# Aleah's Problem

Presented by

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# Making Mathematical Tasks Worthwhile

- Develop an appropriate environment to encourage free expression & careful listening

- Phrase & present the task to focus their thinking

- <u>Explicitly</u> ask students to show their work

- Ask "which or why" & open-ended questions to encourage more thoughtful solutions

- Establish a criteria for "good" communication of solutions

# Criteria for Good Math Communication

**Activity:**
1. Present a problem and a set of student responses
2. Ask students to evaluate each response and write down their ideas about the good and bad points of the solution
3. Develop a set of criteria for 'good' communication

- Is the solution correct and complete?
- Is the explanation clear? Logical?
- Do the steps follow a methodical sequence?
- Are the justifications accurate?
- Can you identify vague or omitted pieces of the argument?
- Can the presenter provide those missing pieces?

# Background

**Objective**

Overarching Goal:

- Students will discover patterns that lead to algebraic equations.

Lesson Objectives:

- Students will represent and solve a story problem using a variety of strategies (multiple representations).

**Prior experiences**

- Observe and generalize patterns using input-output machine.
- Connecting input-output machine pattern to a rule or function. (in words)
- Translating rules to equations with variables.
- Graphing ordered pairs from a table with input-output machine.
- Penny Jar Problem—introduction to Writing one equation.
- Familiarity with Venn Diagram
- Exposure to multiple representations in problem solving (star)

# Aleah's Problem

Aleah and her younger brother have been given money to put into their savings account from her dad. Aleah has 180 dollars saved all in 10 dollar bills. Her younger brother has 110 dollars saved all in 5 dollar bills. Every Friday, Aleah's dad let her and her younger brother go with him to Wal-Mart and spend some of the savings money. Aleah spends 10 dollars every Friday, while her little brother spends 5 dollars every Friday.

One Friday they look into each others' wallets, the younger brother had more money in his wallet then Aleah did. When this happened, how many Friday's had it been since they started spending money?

Aleah's Savings

Little Brother's Savings

WAL★MART
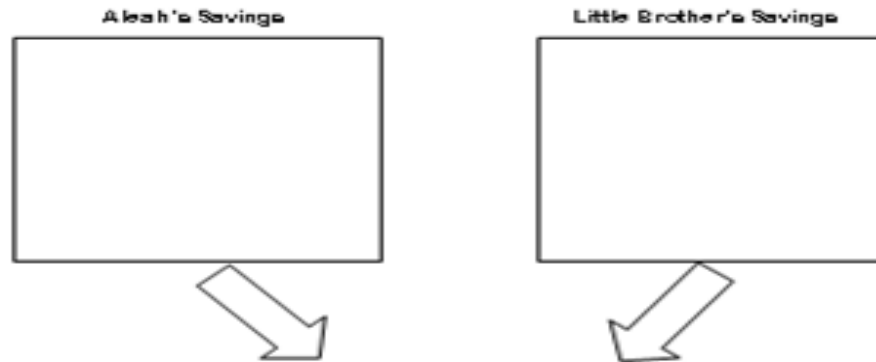
# About the Class

- 18 students present, 10 boys: 8 girls
- 3 ESOL students
- 8 students have IEPs with math goals
- Ethnicity
  - African-American – 6 students
  - Asian – 1 student
  - Hispanic – 7 students
  - Multi-racial – 2 students
  - White – 2 students

# Teacher's Role

- Emphasize physical models (linear and non-linear), data, & graphs

- Capitalize on students' previous problem solving experiences

- Ask questions leading students to clarify their attempts to solve a problem

- Provide **repeated** opportunities for problem solving to develop algebraic thinking

- Empower students to move to new levels of abstraction & generalization

# Student's Role

- Compute numerical values and generalize beyond specific values to values not handled yet

