

# **The Relationship Between Engagement and Tactile Learning in Multiplication**

Mikayla McBride

The LeBron James Family Foundation College of Education

The University of Akron Honors Research Project

Professor Karen Plaster

April 15, 2021

## **ABSTRACT**

Engagement is a key component to have in every classroom. There are many different ways to increase levels of engagement between students and their learning (Labri, 2016). In this study, the researcher will be observing the relationship between tactile learning and engagement in a multiplication lesson. To perform this study, an 8-year-old female will be the participant. Throughout the study, the level of engagement will be observed when tactile learning is used with a multiplication lesson. When the study was finished, it was found that tactile learning does increase engagement in a math classroom setting. The participant remained thoroughly engaged and extremely excited with the material. She was eager to answer more problems and did not want the session to end. When used along with a lesson, math manipulatives increase engagement.

Key Words: manipulatives, tactile learning, engagement, observation

### The Relationship Between Engagement and Tactile Learning in Multiplication

## **LITERATURE REVIEW**

The Journal of Instructional Pedagogies, defines manipulatives as physical objects that are used in the classroom to help teach a lesson by increasing engagement and allowing a hands-on approach (Boggan, 2008). Having manipulatives in the classroom, especially in a math setting, is a growing trend seen within education. When used correctly, they can be extremely helpful to young children (Boggan, 2008). Manipulatives allow students to make connections between math concepts and their learning. According to Furnell and Worrell at Nova, it is important for teachers to create bridges for students between concepts and manipulatives. One

cannot expect a student to do this with no prior knowledge (Furner and Worrell, 2017). This research suggests that even though manipulatives are extremely helpful with allowing students to make connections, they cannot just be handed manipulatives and be expected to fully understand a concept. There needs to be a balance between a teacher directing a lesson and a hands-on component with manipulatives (Furner and Worrell, 2017).

According to research from a 2016 study performed by a university in Ghana, manipulatives are extremely important when teaching math concepts (Labri, 2016). When observing the use of manipulatives in one group compared to another that used no manipulatives, the results were astounding. Every student in the manipulatives group scored higher when assessed over new math concepts than their peers who were taught the math concepts without manipulatives. The students who were taught math concepts using tactile learning were engaged with their learning and made many new connections while using the manipulatives.

This research suggests that the multi-modal approach of tactile learning can benefit more students, especially those who have different learning styles (Labri, 2016). Using manipulatives is very important in the classroom because it allows students to have the material presented in a number of different ways. Labri (2016) suggests that whenever possible, teachers should have manipulatives in their classrooms for teaching math concepts (Labri, 2016). With this research in mind, the researcher plans to see similar results when it comes to student engagement while using tactile learning in multiplication.

Another area involving the use of manipulatives in a math classroom was a student's fluency, problem-solving skills, and reasoning. According to the Malaysian Online Journal of Educational Technology, reasoning and problem-solving abilities increased in students who were able to use LEGO bricks as a manipulative in a math classroom setting (Gunes & Genc, 2021).

The European Journal of STEM Education did further research involving the use of manipulatives within multiplication and division. In one study, they used bundling sticks to see if it could potentially help students solve more difficult multiplication problems (Hurst & Linsell, 2020). The study concluded that the manipulatives helped students complete difficult multiplication problems, but they still struggled with more difficult division problems.

These studies suggest that using manipulatives in a math classroom setting can benefit students. They acknowledge that manipulatives are becoming increasingly more popular throughout the classroom. Tactile learning can help increase reasoning and problem-solving skills when it comes to new math concepts (Grunes & Genc, 2021) and tackle more difficult problems that they otherwise may have not been able to understand (Hurst & Linsell, 2020). These studies provide insight into the need for manipulatives in the classroom due to their many benefits for students.

