Tools for Teaching Mathematics; Math Educational Software

An Honors Thesis (HONRS 499)

by

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Abstract

This project is a compilation of evaluations I conducted of eight technology tools that are useful for teaching mathematics. The evaluations identify the National Council of Teachers of Mathematics and the Indiana Department of Education mathematics standards addressed by each of the technologies. Also included in the evaluations are positive and negative attributes of each technology and sample activities that I have found to be useful in the mathematics classroom for the various programs. The main objective of this thesis is to inform the reader about some of the various mathematical educational technologies available for teaching mathematics and to help teachers make informed decisions about ways in which technology use can be incorporated into the mathematics classroom.
Acknowledgements

- I would like to thank my parents for supporting all of my endeavors, academic or other. I love you both very much.

- I owe The Ball State Mathematics Department a great deal of gratitude for allowing me access to the software programs needed to complete this project. Without their cooperation, this project could not have been completed.

- I also would like to thank Dr. Elizabeth Bremigan for taking on the role of my advisor and for giving her guidance and support throughout the process of this thesis.
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Introduction

This project is a collection of evaluations of various types of technology for the mathematics classroom. There are many reasons that I chose this topic for my senior thesis. One of the reasons that I chose this topic is because I felt it was something that, when finished, could be very helpful to any mathematics teacher. As a mathematics education major, I was required to take a class titled ‘Using Technology in Mathematics Education.’ In this class we were able to touch on some of the software programs that I used in my project, but I wanted to examine the software in depth. The opportunity to complete an honors project gave me the chance to learn more about something in which I was already interested. The major reason I chose to do my honors project over educational mathematics technologies is that I am going to be a math teacher, and I felt that by completing a project on this topic, I would be better prepared to incorporate these types of technology into my classroom. This topic is one that is totally applicable to my career, and will help me to be better at it.

Not only will this project help me to become a better teacher, but it will allow me the opportunity to familiarize other teachers with these various technologies.
There are certain standards and principles outlined by The National Council of Teachers of Mathematics (NCTM) that apply to technology. Through this project I will not only attempt to meet those standards and principles myself, but I will be preparing other educators to attempt to achieve those goals as well. I will do this by sharing copies of my project with various colleagues. NCTM’s position statement, ‘The Use of Technology in the Learning and Teaching of Mathematics’ states: “Technology is an essential tool for teaching and learning mathematics effectively; it extends the mathematics that can be taught and enhances students’ learning.” By completing my thesis about educational software I will be much more adept at incorporating useful technologies into my own teaching, and also be able to share this knowledge with my colleagues. One of the recommendations of NCTM is that all mathematics teachers at every level should have access to different types of professional development involving mathematics technologies, and that technology should be a part of every day lessons. Thus, this thesis is professional development for me, and by including activities for each of the software programs, I am showing ways that technology can be incorporated into day-to-day instruction.
The major importance of this project is that it not only will introduce the teachers to the technologies, but hopefully it will help them to make informed decisions about which technologies would best suit their needs and goals for a particular lesson. NCTM’s 'Technology Principle' states: "The teacher must make prudent decisions about when and how to use technology and should ensure that the technology is enhancing the students' mathematical thinking." By identifying positives and negatives and linking the technologies to the standards teachers will be able to achieve these goals by using this thesis as a guide.

My goal is that after reading this project, an educator would be able to quickly tell which program or technology they think would work well with their lesson. Also, after reading this thesis, I hope that the reader could make some informed decisions about different mathematics technologies, and maybe even start to form some of his own opinions.
The Layout

I evaluated eight software programs for this project. Included in each evaluation is the type of program (instructional or practice), the standards met (NCTM and Indiana), and a list of positives and negatives for each piece of technology. Also included for each piece of technology is a sample activity or worksheet that could be used with each. The type of software, standards met, and positives and negatives are opinions that I developed after becoming very familiar with the technology. Any of the activities that are not original creations of mine have been cited. I created all of the activities that are not cited.

