"Tired of the Same Old Test Questions?" Incorporating Graphing Technology Into Assessment

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Description

In this paper, we will introduce different methods for incorporating graphing technology into the testing process. We will address assessing student knowledge in the use of the graphing calculator, as well as using calculator generated images on exams to give students "visual" supplementation to problems.

Abstract

With the growing use of graphing calculators in the classroom, there is a need for change in the methods used for testing students. Until recently, the design and implementation of tests which incorporated graphing technology was difficult and time consuming. However, the development of computer programs such as TI-Interactive has made this task easier for the instructor. This paper will address different methods for integrating graphing technology into standard student assessment.

Do you find that you teach using the calculator and then test using the same old types of problems?

Graphing calculator-based problems are generally more difficult to produce and definitely more time consuming. Also, non-calculator problems typically work well for some objectives, so balancing the two types on an exam can be interesting. As graphing calculators are used more often in class to enhance learning, instructors may be inclined to include calculator problems on the quizzes and exams. This brings about the problem of creating feasible questions for assessment.
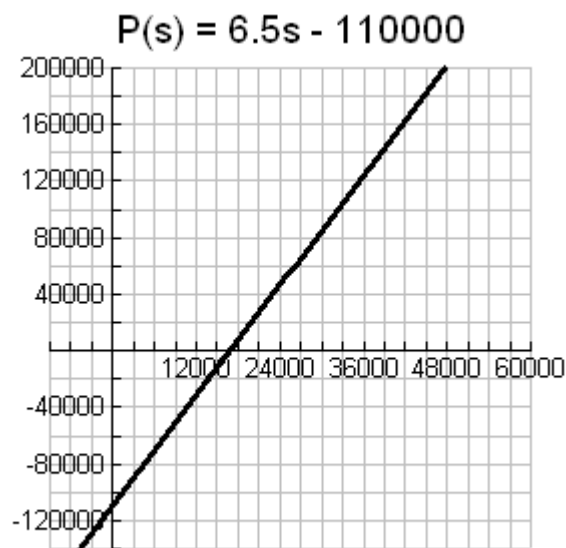
One concern of instructors who incorporate graphing calculators into the classroom is the ability of the student to understand and have a working knowledge of the calculator. In order to assess your students' knowledge, a quiz covering use of the calculator should be given early in the semester. Students should be aware of how to use the basic graphing menu, including changing the window and using the table. They should also be able to replicate basic graphs, such as a cubic function and an absolute value. At some point, students should also be made aware of the "families" of graphs so that they have an idea what the picture should look like before they look at the graph. A handout of the parent functions can easily be created using TI Interactive.

Making Connections

Using the graphing calculator to make connections between algebraic and visual learning has been one of the goals for using technology in the classroom. Students tend to make better connections if they can visualize what is occurring in a problem as well as being able to "solve" for a solution.
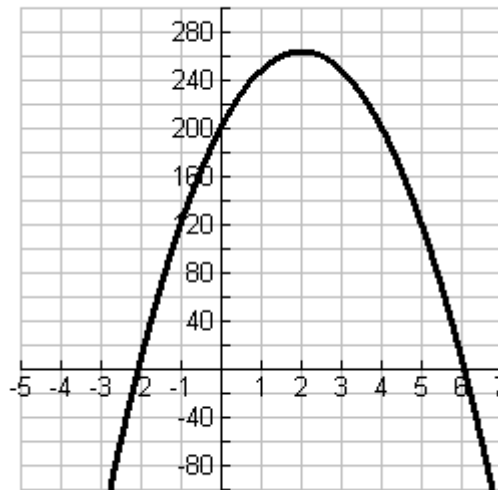
Examples of Connections

Finding the x-intercept(s) of a linear function or a quadratic function: When looking at a graph of an application problem, the first items we should point out are the units for the x-values and the y-values. Many students are still thinking in terms of x and y instead of real-life units. The x-intercept has more meaning for a student if they are trying to find how many products should be produced in order to break even in a profit situation. Even though we can use the polynomial solver to find these solutions, the graph gives a visual effect of where the profit is negative (a loss) and where the profit is positive (a gain).   The following graph illustrates the profit function

