The Ichiro Problem

Adapted by Steve Klarevas
from the Lesson Study by:
Linda Gillen, Candice Ives, Steve Klarevas, and Rae Perry
Math 610: Number Systems and Number Theory for K-8 Teachers, Fall 2011
George Mason University, COMPLETE Math
Fall 2015

The Task

It has been one month since Ichiro's mother has entered the hospital. Ichiro decided to pray with his younger brother at a local temple every morning so that she will get better soon. There are 18 ten-yen coins in Ichiro's wallet and just 22 five-yen coins in the younger brother's wallet. They decided to take one coin from each wallet every day, put them in the offertory box, and continue to pray until either wallet becomes empty. One day when they were done with their prayer, they looked into each other's wallets. The amount of money in the younger brother's wallet was greater than Ichiro's amount of money. When this happened, how many days had it been since they started their prayers?

Big Ideas

- Relationships and patterns
- Solving linear equations (or inequalities) both algebraically and graphically
- Slope as a rate of change and y-intercept as an initial amount
- Writing equations of lines in slope-intercept form

Standards of Learning for Grades 3-4-5	Standards of Learning for Grades 6-7-8	Standards of Learning for Algebra I
3.19 The student will recognize and describe a variety of patterns formed using numbers, tables, and pictures, and extend the patterns, using the same or different forms. 4.15 The student will recognize, create, and extend numerical and geometric patterns. 4.16a The student will recognize and demonstrate the meaning of equality in an equation. 5.17 The student will describe the relationship found in a number pattern and express the relationship.	6.17 The student will identify and extend geometric and arithmetic sequences. 7.12 The student will represent relationships with tables, graphs, rules, and words. 7.13 The student will write verbal expressions as algebraic expressions and sentences as equations and vice versa. 7.13b The student will evaluate algebraic expressions for given replacement values of the variables. 8.14 The student will make connections between any two representations (tables, graphs, words, and rules) of a given relationship. 8.15a The student will solve multistep linear equations in one variable with the variable on one and two sides of the equation. 8.16 The student will graph a linear equation in two variables. 8.17 The student will identify the domain, range, independent variable, or dependent variable in a given situation.	A.4 The student will solve multistep linear equations in two variables, including b) justifying steps used in simplifying expressions and solving equations, using field properties and axioms of equality that are valid for the set of real numbers and its subsets; d) solving multistep linear equations algebraically and graphically; f) solving real-world problems involving equations. Graphing calculators will be used both as a primary tool in solving problems and to verify algebraic solutions. A.5 The student will solve multistep linear inequalities in two variables, including a) solving multistep linear inequalities algebraically and graphically; b) justifying steps used in solving inequalities, using axioms of inequality and properties of order that are valid for the set of real numbers and its subsets; c) solving real-world problems involving inequalities. A.6 The student will graph linear equations and linear inequalities in two variables, including a) Slope will be described as rate of change and will be positive, negative, zero, or undefined; b) writing the equation of a line. A.7 The student will investigate and analyze function (linear and quadratic) families and their characteristics both algebraically and graphically, including f) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic.

Process Goals

- Problem Solving and Reasoning – Students will examine relationships and patterns and use their understanding of slope as a rate of change and y-intercept as an initial amount in the form y=mx+b to determine both algebraically and graphically the relationship between the money in two brothers' wallets.
- Connections and Representations – Students will recognize and use mathematical connections to extend or generalize patterns. Students will use abstract or symbolic representation to record their findings and solve the problem.
- Communication – Students will justify their findings and present their results to the class with precise mathematical language.

Related Task – Buying mp3s

You have decided to use your allowance to buy an mp3 purchase plan. Your friend Alex is a member of i- sound and pays $1 for each download. Another one of your friends, Taylor, belongs to Rhaps and pays $13 a month for an unlimited number of downloads. A third friend, Chris, belongs to e-musical and pays a $4 monthly membership fee and $0.40 a month per download. Each friend is trying to convince you to join their membership plan. Under what circumstances would you choose each of these plans and why?

Related Task – Carlos' Cell Phone

Carlos is thinking of changing cell phone plans so he is comparing several different plans.

Plan 1) Pay as you go plan $0.99 per minute
Plan 2) $30 monthly fee plus $0.45 per minute
Plan 3) $40 monthly fee plus $0.35 per minute
Plan 4) $60 monthly fee plus $0.20 per minute
Plan 5) $100 monthly fee for unlimited minutes

What will Carlos need to consider to make his decision? How can Carlos figure out which plan is best for him?

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Lesson Plan

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Materials

- The task
- Several coins and a coin bank (for teacher demonstration)
- Graph paper
- Rulers
- Manipulatives such as two-color counters or linking cubes
- Calculators
- One large presentation paper per group

Facilitating Task

- Class will be divided into groups of 3-4 students.
- Read the task together and answer clarifying questions.
- Groups will be given materials upon request.
- Give students individual think time and then work together in groups.
- Groups present findings during last 10-15 minutes of class.

Misconceptions

- What is the first day, day zero or day one?
- Incorrectly defining the variable (i.e., number of days versus number of coins versus value of coins)
- Incorrectly answering the question (i.e., 15 days versus 14 days)

Suggested Prompts or Questions

- What is the question asking?
- What is the unknown?
- How will you represent the unknown?
- What is the pattern?

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Name_____
Date_____

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Answer the question using pictures, words, tables, graphs, and/or symbols.