The standards addressed portion of each evaluation has the type of standard in bold (NCTM or Indiana Standards). Beneath the type of standard is an underlined heading. This heading lists the general standards addressed. Below the general standard is at least one bulleted statement. The bulleted statements are italicized and are the more specific aspects of each standard. Following the bulleted items is a short description of how I felt the technology addressed that particular standard.
Data Explorer

Manufactured by- Sunburst Communications, Inc.
Copyright- 1998
Version- 1.1
Use- practice

Overview
When first opening the software the user has the choice of making a survey or analyzing data. The most useful part of the software is the analyzing data portion. Students can choose between exploring category data, using category data, exploring number data, using number data, and using mixed data. Once the student has chosen what he wants to do, he will need to enter the data in a spreadsheet, or what the software calls a datasheet. After entering the data students can make various graphs including stem-and-leaf plots, Venn diagrams, box plots, line plots, histograms and more. This software also can make important calculations, such as finding the least-squares fit line and the equation of that line.

NCTM Standards
Measurement
- Understand measurable attributes of objects and the units, systems, and processes of measurement
  - Make decisions about units and scales that are appropriate for problem situations involving measurement

This standard and expectation are addressed in every aspect of the software. Once a group of data has been graphed, the student can change the units and scales of the graph to something that may be more appropriate depending on the data set.

Data Analysis and Probability
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
  - Know the characteristics of well-designed studies, including the role of randomization in surveys and experiments

This standard and expectation is addressed by the 'survey' portion of the software. As students use the software and
take more and more surveys, they will learn what characteristics helped make the survey more successful than a previous one or vice versa.

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
  - Understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable

This standard and expectation must be addressed before the students even use the software. Once the students decide they are going to use the ‘Analyze Data’ portion of the software their next choice is going to be between number data and categorical data. If students do not know what the difference is they will not be able to effectively use the software.

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
  - Understand histograms, parallel box plots, and scatter plots and use them to display data

The software addresses this standard and expectation by allowing students the option to use these types of representations along with others to display data.

Problem Solving
- Monitor and reflect on the process of mathematical problem solving

This software contains a ‘notebook’ under each category. The notebook can be used by students to jot down anything that they think they might forget, or anything that they learned that might be helpful in the future. By giving students this ‘notebook’ the software is encouraging students to reflect on their work.

Representations
- Create and use representations to organize, record, and communicate mathematical ideas

This standard is addressed throughout the software because students are choosing which graphs best represent a data set.
Indiana Standards
Integrated Mathematics I, Standard 4

- Construct a line plot
- Find measures of central tendency for a set of data
- Construct a frequency table for a set of data
- Construct a scatterplot from a set of data
- Calculate the sum of squared difference for a set of data
- Plot the least squares regression line from a set of data

All of these standards are met by this software program. Many of them are met by the graphing capabilities of the software. Others are met by the fact that the software will calculate certain statistical values.

Positives

- Wide variety of representations
  Each section of the software, not including the survey portion, allows students to choose from a wide variety of graphs to display their data. This is a positive because it can help students to see and understand which graphs work best with which types of data.

- Survey section
  The ‘survey’ section of the software is a positive for many reasons. Students can create and give a survey using this software. Once the survey has been taken, the software will display all responses on a data sheet. These reasons make the ‘survey’ section a positive addition to the software.

Negatives

- Automatically rounds
  In the ‘use number data’ portion of the software numbers are automatically rounded to two decimal places. However, in the ‘use category data’ portion of the software the numbers are not automatically rounded.
• The Label Column
When entering a data set, I chose to have the years be the label for the other information, which seemed logical to me. However, this made it very difficult for me to view graphs the way in which I wanted. The label column doesn’t actually get graphed, so I would have to enter the years in as a variable if I wanted them to ever show up on an axis in the graph.
Data Explorer Activity Sheet

- This activity was adapted from one found on the website http://askeric.org/Virtual/Lessons/Mathematics/Statistics/STA0002.html. The activities were originally designed to be completed using a graphing calculator, however; I have modified them to be used with the Data Explorer software.

- This activity would be most useful in a statistics lesson or class.

- This sheet serves as a direction sheet and as a place to record answers.