- Describe/extend patterns beyond current problem

- May use a graphing calculator or similar technology to generate graphs/tables

- Identify, describe, & extend a pattern

- Recognize and describe the thinking process to become a better problem solver
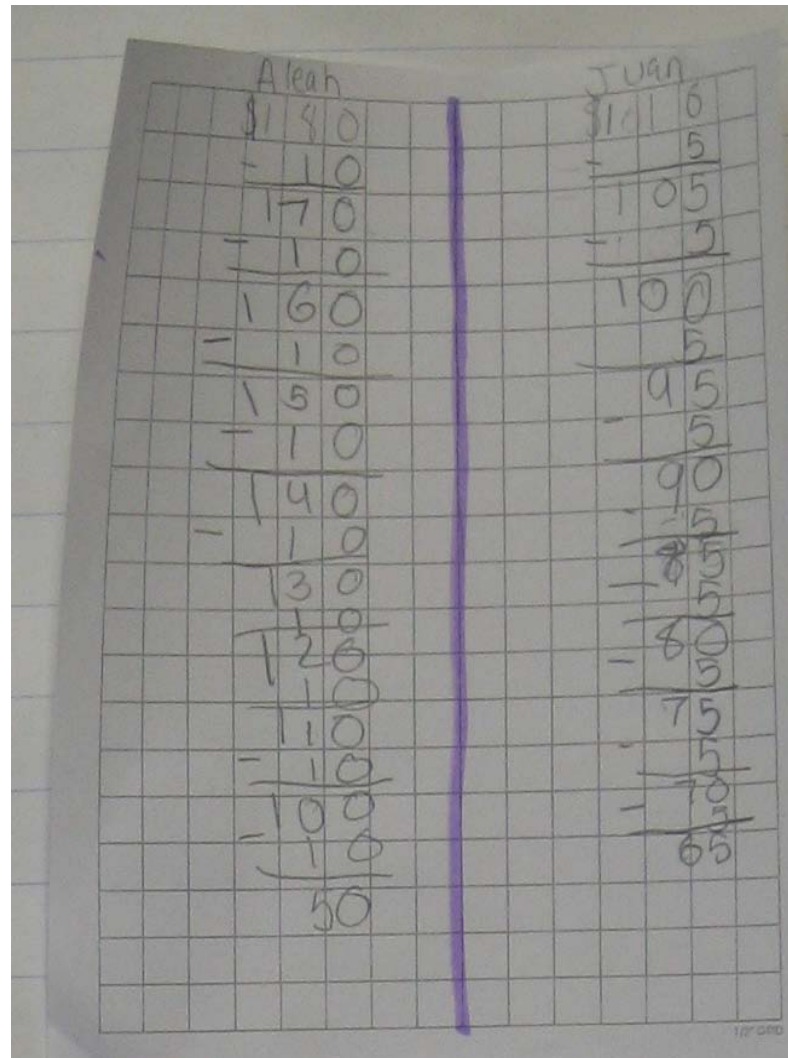
# Teacher's Example
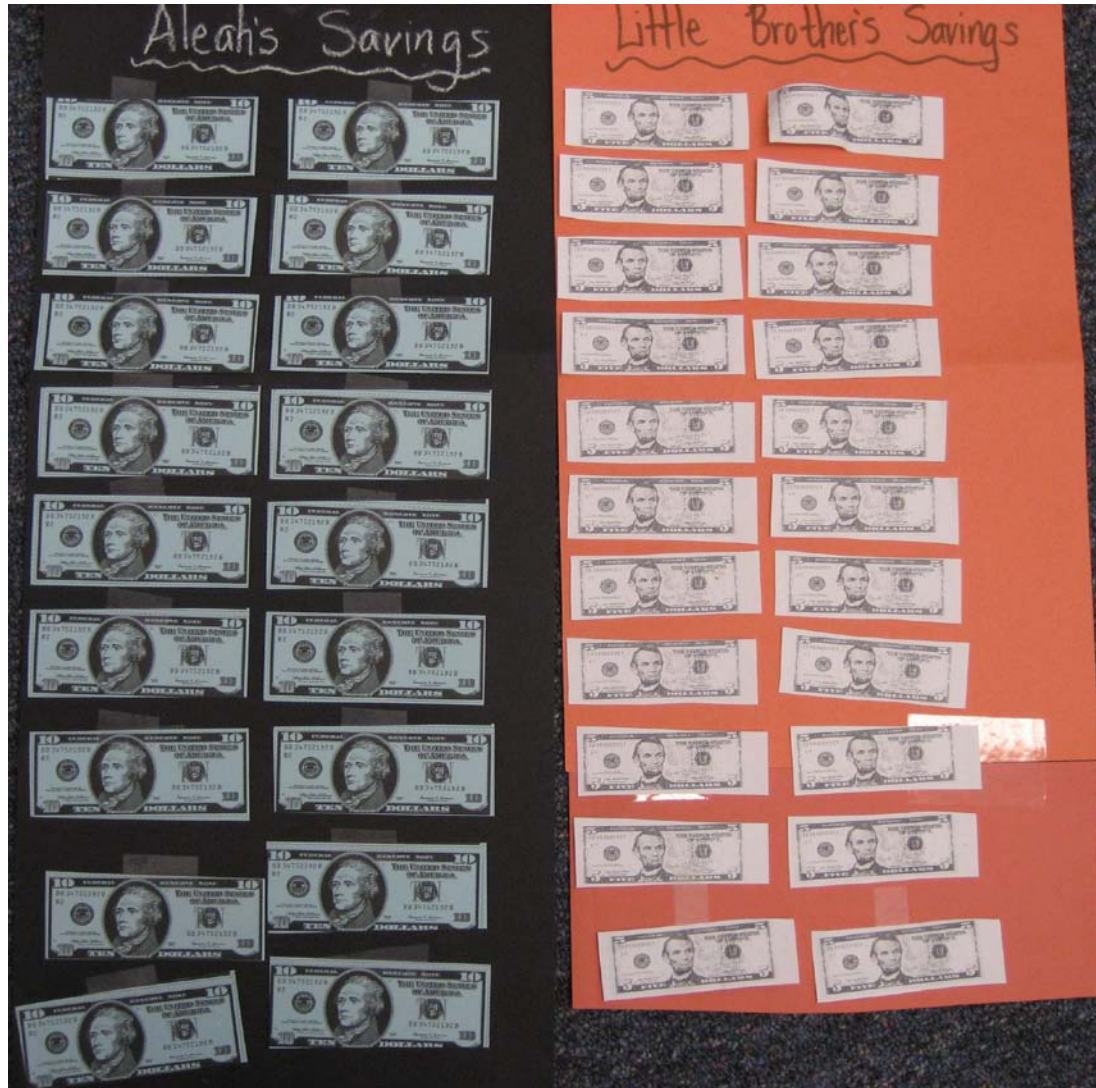
# Concrete Method
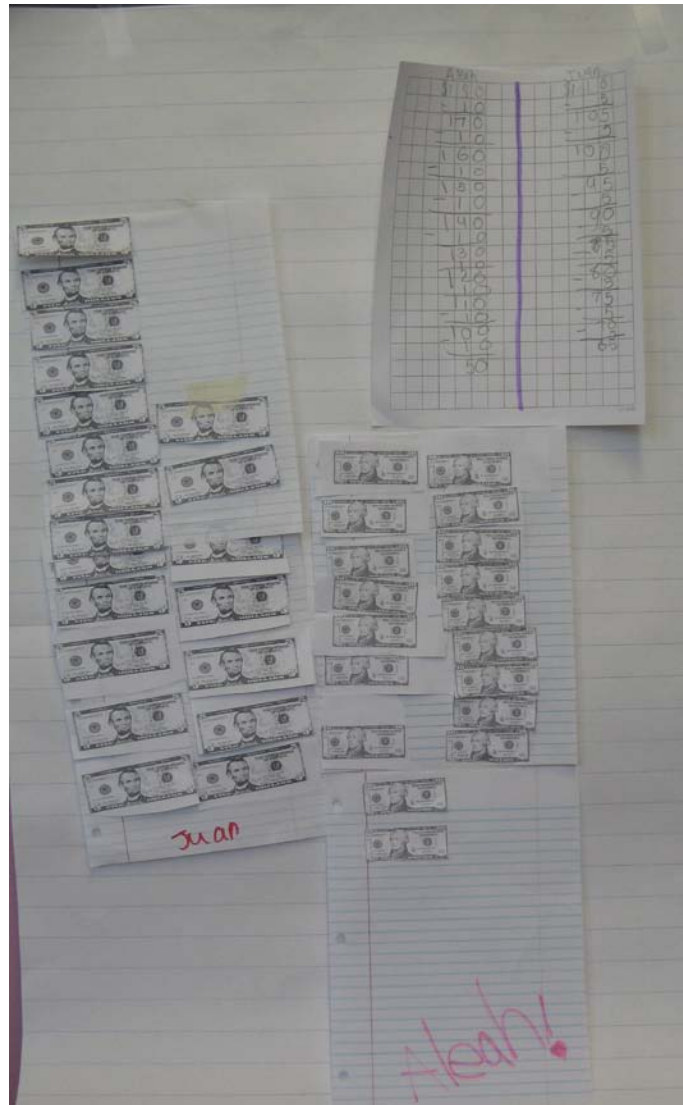


