Real-World Problem Solving with Systems of Linear Equations

Solving Systems of Linear Equation with a Focus in Relevant Real-World Applications

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Dedication

To my husband, Albert Dalipi, for his unconditional patience and encouragement and for acting as editor of my academic writing during my entire education pursuit.

Acknowledgements

I would like to thank professor Wade for supporting my goals of completing my thesis in a timely manner, and provided me with feedback on my research and writing.

Thank you to all my professors at in the Masters of Secondary Mathematics Education program at SUNY Brockport for shaping me as a learner and as a teacher.

Abstract

This curriculum project was designed to teach systems of equations through the use of real-world problems and scenarios. Its aim is to make mathematical concepts more tangible and applicable in students' lives by infusing real-world application of systems of linear equations. This project includes a structured curriculum consisting of four lessons, presented in a sequential manner. It starts by covering the topic of solving systems through graphing, followed by an exploration of algebraic methods and their applications, all designed to facilitate overall comprehension. All lessons are aligned with the NYS Next Generations Mathematics Standards to ensure that the curriculum not only creates an environment where students can build their understanding but also meet the highest educational benchmarks. The literate review explores the coaching techniques and theories that formed the groundwork in which this curriculum was built upon. Keys for all students can be found in the appendix.

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Introduction

One of the main goals of mathematics educators is to find instructional strategies that make leaning math meaningful, authentic, and engaging for students. The traditional method of a teacher imparting knowledge to students while they passively receive and memorize the information is no longer the path to engaged and inspired learning. Recognizing the importance of engaged and inspired learning, many within the education system now emphasize cultivating a learning environment where mathematics is relatable and applicable to students' everyday lives. Real-world connections stand out as a powerful means of actively involving students in the learning process and increasing communication and collaboration in the classroom. By incorporating real-world applications of math students are more prone to engage in discussions, share and explore ideas (Jones & Tanner, 2002). Nevertheless, it poses a great challenge for educators to develop activities and mathematical problems that are authentic, possess real-world relevance, and align with the traditional curriculum that educators are still required to teach. The purpose of this curriculum project is to provide teachers with exemplar lessons that integrate authentic situations into linear equations instruction.

Literature Review

In mathematics education, teachers question how to connect students' learning experiences with relevant real-world applications. This literature review thus delves into the importance of establishing a strong connection between student's everyday experiences and how educators can make learning mathematics meaningful and relevant to the world our students live in. The overarching aim should always be to enrich student learning experiences and enhance their engagement in mathematical tasks.

Definition of Real-World Connections

There is a lack of a formal and universally agreed-upon definition of a real world connections among secondary education teachers. As Gainsburg (2008) points out, this term can encompass a range of elements, including examination of real data, discussions about mathematics in society, analogies, hands-on representations of mathematical concepts, modeling real-world phenomena, and traditional word problems. Real world connections can also refer to any link between classroom mathematics and the outside world that allow students to relate mathematical concepts to their daily lives. Additionally, some consider real world connections as a means of learning or a method of practicing mathematics. For example, Van Den Heuvel-Panhuizen (2000) Realistic Mathematics Education (RME) places a strong emphasizes on providing students with situations that they can envision and make tangible, but which may not necessarily be applicable in the real world. Dickenson and Hough (2012) shared that real world connections can be presented as scenarios in the form of stories, puzzles or fictitious situations students can imagine as authentic. Boaler (1993) also suggested that it is not solely the mathematical problem itself but the learning environment that influences student learning. The learning environment is also connected to making real world questions authentic in ways that show the usefulness of mathematics (Vos, 2018). Thus, the concept of real-world connections can have various forms and meanings and it is the multitude of these forms that makes exploring and studying these connections into mathematics education complex and complicated.

Benefits of Connecting Mathematics to the Real-Word

Incorporating relevant real-world connections into mathematics classrooms offers significant benefits for both students and teachers. For students, real-world connections make mathematics more motivating and meaningful. It allows for students to make connections with

their previous experiences and it better equips them to apply their mathematical skills to new situations they might encounter in their everyday life. Boaler's (1998) research informed that students from traditional, rote-learning- focused classrooms struggle to translate their mathematical skills into real life settings. Similarly, Zempke and Zempke (1981) pointed out that students are not primarily driven to learn for the sake of just learning itself, instead, they are motivated to acquire knowledge and skill "because they have a use for the knowledge or skill" (p.46). For teachers the benefits are increased student motivation and engagement. When students grasp the practical relevance of mathematics, they can become more self-directed, independent and inquisitive learners, easing the burden on constantly having to stimulate interest in students. When students are empowered to plan and make independent decision through investigative learning, then educators can create enriched teaching and learning experience (Boaler,1998).