- Included here is a blank copy of the activity sheet and print outs of what the students work on data explorer should look like. The program will not print all of the least-squares fit line, but the very end of it does print, and it shows up on the samples of student work.
Data Explorer Activity Sheet

Activity 1

High School and College GPA's

<table>
<thead>
<tr>
<th>Student</th>
<th>High School GPA</th>
<th>Freshman Year GPA</th>
</tr>
</thead>
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<td>2.00</td>
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<tr>
<td>11</td>
<td>3.25</td>
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</tr>
</tbody>
</table>

Let High School GPA be your x values and College GPA’s be your y values

1. Make a scatter plot of the data on data explorer.

2. Graph the Least-Squares Fit line.

3. Find the equation of the Least-Squares Fit line in the form y=mx+b

4. a) If you earn a 3.80 GPA in high school, predict what you would get in college for your Freshman year GPA.

   b) If a freshman in college got a 3.60 GPA, what would she have got for her high school GPA?
Activity 2

Chirping Frequency and Temperature for the Striped Ground Cricket

<table>
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<th>Cricket</th>
<th>Chirps/second</th>
<th>Temperature, °F</th>
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<td>76.3</td>
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</table>

Let chirps/second be your x values and temp, °F be your y values.

1. Make a scatter plot of the data on data explorer.

2. Graph the Least-Squares Fit line

3. Find the equation of the Least-Squares Fit line in the form y=mx+b

4. a) If you had a listening device and used it in the morning when you woke up and measured a striped ground cricket chirping at a rate of 18 chirps per second, how warm would you say the ground temperature is?

   b) If the ground temperature reached 95°F, at what rate would you expect those little guys to chirping?

This activity has been adapted from
Hyatt, David G., Solving Linear Regression Problems Using the TI83 Graphing Calculator, http://askeric.org/Virtual/Lessons/Mathematics/Statistics/STA0002.html. 11/14/02
### Title: High School and College GPA's

Description: Comparing High School GPA's to freshman Year of College GPA's

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Least-Squares fit

\[ y = 0.73x + 0.26 \]
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</tr>
</tbody>
</table>
Least-Squares fit

\[ y = 3.25x + 25.96 \]
The Factory Deluxe

Manufactured by- Sunburst Communications, Inc.
Copyright- 1999
Version- 1.2
Use- practice

Overview
Upon opening this software program a menu comes up asking for a first and last name. After entering those there is a menu where the user can choose between 'Build it,' 'Research it,' 'Try it,' 'Ship it,' and 'Deliver it.' The 'Build it' portion of the software has the user try to recreate a given shape. The 'Research it' portion of the software has the user attempt to minimize the machines used but still create the same shape. The 'Try it' section of the software is practice for the 'Build it' portion. The 'Ship it' portion of the software has the user group shapes by certain geometric qualities. Finally, the 'Deliver it' section of the software the users are playing a game against an opponent, the computer or a friend. The user will win by choosing the shapes with the largest area.

NCTM Standards
Number and Operations
- Compute fluently and make reasonable estimates

This standard is addressed in the 'Deliver it' portion of the software. When playing 'Deliver it' the students must estimate areas of certain shapes.

Geometry
- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
  - Analyze properties and determine attributes of two- and three dimensional objects

The software addresses this standard in the 'Ship it' portion of the exercises when the students are trying to determine what shapes have the correct characteristics to go in certain boxes. This standard is also addressed in the 'Build it' portion of the exercises when the students are trying to recreate the given shape with various tools. The students must understand properties of the given shape in order to correctly recreate it.
• **Specify locations and describe spatial relationships using coordinate geometry and other representational systems**
  
  - Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations

This standard is addressed in the ‘Deliver it’ portion of this software. In order to move as much as possible, and therefore be ahead of the opponent, the student must choose the shape that they think has the largest area. The students are given an ‘Estimator’ that is a Cartesian grid without the axes. The students can then use the ‘Estimator’ to decide which shape will give them the most moves forwards.

• **Apply transformations and use symmetry to analyze mathematical situations**
  
  - Use various representations to help understand the effects of simple transformations and their compositions

This standard is addressed in entirety in the ‘Build it’ portion of the software. The students must take a regular shape and try to rotate it, stripe it, and punch it in the correct places in order to make it look like the given shape.

