Teacher Instructions: Mary Quite Contrary

Grade Level: K – 2

Task: Mary Quite Contrary, How Does Your Garden Grow?

Standard: Patterns, Functions, and Algebraic Concepts

Mary was planting a flower garden.
In the first row she planted 7 flowers.
In the second row she planted 14 flowers.
If this pattern continues, how many flowers would she plant in the 10^{th} row?
If this pattern continues, how many flowers would she plant in the 100^{th} row?
Can you figure out a rule for finding the number of flowers in any row?

Teacher Note: A Revised Version of this task has been provided for kindergarten/first grade students.

Context – From the Author: This problem was written after a study of patterns had occurred with the children. Many of the first and second graders who engaged in this task were involved in a garden growing project. This is where the idea for this problem came in. Students had also been introduced to representing math rules using algebraic notation.

What the task accomplishes…

- The task provided an opportunity for students to work with patterns and to identify a pattern algebraically.
- It also allowed students with less skills and confidence with algebra to solve the problem using multiplication or repeated addition.

What students will do…

- Most of the students who engaged in this task began by getting out manipulatives such as color tiles and built the actual rows. They would place seven tiles in one row, then 14 in another. Some of the children did 7 tiles in the first row, 7 in the second and so on. From that simple observation, the teacher could clearly see who understood the problem or better yet, how each person was interpreting the problem. From the tiles, the students transferred the data to tables and charts to identify and name the pattern.

Time Required: Less than 1 hour

Interdisciplinary Links: Of course, science links here nicely. The whole concept of planting and growing things is so exciting for children. The problem could be integrated into any kind of growing project with a few minor adaptations. For example, if the class was growing tulips, tulips could become the flower planted.

Teaching Tips…

- Allow the children time to work with the manipulatives. This will allow for students to better visualize the pattern.
- It may also be necessary to provide some students with a chart that they have to fill in, which will get them started and model this type of problem solving strategy.

- To make the problem more challenging, you could ask the students to determine the total number of flowers Mary would need to complete her project.

Suggested Materials: Color tiles or other manipulatives that can be placed in rows and counted, and calculators for those who need them.

Possible Solution…
The 10th row would require 70 flowers
The 100th row would require 700 flowers
The pattern is: n x 7 or multiply the rows by 7 each time

Kindergarten Version:
The 5^{th} row would require 25 flowers
The 10^{th} row would require 50 flowers
The pattern is: n X 5 or multiply the rows by 5 each time

Benchmark Descriptors:
- The benchmark descriptors and rubric are designed to help the teacher analyze student thinking and understanding at each of the four performance levels.
- The descriptors are generalizations of what student work could look like.
- It is not possible to anticipate every answer a student can give, so in scoring student work the teacher must use these generalizations to come to their own conclusions as to where a student is performing on the assessment.
- It is recommended that teachers create their own task specific rubric by listing the specific math skills that would make up each section of the four performance levels.

Teacher Note: There are no benchmark descriptors or papers available for the Revised Version of the kindergarten/first grade task.

Novice
- ✓ The student work at this level shows rudimentary understanding of the problem.
- ✓ The student may simply interpret the pattern as row 1 = 7, row 2 = 14, row 3 = 7, row 4 = 14, etc. Or, this student may not be able to extend the pattern to 10 rows.
- ✓ The representation may be very weak and sketchy, lacking labels to help the reader understand what the child is trying to show.

Apprentice
- ✓ The apprentice shows some understanding of the problem, and the student has some correct work.
- ✓ The student's work lacks labels and organization.
- ✓ Parts of the student's solution show good reasoning, but there are some gaps.
- ✓ The student uses basic math language and representation to communicate.

Practitioner
- ✓ This work shows complete understanding of the problem.
- ✓ The student is able to achieve correct solutions for rows 10 and 100.
- ✓ The student uses appropriate math language and representation to communicate the solution.

