Rich Mathematical Task – Grade *8* – *The Principal's Dilemma*

Task Overview/Description/Purpose:

Given club membership data, students will determine which club has the least amount of growth in order to develop problem solving using operations with integers and rational numbers. This task is designed to deepen understanding that percent of change is measuring the percent a quantity increases or decreases. The task requires the students to determine percent of change and to also consider whether using only one criterion is appropriate to make a decision.

Standards Alignment: Strand – *Computation and Estimation*

Primary SOL: 8.4 The student will solve practical problems involving consumer applications.

Related SOL (within or across grade levels/courses): 5.6ab, 6.5bc, 6.6b, 7.2, 7.3

Learning Intention(s):

- **Content -** I am learning about percent of change (percent increase or percent decrease) and how it can be used to solve practical problems.
- **Language-** I am learning how to explain my thinking using computational evidence in my justification.
- **Social-** I am learning to engage in productive discussions with my peers about how I came to my conclusion and to hear and value other viewpoints.

Success Criteria (Evidence of Student Learning):

- I can determine the percent of change to solve a practical problem.
- I can justify my conclusion using computational findings from the given data both verbally and in writing.
- I can discuss and acknowledge the differences in our solutions to the Principal's Dilemma with my peers.

Mathematics Process Goals
Describe how students will engage in these process goals:

Problem Solving	Students will apply the concept of percent change to compare growth in a practical situation.
Communication and Reasoning	Students will identify which club the school board wishes to close and justify their choice using computational evidence. They will claim whether they agree or disagree and explain their thinking.
Connections and Representations	Students will make connections between calculating percent of changed to represent growth and how that growth is used in real-world contexts to make decisions.

Task Pre-Planning

Approximate Length/Time Frame*: 45-50 minutes*

Grouping of Students: *Setting the stage for the task should be done with the whole group. The computational part of the task should be completed independently (approximately 10-15 minutes). After this initial independent work time, the teacher should group students with similar conclusions to receive peer feedback and refine their thinking (approximately 5-10 minutes). Then the teacher should partner students who have different positions to share their*

Task Pre-Planning

viewpoints (approximately 5-10 minutes). Students should close the task by reflecting independently. Do the students still agree with their original conclusion or has it changed, explaining their thinking.

Materials and Technology:	**Vocabulary:**
• *calculators* • *task* • *pencil*	• *percent of change/increase/decrease* • *percent change* • *percent increase* • *percent decrease* • *difference* • *ratio*

Anticipate Responses*:* See Planning for Mathematical Discourse Chart (Columns 1-3)

Task Implementation (Before)

Task Launch:

- In large group facilitate setting the stage with the following questions:
  - How can you compare numbers? (Open ended)
  - How can you compare growth? Give some examples.
  - What is percent of change? (the percent of increase or decrease between two numbers)
  - When is percent of increase a positive situation? When is percent of increase a negative situation?
- Read the task together using the Three Read Protocol. (Read three times with a different focus each time. First focus is comprehending the text (context). Second focus is comprehending the mathematical structures of the situation. The third focus is identifying possible solution strategies.)

Task Implementation (During)

Directions for Supporting Implementation of the Task

- Monitor – Teacher will listen and observe students as they work on the task and ask assessing or advancing questions (see chart on next page)
  - Provide 10-15 minutes for students to complete the computational portion of the task and make their recommendation.
  - Group student who have similar conclusions regarding which club they would cancel.
  - Allow them to discuss their findings and reasons why they believe that their choice should be canceled. In the case of large number of students with the same club choice, break into smaller groups of 4-6. Provide 5-10 minutes for discussion and review of their results. Students may revise their individual work at this time.
  - Ask existing groups to split up and find another group to share their conclusions. Provide 5-10 minutes for students to share their different conclusions. Let students know that they should NOT write anything down at this time.
  - Ask students to return to their original seats for the whole group discussion.
- Select – Teacher will decide which strategies or thinking that will be highlighted (after student task implementation) that will advance mathematical ideas and support student learning
- Sequence – Teacher will decide the order in which student ideas will be highlighted (after student task implementation)
- Connect – Teacher will consider ways to facilitate connections between different student responses

Suggestions for Additional Student Support:

- Ask leading questions for the student who cannot get started.
- Ask and answer questions about unknown words or vocabulary.
- Provide word wall cards or visuals to aid with memory.
- Provide task with graphic organizer(attached) for students to support organization and problem-solving structure.
- Allow students with motor processing difficulties to communicate the reasoning in other ways such as video recording or typing answers.
- Ask students with attention challenges to restate the problem or important information.
- For ELs with first language literacy, try to provide prompt, or parts of prompt, in their home language using Google Translate.

Task Implementation (After)

Connecting Student Responses (From Anticipating Student Response Chart) and Closure of the Task:

- Based on the actual student responses, sequence and select specific students to present their conclusions during final class discussion after individual student reflection is finished. Suggested sequence could be Robotics, Environmental/Drama, Chess and remaining clubs.
- In large group discussion, draw out the connections between growth percent and the difference between the years. Be sure to illustrate that you can have a large percent of growth in a club with small membership
- Lead the class discourse to determine the validity of only using the percent of growth as a criterion to keep a club. Connect different students' responses to the percent of increase to the idea of growth percent.
- Explicitly discuss that a strong justification must have data that supports the position.
- After the whole group discussion, have students complete the reflection portion of the task.

Teacher Reflection About Student Learning:

- Were the instructional objectives met? Were the students able to find the percent of change?
- Were the process goal objectives met? Were students able to explain their work verbally (oral and written forms)? Does vocabulary need further development?
- Were the students productively engaged?
- Was enough support provided during the task using the chart of anticipated responses? Did additional responses occur that were not anticipated?
- What common mistakes did the students struggle with the most? Were there recurring student misconceptions?
- How will the evidence provided through student work inform further instruction?
- Did the task rubric assist in identifying students who need additional support? What additional assistance and support will be needed for students who are developing or emerging?