**Measurement**

• **Apply appropriate techniques, tools, and formulas to determine measurements**

The ‘Ship it’ portion of the software addresses this standard. If students know the appropriate formulas for the areas of the shapes, they will easily be able to tell which shape has the largest area when aided by the estimator. For instance, the estimator could help the student get an approximation for the length of the base and height of a triangle. The student could then apply the formula and be able to compare the area of the triangle to the area of the other shapes.
Connections
  • Recognize and apply mathematics in contexts outside of mathematics

The software makes an attempt to address this standard by taking the form of a factory and showing where this particular factory would use mathematics in each of its departments.

Indiana Standards
Geometry
  • Apply transformations (slides, flips, turns, expansions, and contractions) to polygons to determine congruence, similarity, symmetry, and tessellations. Know that images formed by slides, flips, and turns are congruent to the original shape.

The students are doing this in the ‘Build it’ portion of the software. They must take an ordinary shape and make it appear as the given shape by rotating it, or altering its appearance in another way.

  • Identify and describe triangles that are right, acute, obtuse, scalene, isosceles, equilateral, and equiangular

The students have to sort triangles based on some or all of these qualities, among with other shapes in the ‘Ship it’ portion of the software.

  • Define, find, and use measures of circumference, arc length, and areas of circles and sectors, and use these measures to solve problems

The ‘Ship it’ portion of the software has qualifications for certain boxes that require the students to know these definitions and what they are on a given circle.

Positives
  • All ability levels
  This software can be used by all ability levels in a particular classroom. In the ‘Build it,’ ‘Research it,’ and ‘Ship it’ portions of the software the student can select a level from one to nine, with one being the easiest and nine being the most difficult. In the ‘Deliver it’ portion of the software the student must choose if they are going to play against
"C.B." a beginning computer, 'Mack' an expert computer, or a friend. The only portion of the software that does not cater to different ability levels is the 'Try it' portion of the software, which is not a negative because in that portion of the software the student is merely trying out different combinations of the machines from the 'Build it' portion of the software.

• Working with angles
The 'Build it' portion of the software is very good at getting students to become familiar with angles. In order to successfully build many of the shapes, the students must have a good concept of what a certain degree turn would do to a shape.

• Recognizing unnecessary operations
The 'Research it' portion of the software challenges students to see if they could build the desired shape with fewer machines than are given. This challenges students to see if they can recognize a way to use fewer operations, for example, recognizing where two rotations can be combined into one. I feel that this is a positive because it is another way to familiarize students with different ways to come up with the correct end result, which happens often in mathematics.

• Many different aspects of geometry
This software as a whole addresses many different aspects of geometry. 'Build it' deals with shapes and rotations, 'Ship it' works with different characteristics of the shapes, such as isosceles or regular shapes, and 'Deliver it' is based on estimating areas of various shapes. I think that this is a positive because the more areas that a software package covers, the more valuable it becomes as a resource.

• Fun and Challenging
I found this software to be fun and challenging at the same time, which are wonderful assets for software to have. The students will become more familiar with a variety of different aspects of geometry, but will also have fun and be challenged at the same time.
Negatives

- Limited Number of Machines
  In the 'Build it' portion of the software there is a limit to the number of machines that can be used. Although this encourages students to find the most concise way to achieve the end result, it could become frustrating if the students do not see any way to accomplish the desired shape without more machines.
The Factory Deluxe

Build It
&
Ship It

- I created these two activity sheets as supplements to the 'Ship it' and 'Build it' portions of this software.

- These activity sheets could be used in any middle school geometry unit, or even a high school geometry unit.

- Students will use both of these sheets as ways to document their progress and work when using this software program.

- Included here is a blank copy of the 'Build It' activity sheet and a completed sample of the activity sheet. Also included are a blank copy of the 'Ship It' activity sheet and a sample of what it might look like when completed.
The Factory Deluxe
Build It

Draw your goal shape and tell what you used to build it.

- If you used the rotator, how many degrees did you rotate?
- If you used the puncher, how many holes did you punch, what shapes were the holes, and where did you punch them?
- If you striped, where did you stripe?

If you build it and it doesn’t work, get another sheet and try again!

Goal Shape

Build it!