Subtracting Using Manipulatives

# Concrete Method



Repeated Subtraction Method

# Pictorial Method

# Table Method



| Friday | Walmart Aleah | Juan |
|---|---|---|
| 1 | 170 | 105 |
| 2 | 160 | 100 |
| 3 | 150 | 95 |
| 4 | 140 | 90 |
| 5 | 130 | 85 |
| 6 | 120 | 80 |
| 7 | 110 | 75 |
| 8 | 100 | 70 |
| 9 | 90 | 65 |
| 10 | 80 | 60 |
| 11 | 70 | 55 |
| 12 | 60 | 50 |
| 13 | 50 | 45 |
| 14 | 40 | 40 |
| (15) | 30 | 35 |

# Graphing Method



1-centimeter Grid Paper
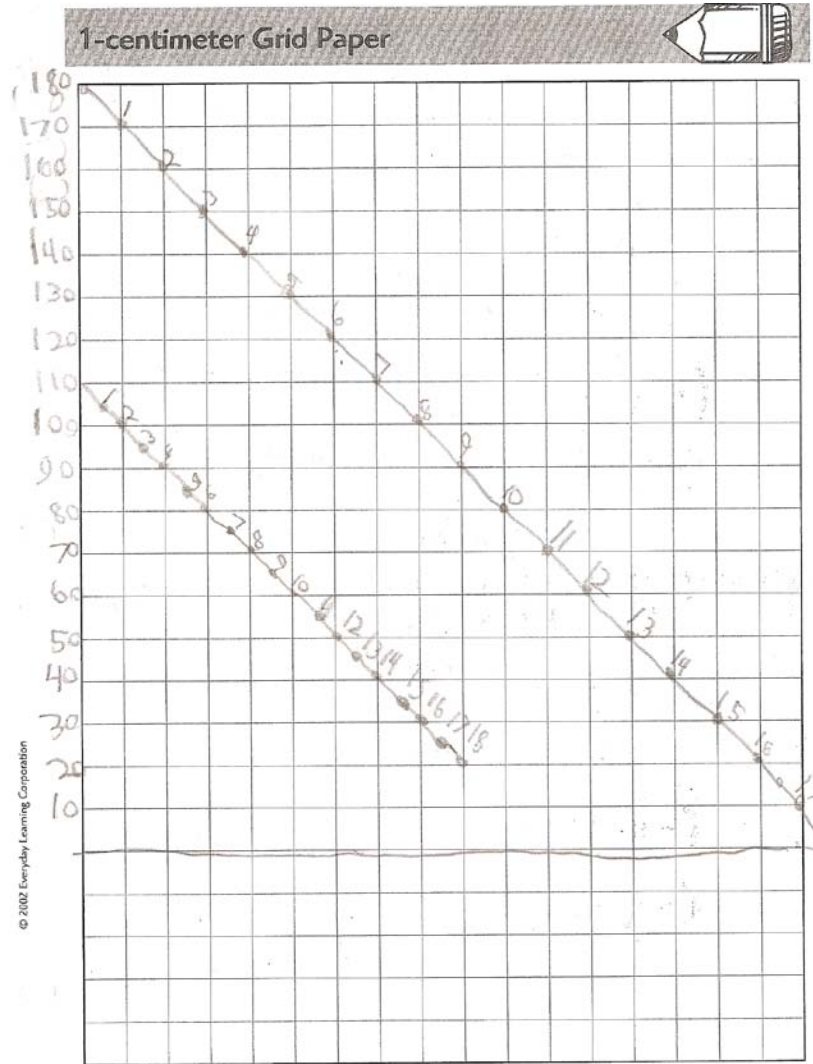
Use with Lesson 1.6.