Expert

- ✓ The expert will have an in-depth understanding of the task, and will achieve correct solutions for rows 10 and 100.
- ✓ Expert math representations will be very detailed, and experts will use sophisticated mathematical language including algebraic notation.
- ✓ The expert will find a rule for finding the flowers for any row, and will make other mathematically relevant observations, such as finding the total number of flowers needed.

APS Mathematical Standards…

- ❖ **The math standards stated for this task are aligned to the APS Draft Standards 2000.**

Number Sense and Operations: Learners will demonstrate number sense through experiences with meaningful mathematical problems while focusing on number meaning, number relationships, relative effects of operations, and multiple representations to communicate sound mathematical thinking.

Kindergarten:

Number Operations: Model addition and subtraction situations

- **Record** numerical information.

First Grade:

Number Relationships: Increase the number of objects in groups and sets to understand the relationship of quantities.

- **Build** combinations of numbers to 20 in different ways using pictures, stories, and objects to model the combinations.

Operations: Model and record addition and subtraction in a variety of ways.

- **Develop** strategies and estimation skills for solving addition and subtraction problems.
- **Record** strategies for solving, combining, and separating problems using pictures, numbers, equations and words.

Second Grade:

Number Meaning: Extend and model number names with quantities to 100.

- **Develop** fluency and **apply** patterns in skip counting.

Number Relationships: Demonstrate fluent and flexible use of numbers.

- **Identify** number sequences.

Operations: Model, solve, and record solutions to addition and subtraction problems using a variety of strategies.

- **Invent, present, defend, develop, and record** multiple strategies to solve addition and subtraction problems.

Patterns, Functions, and Algebraic Concepts: Learners will demonstrate an understanding of algebraic concepts through experiences with meaningful mathematical problems while focusing on discovering, describing, modeling and generalizing patterns and functions, representing and analyzing relationships, and finding and supporting solutions.

Kindergarten:

Patterns: Demonstrate effective skills to establish an understanding of the predictability and reliability of recurring patterns.

- **Identify, describe, and extend** patterns with familiar objects in both classroom and real-life situations.
- **Create, describe, and extend** patterns.

First Grade:

Patterns: Extend patterning skills that establish a sense of predictability and reliability to more complex patterns.

- **Identify, describe, and extend** patterns with familiar objects in real-life situations.
- **Describe** how a pattern develops, repeats, and builds toward more complex patterns.

Second Grade:

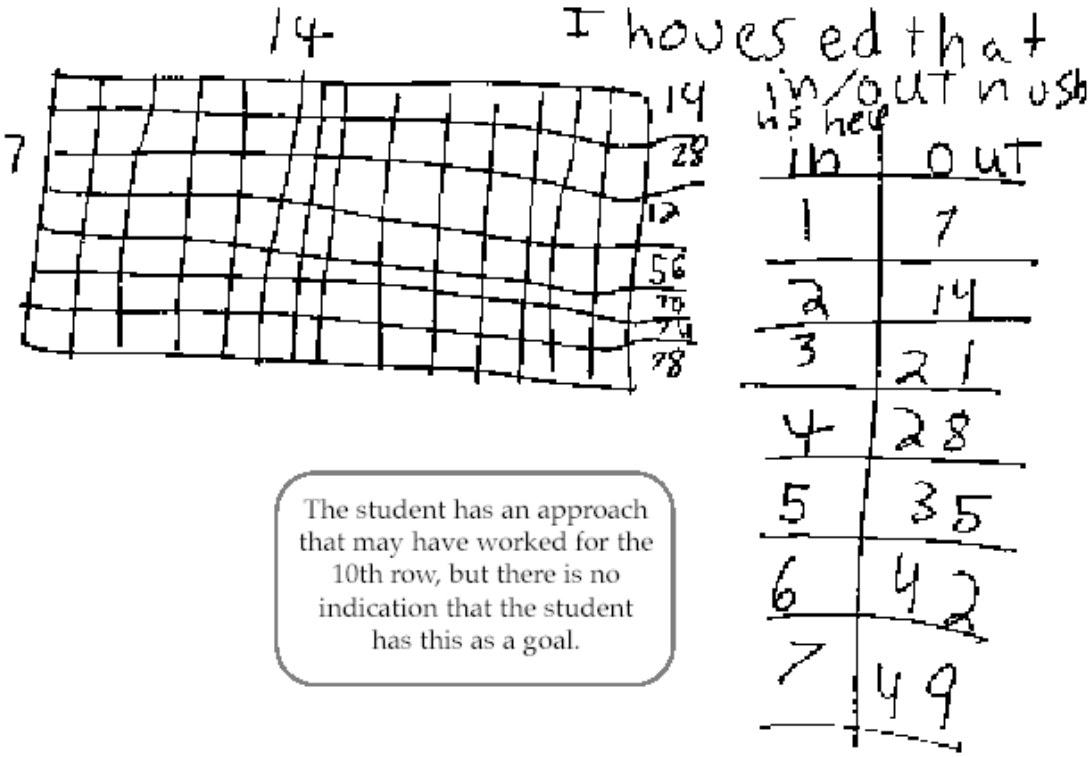
Patterns: Extend patterning skills to include numerical patterns and problem solving, focusing on the predictability and reliability that patterns allow.

