OER In Mathematics Professional Development Project

Lesson Plan

Topic of the lesson:	Standard(s)/Learning Result(s):
Ratios and Proportions	**Rational Number: Ratios and Direct Proportion** Students understand that when the ratio of two varying quantities is constant, the two quantities are in direct proportion: (a) use ratios to compare quantities and use comparison to solve problems; (b) identify proportional relationships (7:3:a-b).

Goal(s) of the Lesson:

What do you want the students to know and be able to do? What overarching questions do you want them to be able to answer?

The concepts of determining proportionality, comparing ratios, and solving ratios in contextual problems may require multiple lessons, depending on the prior knowledge students bring to this topic. For this lesson, students should work on at least one of the following goals: (1) determine when ratios are in direct proportion, (2) compare ratios, and/or (3) solve problems by comparing ratios.

- Students should be able to accurately determine if two ratios are in direct proportion.
- Students should be able to accurately compare ratios, determining which one in a pair of ratios is greater than the other.
- Students should be able to accurately use comparison to solve problems with ratios.

Context

What should students know to engage in the lesson?

Students should understand:

- a ratio as a comparison of two quantities
- ratios can be represented in multiple forms including a:b and a/b
- a ratio can be written as a:b or b:a (e.g. 2 apples to 3 oranges can be written as 2 apples:3 oranges or 3 oranges:2 apples)
- ratios can be written to represent different relationships, including part:part and part:whole (e.g. building from the example above, 2 apples: 5 pieces of fruit)
- the two quantities in a ratio may have the same units or different units
- two ratios can be compared to determine if they are proportional or if one is greater than the other
- when comparing ratios, the units are important and determining an answer may require the accurate interpretation of the relationship between the units (e.g. if students have a number result that represents miles per hour vs. hours per mile)

Associated Student Difficulties

Describe known misconceptions (overgeneralizations, common errors, and misunderstandings) associated with the content in this lesson?

Sometimes students think additively when working with ratios, i.e. see the sum or difference between the quantities, rather than multiplicatively. For example, a student may see a ratio 5:4 as (4+1):4 and reason that it is proportional to 9:8 since this can be thought of as (8+1):8, and in both cases the first quantity is one (1) more than the

second quantity. In addition, students sometimes know an algorithm or computation method to compare ratios, but may not know how to apply this method within a contextual problem. For example, a student may divide quantities in each of two ratios correctly but interpret the results incorrectly: when solving a problem asking for the higher scoring rate which compares (a) two soccer games in which one goal was scored (2:1) to (b) nine soccer games in which three goals were scored (9:3), they might compare 2/1 =2 to 9/3=3 and conclude that since the second quotient (3) is higher, the second ratio represents the higher scoring rate (since they are not thinking of the meaning of the ratio as they have set it up, e.g. 9 matches per 3 goals = 3 matches per goal, a lower scoring rate than 2 matches per goal). Similarly, some students may compare ratios by comparing the products of cross-multiplication and interpret the results incorrectly.

Planning for Differentiation

Describe how the lesson design incorporates a plan for differentiation.

This lesson calls for customizing instruction at the class level based on the results of a pre-assessment, and working toward at least one of the three goals outlined above.

Pre/Post Assessment

Review what you want students to know and be able to do. How will you determine what they know and don't know? How will you determine that they have met the target? (Describe the pre/post assessment)

Pre-Assessment (Probe): Administer the Is it a Proportion? assessment to determine if students can determine if the given ratios are in direct proportion and can accurately compare the ratios in the contextual problems.

- Review results to determine specific instructional interventions.
  - If students struggle with assessment problem numbers 1- 5, you may want to focus on the goal of determining if two ratios are in direct proportion and use exploration 2 (CompareNumberLines_Exploration2-OERMath)
  - If students answer problems 1-5 mostly correctly, but many students miss one or more of problems 6-8, you may want to focus on strategies to compare ratios and solving problems with ratios by comparison using exploration 3 (CompareNumberLines_Exploration3-OERMath)
  - Exploration 1 (CompareNumberLines_Exploration1-OERMath) also may be useful for comparing with percent
  - All 3 explorations, or explorations you modify or create, may also be used in a lesson or multiple lessons

Post Lesson Assessment: Re-administer the same assessment or an equivalent version to determine any learning.

Materials & Resources

Describe any tools and resources that are needed to support the lesson.