Teachers Role in Making Mathematics Applicable and Relevant

Educators play a vital role in establishing connection between students' lives and mathematics. While it might seem daunting, the task of establishing connections between real-life mathematics and students is entirely achievable through adopting student-centered, active and meaningful teaching methods. When teachers craft engaging, rich and relevant mathematical problems that resonate with students in the classrooms, then student interest increases as well as the potential for learning (Altaylar & Kazak, 2021). Together, applied problem-solving tasks and the environment plays a great role as well in contributing to students learning. Providing students with word problems that have an unrealistic meaning or that are not applicable to students' lives is not sufficient and often causes confusion for students. Many word problems in current curriculums are constructed realities, and they appear to refer back to other word problems rather

than mirroring actual real-world situations as argued by Gerofsky (2006). Real-life situations tailored to align with specific mathematical concepts that do not represent genuine real-word scenarios typically do not have the same effect in students' engagement and thus opportunity to learn.

Curriculum Project

Overview

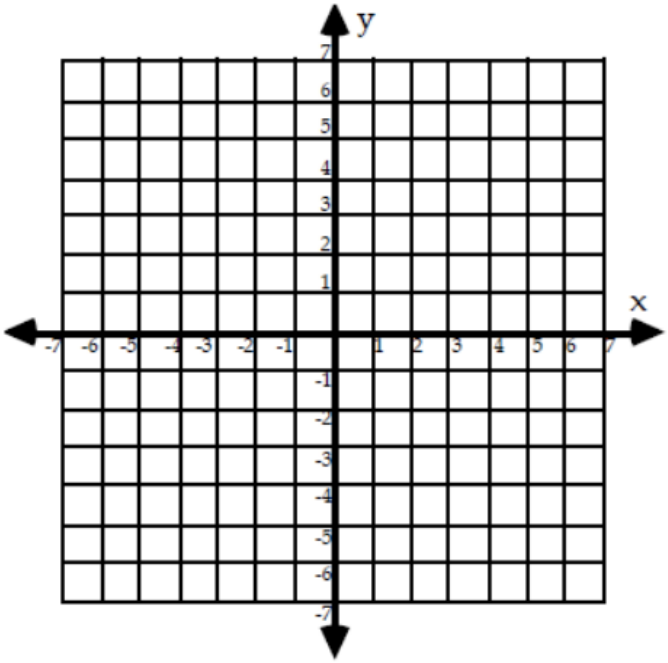
Lesson 1	Students will focus in solving real- world problems by graphing. During this lesson students will work on groups that will be preassigned from the teacher before the class. Students can be allowed graphing calculators however; it is encouraged that they graph the situation by hand. The exit ticket is designed for the students to work on it independently. They should be equipped with rulers and have extra graphing paper to graph their graphs.
Lesson 2	Students will focus on solving real-world problems related to systems of equations by substitution method. Another focus for this lesson is to be able to write a system of equations given word problems.
Lesson 3	During this lesson students will work on solving real-world problems using elimination in Polypad.
Lesson 4	This lesson will take 2 days to complete, depending on the classroom it can require more time due to the need for research. Students will have to gather data and create their own real-world scenario to complete the given project.

Lesson 1

Subject	Pre-Algebra, Algebra 1, or Algebra II
Grades	8, 9, 11
Lesson Title	Solving Systems by graphing with a concentration on real world problems
Standards	• CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • CCSS.Math.Content.HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
Learning goals	• Students will graph two linear equations on the same coordinate system given a world problem • Students will identify the solution of the system after graphing the lines • Students will explain what the solution means in terms of the problem.
Procedures/ Timeline	<u>45 minutes</u> - Warm up (5 minutes) - Divide students in groups and allow them to sit together in the student group centers. (5 minutes) 1. Make lists of the students' groups before the class begins. Students can be grouped based upon different criteria such as academic achievement. 2. Create group centers where each group can gather up and discus the work together. Having mini white boards for each group can help students explain their thoughts better to their group members. - Each group will work on the worksheet printed out by the teacher. (15 minutes). In the meantime, the teacher will visit each group ang ask guiding questions. The teacher will take notes of common misconceptions she will later address during discussion time. - Teacher will answer and discus the questions found on the worksheet with the whole class. This is a student led discussion where the teacher will ask questions to guide students answers (10 minutes) - Exit ticket/lesson assessment (10 minutes)

Warm up Activity

1. Graph 2x-y=4 in the grid provided bellow. (Name your line)



2. Kristi charges a flat fee of $4 and $5 per hour for babysitting one child. If she is babysitting two children, she charges $8. Write an equation for the cost, x, after y hours of babysitting one child. Write an equation for the cost, x, after y hours of babysitting two children. What do you think the slope and the y-intercept represent in each case?