End Result

If it didn’t work, what do you think went wrong?

Attach your next try to this paper before turning it in to me.
The Factory Deluxe
Build It

Draw your goal shape and tell what you used to build it.

- If you used the rotator, how many degrees did you rotate?
- If you used the puncher, how many holes did you punch, what shapes were the holes, and where did you punch them?
- If you striped, where did you stripe?

If you build it and it doesn't work, get another sheet and try again!

<table>
<thead>
<tr>
<th>Goal Shape</th>
<th>Build it!</th>
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<tbody>
<tr>
<td></td>
<td>Striper</td>
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<tr>
<td></td>
<td>Tuber</td>
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<td></td>
<td>Puncer</td>
</tr>
</tbody>
</table>

If it didn't work, what do you think went wrong?

Attach your next try to this paper before turning it in to me.
The Factory Deluxe
Ship It

Draw the shapes that you need to ship, and list your categories, then draw a line connecting the correct category to the correct shape.

Level

Shapes

Categories
The Factory Deluxe
Ship It

Draw the shapes that you need to ship, and list your categories, then draw a line connecting the correct category to the correct shape.

Level: 5

Shapes

Categories
- rectangles
- shapes with rounded corners
- isosceles trapezoids
- box below large square shapes
- boxes below
- striped shapes
- no equilateral polygons
- box above has red shape
- box above
- no rounded shapes
- no scales
- triangles
Geometer's Sketchpad

Manufactured by- Key Curriculum Press
Copyright- 2001
Version- 4.0 Student Edition
Use- Instructional and/or Practice

Overview
This software is essentially a blank slate. It is very similar to the "Paint" accessory that comes on most computers. Geometer's Sketchpad has some advanced features such as animation. Even though the software is titled 'Geometer's' Sketchpad, this software could be useful in a variety of other mathematics classes including algebra and precalculus. A middle school teacher could also use this program in her classroom. Whether or not this program is successful for a lesson depends solely on the instructor and how this software is used.

Standards
Geometer's Sketchpad can address a wide variety of standards. What it addresses depends on what a person does with it.

Positives
- Blank Slate
  This program has so many uses that it is similar to a blank slate. The possibilities of what can be done with this software are very numerous.

- Widely used
  Geometer's Sketchpad is a software program that many math educators are aware of and use. This fact is a positive for the software because the more people that use it, the more resources there are available for support, such as websites, and tutorials.

- Building
  Rather than having the students complete a tutorial or an activity, this software program allows the students to actually build whatever it is that they will be using. This is a positive because it will give the students more of a feeling of ownership over whatever it is that they create.
• Demonstrate
  Not only can this software be used for the students’ benefits, but this software can also be used by the teacher for demonstrative purposes. Often times in geometry it is hard to show students why something is always true, this software program could help to actually demonstrate that certain properties are in fact always true.

Negatives
• All the possibilities
  Since this software does in fact have so many possibilities it could be intimidating for a first time user. Once the program is open it is up to the user to make the software useful.

• Time
  In order to use this software, and to make this software useful for students, there is a lot of time involved. To become familiar with this software and all of its capabilities, and even to locate all of the tools, there is a lot of time involved.

• Different versions
  There are several different versions of this software available. The reason I have this listed as a negative is because perhaps the school could get a different version than the educator is familiar with, or a student purchases the wrong version, and there are inconsistencies between the versions. One of these differences was brought to my attention by a teacher whose school had a different version than she did. She was familiar with how to select multiple objects in one version, but could not figure out how to do it in the other version. The different versions could cause for some confusion.
Geometer’s Sketchpad Activity

- I created this activity sheet to be used with Geometer’s Sketchpad version 4.0, student edition.

- This activity sheet was designed for a high school geometry class, but it has been used in a college class as well.

- Students will follow along with the directions on this activity sheet. The questions on this sheet will be filled in as students go along.

- Included here is a blank copy of the activity sheet. Also included are three sample printouts from the software. I created these printouts as examples of some of the things that can be done on Geometer’s Sketchpad.
Name _______________________

GEOMETER’S SKETCHPAD ACTIVITY

Aside from turning in this activity, you will also need to print out your work on sketchpad and turn it in as well.

