six, as used in the upload, with changes in the nomenclature of the criteria to suit the present study for a summary of the four number operations taught: making a connection with the topic through personal experiences, problem-solving reflection, real-world application (integration), and creativity in writing. The journal format chosen depended on each student's special needs. It could be a book, a voice recorder, or an online journal if accessible. The mathematics journal was developed to provide feedback that promotes reflection, critical thinking, the communication of number operations in financial literacy, and their application in solving financial problems.

Extraneous variables, such as group interaction effects and group initial differences (due to intact-class assignments), were controlled by using distant locations and homogeneity tests, respectively. Both pre-test and post-test were administered under standard examination conditions.

## **4. Data analysis**

Research questions were answered using means and standard deviations, while the hypotheses were tested at a 0.05  $\alpha$  level using two-way Analysis of Covariance, accounting for selection randomness, homogeneity of variance, normality of the distribution, measurement on an interval scale, and independence of samples. The scores were analyzed to ascertain the effectiveness of the strategy on students with special needs, integrating the number of operations with financial literacy clearly used in NORWFLJT.

## **5. Results**

The following results were obtained from the research:

**Research Question 1:** What is the mean difference between financial literacy scores of students with special needs taught number operations using the mathematical journaling strategy and those taught using lecture methods?

Table 1 shows homogeneity in the pre-test mean scores of students with special needs between the experi-

mental and control groups, with means and SDs of 12.95 (4.00) and 12.49 (3.56), respectively. The table also shows higher mean and SD values for the experimental group than for the control group in the post-test: 24.58 and 3.27 and 15.43 and 3.43, respectively. This indicates that students with special needs taught number operations using MJS were able to integrate number operations with solving financial problems compared to those taught using LM.

**Research Question 2:** What is the mean difference in financial literacy scores between male and female students with special needs taught number operations using a mathematical journaling strategy?

Table 2 shows homogeneity in the pre-test mean scores of male and female students with special needs in the experimental group, with means and SDs of 13.54 (4.39) and 12.27 (3.29), respectively. The table also shows a higher mean and SD in the post-test for the experimental group than in the pre-test (24.85 and 3.36 and 24.27 and 3.28, respectively), with a mean gain difference of 0.69. This indicates homogeneity in the ability of both male and female SSNs to integrate number operations with solving financial problems.

**Hypothesis 1.** *Students with special needs do not show significant improvement in their ability to integrate number operations with financial literacy compared to those who do not use the strategy.*

Table 3 indicates that  $F(1, 49) = 21.346, p = 0.000 < 0.05$ . This signifies that the probability level is less than the specified alpha level of 0.05. Consequently, the null hypothesis is rejected. This means that there is a significant improvement in their ability to integrate number operations with financial literacy when taught using MJS, compared with those taught using LM. This shows that the effect of MJS on SSNs in number operations, integrating it with financial literacy, is positive. A partial Eta squared of 0.813 was obtained for the strategy. This implies that 81.3% of the integration of number operations with financial literacy can be attributed to the strategy employed in learning and assessing SSN in junior high class two number operations. Though the sample size is small, the effect size obtained is large. This is impressive, given the reduced variability in the sample. This shows that MJS has a sustained impact on SSNs' financial literacy, with a variance of 81.3%. This study has sufficient power in dictating significant effects despite its small sample size, with an ANCOVA statistical power of approximately 0.80. This effect size expresses the robustness of the results and the effect of MJS on SSNs' financial literacy skills.

**Hypothesis 2.** *There is no significant mean difference in financial literacy scores between male and female students with special needs taught number operations using a mathematical journaling strategy.*

Table 4 indicates that  $F(1, 21) = 0.320, p = 0.578 > 0.05$ . This signifies that the probability level is greater than the specified alpha level of 0.05. Consequently, the null hypothesis is not rejected. This means there is no significant difference in financial literacy between male and female SSN taught number operations using MJS. A partial Eta square of 0.015 was obtained for the strategy. This implies that only 1.50% of the integration of number operations with financial literacy can be accounted for by gender in MJS. This shows a small effect size, indicating that the difference between male and female students' scores is insignificant. The statistical power indicates that the non-significant result is due to a lack of difference between male and female students' scores, given the homogeneous sample and reduced variability.