- Student Exploration(s): One or more of the following: CompareNumberLines_Exploration1-OERMath, CompareNumberLines_Exploration2-OERMath, CompareNumberLines_Exploration3-OERMath

Technology Tools / Applets

What technology tools, applets, and/or resources you will use for this lesson?

- Comparing Number Lines applet: http://maine.edc.org/file.php/1/tools/CompareNumberLines.html
- Projector
- Laptops
- Smartboard (optional)

What management strategies will you utilize during the lesson?

- Load the applet and a starting configuration on the teacher computer before having students launch the applet
- If you typically experience long loading times on your network, have students load the applet in 2-4 groups (not all at once)
- Put the link to the applet on a classroom wiki (or blog, online bookmarks, or other management site)

Teacher Notes:

Lesson Description

Preparation

What resources will you need? What type of preparation is needed before you can begin the lesson?

- Laptops
- Print Pre and Post Lesson Probes (Or make sure the probes are in an online administration site such as ThatQuiz.org)
- Print Exploration(s) planning to use
- Approximate Time: If a long block: 75 to 90 minutes; or 15-25 minutes one class (pre-assessment) and 45-60 minutes the second class

	Lesson	Questions for Learners	Notes / Reflections
Introduction	At the beginning of the lesson or the day before the main part of the lesson (so you can analyze the pre-assessment data, plan instruction, and copy appropriate explorations as needed): • Introduce the topic of comparing ratios and the pre-assessment (5 min.) • Students complete the pre-assessment (5-15 min). • Engage students in responding to the pre-assessment questions and results without sharing definitive "answers." Show and analyze electronic results (if using clickers, ThatQuiz, Google Forms, etc.) and/or elicit example responses and student opinions. (5-10 min.)	Possible questions to ask or discuss, as appropriate, before the assessment: - What are some examples of relationships a ratio can represent? - What are some ways ratios can be written? - What does it mean for ratios to be in proportion, or in direct proportion? - How can you decide from two ratios written in fraction form if they are proportional? - What are ways you can write ratios from contextual problem scenarios? (e.g. $part_1$:$part_2$, $part_2$:$part_1$, and $part_1$:whole) - How do you accurately compare ratios found in contextual problems?	1) Review probe prior to instruction, make observations about misconceptions and determine accurate responses 2) After the introduction, determine instructional strategy and materials to best address any misconceptions or gaps in understanding shown in the pre-assessment results. *If all students answered all questions accurately and the subsequent class discussion showed clear understanding, determine if you will probe more deeply or move to a more advanced topic or a different topic.*

	Lesson	Questions for Learners	Notes / Reflections
Core Instruction	• Use a combination of guided instruction and student exploration throughout the lesson, pausing as appropriate to engage small groups or the entire class in discussion. • Students engage in 1 or more Comparing Number Lines explorations, either individually or in pairs. (15-20 min.) • Pause to explore applet features and functions as appropriate to promote deeper understanding of why the applet functions a certain way. • Ask questions to address any misconceptions or gaps in understanding related to the pre-assessment, such as viewing proportionality as additive (instead of multiplicative) • Select students to report out about their findings using the applet by demonstrating with the projector or interactive whiteboard. (5-10 min.) • Discuss and review the meaning of direct proportionality, common mistakes/misconceptions related to ratios as appropriate to the class, and example stratgies for determining if a given pair of ratios is directly proportional. (10 – 15 min.)	What are noticing about ratios that are proportional by using this applet? (related to both the visual of the number line and the number values) What do you notice about the numbers in the ratios that are proportional? What is a strategy you can use, other than the applet, to determine if two ratios are proportional? How is this strategy related to the number line model in the applet? What happens if you set up a ratio as a fraction that is "upside down" or instead of a/b you use b/a? How does this affect your answer when you are compare ratios? When you find a unit rate? When you find a constant of proportionality? When you interpret the results of cross-mulitplication? Optional: How are the concepts of "unit rate" and "constant of proportionality" related to each other?	
Closure	Students take the post-assesment (5-15 min.) Share the results with students and ask them to help interpret the results in light of both accurate responses and the pre-assessment results. (5-10 min)	What does the data from the post assessment tell us about the current understanding of our class on this topic? / What types of problems or problem numbers from the post-assessment show areas we need to work more on this topic? What areas of this topic do the pre- and post-assessment results show as areas of increased understanding?	Review data Reflect on remaining areas of difficulty Determine next instructional steps