Carshop!

Summary

Students go car shopping online, investigate the relationship between variables such as interest rate and monthly payment, develop two payment plans using online loan calculators, write a slope-intercept equation for each plan, and create a graph and table for the equations using a graphing calculator.

Main Core Tie

Secondary Mathematics I

Strand: ALGEBRA - Reasoning With Equations and Inequalities (A.REI) Standard A.REI.11

Additional Core Ties

Secondary Mathematics I

Strand: ALGEBRA - Reasoning With Equations and Inequalities (A.REI) Standard A.REI.10

Secondary Mathematics I

Strand: ALGEBRA - Reasoning With Equations and Inequalities (A.REI) Standard A.REI.6

Time Frame

5 class periods of 45 minutes each

Group Size

Small Groups

Materials

- computer lab with the Carshop! Student Page bookmarked
- one web quest instruction sheet and assessment rubric per student
- graphing calculators (if unavailable click link for web site listed below)
- one poster board and sheet of graph paper per group
- scissors
- glue
- markers
- construction paper (optional)

Background for Teachers

Although this lesson was designed for students who already have problem-solving experience with real-world linear situations, it could be adapted to introduce linear equations to students.

Student Prior Knowledge

To complete the lesson as written, students should have some experience in recognizing a linear situation; creating a graph, table, and slope-intercept equation for a real-world linear situation; relating the rate of change in the situation to slope; and relating the initial conditions to y-intercept. Students should also be able to use a graphing calculator to choose an appropriate window, graph linear equations, and find a point of intersection.

Intended Learning Outcomes

- Cooperatively and independently explore mathematics, using inquiry and technological skills.

Make connections from mathematical ideas to life.

Instructional Procedures

Day 1: Shopping

Mathematical Goal:

Investigate and communicate about the relationship between several variables

Preparation:

Check with your school's computer lab personnel ahead of time to temporarily override any filters that will keep students from accessing the sites in this web quest. Also have them bookmark the Carshop! Student Page on each computer.

Students should be in groups of two or three.They will need to decide together on one car to buy.

Introduction:

Present students with the following situation and task:

"Within the next year or two you will probably have a driver's license. One thing leads to another and sooner or later it will be time to buy a car. What can algebra do to prepare you for this exciting event? Let's go car shopping and find out! You will be granted a loan for your first car--woohoo!--if you can convince the loan officer that you are not a poor financial risk. To prove that you are financially wise beyond your years you must study two payment options, choose the smartest one, and explain your reasoning. If you do not succeed, your loan will be denied, so judge carefully."

Give each student a web quest instruction sheet. Have them open the Carshop! Student Page on their computer. It's an abbreviated version of the web quest instructions that will allow them to click on necessary links.

Activities:

First they will choose a car at http://www.cars.com/go/index.jsp. and print a vehicle summary which includes purchase price.

Next, by playing with interactive dashboard dials, they will investigate variables (such as term and interest rate) which influence how they will pay for their car.

http://www.lendingtree.com/common/bp/autotrader4/autohowmuchcalc.asp?

Circulate among groups of students and ask questions such as, "What happens to the variable 'loan amount' if you increase the variable 'monthly payment'?" Or depending on the student, a more open-ended question such as "What are some of the variables that influence how you pay for your car? How do these variables affect each other?"

Note: Depending on how and when you ask the question about what variables affect car payment, students may respond with: the options you choose, what kind of transmission, leather seats, etc. Acknowledge that these are indeed variables; they affect the total purchase price of the car. Then redirect them to the variables that affect a payment plan (see the red dashboard dials).

Day 2: Exploring Payment Plans

Mathematical Goals:

Continue to investigate the relationship between variables

Create two payment plans for car purchase and write a slope-intercept equation for each plan

Preparation:

Make sure computer lab is ready.

You may want some printed copies of the loan application to send home with slower students.

Introduction:

Present students with the following task:

"Yesterday you chose your dream car; today you will figure out how to pay for it."

Discussion:

Take two or three minutes to ask students what variables will influence how they pay for their car.

Ask them what they noticed about the relationships between variables.

For example, they may say they noticed when they lengthen the term from 12 months to 72 months the monthly payment is a lot lower.

Ask how many different options there are for payment plans.

(Probably lots and lots since you can change different combinations of variables and there are many possible values for each variable.)

Tell them that today, to simplify things, they will be limited to controlling only two variables: price of car and down payment.

You may wish to ask, "How did you have control over the variable of car price?"

(We chose the type of car, we chose the options, those were all variables.)

Activities:

First, students will use the auto loan calculator at this link to create and print two payment plans for the car they have selected: http://www.lendingtree.com/stmrc/java/AutoLoan.asp?bp=autotrader4

Circulate among students.

To make the math more interesting, encourage them to choose a plan with a large down payment and a plan with little or no down payment.

Second, students will explore three purple graphs on the loan calculator.

As you circulate, ask them what they learned from each of the purple graphs.

Third, students fill out but DO NOT SUBMIT a loan application at this site. They should print a copy of the application. https://www.capitaloneautofinance.com/Loan/ApplyNow/LoanApp.aspx?

Note: The order of activities 4 & 5 on the web quest instructions can be reversed. You may wish to have slower students skip to writing equations after printing their two payment plans. You may want to give these students a printed copy of the loan application to complete at home, or you may have them omit the loan application altogether. (It is not important to the mathematical goals of the lesson. It is intended as a piece of lifelong learning.) Faster students may complete the loan application online as instructed and then write the equations (on day three if necessary).