- **Identify** patterns in the number system.
- **Develop and apply** more complex patterns and relationships in real-life and math problem situations.
- **Recognize, describe, extend, and create** a wide variety of patterns.

Benchmark Papers

Novice

It is unclear what this diagram represents.



The student has an approach that may have worked for the 10th row, but there is no indication that the student has this as a goal.

Little or no math language is used.

Apprentice

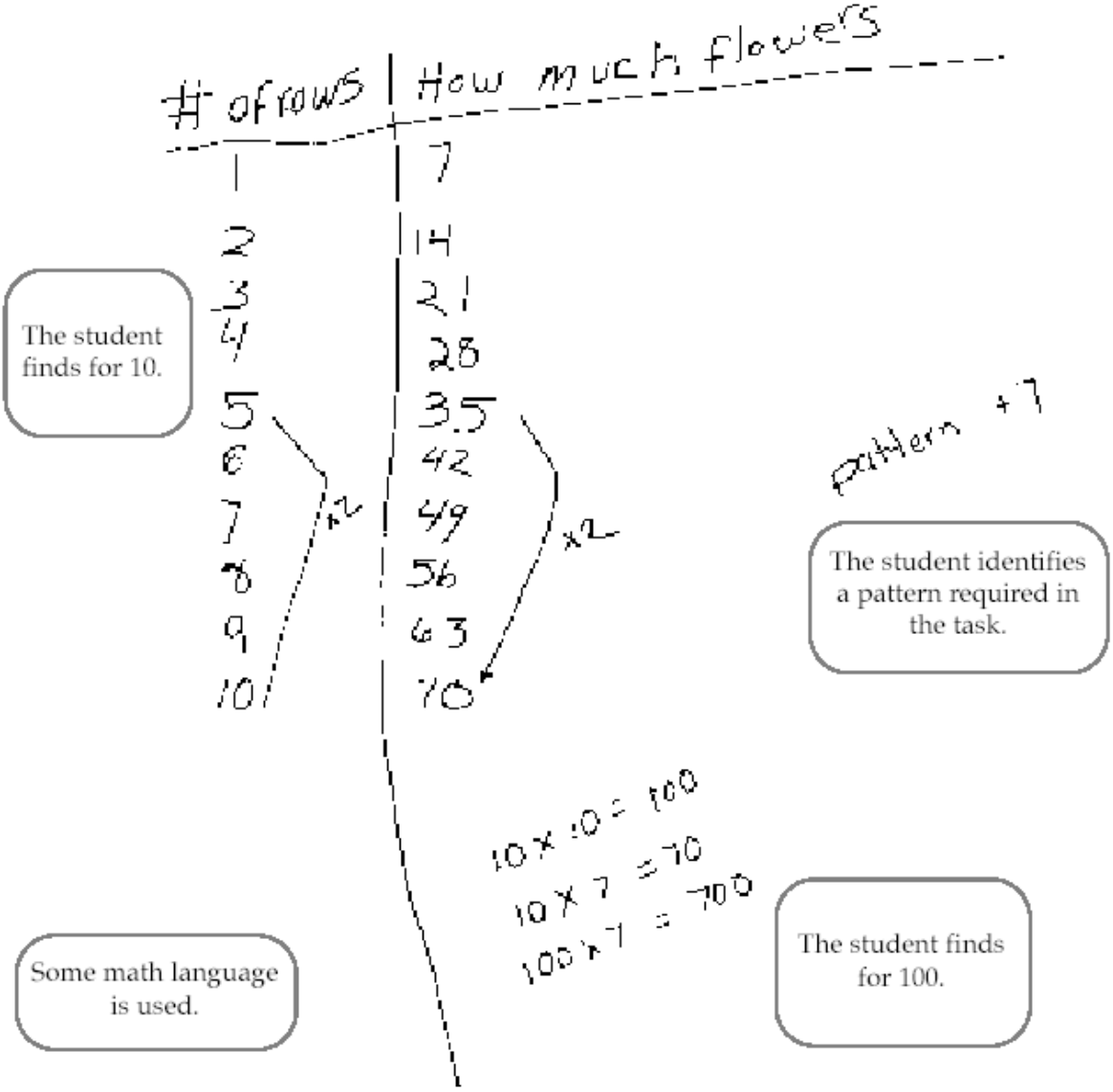
The student lacks documentation to support her/his solution. The answers seem to appear from no where.