$$P(s) = 6.5s - 110000$$

Another example that can be use to help make the connection between points on the graph and a real-life situation is the projectile function. The y-intercept and the x-intercept take on new meaning if they can be approached as the initial height of the object (before it is thrown or dropped) and the time at which the object hits the ground. This is also a good time to bring in domain and range. For example, does y = -3 have any meaning here? It is much easier to connect the vertex as a maximum point if the
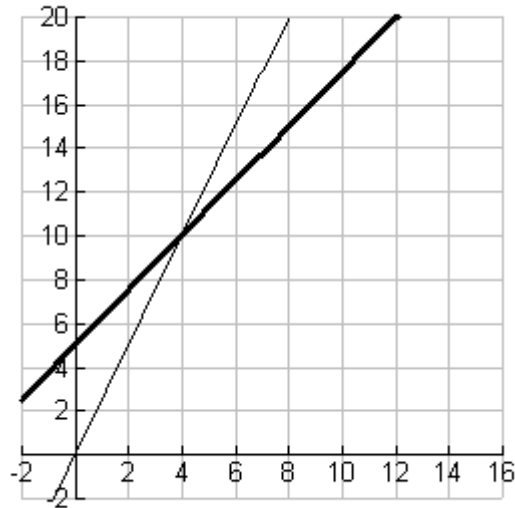
student can see this point on the graph. Of course, by using the calculator and the graphing menu (the calculate menu), the values for these points are easier to obtain than if calculated algebraically.

$$h(t) = -16 \cdot t^2 + 64 \cdot t + 200$$

Inequalities also fall into the category of making connections between algebraic problems and graphing. Many inequalities are set up to compare two plans of action. A popular question to introduce this idea concerns Bar A which has a cover charge of $5 but the beer is only $1.25 versus Bar B which has no cover charge and charges $2.50 per beer. Let x = the number of beers you drink and then y = cost to drink at that bar. After discussing which bar is better for you and your friends, the students come to the conclusion that at some point, they are equal. Solving algebraically, they find that at 4 beers, the cost is the same for both bars. Graphing the two equations on the same set of axes, we see that the point where both have the same cost is the intersection of the two lines. To introduce the idea of inequality, you can use the trace function to show the cost of 2 beers for each bar and then 5 beers for each bar. This helps them to see

that if you drink less than 4 beers, Bar B is the better deal (the cost is less) and after 4

beers, the inequality is reversed and Bar A is cheaper.
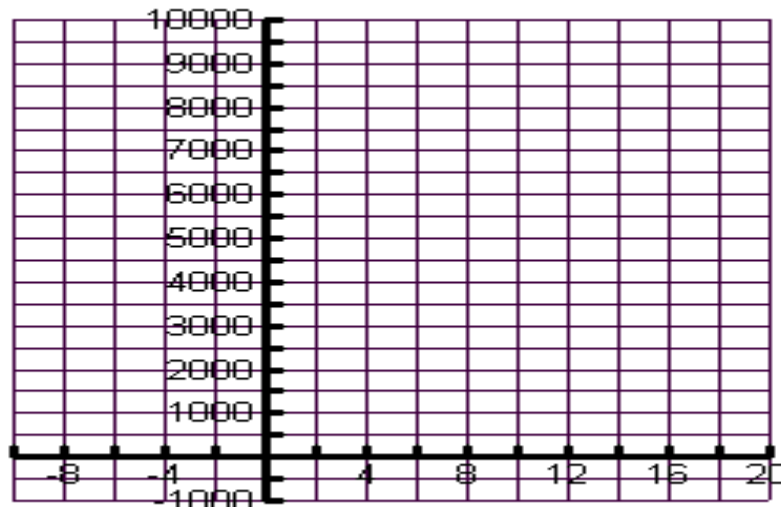

Designing Test Questions

When designing test questions, you should first decide if you wish to test the

students' knowledge of graphing or if you really wish to test their understanding of the

graph itself and the significant ordered pairs that we find there.

TI Interactive makes it easier to create different types of assessment questions.

You could create matching questions where the student matches the appropriate

window to each picture. Another suggestion is to give the students the equation and

then have them sketch the graphs using different window settings to find the "most

complete" picture of the graph. This enables them to see that the picture changes with

a change in the window settings.

If you are testing their ability to replicate a graph, then using a sketch of the

coordinate system may be appropriate. Including scales on the axes will help the

student to set the window accordingly on their calculator. This allows you to move away

from graphing the "simple" equations that fit on the standard window to graphing any

equation on an appropriate window. For example, sketch the graph of

$f(t) = 2000 \cdot e^{(0.14 \cdot t)}$

        If testing their ability to find information from a graph (application-type problems),

It is more convenient to give the formula <u>and</u> the graph so that they can recreate the

graph on their own calculators in order to use the calculate functions and the table to

answer questions. For example,

If $f(t) = 2000 \cdot e^{(0.14 \cdot t)}$ models the population of a town t years after 1985, the following
questions could be posed.

       a.   Find the population in the year 2000. (The student could use the table

             or the trace function to answer the question).

       b.   When will the population reach 5000? (The student could graph the

             equation and y = 5000 then find the intersection.)

Summary

The use of TI Interactive has made it easier to incorporate graphing calculator based questions on quizzes and test. These problems assess the students' comprehension of an application rather than testing their ability to graph. By using the graphing calculator in the classroom and on assessments, instructors can move away from creating tables and plotting points to making visual connections which enhance comprehension.