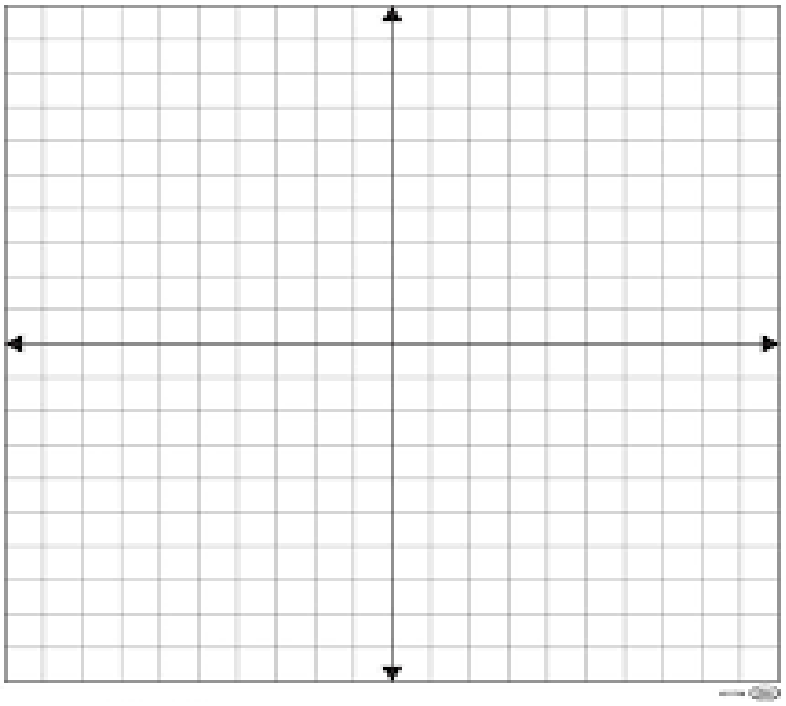
Worksheet

1. The temperature in Scarsdale, NY started at -10 °C and rose 2 degrees every hour. The temperature in Utica NY started at -16°C and rose 1 degree every 3 hours. Convert degrees in Fahrenheit given the conversion formula F=C*(9/5)+32. Students van use graphing calculators to graph the graphs.

Fill in the gaps

Scarsdale	**Utica**
m=	m=
b=	b=
equation:	equation:

Graph each line, Label x-axis with _____ and y-axis with _____



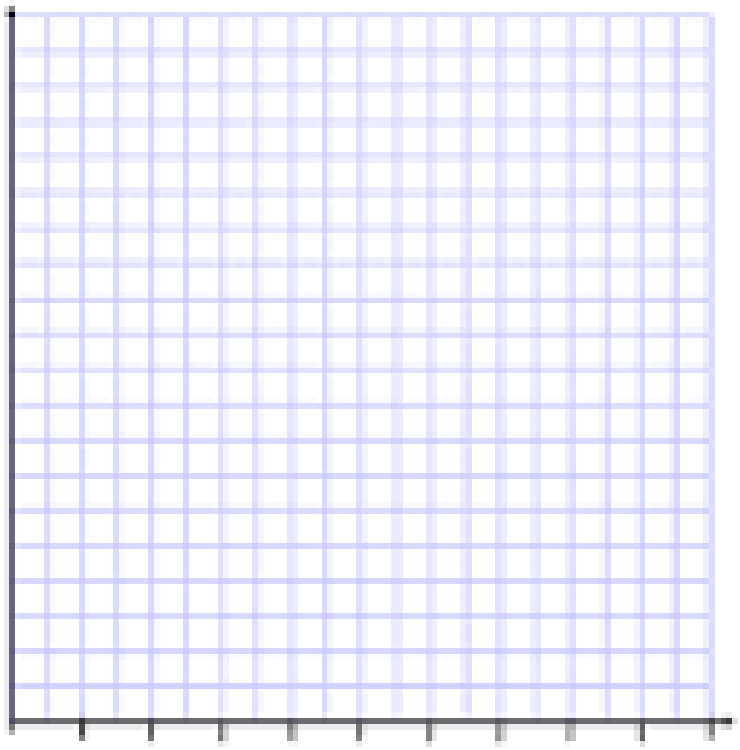
Refer to your graph to answer the following questions:

1. After how many hours the temperature will be the same? _____
2. What is this temperature in degrees? _____
3. Write the solution to the problem as a ordered pair? _____
4. What would mean for this problem to have no solution? _____
5. What is this temperature in Fahrenheit ?

The teacher will have a whole classroom discussion and will solve/ model this question on the board to clarify any misconceptions she/he noticed during group work.

Exit ticket/ Assessment (Independent work)

Mr. Albert and Mr. Noah are both taking a road trip to Boston. Mr. Albert, in his gray Toyota, started 50 miles from Scarsdale and drives at an average speed of 60 mph. Mr. Noah in his red Honda, started 10 miles from Scarsdale and drives at an average speed of 45 mph.



1. Write an equation representing the miles driven by each car.

Red Car _____ Gray Car_____

2. For both car make a graph using different colors for each line.

3. Who will get to Boston first? How do you know?

4. Will the cars be next to each other on the highway? How can you tell?

Lesson 2

Subject	Pre-Algebra, Algebra 1, or Algebra II
Grades	8, 9, 11
Lesson Title	Solving Systems by substitution with a concentration on real world problems
Standards	• CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • CCSS.Math.Content.HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
Learning goals	• Students will use substitution method to solve systems of equations and apply this method to real world problems • Students will explain what the solution means in terms of the real world problem.

Procedures/ Timeline	<u>45 minutes</u>
	- Warm up (5 minutes)
	- Instruction (15 minutes)
	  • Define substitution as a method of solving systems of equations
	  • Demonstrate how to solve a system of equation using substitution with an example
	- Application (20 minutes)
	  • Hand out worksheets with real world problems that involve systems of equations
	  • Instruct students to work on groups of 4 and assign the groups based upon the criteria that best fits the classroom.
	  • Walk around, ask guiding questions and encourage students to check their work.
	- Exit ticket/lesson assessment (5 minutes)

Warm up

What is the value of:

1. $3\mathrm{b} - 10\mathrm{a}$ when a= (-3) and b=20?