Pre-image: ____________________________________________
Image: ________________________________________________

Part I
Reflect a circle, irregular triangle, and an irregular polygon (your choice) over a line segment.

To do this:
1. Select the circle button on the left hand side of the screen, and use it to draw a circle.
2. Select the segment button on the left hand side (LHS) of the screen, and use it to draw the segment you want to reflect the circle over.
3. With only the line segment highlighted go to the transform button at the top of the screen and select ‘mark mirror.’
4. Use the arrow button on LHS of the screen to highlight only the circle.
5. Go to the transform button at the top of the screen and select reflect.

• To draw the irregular triangle and irregular polygon use the segment button on the LHS of the screen.
• When highlighting the portions of the polygon to be reflected remember to highlight your vertices.

Questions:
1. What do you notice about the image of the circle?

2. Could the image of the triangle ever be the same as the pre-image? If so explain.

3. Could the image of your random shape ever be the same as the pre-image? If so explain.

4. In this part of the activity you were performing reflections. Write a definition for reflection in your own words.
Part II
Reflect an irregular triangle and an irregular polygon (your choice) over two parallel lines, or segments.

To do this:
1. Use the segment button on the LHS of the screen to construct your triangle.
2. Draw the first segment you want to reflect the triangle over, again using the segment button from the LHS of the screen.
3. Using the point button from the LHS of the screen, mark a point that you want the second line (that will be parallel to the first segment) to go through.
   a. HINT: It will be best if you choose your parallel lines such that they run horizontally across the page rather than vertically.
4. Highlight the segment and the point using the arrow button on the LHS of the screen.
5. Go to the construct menu at the top of the page, and select construct parallel line.
6. Now mark the first segment as a mirror, and reflect your triangle over it the same as in part one.
7. Now mark the second parallel line as a mirror, and reflect the image from the previous step over the line the same way as in part one.
   • Repeat these steps for the irregular polygon.

Questions:
1. What do you notice about the final image and the pre-image?

2. What do you think would happen if the two parallel lines are really close to each other? Or really far apart from each other?

3. In this part of the activity you were performing translations. Write a definition for translation in your own words.
Part III
Reflect any triangle and any irregular polygon (your choice) over two intersecting line segments.

To do this:
1. Draw your triangle using the segment button on the LHS of the screen.
2. Also using the segment button from the LHS of the screen construct two intersecting lines.
3. Mark the segment closest to your triangle as the mirror, and reflect your triangle over it the same way as in parts one and two.
4. Next mark the second segment as the mirror, and reflect the image from your first reflection over it.

• Repeat these steps for the irregular polygon.

Questions:
1. What happened to the final image? Is it the same as the pre-image? If not, what is different? If so, why?

2. Under this type of transformation does each vertex on the shape move the same distance?

3. In this part of the activity you were performing rotations. Write a definition for rotation in your own words.
Move Around the Lines, What do you notice about the relationships between certain angles?

\[ m\angle HCE = 115.91° \]
\[ m\angle ABC = 115.91° \]
\[ m\angle CBD = 64.09° \]
\[ m\angle ECK = 64.09° \]
\[ m\angle EKJ = 113.32° \]
\[ m\angle KDI = 113.32° \]
\[ m\angle KDB = 66.68° \]
\[ m\angle EKC = 66.68° \]
\[ m\angle HCE + m\angle CBD = 180.00° \]
\[ m\angle EKJ + m\angle KDB = 180.00° \]
\[ D_A = -0.65 \]
\[ y_A = 0.76 \]

Notice how the tangent changes as the circle is animated.

\[ m \angle DBA = 0.73\pi \text{ radians} \]
\[ \frac{y_A}{D_A} = -1.16 \]
What do you notice about the relationship between the two angles?
Is it true when the angle is changed?

$m\angle DCB = 66.52^\circ$
$m\angle DAB = 33.26^\circ$
Overview
When first opening the software the user must go up to programs and select one of the four. The options are: Equation Grapher, Linear and Quadratic Graphs, Green Globs, and Tracker. The Equation Grapher portion of the software is a grid where students can graph various equations. The Linear and Quadratic Graphs section of the software will give the user a graph, and the user needs to type in the correct equation. Green Globs is a game that has the player try to hit as many of the 'green globs' on the grid using as few lines as possible by typing in the appropriate equations. The Tracker portion of the software is similar to the game 'Battle Ship'. There will be some type of hidden graph that the user needs to find by using trackers (a point) to try to hit the graph. After the user thinks they know what the graph is, they need to identify it by its equation.

