Performance Based Learning and Assessment Task

Translating and Evaluating Cell Phone Plans

I. ASSESSMENT TASK OVERVIEW & PURPOSE:
This task requires students to translate verbal expressions describing cell phone plans into algebraic expressions and evaluate these expressions to determine the most cost-effective plan.

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III. COURSE: Algebra I

IV. CONTENT STRAND:
Expressions and Operations

V. OBJECTIVES:
Students will be able to translate verbal expressions into algebraic expressions and evaluate these expressions for given values in the context of a real-world situation.

VI. REFERENCE/RESOURCE MATERIALS:
Copies of the Graphic Organizer (adapted from the VDOE ESS Lesson "Translate and Evaluate")
Copies of the "Mathematical Translations Matching" activity sheet (from the VDOE ESS Lesson "Translate and Evaluate")
Copies of the "Translating and Evaluating Cell Phone Plans" assessment task
Calculators
Computers with Internet access
Glue or tape
Colored paper

VII. PRIMARY ASSESSMENT STRATEGIES:
Students will use the assessment list as a tool for self-assessment on several criteria including mathematical accuracy, quality of explanations, and neatness. The teacher will use the assessment list as a rubric to assess student work.

VIII. EVALUATION CRITERIA:
The assessment list, which includes a student self-assessment, the teacher rubric, and a benchmark of exemplary student work for the activity are attached.

IX. INSTRUCTIONAL TIME:
One 90-minute block or two 45-minute periods

Translating and Evaluating Cell Phone Plans

Strand
Algebra (Expressions and Operations)

Mathematical Goals and Objective(s)
Students will be able to translate verbal expressions into algebraic expressions and evaluate these expressions for given values in the context of a real-world situation.

Related SOL
- A.1 (represent verbal quantitative situations algebraically and evaluate these expressions for given replacement values)

NCTM Standards
- Use symbolic algebra to represent and explain mathematical relationships
- Apply and adapt a variety of appropriate strategies to solve problems
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others

Materials/Resources
- Copies of the Graphic Organizer (adapted from the VDOE ESS Lesson "Translate and Evaluate")
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Assumption of Prior Knowledge
- Prior to attempting this task, students should be familiar with variables and algebraic expressions. They should be familiar with words and phrases that represent the four operations of addition, subtraction, multiplication, and division, as well as words representing repeated multiplication such as "squared" and "cubed." Students should be able to translate verbal expressions into algebraic expressions and use the order of operations to evaluate these expressions for given values of the variables.
- Students may have misconceptions about the phrase "less than," not realizing that the algebraic expression must be written in a different order than the verbal expression. They may also have difficulty with the last question of the assessment task, as it is more open-ended and requires them to create their own expression that, when evaluated, must fall within a certain range.

Introduction: Setting Up the Mathematical Task
- The learning activity and assessment task are intended to take approximately one 90-minute block or two 45-minute periods.
- The teacher will introduce the task by saying, "In this task, you will translate verbal expressions describing cell phone plans into algebraic expressions and evaluate these expressions to determine the most cost-effective plan."
- Before beginning the task, students will be given a graphic organizer in which they will list words and phrases indicating each operation (addition, subtraction, multiplication, division, and exponents). Answers will be shared and discussed as a class. Students will then be placed into groups of 2 or 3 to complete the "Mathematical Translations Matching" activity. This involves cutting out squares and

matching verbal expressions with their corresponding algebraic expressions. They will glue or tape their matches to a sheet of colored paper. To practice evaluating expressions, they will use one of their ages as a replacement value for the variable in each expression and record their work on the colored paper next to the expression.

Student Exploration

Student/Teacher Actions:

- Students will work with their group members to complete the "Mathematical Translations Matching" activity. The teacher will rotate around the room, checking in with each group to answer/ask questions in order to facilitate learning. After each group completes the activity and it has been checked by the teacher, they will be instructed to evaluate each of the expressions using one of their ages in place of the variable. Answers will be shared and discussed as a class.
- As an assessment of learning, students will work individually to complete the "Translating and Evaluating Cell Phone Plans" task.
- On both the matching activity and the assessment task, students may have misconceptions about the phrase "less than," not realizing that the algebraic expression must be written in a different order than the verbal expression. To address this, the teacher could provide a simple example such as "What is 5 less than 10?" and ask students how they came up with their answer. Students may also have difficulty with the last question of the assessment task, as it is more open-ended and requires them to create their own expression that, when evaluated, must fall within a certain range. The teacher can suggest students use trial and error with their calculator until they come up with an expression that falls within the range. Students should be encouraged to think about which operations will increase/decrease the amount and by how much. Simple examples can be provided if students have difficulty with this.