2. $-10\mathrm{x} + 4\mathrm{y}$ when x=(-3) and y=5

Simplify

3. $a^2 + b^2 = c^2$ when $a = 10, b = 2x - 3 \; and \; c = x$

Teacher instruction/ modeling of substitution.

Noah went to the store to buy plums and peaches to make jam. The number of plums he bought is 3 times more than the peaches. The plums cost $0.75 each and the peaches cost $0.80 each. If the total amount of moneys he spent is $18.3, how many peaches did Noah buy?

Worksheet (groups of 4)

1- A coffee shop sells coffee and hot chocolate. A customer orders 3 cups of coffee and pays $8.75. Another customer orders 2 cups of hot chocolate and 1 cup of coffee and pays $5.25. What is the price of a cup of coffee and one cup hot chocolate? (Round to the nearest cent)

2- Teacher 1, teaches math and charges a flat rate of $50 for traveling to the students' homes plus $75 per hour of work. Teacher 2 also teaches math, charges a flat fee of $75 plus $60 per hour of work. If a student needs to meet with the teacher and study for two hours which teacher would cost him less money to work with? How many hours does the student need to work for both the teacher to cost the same?

3- Angel X and Y are supplementary angles. Angles X is 4 times larger than Angle Y. What is the measure of the X and Y?

Exit ticket/ Assessment

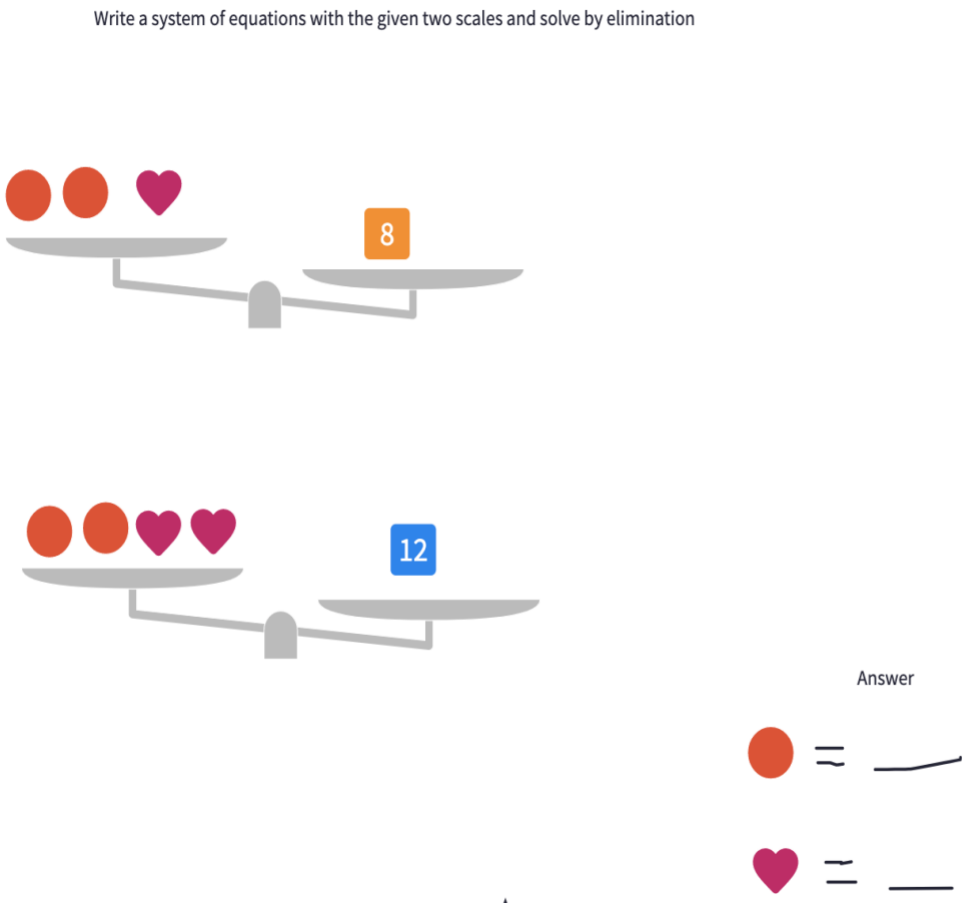
1- Noah has a total of 46 puzzles. He only has animal and fruits puzzles. He has 20 more animal puzzles than fruit puzzles. How many animal and fruits puzzles are there?