The student finds a rule but she doesn't seem to know it will work for any number.

It is not clear what this diagram with its shading represents.

Some math language is used.

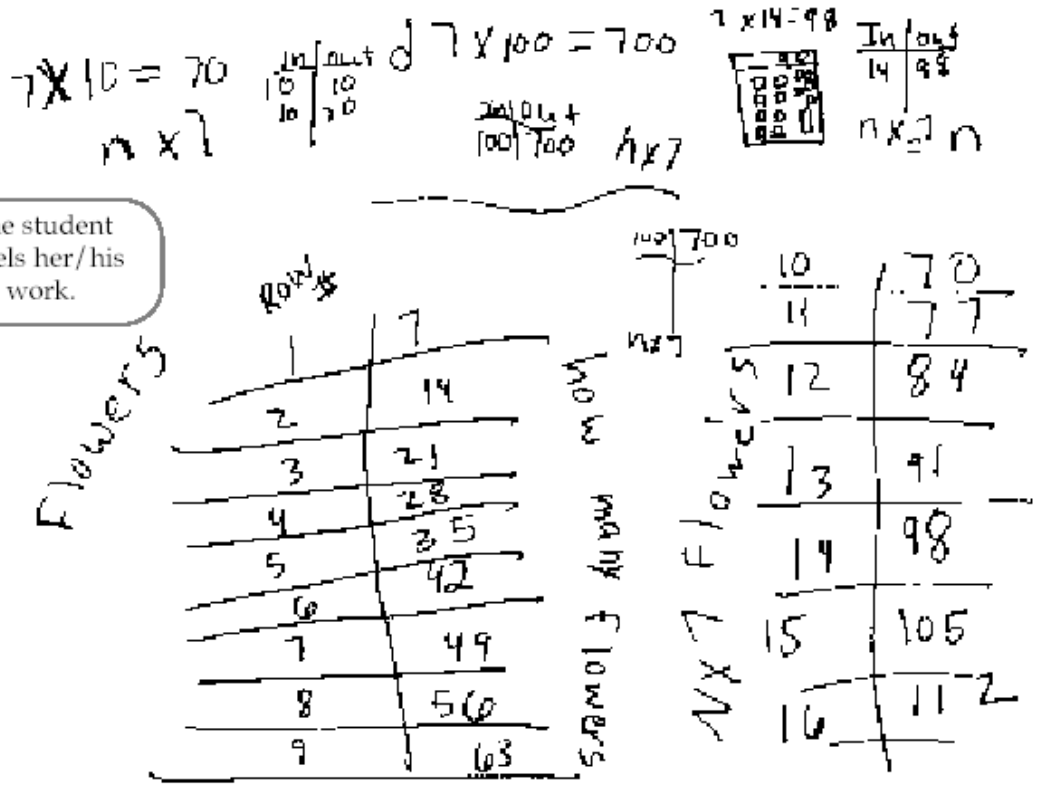
Practitioner



Expert