## **METHODOLOGY**

For this study, the researcher worked with one participant. The participant was an 8-year-old female who was in the second grade. She will be referred to as Megan. Megan has a very strong love for math and enjoys learning new math concepts whenever she can. According to her mother, Megan scores well above average on every standardized state test in the math content area. She also scores highly in other content areas, but math is always the highest score. Megan is also one of three of the highest-achieving students in her math classroom. She is in an advanced group in the class that gets to complete challenge questions due to their early finishing. Megan enjoys the chance of a challenge because of her love of math. Although not a second-

grade concept, she has begun to teach herself multiplication through the idea of repeated addition. Both Megan and her mother signed consent forms to take participate in this study.

### Procedure

The researcher worked one-on-one with Megan for an entire afternoon at her house to complete the case study. They worked in a quiet space dedicated to homework and reading. The area had a small desk that Megan worked at and a large whiteboard on an easel that the researcher could write on. The researcher began with a pre-assessment of multiplication. Megan was presented with basic multiplication problems as well as one story problem. The problems Megan solved were:

1. Suzie has 5 bags of candy. Each bag has 5 pieces of candy in it. How many pieces of candy does Suzie have in all?
2.  $7 \times 3 =$
3.  $4 \times 8 =$
4.  $9 \times 3 =$
5.  $7 \times 5 =$

After observing Megan demonstrating how she uses repeated addition, the researcher developed these questions. The researcher created these problems because they involved with smaller numbers that Megan could use with repeated addition. For example, she could easily add nine, three times using a familiar strategy. The researcher included a story problem because the researcher wanted to see if Megan could determine important information from the question to set up a multiplication problem.

When she finished the pre-assessment, she completed a math questionnaire with questions regarding her feelings toward math. Megan provided an opinion about math by circling a number 1 through 5, saying whether she agreed or disagreed with the statement. 1 meant that Megan strongly disagreed and 5 meant that she strongly agreed. The questionnaire consisted of these statements for Megan to answer; (1) I enjoy math, (2) Math is difficult to me, and (3) I enjoy learning new math ideas.

The researcher chose these for Megan to respond in order to understand her feelings and opinions towards the subject of mathematics. The researcher also wanted to see how Megan felt about learning a new way of doing a multiplication problem instead of continuing a method she had been teaching herself.

After the pre-assessment and questionnaire, the researcher taught Megan a new way of solving multiplication problems while using manipulatives. The researcher started by giving Megan a handful of counters to use as the manipulatives for the afternoon. The researcher explained that she would put the manipulatives into groups to solve multiplication. The researcher began with the easier problem of  $6 \times 2$ . The researcher showed Megan how they could make two groups of six counters. They could then count all the counters to get our answer of 12. Megan then used the counters to complete multiplication questions.

After the lesson was over, Megan completed a post-assessment. The post-assessment consisted of the following questions:

1. Lucy has 6 bags of apples. There are 3 apples in each bag. How many apples does she have altogether?
2.  $5 \times 7 =$
3.  $4 \times 3 =$

4.  $6 \times 4 =$

5.  $5 \times 8 =$

The researcher chose these questions for similar reasons to the pre-assessment. The researcher wanted the numbers to not be too large to avoid overwhelming Megan. The researcher wanted Megan to be able to attempt grouping with manipulatives but still be able to use repeated addition if needed. The researcher chose another story problem because the researcher wanted to see if Megan could once again pull necessary information out of the question to set up a multiplication problem.

Following the post-assessment, there was a second questionnaire. These statements gave opinions related to learning multiplication with manipulatives. Megan had to circle a number 1 through 5, 1 being that she strongly disagreed and 5 being that she strongly agreed. The second questionnaire consisted of the following for Megan to respond to; (1)Using manipulatives helped with me understand the lesson better, (2)Using manipulatives helped me work faster, and (3)I enjoyed using manipulatives to learn this math lesson

The researcher chose these statements for Megan to respond to because they wanted her opinion on using tactile learning for a math lesson to see if she noticed a difference between her enjoyment of doing the problems, and the speed of solving them. If Megan gave a four or higher, it would mean that her engagement increased because she was happy and present while solving problems.