Lesson 3

Subject	Pre-Algebra, Algebra 1, or Algebra II
Grades	8-12
Lesson Title	Solving Systems by elimination with a concentration on world problems
Standards	• CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • CCSS.Math.Content.HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
Learning Goals	• Define what a system of equations is and understand the concept of a solution to a system of equations • Solve a system of linear equations using elimination in polygon • Apply their knowledge of solving systems of equations to real-world problems
Procedure/ Timeline	- **Instruction** - The teacher will redefine what a system of equations is. - The teacher will remind students of the two previous methods they used to solve systems of equations - After a general review on systems, polypad presentation will be shared on the white board. - The teacher will lead a discussion on solving the problem provided as a whole classroom using scales in polygon **Guided practice** - Students will work in pairs to solve the following real-world problems. - They will be provided with a Chromebook per pair to help them solve the systems using polypad. - The teacher will discuss and go over the questions after walking around the classroom and checking each group. **Independent practice** - A question will be assigned on polypad for students to independently solve

Teachers example used during instruction

Polypad link =>. polypad.org/v8D281Ep1FWZw



Guided practice (Feel free to use the scale on polypad to help solve the system)

1- A pet store sells dogs and cats. They have a total of 30 animals and the total cost of the animals is $400. Dogs cost $20 each and cats cost $10 each. How many dogs does the pet store have?

2- Tickets to a movie cost $4 for adults and $3 for students. A group of friends and their parents purchased 15 tickets for $53. How many adult tickets where there? How many students went to see the movie?

3- The age difference between two brothers is 8 years. The sum of their ages is 98. What is the older brother's age?

4- The length of a rectangle shaped garden is 4 feet greater than 2 times the width. The perimeter of the garden is 31 feet. Find:

- The length of the garden
- The width of the garden
- The area of the garden

Independent practice

Polypad link => polypad.org/u416BbsuCqYo6A

3 small vases and one large vase hold 6 liters of water. If you poured one large vase into a small vase and filled it,
you would still have 2 liters of water left in the large vase.
How much water can a large vase hold? What about a small vase?

Use the scale to model the problem. Set up a system of equations and solve it by elimination.

Lesson 4

Subject	High School Math
Lesson Title	Modeling problems related to systems of linear equations
Standards	• CCSS.Math.Content.HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • CCSS.Math.Content.HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
Learning goals	• Students will develop an understanding of how systems of linear equations can be used to model and solve real-world problems in various fields of their everyday life. • Students will make an informed decision by using systems of equations to analyze real word situation.

Project Title: Lease a car vs. Buy a car

Procedures: Day 1

- The teacher will assign the project to the students individually after students have mastered solving systems of equations.
- After receiving the project instructions students will be provided with individual Chromebook to do their research.
- Students will be given 35 minutes after the teacher's explanation to research, gather data and write their systems of equations
- After researching during class time students will be allowed to continue working on their projects at home. In this manner they can have more access to materials to help better design the project. Students will be encouraged to visit dealerships to ask questions regarding the different options they offer.

Day 2

- Students will share their project with two friends and each one of the friends will make respectful comments and suggestions about the project using colorful sticky notes to mark what they would change and not damage the projects. (20 minutes, each project 10 minutes)
- Students will be given the last 25 minutes of the class to edit their classmates' suggestions and answer the following to questions:

    1- What is one thing that you changed in your project after peer review and why?
    2- What is one thing that you kept the same after the peer review?

- Projects are due at the end of the class.

Project Introduction (for students)

Systems of linear equations can be applied to various real-life scenarios, including financial decision-making. One commonly used approach is to utilize these equations to compare different situations. In this project, we will examine the cost and benefits of renting versus buying a car, using linear systems of equations to compare the expenses associated with each option.

Assignment:

- Decide what car model you would like to rent or own.
- Gather information and collect data from rental companies and car selling companies such as Toyota, Honda, Ferrari, depending on the car make you chose, through their websites for monthly cost of renting and buying the car
- Gather information on how much will car insurance cost for each scenario.
- Write a system of linear equations to represent each scenario.
- Make a graph to model each one of your equations
- Solve your system by using any of the methods you prefer if you can rent the car for 5 years and assuming that you want to pay off the car in 5 years if you buy it.
- Display your project on a creative way.

Grading Rubric

	4 points	**2 points**	**0 points**
Data collected	The data collected is accurate and is cited correctly at the end of the project	The data collected is not all accurate nor is it fully cited	The data collected is not accurate and is not cited correctly at the end of the project
Equation's accuracy	Both equations are formulated correctly	One of the equations is correct only	Both equations are wrong
Graphing representation	Both lines are correctly graphed and the graphs are labeled	One of the lines is not correctly graphed	Both equations are not correctly graphed
Algebraic solution and explanation	The system of equations is correctly solved	There are calculation mistakes in the solution of the system	The solution is completely wrong
Organization and neatness	The final project is written in an organized and neat manner, easy to read and understand	It is possible to read the project and the work is not messy	The project is hard to read and disorganized

Classroom Implementation

This curriculum was taught in two classrooms, one Algebra 1 class and one Algebra 2 class during the same time of the school year. The reason behind it is because both Algebra 1 curriculum and Algebra 2 curriculum have a chapter of solving systems of equations and it would be beneficial to compare how the two group ages performed. After the implementation of this project and discussing the results with my collogues we created a list of things that worked really well and a list of things that need to be improved for the project to better help students understand the topic and that other teacher who will use this project in their classroom should focus on and change beforehand.

