**Instructional Design Project**

**Applications of Linear Equations**

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**Rationale**

The unit I chose is on from my Math 1205 course for applications of linear equations. Essentially, this chapter is a dreaded “word problem” chapter of the course. Students groan, whine, and tune out for this unit quarter after quarter. I need to address this issue of problem solving with adult learners. I have to work within some tight constraints because of my adjunct status and course requirements for my department. Even so, I feel that there is a great need to contextualize these application problems with adult learners. Zavarealla and Ignash (2009) cite the high dropout rates among college developmental math students. My course is a lecture based course with an online homework component. Many students who fail or withdraw from developmental math courses never go on to complete their degree program (2009). Contextualizing the content can help students relate to and retain the content of a course (Chiarelott, 2006). I feel that a constructivist view of the unit helps student to create the knowledge together as peers (Ornstein, 2009). In this unit, I will rely on students completing Lecture Prep assignment before each class meeting. This assignment will give them some interest and personal relevance to the lesson being taught. During class, my lectures are being truncated to give more time for students to work together. I will give some time to discuss the problems and invite student ideas for strategies in solving these problems. We will complete some sample problems from the Zip Notes. Then, I will be breaking the class into groups. They will solve and create problems in groups. They will then explain to the class their assigned problem on the board.

This lesson design moves away from the lecture and Q&A method of teaching math which is prevalent at the college level. The main disconnect is developmental students are not ready academically for the college level work. I want to put the learning focus back on the students as creating knowledge rather than the teacher centered passive learning model of the traditional college math course.

**Unit Objectives**

**Math**

This unit will meet the following course objectives from the Syllabus 2. This unit relies heavily on practicing learning objectives from previous units which are listed in each lesson.

5.00 Solve problems involving the application of linear equations (Analysis/Application)

5.03 Solve investment problems

5.04 Solve value mixture problems

5.05 Solve percent mixture problems

5.06 Solve uniform motion problems

5.07 Solve perimeter problems

**Pre Assessment**

The pre-assessment for this unit is the completion of the exam over the previous chapters. The exam is a review of solving and simplifying equations and expressions in one variable. It also includes a solid review of the Order of Operations agreement and numeracy skills. The beginning of this chapter always starts with short discussion about word problems. I allow students to voice their past difficulties with these types of problems and share some strategies for solving them before we begin to tackle specific problem types. I acknowledge that working with adult learners gives me the freedom to ask my students, “how do you learn?” and “What works for you?” Adult learners are more aware of their own thought process.

**Introductions to Application problems**

I. Solving problems with two unknowns (3.3 part one)

II. Objectives

* Find a pair of integers that will result in both a given product and a given sum (Application)
* Translate a sentence into an equation and solve it (comprehension/application)

III. Procedures

*Phase Description of Activity*

Engagement (20 minutes)

 Watch the TED talk on problem solving (<http://www.ted.com/talks/dan_meyer_math_curriculum_makeover.html>) Discuss applications of number relationship problem in the real world. Ask students to give ideas and strategies for attacking the dreaded word problem. I will take the role of note taker on the board for this discussion.

Exploration (25 minutes)

Students will complete their exploration of the topic *prior to class* in the form of a Lecture Prep assignment.

Explanation (15-20 minutes)

 I will demonstrate problem solving through lecture and question/response using the Zip Notes required for the course.

Extension: (30-35 minutes)

 Students will practice in small groups. After they have completed three problems on their own, I will assign each group to create a problem of the same type they have been working on. Then each group will solve another group’s created problem.

Evaluation: (0)

 Students will complete a three to four question “quiz” using their notes from class at the end of the next lesson.

IV. Materials and Resources

 Instructor Computer

Zip Notes (pages 55-56)

 Document camera

 Projector

 Dry erase board

 Markers

 Writing utensils, calculators, notebooks (student supplies)

**Chapter 3.3 Perimeter and Angle Problems**

I. Solve problems using the perimeter and area formulas and solve problem involving complementary and supplementary angles.

II. Objectives

* Translate a sentence into an equation and solve it (comprehension/application)
* Solve perimeter problems
* Understand complementary and supplementary angle definitions

III. Procedures

*Phase Description of Activity*

Engagement (3-5 minutes)

I will give students a break in the middle of my two and half hours lecture time. When they return from break, I will ask about home improvement and gardening stories.

Exploration (25 minutes)

 This is completed *prior to class* in the form of a lecture prep assignment.

Explanation (20-25 minutes)

 I will spend some time explaining and demonstrating the problem solving process for the different perimeter, area, and angle problems using the Zip Notes.