## **RESULTS**

### **Pre-Assessments Results**

In the pre assessment Megan received a 100%. She used the strategy of repeated addition to solve the multiplication problems. She also used the counting by fives strategy when it came to multiplying a number by 5. In her pre-assessment questionnaire, Megan gave a variety of answers.

**Table 1**

<b>Questionnaire Statement</b>	<b>Response</b>
I enjoy math	5
Math is difficult for me	1
I enjoy learning new math ideas	5

For statement one, “I enjoy math,” she gave the response of a 5, meaning that she strongly agreed. For statement two, “Math is difficult to me,” she gave a response of 1, meaning that she strongly disagreed. For statement three, “I enjoy learning new math ideas,” she gave a response of 5, meaning she strongly agreed.

### **Lesson Observations**

When observing Megan’s engagement when it came to using manipulatives, she immediately took interest. She enjoyed the idea of not having to write out all of the repeated addition like she had been doing. After showing the example of  $6 \times 2$ , Megan caught on to what to do. For the next problem of  $6 \times 3$ , Megan grabbed the chips excitedly. She stated, “ $6 \times 3$ , you can do 6 groups of 3 or 3 groups of 6!” While working out  $6 \times 3$ , Megan was also able to see there were 2 groups of 9. She stated, “9 plus 9 is 18!” Megan continued to work through



problems with ease and great understanding. Throughout the entire process, Megan remained extremely engaged and very interested in learning the new concept. She kept saying that grouping was easier for her. She said, “You don’t have to stretch your mind like for addition.”

### **Post-Assessment Results**

In the post-assessment, Megan received another 100%, but this time she used different strategies. Megan used grouping for solving the questions. As she took the post-assessment she exclaimed, “I love grouping!” She also used a strategy of drawing out groups. In her post-assessment questionnaire, she gave all the same responses.

**Table 2**

<b>Questionnaire Statement</b>	<b>Response</b>
Using manipulatives helped me understand the lesson better	5
Using manipulatives helped me work faster	5
I enjoyed using manipulatives to learn this math lesson	5

For all three statements, Megan answered 5, meaning that she strongly agreed with the presented idea. Megan was very responsive to the use of manipulatives and shared that she preferred the method compared to repeated addition on paper.

### **DISCUSSION AND CONCLUSION**

In this study, the researcher found that using a multi-model approach of manipulatives in the classroom was extremely beneficial to the learning process (Labri, 2016). The researcher believes that Megan had a successful experience with the manipulatives due to her prior knowledge of teaching herself multiplication concepts (Furner & Worrell, 2017). Megan shared multiple times that she preferred the hands-on better than doing repeated addition on a separate paper. Throughout the experience, the researcher observed that tactile learning in teaching multiplication does, in fact, increase engagement (Labri, 2016). The researcher came to this conclusion by observing the student working and listening to the things she said. She continued to announce just how much better she liked using manipulatives. Megan also was continuously eager for more. The manipulatives gave her a sense of being able to confidently do any problem thrown at her (Hurst & Linsell, 2020). Once one problem was completed, she kept asking for more. She was always very excited to grab the manipulatives as soon as the researcher gave her a new problem. Megan was extremely engaged with the material and the use of tactile learning. Megan's responses of 5's on her post-assessment questionnaire also helped the researcher observe that her engagement increased. She strongly agreed that the math lesson was enjoyable and that she enjoyed using manipulatives to solve the math problems.

Along with increased engagement, the researcher also saw growth in Megan's reasoning while using manipulatives (Gunes & Genc, 2021). Instead of doing repeated addition on paper, Megan was able to visualize problems with the manipulatives and find the solution in her head. There is also evidence of her reasoning increasing due to her response of a 5 on the questionnaire statement that read, "Using manipulatives helped me work faster." By making connections with the manipulatives through prior knowledge,

In conclusion, it is very important to incorporate tactile learning when teaching multiplication concepts within a classroom. It allows the student to have the material presented in more than one way and allows a multi-modal approach to learning. As a teacher, the researcher plans to incorporate manipulatives not only with multiplication but with many other math concepts as much as they can.