Fourth, students write a slope-intercept equation for each of their two financing plans.

As you circulate you may ask questions such as:

"Is there an amount in this situation that is paid only once?" (to help struggling students identify the initial conditions, y-intercept).

"What is the rate of change in this situation?" (slope, $/month).

"What will the variable y represent in your equation?" (total paid)

"What will the variable x represent in your equation?" (number of months)

Note: Some students may not write their equations until day three--hopefully these are the faster students who took time on day two to complete loan application.

Day 3: Evaluating and Choosing a Payment Plan

Mathematical Goals:

Communicate the meaning of a slope-intercept equation

Make a graph and a table for a linear situation

Find the solution to a system of equations graphically or by looking at a table

Read values from a table or graph and interpret the meaning of the values by connecting them to a real-world situation

Preparation:

Make sure graphing calculators and graph paper are available.

This part of the lesson may take place in a regular classroom, but you may wish to stay in the lab to use an online graphing calculator at http://www.coolmath.com/graphit/index.html (If you do not have graphing calculators, students may graph by hand, but it's messy with slopes such as $273.64.)

Students who know how to create a spreadsheet may transfer the table from their calculator to a spreadsheet rather than writing it out by hand.

Introduction:

Present students with the following task:
"It's time to organize and analyze the data you've collected. Once you have completed a graph, table, and equations for the two payment plans. You will study them to figure out which payment plan to choose. Tomorrow, you will use your graph, table, and equations to justify your choice to the loan officer."
Discussion:
If all groups finished equations yesterday, you may take some time to discuss as a class how they came up with their equations and what they mean.
Activities:
First, students will finish writing equations if not done on day three.
Second, they will use a graphing calculator to create a table and graph of the two plans.
Third, they will use their calculators to find the point of intersection of the two lines.
Fourth, using the y-intercepts and the point of intersection to guide them, they will transfer their graphs to graph paper. (This will go on a poster; they should make it large.)
Fifth, they will transfer their tables to paper or spreadsheet and print. (Should also be large.)
Hint: have students set calculator table for x=6, 12, 18, 24...60.
Sixth, students will prepare to visit the loan officer by thinking about the data they have collected.
Have them discuss the questions on their web quest instructions with their group and record their responses on the paper.
Circulate and discuss the questions with them.
Seventh, students will choose a payment plan and be prepared to defend it.
Encourage them to come up with a good argument for their choice. Point out that they can use their graph and table as visuals to help communicate effectively. They can also use the equations to prove their point. Ask them how they can use these tools. For example, they could substitute 60 months for x in each equation and show that one equation produces a greater y (total paid) than the other.
Day 4: Defending a Payment Plan
Mathematical Goal:
- Communicate effectively about mathematical reasoning and proof
- Use multiple representations to enhance communication about mathematics

Preparation:
Make sure materials for creating posters are available.
Also hand out Carshop! Rubric.
Introduction:
Present students with the following situation and task:
"The moment of truth has arrived. The loan officer will evaluate your financial and mathematical knowledge to decide whether or not to approve you for a loan. Make sure your data is well-presented and be prepared to explain your thinking. You will make a poster that you will use to present the two payment options to the loan officer. This will help explain why one plan is better, and convince her that you are a safe risk for her company. You will also share this poster with the class."
Activities:
Students will assemble their posters according to the web quest instructions.
As they work, circulate among them discussing main ideas from the lesson.
When a group finishes or gets close to finishing, you can use your discussion as a final assessment.
You may even fill out their rubric. This will be their visit to the loan officer.
Make note of interesting ideas or visuals shared by students and incorporate them in tomorrow's class discussion.
If you don't get around to all groups the remainder can turn in their web quest instruction sheet and you can read their conclusions and reasoning.
You may have students hang posters or ask them to share a particular aspect of their poster

tomorrow during the wrap-up discussion.
Ask groups who finish extra early to come up with questions about their Carshop! Poster to ask other class members tomorrow.
For example, "Use our equations to find out how much we will end up spending with each financing plan." (Students will need to put 60 in for x, number of months, and evaluate the equation.) Or, "By which month will we have paid a total of $9,350.78?" (Substitute for y, solve for x.) "Our car cost _____; how much interest will we be paying with each plan?" (Subtract car price from the 60 month amount shown on graph and table.)
Day 5: Whole Class Discussion
Mathematical Goals:

- Communicate effectively about mathematical reasoning and proof
- Use multiple representations to enhance communication about mathematics
- Draw conclusions about how loans and interest work based on equations, graphs, and tables

Preparation:
Know which students you would like to present ideas and in what order so that the ideas build on each other.
Discussion:
Ask questions about any of the material from the web quest activity for which students need reinforcement. Use student examples and explanations as much as possible to clarify concepts for other students.
The main part of the discussion should be about why students chose a particular payment plan, how they were able to distinguish the best plan, multiple representations and strategies for finding the best plan. Once again invite as many students as possible to come up front or to share ideas from their seats.
Sample Questions:
Were students surprised that the total amount paid was different under each plan even though the car was the same?
Why were the totals different?
How many months did it actually take to pay for the car itself? What was all the extra money for?
Why doesn't everybody make a large down payment to save on interest?
What about paying cash for the car?
Extra Questions:
How long is your 60 month line? What portion of its length represents the price of the car? What portion of its length represents interest?
Thinking of the red dashboard calculators or purple graphs: The relationship between which variables is direct variation? The relationship between which variable is inverse variation?

Authors

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