Extension: (30-35 minutes)

 Students will again break into groups to complete practice problems together. Then I will ask a group speaker to complete and explain each group’s assigned problem on the board. Students will use the information gathered from their lecture Prep questions to create a perimeter problem based on room in their own home.

Evaluation: (15 minutes)

 Students will complete a short three to four question quiz over the previous two problem types. They may use their notes from class.

IV. Materials and Resources

 Lecture Prep Assignments

Zip Notes (pages 56-59)

Quiz

 Document camera

 Projector

 Dry erase board

 Markers

 Writing utensils, calculators, notebooks (student supplies)

**Consecutive Integers**

I. Solving problems to find consecutive integers and consecutive even and odd integers

II. Objectives

* Find a pair of integers that will result in both a given product and a given sum (Application)
* Translate a verbal expression into a variable expression (Comprehension)
* Solve equations of the form x + a =b and ax = b (application)
* Solve equations of the form ax + b = c and ax + b = cx + d (application)
* Solve application problems (Synthesis/Application)

III. Procedures

*Phase Description of Activity*

Engagement (15 minutes)

 I will hand out consecutively numbered cards. I will group students in four to five groups (depending on class size). I will have two groups of consecutive numbers and one groups of consecutive odd and a final group of consecutive even numbers. Then we will talk about making sums and products from our given numbers. I will record the sums and the products on the board for later use.

Exploration (25 minutes)

 Students will complete their exploration of the topic *prior to class* in the form of a Lecture Prep assignment.

Explanation (20 minutes)

 I will use the Zip Notes to complete some example problems using the document camera.

Extension: (40 minutes)

 The students will do some practice problems in their groups. Finally they will create problems based on the numbers for their groups. Then we will assign the created problems to the other groups in the class. Each group will solve and explain another group’s created problem.

Evaluation: (0 minutes)

 Students will be quizzed at the conclusion of the next lesson

IV. Materials and Resources

 Lecture Prep Assignments

Zip Notes (pages 60-61)

Quiz

 Document camera

 Projector

 Dry erase board

 Markers

 Writing utensils, calculators, notebooks (student supplies)

 **3.3 and 3.5 Number Value Problems and Investment problems**

I. Solving two variable problems using the table method and the equation building method.

II. Objectives

* + Solve investment problems
	+ Solve equations of the form ax + b = c and ax + b = cx + d (application)
	+ Translate a verbal expression into a variable expression (Comprehension)
	+ Evaluate and simplify variable expressions

III. Procedures

*Phase Description of Activity*

Engagement: (5 minutes)

 After a break, we will have a short discussion about retirement savings and diversification. How do you keep track of interest in multiple accounts and balancing risk and return. This is by no means a financial lecture, but a conversation about how we can apply math to our money matters.

Exploration: (25 minutes)

Students will complete their exploration of the topic *prior to class* in the form of a Lecture Prep assignment.

Explanation: (20 minutes)

 I will use the zip notes to discuss model the problem solving process. I will model the table method as well as the equation building method for these problems.

Extension: (30 minutes)

 Students will work in groups to solve problems together. They will create problems based on the information gathered in their lecture prep questions. They will then chose a speaker to complete the problem on the board.

Evaluation: (10 -15 minutes)

 Students will complete a four question quiz on the previous two lessons. They will be able to refer to their notes from class.

IV. Materials and Resources

Lecture Prep Assignments

Zip Notes (pages 62-64, 68-69)

Quiz

 Document camera

 Projector

 Dry erase board

 Markers

 Writing utensils, calculators, notebooks (student supplies)

**3.4 Distance problems**

I. Using the distance formula in multiple forms

II. Objectives

* Evaluate and rewrite formulas
* Recall and use the distance formula in three forms
* Build and solve equations using the distance formula.

III. Procedures

*Phase Description of Activity*

Engagement: (10 minutes)

 Using the student’s Lecture Prep assignments, we will discuss how the distance formula can help us plan a jogging schedule in an area Metro Park that fits into our day.

Exploration: (25 minutes)

 Students will complete their exploration of the topic *prior to class* in the form of a Lecture Prep assignment.

Explanation: (40-50 minutes in 2 time periods of 20-25 minutes)

 I will demonstrate and model problem solving strategies for different distance formula problems in this section using the Zip Notes. After I have explained one type of problem we will move on to the extension exercises. We will come back to explanation for a second round after a break. We will use the

Extension: (40 minutes in two time periods of 20 minutes)

 Students will work in groups to practice these problem types with problems we create as a class from their Lecture Prep assignments. Each group will solve a problem on the board and explain it to the rest of the class.

Evaluation: (20 minutes)

Students will be complete a quiz of four questions using their notes as reference.