# Similarities between Concrete and Graphing Methods

Compare and Contrast your way of solving Aleah's Problem
with a different method that you have seen used today.
What is unique about both of the methods?
What is similar about them?
Fill out this Venn Diagram with your ideas.

- Drawing pictures
- Keeping talleys
- listing

- using money ($10-$5)
- Little brother had more money

- cuting out the money
- useing graph paper
- 1

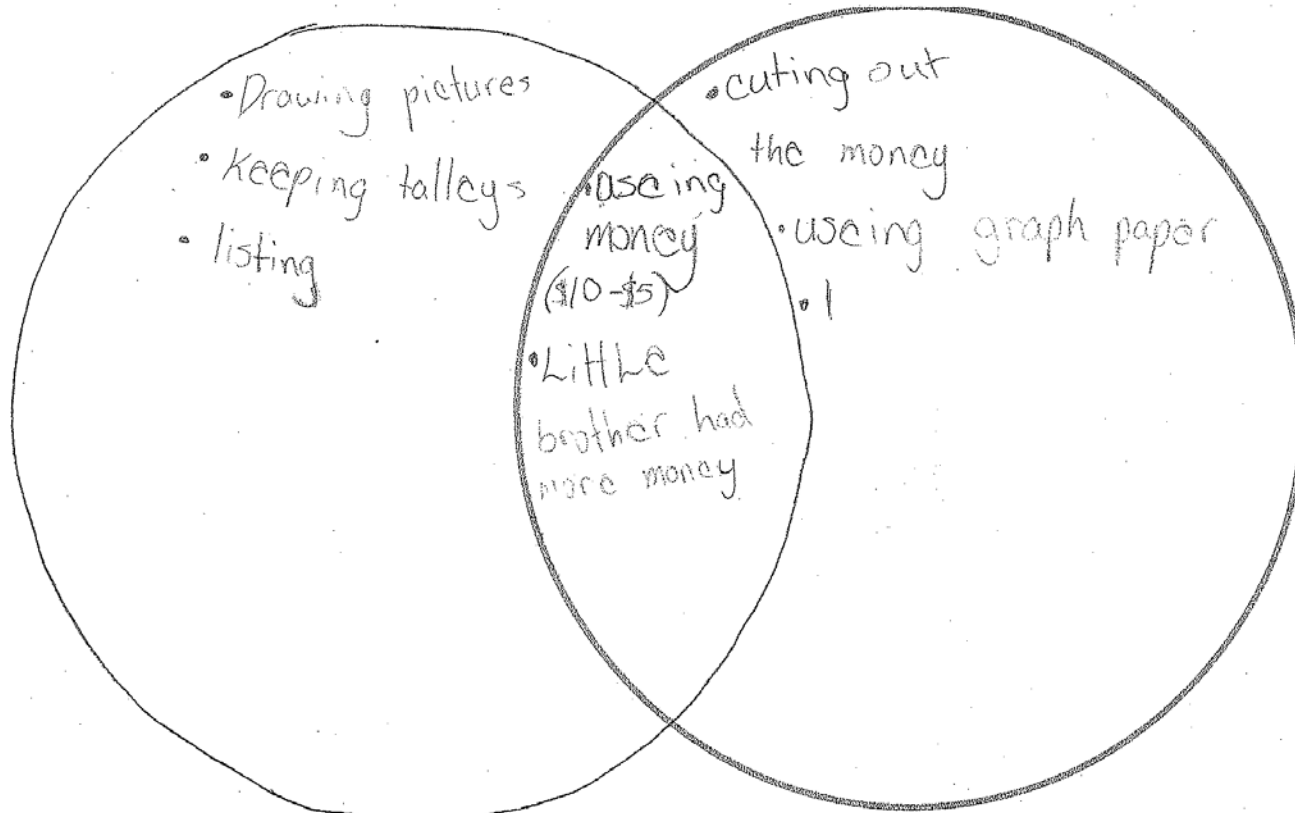Your Way of Solving Aleah's Problem          Another Way of Solving Aleah's Problem
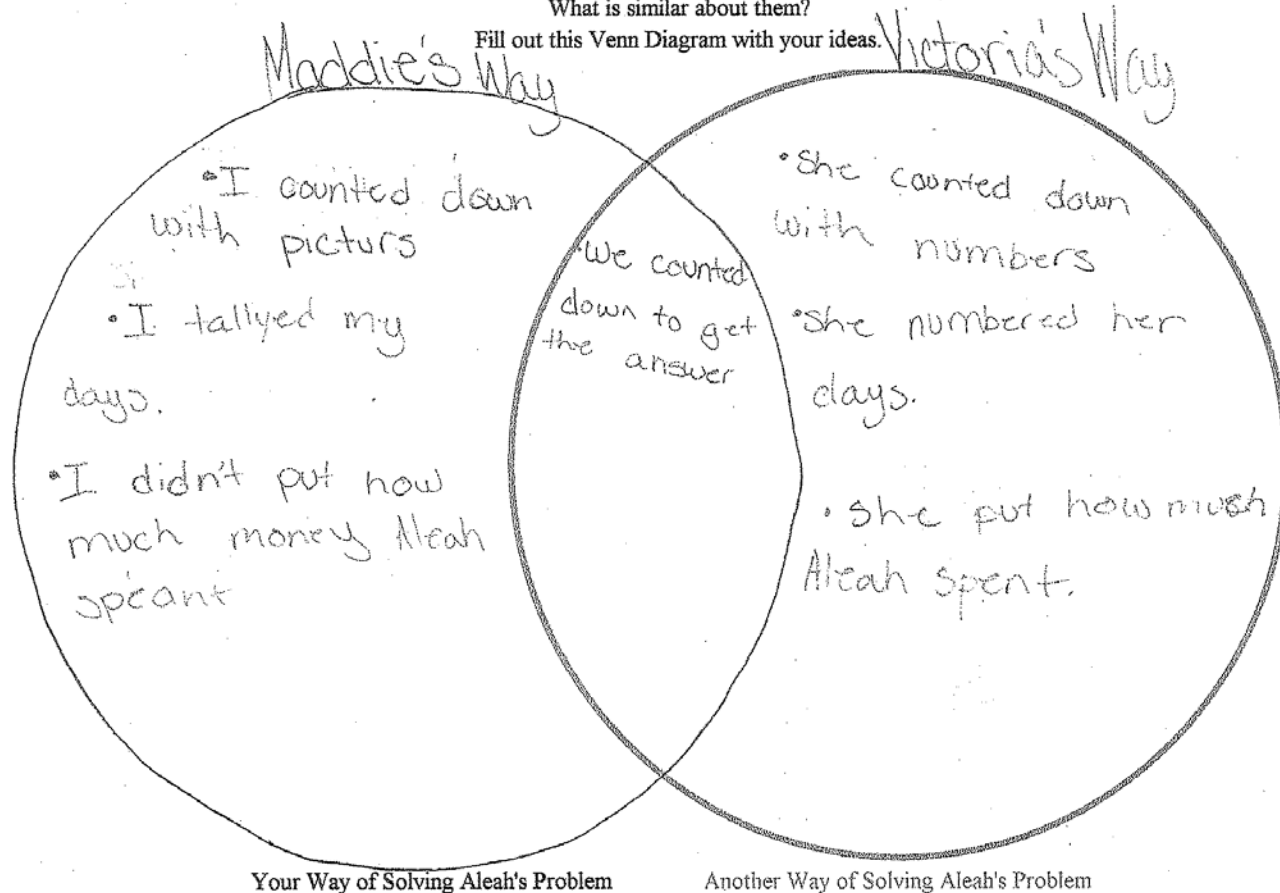
# Comparing Concrete and Pictorial Methods