The student finds for 10.

The student finds for 100.

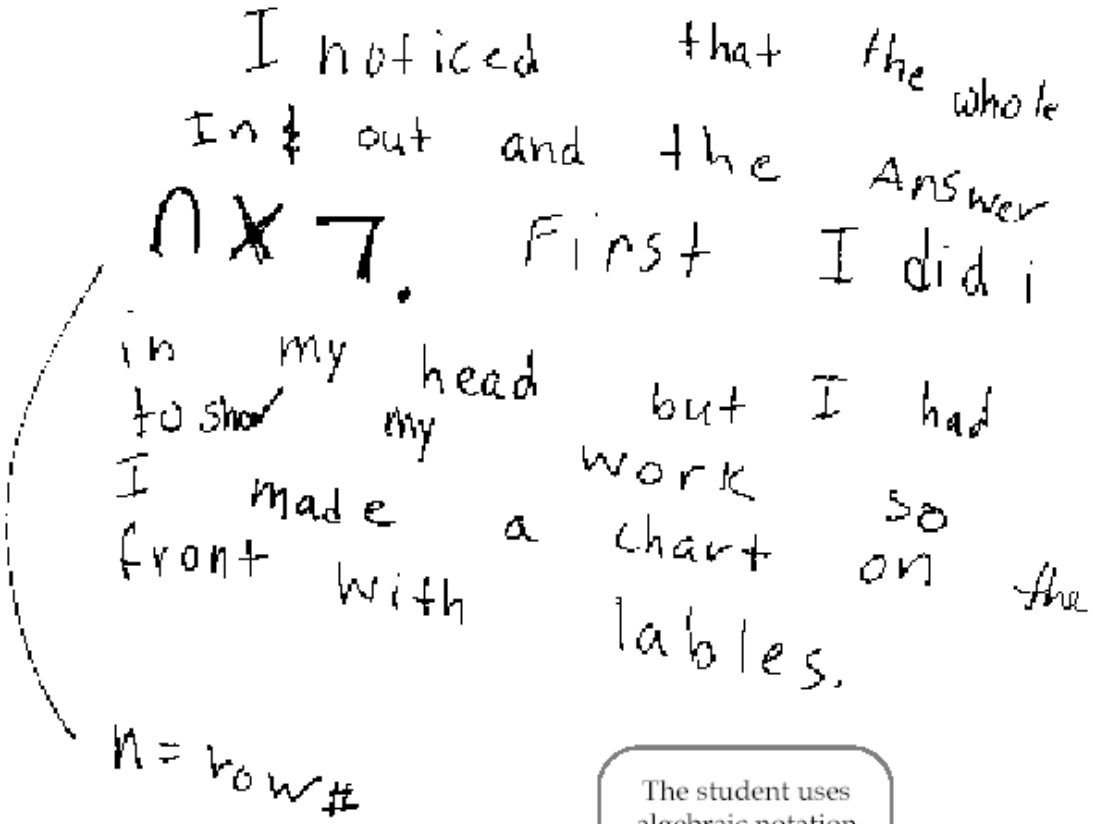


The student labels her/his work.

Representations are accurate.

The student finds for any number.

Expert



The student uses algebraic notation with defined variables.