- Things to change

1- Question 1 in lesson 1 worksheet should be modified. The students were confused as to how can h=-3.6 where h represented hours. If the solution to the systems was a different answer, positive numbers, students would have reasoned easier and would have made more realistic sense to them.

2- The graph provided in the exit ticket in lesson 1 should be modified because the intersection of the lines was outside of the graph. Meanwhile students were solving this question, they created a new coordinate system in a separated sheet to fit the answer.

3- In lesson 2, question 3 could have been replaced or rephrased because it does not fall in the category or real-world applications.

- Things that worked well

The rest of the project worked good and students were interested and fully engaged. The part that stood out for me and my coworkers is lesson 4. The algebra 2 class was very excited to partake in that project because the majority of them are turning 16 soon and they will be able

to drive a car. This lesson would have been even more interesting if students were required to go to dealerships and ask gather data in person. It would have been a good experience for them.

Conclusion

Real world connections are one of the most important parts of learning and teaching mathematics. Throughout my years of education to become a teacher I have been told many times from all my professor that incorporating real world into mathematics and vice versa is a great way to increase students understanding. However, few education professors focus on giving examples and ideas as to how can educators use these authentic real-world connections in secondary mathematics classroom. This curriculum project was designed to help and give teachers a break from having to find and come up with creative ways to engage their students. Another reason for creating this curriculum is to bring all of the educator's attention to real world application of mathematics. Through this curriculum I hope to give ideas as to how teachers can build skills, transfer formulas and calculations into solving real world situations through collaboration, communication and independence.

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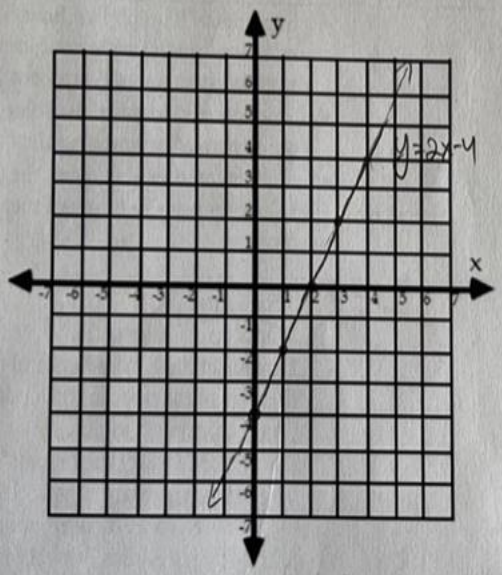
Appendix

Warm up Activity

1. Graph 2x-y=4 in the grid provided bellow. (Name your line)



$2x - y = 4$

$-y = -2x + 4$

$y = 2x - 4$

$m = \frac{2}{1}$

$b = -4$

2. Kristi charges a flat fee of $4 and $5 per hour for babysitting one child. If she is babysitting two children, she charges $8. Write an equation for the cost, x, after y hours of babysitting one child. Write an equation for the cost, x, after y hours of babysitting two children. What do you think the slope and the y-intercept represent in each case?

$x = 4 + 5y$ → one child

$x = 4 + 8y$ → 2 children

The slope represents the price per hour.

y-intercept represents the flat fee

Worksheet

1. The temperature in Scarsdale, NY started at -10 °C and rose 2 degrees every hour. The temperature in Utica NY started at -16°C and rose 1 degree every 3 hours. Convert degrees in Fahrenheit given the conversion formula F=C*(9/5)+32. Students can use graphing calculators.

Fill in the gaps

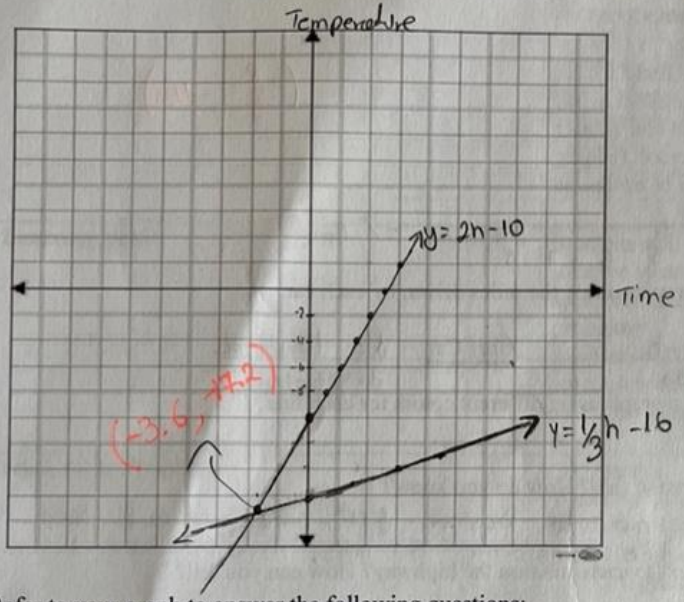
Scarsdale
m= 2
b= -10
equation: T = 2h-10

T=-10 when h=0
T=2h-10

Utica
m= 1/3
b= -6
equation: T = 1/3 h - 16

T=-16 when h=0
T = 1/3 h + b
T = 1/3 · 0 + b
-16 = b

Graph each line, Label x-axis with time and y-axis with temperature



h=-3.6

Refer to your graph to answer the following questions:

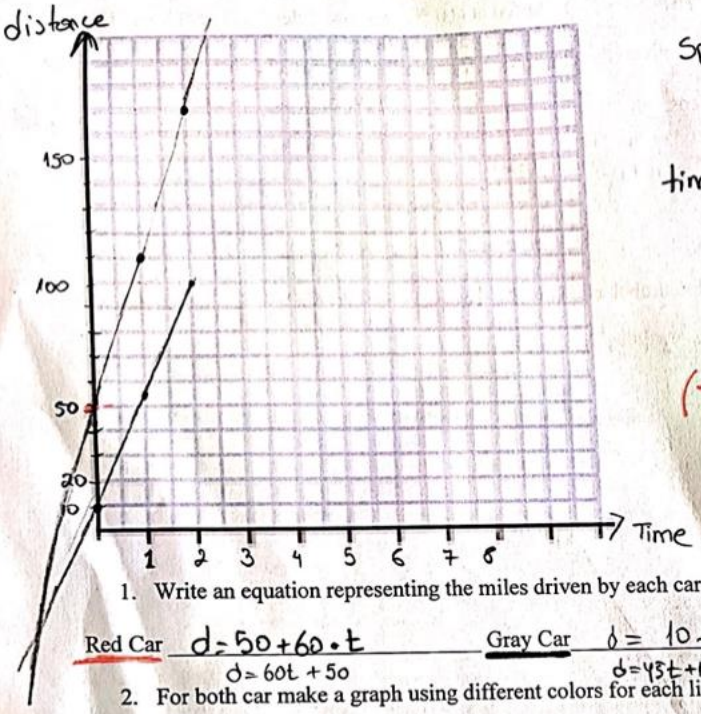
1. After how many hours the temperature will be the same? -3.6 hours but we cannot have negative time.
2. What is this temperature in degrees? — DNE
3. Write the solution to the problem as a ordered pair? (-3.6, -17.2)
4. What would mean for this problem to have no solution? The temperatures in the two cities will never be the same.
5. What is this temperature in Fahrenheit ? ↳ — DNE

Temperatures will never be the same

The teacher will have a whole classroom discussion and will solve/ model this question on the board to clarify any misconceptions she/he noticed during group work.

Exit ticket/ Assessment (Independent work)

Mr. Albert and Mr. Noah are both taking a road trip to Boston. Mr. Albert, in his gray Toyota, started 50 miles from Scarsdale and drives at an average speed of 60 mph. Mr. Noah in his red Honda, started 10 miles from Scarsdale and drives at an average speed of 45 mph.



Speed = $\frac{\text{distance}}{\text{time}}$

time = $\frac{\text{distance}}{\text{speed}}$

$\left(\frac{-8}{3}, -110\right)$

1. Write an equation representing the miles driven by each car.

Red Car $d = 50 + 60 \cdot t$ $d = 60t + 50$ Gray Car $d = 10 + 45 \cdot t$ $d = 45t + 10$

2. For both car make a graph using different colors for each line.

3. Who will get to Boston first? How do you know?

Albert will get to Boston first, since he will take only 1 hour to cover the remaining 60 miles.

4. Will the cars be next to each other on the highway? How can you tell?

They will meet each other after 2 hours and 40 minutes (8/3).

Warm up
What is the value of:

1. $3b - 10a$ when a= (-3) and b=20?

$3(20) - 10(-3) = 60 + 30 = \boxed{90}$

2. $-10x + 4y$ when x=(-3) and y=5

$-10(-3) + 4 \cdot (5) = 30 + 20 = \boxed{50}$

Simplify

3. $a^2 + b^2 = c^2$ when $a = 10, b = 2x - 3$ *and* $c = x$

$(10)^2 + (2x-3)^2 = x^2$

$100 + 4x^2 - 12x + 9 = x^2$

$\boxed{3x^2 - 12x + 109 = 0}$

Teacher instruction/ modeling of substitution.

Noah went to the store to buy plums and peaches to make jam. The number of plums he bought is 3 times more than the peaches. The plums cost \$0.75 each and the peaches cost \$0.80 each. If the total amount of moneys he spent is \$18.3 how many peaches did Noah buy?

plums = x
peaches = y

$$\begin{cases} x = 3y \\ 0.75x + 0.80y = 18.3 \end{cases}$$

$0.75 \cdot 3y + 0.80y = 18.3$

$2.25y + 0.80y = 18.3$

$3.05y = 18.3$

$y = 6$ $\quad x = 17$

He bought 6 peaches and 17 plums.

Worksheet (groups of 4)

1- A coffee shop sells coffee and hot chocolate. A customer orders 3 cups of coffee and pays $8.75. Another customer orders 2 cups of hot chocolate and 1 cup of coffee and pays $5.25. What is the price of a cup of coffee and one cup hot chocolate? (Round to the nearest cent)

1 hot chocolate

coffee = x

hot chocolate = y

$y + 3x = 8.75 \rightarrow y = 8.75 - 3x$

$2y + x = 5.25$

$2(8.75 - 3x) + x = 5.25$

$17.5 - 6x + x = 5.25$

$-5x = -12.25$

$x = 2.45$

$y = 8.75 - 3 \cdot 2.45$

$y = 1.4$

Answer: A cup of coffee costs $2.5 and a cup of hot chocolate costs $1.4.