Compare and Contrast your way of solving Aleah's Problem
with a different method that you have seen used today.
What is unique about both of the methods?
What is similar about them?
Fill out this Venn Diagram with your ideas.

Maddie's Way

Victoria's Way

- I counted down with picturs
- I tallyed my days.
- I didn't put how much money Aleah speant

- We counted down to get the answer

- She counted down with numbers
- She numbered her days.
- she put how much Aleah spent.

Your Way of Solving Aleah's Problem

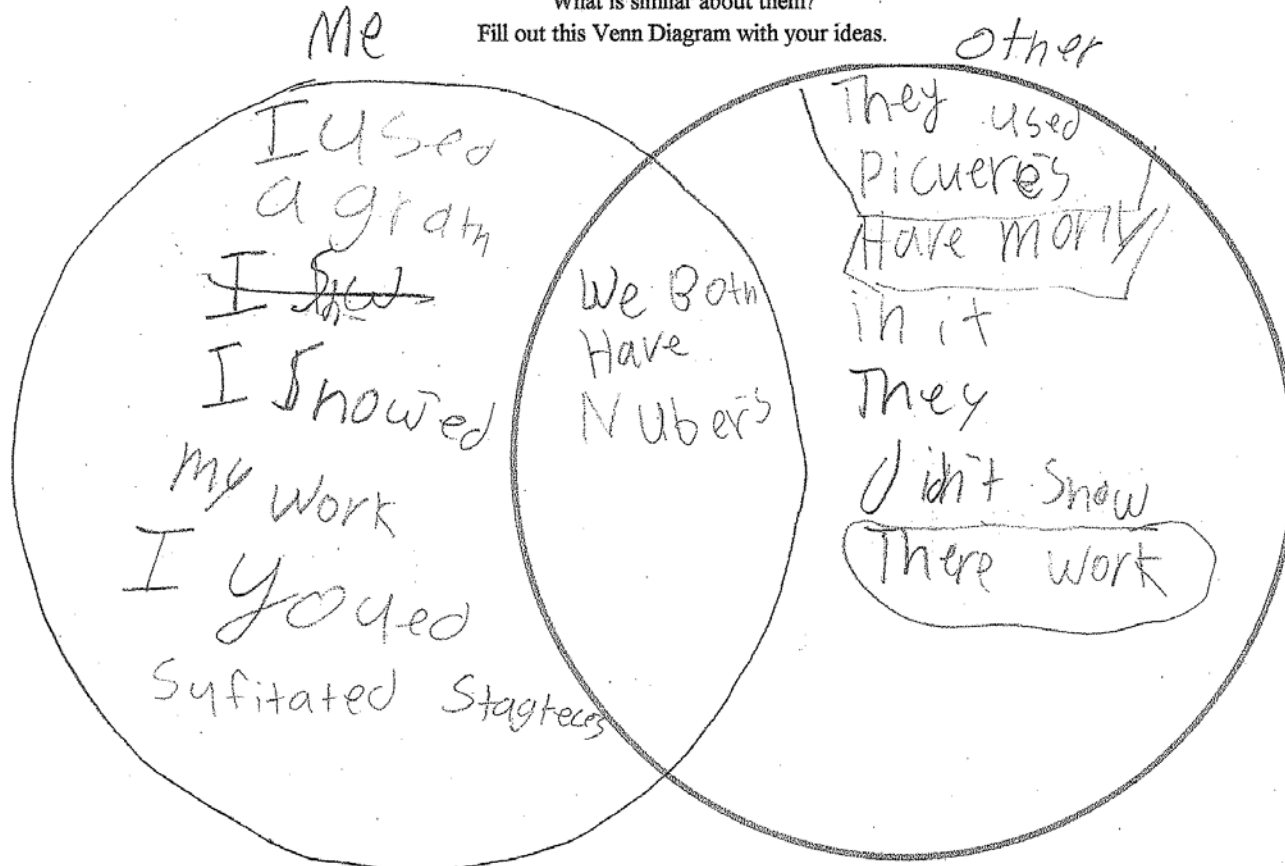Another Way of Solving Aleah's Problem

# Comparing Graphing to Pictorial Methods



Compare and Contrast your way of solving Aleah's Problem
with a different method that you have seen used today.
What is unique about both of the methods?
What is similar about them?
Fill out this Venn Diagram with your ideas.

Me

Other

I Used a gram

I Shed

I Showed my work

I youed Syfitated Stagteces

We Both Have Nubers

They used Picueres

Have morly in it

They didn't Show There work

Your Way of Solving Aleah's Problem