IV. Materials and Resources

Lecture Prep Assignments

Zip Notes (pages 65-67)

Quiz

 Document camera

 Projector

 Dry erase board

 Markers

 Writing utensils, calculators, notebooks (student supplies)

**3.5 Chemical Mixture Problems and Value mixture Problems**

I. Solving percent mixture problems

II. Objectives

* Solve percent problems
* Solve equations of the form ax + b = c and ax + b = cx + d (application)
* Translate a verbal expression into a variable expression (Comprehension)

III. Procedures

*Phase Description of Activity*

Engagement: (15 minutes)

 We will discuss the mixture problem as the bane of algebra students, briefly. I usually have three to four students who are retaking this course each term. This will bring them into the discussion. We will watch this video on mixture problems: <http://www.youtube.com/watch?v=GaFKzDYbQls&noredirect=1> On using the mixture Picture to work through the problems.

Exploration: (25 minutes)

 Students will complete their exploration of the topic *prior to class* in the form of a Lecture Prep assignment.

Explanation: (25-30 minutes)

 I will work through some problems from the Zip Notes to create “Mixture Pictures” for the problems. Then we will discuss the solving strategies. I will make sure to cover the percent values for pure substance and pure water.

Extension: (35-40 minutes)

 Students will practice some mixture problems from the text in groups. We will work through multiple forms of the problems. Students will use the data collected in their Lecture Prep assignment to create problem in groups, and demonstrate their created problems on the board.

Evaluation: (15 minutes)

 Students will complete a three question quiz to practice this problem type.

\*\*the remainder of this class meeting will be a review of the entire Chapter 3. (Approximately 50 minutes)

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IV. Materials and Resources

Lecture Prep Assignments

Zip Notes (pages 70-73)

Quiz 5

 Document camera

 Projector

 Dry erase board

 Markers

 Writing utensils, calculators, notebooks (student supplies)

**Post Assessment**

 For the post assessment, an exam worth 125 points will cover this unit and the next unit on graphing. Below is the exam.

1. A paint store sells one brand of interior paint for $16.59 per gallon and the same brand of exterior paint for $18.75 per gallon. A remodeling contracting company purchases a total of 260 gallons of both types of paint for $4546.68. How many of gallons of each type of paint did they buy?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Price of 1 | Number | Total $ |
| Interior Paint |  |  |  |
| Exterior Paint |  |  |  |
| Totals |  |  |  |

1. Dr. Nungesser is mixing chemicals for a lab class. He has some 40% Sodium Hydroxide solution and some 25% sodium hydroxide solution. How much of each solution should he mix together to get 73 liters solution that is 36%?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Amount | Rate | Quantity of Pure |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

1. 300 tiles are required to tile a 750 sq. ft. area. How many tiles are needed to tile a 1900 sq. ft. area? (Round to the nearest whole tile)
2. What number is 62% of 5486? (round to the nearest hundredth)
3. What percent of 1532 is 444.28?
4. What is the equation of a line with the slope of $-\frac{3}{5}$ and passes through the point (-5,6)
5. First quarter sales were $4218 and second quarter sales were $6158. What was the percent increase from quarter one to quarter two? (Round to the nearest tenth percent)
6. What is the unit rate if you paid $47.95 for 13.3 gallons of gas?
7. The sum of 3 consecutive odd integers is 567. What are the integers?
8. What is the slope of the line that passes through the points,

 (-5,4) and (3, -1)?

1. Solve for x.

$$\frac{24+x}{70}=\frac{x}{10}$$

1. Graph the following points and *label* them:
2. (-2,3)
3. (5,2)
4. (1,-6)
5. (-2,-4)
6. Graph the following lines:
7. $y=-\frac{1}{2}x+6$



1. $-4y+8x=20$
2. Jason and George decided to go for a run in the park this morning. Both men started at opposite ends of the 22 mile running trail at 6:15 am. If George runs at 6 mph and Jason runs at 7.5 mph, **what time** will they meet on the trail?
3. Write the equation of the line with an x-intercept of (3,0) and a y-intercept of (0,-6).
4. The perimeter of a rectangle is 78m. The width of the rectangle is six meters less than the length. What is the width and length of the rectangle?
5.  Graph the following line: y=3

 What is the slope?

1. The difference between two numbers is seventy-eight. Three times the larger number is two hundred seventy-nine minus twice the smaller number. Find both numbers.

Zelda invests money into two simple interest plans. She invests thirty five percent of her money at an APR of 10% and the rest at an APR of 8.5%. If the total interest after one year from the investment is $4061.25, how much was invested in each account?