## References

Furner, J. M. and Worrell, N. L. (2017) "The Importance of Using Manipulatives in Teaching Math Today," *Transformations*3: (1), Article 2.

Güneş, H. and Genç, Z. (2021). The effect of LEGO manipulatives on student performance in the mathematical skills of the 2nd grade: Parents 'and students' views. *Malaysian Online Journal of Educational Technology*, 9(4),50-67

Hurst, C. and Linsell, C. (2020). Manipulatives and Multiplicative Thinking. *European Journal of STEM Education*, 5(1), 04. <https://doi.org/10.20897/ejsteme/5808>

Labri, E. (2016). The Use of Manipulatives in Mathematics Education [Catholic University College of Ghana.] *Journal of Education and Practice*.7 (36).

Boggan, M. (2008). Using Manipulatives to Teach Elementary Mathematics. *Journal of Instructional Pedagogies*. 9(1).

# Appendix

## Pre-Assessment

### Multiplication Pre Assessment

Name Rebecca

1. Suzie has 5 bags of candy. Each bag has 5 pieces of candy in it. How many pieces of candy does Suzie have in all?

25 count by fives

5 10 15 20 25

2.  $7 \times 3 = 21$

3.  $4 \times 8 = 32$

$4+4=8$     $4+4=8$     $4+4=8$     $4+4=8$

2   4   6   8

$8+8+8+8=32$

4.  $9 \times 3 = 27$

5.  $7 \times 5 = 35$

$14+14=28$     $28+7=35$

~~35~~

## Pre-Assessment Questionnaire

For the following questions, circle any number 1 through 5, 1 being strongly disagree and 5 being strongly agree.

1. I enjoy math

1 2 3 4 5

2. Math is difficult to me

1 2 3 4 5

3. I enjoy learning new math ideas

1 2 3 4 5



## Observation Notes

### Observation Notes

- Student uses repeated addition to solve multiplication
- Student enjoyed not having to show work
- Student caught on quickly for grouping
  - " $6 \times 3$ , you can do 6 groups of 3 or 3 groups of 6"
  - Missed a group of 3, answered
  - Saw that there were 2 groups of 9 ( $9 + 9 = 18$ )
  - $11 \times 4$  said 43, missed one

### Grouping VS Repeated Addition

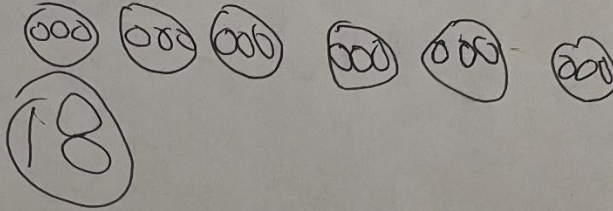
- Prefers grouping  $\rightarrow$  "It's easier", "you don't have to stretch your mind with addition"
- "Addition is harder than multiplication"
- Student began drawing out grouping for post test
- Kept saying she enjoyed grouping compared to repeated addition

## Post-Assessment

### Post Assessment Multiplication

Name Rebecca

1. Lucy has 6 bags of apples. There are 3 apples in each bag. How many apples does she have altogether?



2.  $5 \times 7 = 35$

3.  $4 \times 3 = 12$

4.  $6 \times 4 = 24$

5.  $5 \times 8 = 40$



## Post-Assessment Questionnaire

For the following questions, circle any number 1 through 5, 1 being strongly disagree and 5 being strongly agree.

1. Using manipulatives helped with me understand the lesson better

1 2 3 4 (5)

2. Using manipulatives helped me work faster

1 2 3 4 (5)

3. I enjoyed using manipulatives to learn this math lesson

1 2 3 4 (5)