Mathematical Literacy: The Effects of Mathematics Journals on Student Understanding of Fractions in a Montessori Classroom

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Will the use of student-created math journals effect student ability to make sense of problems and persevere in solving them, reason abstractly and quantitatively, construct viable arguments, and critique the reasoning of others when assessed on understanding fractions as detailed in CCSS 4.NF, 5.NF, and 6.NS?
Research Question 2: Journaling as a Communication Tool

To what extent will math journals effect student communication of mathematical concepts involved in understanding fractions?
Research Question 3: Drawing Mathematical Models

What effect will math journals have on student ability to draw models representing their understanding of fractions?
The purpose of this action research project was to explore the impact of a small group intervention plan that focused on mathematical literacy, using student journals to effect understanding of fractions.
The Benchmarks of Student Understanding

- **Speak it:** Collaborative student discussions to organize thinking and practice language skills.

- **Draw it:** Students draw models to illustrate calculations.

- **Write it:** Students write about the process using the language of justification.
The Literature: An elementary understanding of mathematics has long-term implications.

The 2015 Center for Poverty Research report and the research of Siegler and Lortie-Forgues (2015) indicated a strong correlation between poverty and level of education, specifically 5th grade mathematics, supporting the premise that mathematical knowledge during elementary school is a strong predictor of financial stability in adulthood.
The Literature: An elementary understanding of mathematics has short-term implications.

The 2010 adoption of the CCSS (Common Core State Standards) by many states completed what Bernadowski (2015) called a shift in focus requiring "an in-depth ability to make connections by using multiple models of solving, writing, and justifying answers" (p. 3).
Hughes, Powell, and Stevens (2016) wrote by the end of first grade, students must understand and apply 105 mathematics vocabulary terms and by the end of 5th grade, they are required to utilize 325.
Baumann and Graves (2010) discuss words that have both a general meaning as well as a mathematical meaning: product, difference, and table. This ambiguity of meaning confuses students, necessitating the need for explicit vocabulary instruction.
Instead of saying, *Borrow the one from the four and put it next to the two to make twelve*, teachers should use place value vocabulary to say, *Exchange one ten for 10 ones, combine the 10 ones with the 2 ones to make twelve ones.* (Hughes et al., 2016, p. 11)
Placing value on all students’ right to speak “is rooted in the assumption that we all bring to the classroom experiential knowledge...this knowledge can enhance our learning experience” (hooks, 1994, p. 84).
Montessori’s emphasis on “the work of the hand” and how it connects to student mediation makes journaling a fitting choice for a Montessori classroom (Thompson, 2013).
My Project

The subjects for this study were school children ages 9-12 in an upper elementary classroom of a public Montessori school. All students, grades 4th-6th, participated in the intervention during the course of normal classroom instruction. A total of nine students participated in the intervention.
Data Collected - Quantitative

- Grade-level Pre and Post-Assessments
- Weekly Progress Monitoring Assessments
- Math Journals
Data Collected - Qualitative

• Weekly Teacher Reflection Journal: Promote responsive teaching and facilitate any reteach necessary.

• Student Self-Evaluation: Students rate their confidence on a four point rubric, in week three and week six of the intervention period.
Pre and Post Assessment Data Growth by Student

Individual Student Data

Performance Indicator

Student A | Student B | Student C | Student D | Student E | Student F | Student G | Student H | Student I

Pre-Assessment | Post-Assessment
Pre-Assessment Data

Pre-Assessment Performance Indicators

- Partially Met Expectations
- Approached Expectations
- Met Expectations
- Exceeds Expectations
How Confident are You Solving Fraction Problems?

Confidence Level

Number of Students

<table>
<thead>
<tr>
<th>Confidence Level</th>
<th>Student Self-Perception 1</th>
<th>Student Self-Perception 2</th>
</tr>
</thead>
<tbody>
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<tr>
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Student Confidence Levels Data
Student Self-Evaluation at Weeks 3 and 6
Student Confidence Levels Data
Student Self-Evaluation at Weeks 3 and 6

How Confident Are You Drawing a Fraction Model?

### Bar Chart

- **X-Axis:** Confidence Level (1, 2, 3, 4, 5, 6)
- **Y-Axis:** Number of Students

**Legend:**
- Student Self-Perception 1
- Student Self-Perception 2
Student Confidence Levels Data
Student Self-Evaluation at Weeks 3 and 6

How Confident – Explaining Thinking in Writing?

![Bar chart showing confidence levels of students in explaining thinking in writing at Weeks 3 and 6.]

- Confidence Level 1: 2 students (Student Self-Perception 1: 1 student, Student Self-Perception 2: 1 student)
- Confidence Level 2: 1 student (Student Self-Perception 1: 1 student, Student Self-Perception 2: 0 students)
- Confidence Level 3: 6 students (Student Self-Perception 1: 3 students, Student Self-Perception 2: 3 students)
- Confidence Level 4: 1 student (Student Self-Perception 1: 1 student, Student Self-Perception 2: 0 students)
Conclusions

• Addressing three grade levels was challenging, yet contributed to a deeper understanding of the vertical alignment within the fraction-focused math standards.
Conclusions

• Burns’ descriptions of how to draw representational models for fraction multiplication and division proved useful and provided a needed bridge between the concrete Montessori fraction materials and the abstract standard algorithms.
Conclusions

• The math journals became a useful reference tool for students when completing independent work.
• An improvement would be to use notebooks with grid lines or graph paper.
Conclusions

• Including discussion in each lesson takes time and requires explicit instruction.
How This Research Will Impact My Practice
My Next Steps

I will continue to use math journals.
I will continue to grow my proficiency in eliciting student discourse.
I will continue to support academic language.
I will continue to blend the use of fraction insets with the drawing of mathematical models.
A Parting Quote in Support of Journaling

The hands are the instruments of [human] intelligence... We construct our mind step by step till it becomes possessed by memory, the power to understand, the power to think (Montessori, 1967, p. 27).
References