Monitoring Student Responses

- Students will communicate with their group members during the matching activity, explaining their thinking as they decide how to match the expressions and how to correctly use the order of operations to evaluate them.
- The teacher will rotate amongst the groups to be sure each group is on the correct path. If a student or group is having difficulties, the teacher can ask questions to help clarify the material. This may include asking students to choose a number for the variable, working out the problem, and thinking about how they got their result. If the teacher notices that multiple groups are having trouble with the same thing, he/she may bring the class together to discuss the issue. Either the teacher can provide some guidance, or he/she can call on a student who understands it to explain his/her thinking to the class.
- Groups who finish the activity early may be challenged to create more verbal and algebraic expressions using other terms (for example, "cubed," "square root," "cube root," or "absolute value"). They can also be asked to evaluate the given expressions and/or the ones they created for a negative value of the variable.
- When all groups have completed the activity, the teacher will bring the class together to discuss their results. Student volunteers from each group will be given the opportunity to share their group's results with the class.
- Students will be required to explain their thinking as they complete the "Translating and Evaluating Cell Phone Plans" assessment task. Again, the teacher will rotate around the room to assist students having difficulty. Students who finish early may be challenged to create more verbal and algebraic expressions for the last questions using other terms not listed.

Assessment List and Benchmarks

- The assessment list, which includes a student self-assessment, the teacher rubric, and a benchmark of exemplary student work for the activity are attached.

Sample Graphic Organizer for Mathematical Operations and Symbols

Addition (+)	Subtraction (-)	Multiplication (x)	Division (÷)	Exponents

Mathematical Translations Matching

five more than a number	$n + 6$	$n - 6$	the square of three less than six times a number
twice a number diminished by five	Two third of a number is decreased by 11	five times the sum of *n* and seven	$n + 5$
$\dfrac{50}{n+5}$	six less than a number	the quotient of fifty and five more than a number	$3n - 8$
seven more than one half a number	$5(n + 7)$	$2n - 5$	$(6n - 3)^2$
$\dfrac{1}{2}n + 7$	three times a number minus eight	the sum of six and a number	$\dfrac{2}{3}n - 11$

Performance Based Assessment: Translating and Evaluating Cell Phone Plans

1. You want to get a cell phone plan including unlimited data, texting, and calls for your first phone you are going to purchase this summer from Best Buy. Go to the Best Buy website and find a cell phone you would want to buy and record the price and type. All of the plans at Best Buy have a base service charge of $45 per month plus the cost of the phone. Write an expression to represent the service charge.

2. There are three unlimited plans Best Buy offers and each plan incorporates the service charge. Translate each plan into an algebraic expression using the service charge expression from the above question.

Plan 1: $10 less than twice the amount of the service charge.

Plan 2: The quotient of the service charge and 2 increased by a fee of $60 per month.

Plan 3: The sum of half the number of months cubed and a third of the service charge.

3. Which plan would be most cost effective for a 2-year contract? Show all calculations that led to your results. Explain your results comparing the 3 plans.

4. Best Buy is having a special promotion by challenging customers to create their own plan. Customers must write a verbal expression that must include the service charge and at least two operations. The operations to choose from are listed below. If the plan is within $10 per month of one of the original 3 plans then the customer could choose that plan. Create a 4th plan and show all calculations that led to your results.

Operations: product, more than, less than, double, sum, divided by, square

Addition (+)	Subtraction (-)	Multiplication (x)	Division (÷)	Exponents
SUM INCREASE PLUS ADD MORE THAN TOTAL	DIFFERENCE DECREASE MINUS SUBTRACT LESS THAN	PRODUCT TIMES MULTIPLIED	QUOTIENT DIVIDE RATIO	TO THE POWER OF _____ SQUARE CUBED

| three times a number minus eight | $3n - 8$ |

age 15

$3(15) - 8$
$45 - 8 = 37$

| six less than a number | $n - 6$ |

$15 - 6 = 9$

| the sum of six and a number | $n + 6$ |

$15 + 6 = 21$

| the quotient of fifty and five more than a number | $\dfrac{50}{n+5}$ |

$\dfrac{50}{15+5} = \dfrac{50}{20} = \dfrac{5}{2}$

| five more than a number | $n + 5$ |

$15 + 5 = 20$

| seven more than one half a number | $\dfrac{1}{2}n + 7$ |

$\frac{1}{2}(15) + 7$
$7.5 + 7 = 14.5$

or $\dfrac{15}{2} + 7 = \dfrac{29}{2}$

Two third of a number is decreased by 11	$\frac{2}{3}n - 11$

$\frac{2}{3}(15) - 11$

$10 - 11 = -1$

the square of three less than six times a number	$(6n - 3)^2$

$(6(15) - 3)^2$
$(90 - 3)^2$
$(87)^2 = 7569$

twice a number diminished by five	$2n - 5$

$2(15) - 5$
$30 - 5 = 25$

five times the sum of n and seven	$5(n + 7)$

$5(15 + 7)$
$5(22) = 110$

Performance Based Assessment: Translating and Evaluating Cell Phone Plans

1. You want to get a cell phone plan including unlimited data, texting, and calls for your first phone that you are going to purchase this summer from Best Buy. Go to the Best Buy and find a cell phone you would want to buy and record the price and type. Round the cost to the nearest dollar. All of the plans at Best Buy have a base service charge of $45 per month plus the cost of the phone. Write an expression to represent the service charge.