2- Teacher 1, teaches math and charges a flat rate of $50 for traveling to the students' homes plus $75 per hour of work. Teacher 2 also teaches math, charges a flat fee of $75 plus $60 per hour of work. If a student needs to meet with the teacher and study for two hours which teacher would cost him less money to work with? How many hours does he need to study for, for the teachers to cost the same?

Teacher 1: $50 + 75x = y$

Teacher 2: $75 + 60x = y$

$50 + 75x = 75 + 60x$

$15x = 20$

$x = \frac{4}{3} = 1\frac{1}{3}$

$50 + 75 \cdot 2 = 200$ T.1

$75 + 2 \cdot 60 = 195$ T.2

The second teacher would charge him less for 2 hours of work. Both teachers would charge him the same for 1 hour of 20 min of work

3- Angel X and Y are supplementary angles. Angles X is 4 times larger than Angle Y. What is the measure of the X and Y?

$\begin{cases} x + y = 180 \\ x = 4y \end{cases}$

$4y + y = 180^\circ$

$5y = 180$

$y = 36$

$x = 144$

Exit ticket/ Assessment

1- Noah has a total of 46 puzzles. He only has animal and fruits puzzles. He has 20 more animal puzzles than fruit puzzles. How many animal and fruits puzzles are there?

animal → a

fruit → f

$\begin{cases} a + f = 46 \\ a = f + 20 \end{cases}$

$f + 20 + f = 46$

$2f = 26$

$f = 13$

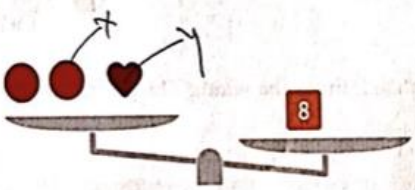
$a = 33$

Lesson 3

Teachers example used during instruction

Polypad link =>. polypad.org/v8D281Ep1FWZw

Write a system of equations with the given two scales and solve by elimination



$$\begin{cases} 2x + y = 8 \\ 2x + 2y = 12 \end{cases}$$

$2x + 4 = 8$

$2x = 4$

$x = 2$

$0 - y = -4$

$y = 4$

Answer

● = 2

♥ = 4

Guided practice (Feel free to use the scale on polypad to help solve the system)

1- A pet store sells dogs (d) and cats (c). They have a total of 30 animals and the total cost of the animals is $400. Dogs cost $20 each and cats cost $10 each. How many dogs does the pet store have?

$$\begin{cases} d+c=30 \\ 20d+10c=400 \end{cases} \xrightarrow{\times -10} \begin{cases} -10d-10c=-300 \\ 20d+10c=400 \end{cases}$$

$$10d=100 \quad \frac{10d}{10}=\frac{100}{10} \quad d=10$$

There are 10 dogs in the store

2- Tickets to a movie cost $4 for adults and $3 for students. A group of friends and their parents purchased 15 tickets for $53. How many adult tickets where there? How many students went to see the movie?

adult → a
student → s

$$\begin{cases} a+s=15 \\ 4a+3s=53 \end{cases} \xrightarrow{\times -3} \begin{cases} -3a-3s=-45 \\ 4a+3s=53 \end{cases}$$

$a=8 \quad s=7$

There were 8 adults and 7 students

3- The age difference between two brothers is 8. The sum of the ages is 98. What is the age of the older brother?

$$\begin{cases} x-y=8 \\ x+y=98 \end{cases}$$

$2x=106$

$x=53$

$53+y=98$

$y=45$

4- The length of a rectangular garden is 4 feet greater than 2 times the width. The perimeter of the garden is 31 feet. Find:

- The length of the garden.
- The width of the garden.
- The area of the garden.

$$\begin{cases} l=4+2w \\ 2l+2w=31 \end{cases} \rightarrow \begin{cases} l-2w=4 \\ 2l+2w=31 \end{cases}$$

$$\frac{3l=35}{3} \quad l=11.7$$

$11.7=4+2w$

$7.7=2w$

$w=3.83$

$A=l \cdot w$

$=11.7 \cdot 3.82$

$A=44.81 \text{ ft}^2$

The area of the garden is 44.81 ft^2

Independent practice

Polypad link => polypad.org/u416BbsuCqYo6A

3 small vases and one large vase hold 6 liters of water. If you poured one large vase into a small vase and filled it,
you would still have 2 liters of water left in the large vase.
How much water can a large vase hold? What about a small vase?

Use the scale to model the problem. Set up a system of equations and solve it by elimination.

Small vase = s

large vase = ℓ

$$\begin{cases} 3s+\ell = 6 \\ \ell = s+2 \end{cases} \Rightarrow \begin{cases} 3s+\ell=6 \\ -s+\ell=2 \end{cases}$$

$4s = 4$

$\boxed{s=1}$

The small vase can hold 1 liter and the large vase can hold 3 liters