The research was conducted in intact classes with students of similar performance levels and cognitive ability. This enabled a homogeneous sample, which, with the effect of MJS, indicated an increase in the effect size due to reduced variability, making it easier to detect significant effects. With a sample size below the recommended 30, the study results can still be considered valid given the large effect size and high statistical power. These results are robust, suggesting a significant impact of MJS on SSNs' financial literacy skills in mathematics and no significant difference in scores between male and female students.

## 6. Discussion of findings

The study's findings demonstrate a notable improvement in SSNs in the experimental group's ability to integrate number operations with financial literacy when taught number operations using MJS, compared to their control group counterparts taught using LM. The initial finding of improvement in SSNs' ability to integrate number operations with financial literacy using MJS is endorsed by research grounded in a successful learning strategy (Powell, 2018). This outcome also resonates with prior studies on MJS's ability to promote reflective, creative, and critical thinking, as well as communication, in mathematics (McCormick & Lucas, 2020). This study confirms that mathematics journaling enables students' participation in learning, enabling them to own their learning through the construction of knowledge as they interact with one another, as asserted by Vygotsky (1978) in his constructivist theory. The results of improvements in SSN in the experimental group taught using MJS indicate that MJS enabled students to communicate mathematical ideas, improved learners' mathematical skills, and proposed solutions to real-world problems (Chapman, 2016; McCormick & Lucas, 2020). This result shows that incorporating mathematical journaling into learning can enhance SSN's conceptualization of number operations, enabling them to integrate their skills into solving real-world financial problems and to showcase their financial literacy in a dynamic world. This result implies that MJS, when used in teaching and learning mathematics concepts, can enhance the appli-

**Table 1.** Mathematical literacy scores of SSNs taught using mathematics journaling strategies and those taught using lecture methods.

| Group           | N  | Pre-Test  |      | Post-Test |      | Mean Gain |
|-----------------|----|-----------|------|-----------|------|-----------|
|                 |    | $\bar{x}$ | sd   | $\bar{x}$ | sd   |           |
| MJS             | 24 | 12.95     | 4.00 | 24.58     | 3.27 | 11.63     |
| LM              | 28 | 12.43     | 3.56 | 15.43     | 3.43 | 3.00      |
| Mean Difference |    | 0.52      |      | 9.15      |      | 8.63      |

**Table 2.** Mean and standard deviation of financial literacy score of male and female SSNs taught using a mathematical journaling strategy.

| Gender          | N  | Pre-Test  |      | Post-Test |      | Mean Gain |
|-----------------|----|-----------|------|-----------|------|-----------|
|                 |    | $\bar{x}$ | sd   | $\bar{x}$ | sd   |           |
| Male            | 13 | 13.54     | 4.39 | 24.85     | 3.36 | 11.31     |
| Female          | 11 | 12.27     | 3.29 | 24.27     | 3.28 | 12.00     |
| Mean Difference |    | 1.27      |      | 0.58      |      | 0.69      |

cation of those skills learned (McCarty & Faulkner, 2020), hence its effectiveness in the study findings on integrating number operations with financial literacy.

The clear result of a notable enhancement in SSNs in the experimental group compared with the control group clearly reveals the efficacy of the intervention. The two-way ANCOVA, conducted to assess differences in integrating number operations knowledge in solving financial problems before and after the intervention, revealed a significant improvement in the experimental group. This shows that the experimental group experienced substantial improvement in using several operations to solve financial problems. This result shows that incorporating mathematics journaling in learning can enhance SSNs' conceptualization of number operations, fostering reflective self-regulated learning, improving mathematics reasoning, and enabling SSNs to integrate their skills with solving real-world financial problems, and showcasing their financial literacy in a dynamic world (Borasi & Rose, 2017; Powell, 2018). This result aligns with previous studies showing that mathematics journaling enhances creative learning experiences and helps students learn to apply their knowledge to solve real-world problems (Afful et al., 2024).