Cell phone type: Samsung Galaxy Express 3 4G LTE

Cost: $80
Setup fee: 45m + 80

2. There are three unlimited plans that Best Buy offers and each plan incorporates the service charge. Translate each plan into an algebraic expression using the service charge expression from the above question.

Plan 1: $10 less than twice the amount of the service charge.

$$2(45m+80) - 10$$

Plan 2: The quotient of the service charge and 2 increased by fee of $60 per month.

$$(45m + 80)/2 + 60m$$

Plan 3: The sum of half the number of months cubed and a third of the service charge.

$$(\frac{1}{2}m)^3 + \frac{1}{3}(45m + 80)$$

3. Which plan would be most cost effective for a 2-year contract? Show all calculations that led to your results. Explain your results comparing the 3 plans.

Plan 1: 2(45 * 24+80) – 10   = $2310

Plan 2: (45 * 24 + 80)/2 + 60(24)   = $2020

Plan 3: $(\frac{1}{2}m)^3 + \frac{1}{3}(45m + 80)$ = $2,114.67

Plan 2 would be the most cost effective plan because it is the one that cost the least for two years.

4. Best Buy is having a special promotion by challenging customers to create their own plan. Customers must write a verbal expression that must include the service charge and at least two operations. The operations to choose from are listed below. If the plan is within $10 per month of one of the original 3 plans then the customer could choose that plan. Create a 4th plan and show all calculations that led to your results.

Operations: product, more than, less than, double, sum, divided by, square

The product of 5 and the setup fee divided by 3.

5(45m + 80)/3

5(45*24 + 80) /3 = $1933.33

Plan 2: $2020/24 = $84.17 per month

Plan 4: $1933.33/24 = $80.56 per month

Element	Assessment points		
	Points Possible	Earned Assessment	
		Self	Teacher
1. Cell phone type, price and expression to represent the service charge.	3		
2. Setup an expression for the 3 plans.	3		
3a. Calculations for the most cost effective plan	3		
3b. Explanation with complete sentences.	3		
4a. Setup an expression with at least two of the given operations representing a 4th plan.	3		
4b. Calculations that shows that the 4th plan is within $10 per month of one of the original plans.	3		
Total points	18		

Teacher Rubric for Performance Based Assessment

#	3 points	2 points	1 point	0 points
1.	Stated the cell phone name, price and correctly wrote an algebraic expression to represent the service charge.	Stated the cell phone name, price and wrote an algebraic expression to represent the service charge.	Stated only the cell phone name and price.	Only stated the cell phone name or price.
2.	Correctly wrote an algebraic expression for the 3 plans	Correctly wrote an algebraic expression for 2 out of the 3 plans	Correctly wrote an algebraic expression for 1 out of the 3 plans	Did not set up either of the expressions correctly
3a.	If the students correctly demonstrated and calculated the cost of all 3 plans.	If the students correctly demonstrated and calculated the cost of 2 out of the 3 plans. OR Correctly demonstrated and calculated the cost of all 3 plans using the incorrect number for the months.	If the students correctly demonstrated and calculated the cost of 1 out of the 3 plans. OR Correctly demonstrated and calculated the cost of 2 out of the 3 plans using the incorrect number for the months.	If the students did not correctly calculate any of the plans.
3b.	Uses mathematical language to thoroughly explain which plan is most cost effective	Uses mathematical language to partially explain which plan is most cost effective	Does not use correct mathematical language to explain.	Uses no explanation.
4a.	Correctly setup an algebraic expression, which includes two of the given operations.	Correctly setup an algebraic expression, which includes one of the given operations.	Setup an expression but did not use the given operations.	Did not setup an expression
4b.	Correctly evaluated the expression for a 2-year contract, correctly converted to a monthly cost and demonstrated that the plan was within $10 of one of the original plans.	Evaluated the expression for a 2-year contract using the incorrect number for months, correctly converted to a monthly cost and demonstrated that the plan was within $10 of one of the original plans.	Correctly evaluated the expression for a 2-year contract and correctly converted to a monthly cost but the plan was not within $10 of one of the original plans.	Evaluated the expression for a 2-year contract