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| Account one |  |  |  |
| Account two |  |  |  |
| Total |  |  |  |

1. How many liters of pure bleach must be added to 275 liters of 19% bleach solution to make a solution that is 55% bleach?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Liters | Percent | Totals |
| Pure |  |  |  |
| 16% solution |  |  |  |
| Combined |  |  |  |

1. Two angles are complementary. One angle is 15 degrees less than two times the other angle. What are the measures of the two angles?
2. What number is 54$\frac{6}{11}$% of 121?
3. Is the following point a solution to the given equation?

(-5,0) $-5y=3x-3$

**\*\*\*\*\*Bonus Questions\*\*\*\*\***

1. At 2:30 p.m., a car traveling 72 mph passes a truck traveling 58 mph going in the same direction on the highway. If the vehicles maintain their speeds, at what time will they be five miles apart?
2. Solve and Check.



1. How do you rewrite an equation that is in standard form in slope-intercept form?
2. When given two ordered pairs and asked to write the equation of a line, does it matter which ordered pair is used in the point-slope formula?

**Attachments**

For these lesson plans I will be using the Zip Notes for the course I teach which are designed by Sandy Siegrist and revised by Emily Dennet. The Zip Notes are required materials for the MTH1205 Course. The pdf of the Chapter 3 zip notes are linked to the Cmap. Additionally, I will be using Lecture Prep assignments as a pre-assessment for each lesson. My Post Assessment well be in the form of 2 quizzes and half of an exam which covers Chapter 3 (application problems) and Chapter 4 (graphing) of Carson and Gillespie’s Elementary Algebra.

Sample quiz questions listed below:

1. A paint store sells one brand of interior paint for $12.99 per gallon and the same brand of exterior paint for $16.99 per gallon. A remodeling contracting company purchases a total of 372 gallons of paint for $5504.28. How many of gallons of each type of paint did they buy?
2. Two angles are supplementary. The first angle is $12°$ more than three times the other angle. What are the measures of the two angles?
3. The Addams, Munster, and Burton families live in houses whose numbers are consecutive *even* integers and total to be 786. What are the house numbers of each family?
4. Zelda invests money into two simple interest plans. She invests two fifths of the money at an APR of 8% and the rest at an APR of 7.6%. If the total interest after one year from the investment is $620.80, how much was invested in each account?
5. Johnny was a chemist son, but Johnny is no more. What he thought was H2O was H2SO4. His father had mixed a solution of pure water and 200mL of 56% H2SO4 in order to get a 30% mixture. How much pure water did Johnny’s father add to the 56% H2SO4?
6. At 6:00 p.m., a car traveling 70 mph passes a truck traveling 62 mph going in the same direction on the highway. If the vehicles maintain their speeds, at what time will they be two miles apart?
7. Huckleberry Finn invests $4500 in two plans. Plan 1 is at an APR of 4%, and plan 2 is at an APR of 6%. If the total interest earned in one year is $234, how much did he invest in each plan?
8. The Candy Shoppe wants to mix 115 pounds of candy to sell for $1.10 a pound. How many pounds of taffy costing $0.99/lb. can be mixed with $1.30/lb. chocolate pumpkins to make this mixture?

Lecture Prep sample questions:

1. Measure the dimensions of a room in your house/apartment. What is the perimeter of the room? What is the area of the floor? What is the area of the walls?
2. Do some internet research. If you are shopping for paint at Lowe’s or another home improvement supply store of your choice, what are some prices per gallon and prices per quart of interior paint? How many square feet do these containers of paint cover?
3. Look up the running/biking trails available online from Columbus Metro parks. (<http://www.metroparks.net/ParksTrails.aspx>) Pick a Trail from any of the parks. How long is the trail? If you were to bike this trail (average speed of 13 mph) how long would it take you to complete it? How long would it take you to walk the same trail (avg . sp. 3 mph)?
4. Go on a field trip this weekend to the grocery store or pet supply store. Find the bulk food (or bulk doggie treat) bins. Price two separate products. What is the price per pound of each? If you bought 3 pounds of the first product and 5 pounds of the second product, what would the total cost be?

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1. Do some label reading over the weekend. Find out the percentage of pure vinegar in your household vinegar jug. You can also use bleach, peroxide, or your favorite alcohol. List the percentages below. Look for different products in your home that have a “percentage pure” listing. Some ideas are juice drinks, lemonade drinks. Cat and dog food also should have percentage break downs for nutritional components. Find at least 3 different products. Name the product and the percentage of “pure stuff” it contains.
2. Look up interest rates online. How much is your bank paying for a 12 month CD? What is the minimum balance of their CD products? How often is interest compounded on a CD? What is the money market account rate? What is the rate for a regular savings account?

**References**

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