This study of the enhanced integration of number operations with financial literacy application in SSN in the experimental group is in resonance with previous research that MJS can be a valuable tool used by learners to demonstrate their learning, as they apply their learning skills

to solving financial literacy problems (Chand et al., 2021; Sagita et al., 2022). This confirms the need for learner-centered strategies in mathematics education for effective application in real-world situations (Taylor, 2021; Donkoh & Amoakwah, 2024; Abaver et al., 2024). This result has demonstrated that mathematics journals enable students to effectively utilize and communicate their mathematical ideas and serve as a tool for educator assessment and feedback (Mullis & Martin, 2017; McCarty & Faulkner, 2020; McCormick & Lucas, 2020). Furthermore, this result provides important feedback for the educator, as it is necessary for SSNs to be empowered to handle financial problems using the numeracy knowledge they acquire, thereby becoming financially literate (Skagerlund et al., 2018; Goyal & Kumar, 2021).

The study's second finding on gender and its interaction with MJS reveals that there exists no significant difference in the financial literacy between male and female SSNs taught number operations using the mathematics journaling strategy. This result aligns with the finding that using MJS enhances mathematics skills and improves all students' performance. This implies that there is no notable difference in the scores of male and female students (Afful et al., 2024). This result aligns with the submission that writing to learn provides opportunities for collaborative learning among male and female students (Ugo & Oliweh, 2024). This finding of no significant difference in gender and its interaction with MJS is consistent with the report

**Table 3.** Summary of two-way ANCOVA results of financial literacy test scores of SSNs taught using mathematical journaling strategy.

| Source          | Type 3 Sum of Squares | Df | Mean Square | F       | Sig.  | Partial Eta Squared |
|-----------------|-----------------------|----|-------------|---------|-------|---------------------|
| Corrected Model | 1416.727a             | 2  | 708.364     | 151.543 | 0.000 | 0.861               |
| Intercept       | 496.479               | 1  | 496.479     | 106.214 | 0.000 | 0.684               |
| NORWFLJT PRE    | 333.648               | 1  | 333.648     | 71.379  | 0.000 | 0.593               |
| Grp             | 992.573               | 1  | 992.573     | 212.346 | 0.000 | 0.813               |
| Error           | 229.042               | 49 | 4.674       |         |       |                     |
| Total           | 21,732.000            | 52 |             |         |       |                     |
| Corrected Total | 1645.769              | 51 |             |         |       |                     |

**Table 4.** Summary of two-way ANCOVA results of financial literacy test scores of male and female students with special needs taught using MJS.

| Source          | Type 3 Sum of Squares | Df | Mean Square | F       | Sig.  | Partial Eta Squared |
|-----------------|-----------------------|----|-------------|---------|-------|---------------------|
| Corrected Model | 192.428a              | 2  | 96.214      | 37.833  | 0.000 | 0.783               |
| Intercept       | 416.320               | 1  | 416.320     | 163.705 | 0.000 | 0.886               |
| Pre             | 190.469               | 1  | 190.469     | 74.896  | 0.000 | 0.781               |
| Gender          | 0.814                 | 1  | 0.814       | 0.320   | 0.578 | 0.015               |
| Error           | 53.405                | 21 | 2.543       |         |       |                     |
| Total           | 14,750.000            | 24 |             |         |       |                     |
| Corrected Total | 245.833               | 23 |             |         |       |                     |

that male and female students with special needs perform similarly in algebra when taught with a peer-assessment strategy (Abaver et al., 2024). From these studies, the present results underscore that neither gender nor the interaction with MJS is significant. This implies MJS could reduce gender bias in the teaching and learning of mathematics concepts, and as shown in the integration of number operations with financial literacy, the application of both male and female SSNs has the same effect.