Planning for Mathematical Discourse- Grade 8 – *The Principal's Dilemma*

Anticipated Student Response/Strategy *Provide examples of possible correct student responses along with examples of student errors/misconceptions*	**Assessing Questions – Teacher Stays to Hear Response** *Teacher questioning that allows student to explain and clarify thinking*	**Advancing Questions – Teacher Poses Question and Walks Away** *Teacher questioning that moves thinking forward*	**List of Students Providing Response** *Who? Which students used this strategy?*	**Discussion Order - sequencing student responses** • *Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion* • *Connect different students' responses and connect the responses to the key mathematical ideas.* • *Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion*
Anticipated Student Response: *I don't know what to do?*	• What information do you have? • What are you trying to determine? • What do you notice about each club membership? What do you wonder? • What is percent of change? What does it represent?	• How can we compare the different club memberships? • What do you need to calculate to compare the club memberships?	**Student D**	
Anticipated Student Response: *Incorrect Use of the Formula* *% change*	• How did you find the percent of change? • Does it make sense that that when your new value is larger, that the percent of change is negative? • Have you tested your percent to see if the data values are the same?	• When is the percent of change an increase? A decrease? • How could you check your results for reasonableness?	**Student B** **Student C**	

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Anticipated Student Response: *Incorrect identification of least amount percent change.*	• What does it mean to have the least amount of growth? How does that relate to the greatest amount of decrease? • On a number line, how do you determine the smaller value when talking about negative integers?	• If you were to graph the percent of change on the number line, where would the value of the smallest amount of growth be located? • How can that help you?	**Student A**	
Anticipated Student Response: *Only finds the club that the school board plans to cancel*	• If you were a student at that school, would you agree with the school board decision? • Tell me about your thinking.	• Do you think only using one data point, the growth percent (percent of increase/ percent increase) is fair? Be sure to explain you position on what **you** would recommend.	**Student E**	

The Principal's Dilemma

Professor Xavier is the principal of Anytown Middle School. He has been told by the school board that he only has enough funding to pay 4 club sponsors next year. The school board has told him to cancel the club with the least amount of growth in membership. Below is a chart detailing club membership for each of the five clubs at Anytown Middle School over the past two years.

Number of Members in...	Chess Club	Drama Club	Anime Club	Robotics Club	Environment Club
2018	11	28	23	32	21
2017	8	33	18	40	25

If the principal follows the school board's request, which club should he cancel for the 2019 school year?

_____

Be sure to justify your response with the percent change of membership growth for each club.

Do you agree or disagree that this club should be cancelled? Why or Why not. If you disagree, what club would you cancel and why?

After discussing with your classmates, have you changed your position? Why or Why not.

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Task Rubric

	Advanced	Proficient	Developing	Emerging
Mathematical Understanding	***Proficient Plus:*** ● Uses relationships among mathematical concepts or makes mathematical generalizations.	● Demonstrates an understanding of concepts and skills associated with task ● Applies mathematical concepts and skills which lead to a valid and correct solution	● Demonstrates a partial understanding of concepts and skills associated with task ● Applies mathematical concepts and skills which lead to an incomplete or incorrect solution	● Demonstrates no understanding of concepts and skills associated with task ● Applies limited mathematical concepts and skills in an attempt to find a solution or provides no solution
Problem Solving	***Proficient Plus:*** ● Problem solving strategy is well developed or efficient	● Problem solving strategy displays an understanding of the underlying mathematical concept ● Produces a solution relevant to the problem and confirms the reasonableness of the solution	● Problem solving strategy displays a limited understanding of the underlying mathematical concept ● Produces a solution relevant to the problem but does not confirm the reasonableness of the solution	● A problem solving strategy is not evident ● Does not produce a solution that is relevant to the problem
Communication and Reasoning	***Proficient Plus:*** ● Reasoning or justification is comprehensive ● Consistently uses precise mathematical language to communicate thinking	● Demonstrates reasoning and/or justifies solution steps ● Supports arguments and claims with evidence ● Uses mathematical language to communicate thinking	● Reasoning or justification of solution steps is limited or contains misconceptions ● Provides limited or inconsistent evidence to support arguments and claims ● Uses limited mathematical language to partially communicate thinking with some imprecision	● Provides no correct reasoning or justification ● Does not provide evidence to support arguments and claims ● Uses no mathematical language to communicate thinking
Representations and Connections	***Proficient Plus:*** ● Uses representations to analyze relationships and extend thinking ● Uses mathematical connections to extend the solution to other mathematics or to deepen understanding	● Uses a representation or multiple representations, with accurate labels, to explore and model the problem ● Makes a mathematical connection that is relevant to the context of the problem	● Uses an incomplete or limited representation to model the problem ● Makes a partial mathematical connection or the connection is not relevant to the context of the problem	● Uses no representation or uses a representation that does not model the problem ● Makes no mathematical connections

Task Supporting Documents

MIP 8.4 Percent of Increase and Decrease

$$\text{Percent of Change} = \frac{\text{New Value} - \text{Original Value}}{\text{Original Value}}$$

- Percent of Change is a ratio of the difference between the values to the original value written as a percent.
- If the new value is larger, the difference is positive and indicates an increase.
- If the new value is smaller, the difference is negative and indicates a decrease.

Possible Graphic Organizers

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Chess	Drama	Anime	Robotics	Environment

Do you agree or disagree that this club should be cancelled? Why or Why not. If you disagree, what club would you cancel and why?

After discussing with your classmates, have you changed your position? Why or Why not.