Another Way of Solving Aleah's Problem

# Lesson Extensions

- **Make a spreadsheet using their graph or table.**
  - Discuss what the $170 is.
  - Are these numbers the money left in savings or the money spent?

- **For students who finish early:**
  - Give them the same problem but change up the numbers.
  - Have them study the table to discover pattern(s).
  - Explain their work in "words."

- **Using the exit cards, have them try the strategy they picked to compare to theirs.**

# Spreadsheet Extension

| Number of Fridays | Aleah's Money | Brother's Money |
|---|---|---|
| Start | 180 | 110 |
| 1 | 170 | 105 |
| 2 | 160 | 100 |
| 3 | 150 | 95 |
| 4 | 140 | 90 |
| 5 | 130 | 85 |
| 6 | 120 | 80 |
| 7 | 110 | 75 |
| 8 | 100 | 70 |
| 9 | 90 | 65 |
| 10 | 80 | 60 |
| 11 | 70 | 55 |
| 12 | 60 | 50 |
| 13 | 50 | 45 |
| 14 | 40 | 40 |
| 15 | 30 | 35 |
| 16 | 20 | 30 |
| 17 | 10 | 25 |
| 18 | 0 | 20 |
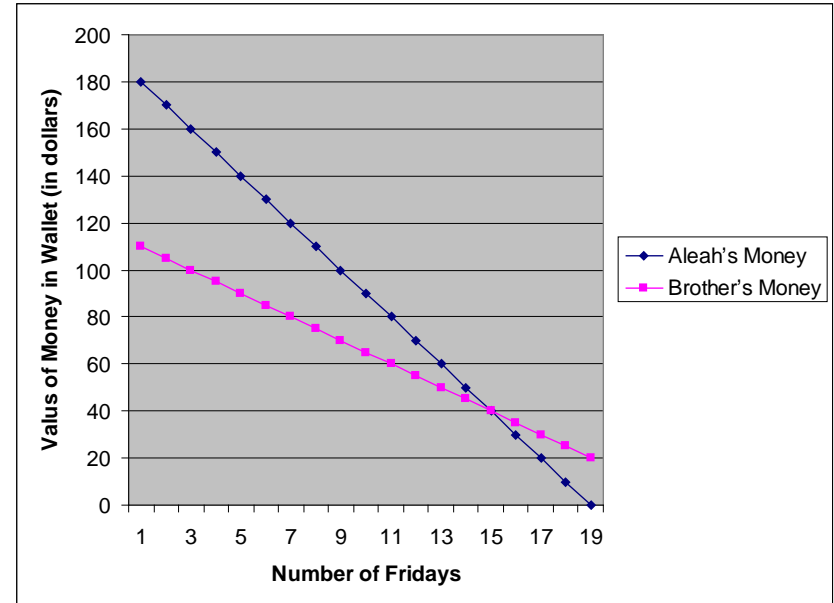
# Lesson Enhancements

- Included a pacing section

- More time for student reflection

- Changed materials

- Added to prior learning section