## 7. Conclusions

This study provided strong evidence for the effectiveness of mathematics journals in improving the mathematics performance of junior high school students. The use of journals was found to significantly enhance students’ financial problem-solving skills, deepen their conceptual understanding, and improve their overall academic performance. These findings suggest that mathematics journals can be a valuable pedagogical tool in mathematics instruction, fostering deeper engagement with the subject and helping students build a stronger foundation in mathematical reasoning. The successful implementation of mathematics journals can have lasting effects on students’ learning experiences. Therefore, educators are recommended to embrace this reflective practice to enhance the learning experience in mathematics classrooms. With continued exploration and integration, mathematics journals could become a key strategy in improving mathematics education worldwide.

The study’s findings shed light on the efficacy of incorporating mathematical journaling strategies with integrating financial literacy through skills learned from number operations. While the control group made substantial progress through the lecture method, the experimental group showed a significant improvement in financial proficiency through the integration of MJS. The results align with the research objectives, which aim to evaluate the impact of mathematical journaling strategies on integrating number operations with financial literacy for students with special needs in junior high class two, thereby integrating these skills into real-world financial problem-solving.

The comparison between the experimental and control groups shows a significant difference in the financial literacy of SSNs taught number operations using the mathe-

matics journaling strategy, with greater improvement than with LM. In general, the study suggests that MJS effectively enhanced junior high class two students’ ability to integrate number operations with financial literacy and that MJS is gender-friendly, supporting both male and female SSNs in learning and integrating knowledge into financial problem-solving. These findings underscore the importance of embracing MJS in mathematics education and its application to problem-solving.

## 8. Recommendations

The following recommendations were made from the research findings.

1. Mathematics educators should encourage students with special needs to journal regularly, whether daily or weekly, to enable reflective, self-regulated learning and the acquisition of several operations skills and other mathematics concepts to be financially literate and able to solve real-world problems.
2. Mathematics educators, curriculum planners, and stakeholders should connect mathematical journaling to real-world contexts and applications in the mathematics curricula.

## 9. Limitations and future research directions

The following are the study’s limitations and future research directions.

1. Future studies should aim to include a larger and more diverse sample of students and teachers; the small sample size of this study may limit generalization of the results to larger populations.
2. Future research should explore the potential of digital tools and platforms to support mathematical journaling and its implementation.

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## Author contributions

Conceptualization, S.M.A.-A. and F.M.M.; methodology, S.M.A.-A.; software, not applicable; validation, S.M.A.-A. and F.M.M.; formal analysis, S.M.A.-A.; investigation, S.M.A.-A.; resources, F.M.M.; data curation, S.M.A.-A.; writing—original draft preparation, S.M.A.-A.; writing—review and editing, S.M.A.-A. and F.M.M.; visualization, S.M.A.-A.; supervision, F.M.M.; project administration, S.M.A.-A.; funding acquisition, not applicable. All authors have read and agreed to the published version of the manuscript.

## Conflicts of interest

The authors declare no competing nor conflicts of interest.

## Data availability statement

The supporting data report is unavailable due to privacy and ethical restrictions for the subjects used for the investigation.

## Institutional review board statement

Ethical standards were maintained by obtaining informed consent from the administrators of the special needs schools before participation; they were informed about the research purpose and procedures. Participants were guaranteed confidentiality, meaning their information would be kept private. This was done verbally by their mathematics educators when explaining the data that would be collected from them. They were duly informed of their right to leave the study at any time they choose to, without penalty. Steps were taken to reduce any assessment-related stress or discomfort. This fostered a culture of voluntary participation, ensuring student safety.

## Informed consent statement

Verbal informed consent was obtained from the authorities in the participants' school for the study. Also, co-authors are included in the paper, and they have read and approved the submission version of the manuscript.

## Sample availability

No physical samples or materials were generated or are available from this study.

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