Scaffolding/Constructing Task: Patterns-R-Us

In this task, students are asked to identify, describe, and explain any patterns they notice when multiplying or dividing numbers by 1000, 100, 10, 0.1, and 0.01.

STANDARDS FOR MATHEMATICAL CONTENT

Understand the place value system.

MCC5.NBT.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

Perform operations with multi-digit whole numbers and with decimals to the hundredths.

MCC5.NBT.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students should develop an understanding that when a number is multiplied by a number less than 1, the product is less than the original number, and when a number is divided by a decimal number less than 1, the quotient will be greater than the dividend. This is important, yet often difficult for students to understand because it is counterintuitive based on students' previous experiences with multiplication and division.

Calculators are optional for this investigation. However, students will be more likely to explore a variety of numbers and be able to recognize patterns more efficiently with the use of a calculator. Require students to record what they put into the calculator and the result. If students could benefit from some practice with multiplication and/or division, require them to solve the problems in part one without a calculator and allow students to use a calculator for the rest of the task.

COMMON MISCONCEPTIONS

- *Multiplication can increase or decrease a number*. From previous work with computing whole numbers, students understand that the product of multiplication is greater than the factors. However, multiplication can have a reducing effect when multiplying a positive number by a decimal less than one or multiplying two decimal numbers together. We need to put the term *multiplying* into a context with which we can identify and which will then make the situation meaningful. Also, using the terms *times* and *groups of* interchangeably can assist with the contextual understanding.

ESSENTIAL QUESTIONS

- What happens when we multiply decimals by powers of 10?
- How do the rules of multiplying whole numbers relate to multiplying decimals?

MATERIALS

- "Patterns-R-Us" recording sheet
- Calculators

GROUPING

Small group task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Comments: This task is designed to serve as a discovery opportunity for the students. Students should notice that a pattern is created when a number is multiplied or divided by a power of 10. While students may notice patterns in each individual part of the task, encourage them to look for a pattern when considering the overall task. Students should be able to explain and defend their solutions through multiple representations. For example, students should try several numbers for each part to verify that each number follows the same pattern. This activity lends itself to working in pairs for reinforcement.
An introduction for this task could be a round of "What's My Rule?" The rule could be x1000, x100, x10, x0.1, or x0.01. Also, the rule could be ÷1000, ÷100, ÷10, ÷0.1, or ÷0.01.

TASK

Students will follow the directions below from the "Patterns-R-Us" Recording Sheet.

A statistician is interested in finding out what pattern is created, if any, under certain situations. Your mission is to help come up with concrete rules for certain mathematical situations. Record all of your work and explain your thinking in order to defend your answer. Good luck!

Part 1

1. Start with any whole number, for example 18.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?

Part 2

1. Pick any decimal as your number, for example 12.3.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?

Part 3

1. Start with any whole number, for example 18.
2. Divide that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you divided your number by 1,000,000? 0.00001?

Part 4

1. Pick any decimal as your number, for example 10.8.
2. Predict what will happen when you divide that number by 1000, 100, 10, 0.1, and 0.01.
3. After working out the problem, is your prediction correct? Why or why not?
4. Is there a similar pattern that you recognize?

FORMATIVE ASSESSMENT QUESTIONS

- How did you get your answer?
- How do you know your answer is correct?
- What would happen if you started with a different number?
- What patterns are you noticing?
- Can you predict what would come next in the pattern?

DIFFERENTIATION

Extension

- Have students multiply a number by 0.1. Now ask them to divide that same number by 10. What happened? Repeat this with several numbers. Can a conjecture be made based on the results? Have students write their conjecture. Now, share their conjecture with a

partner. Are the two conjectures the same? (You may also use 0.01 and 100 as another example.)

Intervention

- Pair students who may need additional time so that they will have time needed to process this task.

Name_____ Date_____

Patterns-R-Us

A statistician is interested in finding out what pattern is created, if any, under certain situations. Your mission is to help come up with concrete rules for certain mathematical situations. Record all of your work and explain your thinking in order to defend your answer. Good luck!

PART ONE

1. Start with any whole number, for example 18.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?

PART TWO

1. Pick any decimal as your number, for example 12.3.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?

PART THREE

1. Start with any whole number, for example 18.
2. Divide that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you divided your number by 1,000,000? 0.00001?

PART FOUR

1. Pick any decimal as your number, for example 10.8.
2. Predict what will happen when you divide that number by 1000, 100, 10, 0.1, and 0.01.
3. After working out the problem, is your prediction correct? Why or Why Not?
4. Is there a similar pattern that you recognize?