NCTM Standards
Algebra
- Understand patterns, relations, and functions
  - Understand relations and functions and select, convert flexibly among, and use various representations for them

Green Globs and Graphing Equations allows students to represent equations and functions as graphs. This program also has features that have the students convert from the graphs to the functions.

Indiana Standards
Algebra I, Standard 4
- Graph a linear equation

This software allows students to graph equations of lines in the 'Linear and Quadratic Graphs' portion. Students also have the ability to graph lines in the 'Green Globs' portion of the software.
• Write the equation of a line given appropriate information

This standard is addressed in the 'Green Globs' portion of the software. Students are given certain points that they want a line to go through. The students then type in equations of lines that they think will go through those given points.

Algebra I, Standard 8
• Use graphing technology to find approximate solutions of quadratic and cubic equations.

This software allows students to graph quadratic and cubic equations. Students are then able to see approximate solutions.

PreCalculus Standard 4
• Define and graph trigonometric functions (i.e., sine, cosine, tangent, cotangent, secant, cosecant).

The students can graph trigonometric functions on the 'Equation Grapher' portion of the software. Students also have the ability to play an expert game of 'Green Globs' in which trigonometric functions can be used.

• Draw and analyze graphs of translations of trigonometric functions, including period, amplitude, and phase shift.

The 'Equation Grapher' portion of the software will graph these equations. Students may also use these equations in an expert game of 'Green Globs.'

Positives
• Excellent Review
The 'Linear and Quadratic Graphs' portion of this software would be an excellent review for students before a quiz or test. The computer will show a picture and the students have to type the equation of that graph. If the students are correct, the computer moves on to another graph. If the students are wrong, the computer shows the students what the graph of their equation looks like, along with the desired graph, and the student can then try again.
• **Useful in many classes**

This software can be used in many different classes. All four sections of this software can be applied in a pre-algebra or Algebra I class in which students are first learning how to graph equations. The software is also useful in trigonometry, pre-calculus and calculus classes when students are working with parabolas, ellipses, and hyperbolas.

• **Homework Helper**

The 'Equation Grapher' portion of the software could be used as a homework aid to help students check answers. Access to the 'Equation Grapher' portion of the software outside of class time, perhaps after school, could help those students that do not have graphing calculators.

• **Color Coded Graphs and Equations**

In the 'Equation Grapher' section of the software all graphs that show up on the screen are color coded so that the corresponding equation (all of which are shown in the upper left-hand corner of the screen) is in the same color. This could be extremely helpful to students when they are graphing similar graphs or equations.

• **Equations in Any Form**

The 'Equation Grapher' part of the software will graph equations in any form except exponential. This is a positive because students are able to write and recognize equations in forms other than the y = form.

**Negatives**

• **Only Graphs Two-Dimensional Graphs**

The entire software package only deals with two-dimensional graphs. While this might not seem to be to be a disadvantage at the high school level, it could make the software less valuable as a demonstrational tool in the upper level high school courses.
• Only Shows Five Graphs
  'Equation Grapher' will only show five graphs at a time. Once there are five on the screen and a sixth graph is attempted, the program will tell you that you need to delete one of the other graphs first. This causes a problem any time a student needs to see more than five graphs at a time.
Conic Sections

- I created this activity sheet to be used with the graphing portion of the Green Globs software program.

- This activity would best work in an Algebra II class or maybe a precalculus class.

- The students will use this sheet to transform the forms of the equations into standard form. They will then use the Green Globs software to graph the equation in both of its forms to make sure they are correct. Students would not be able to check both of their graphs on a graphing calculator because they only graph equations in the form $y = \cdot$.

- Included here is a blank copy of the activity sheet.
Conic Sections

Determine if the following equations represent circles, ellipses, hyperbolas, or parabolas. Then transform the equations into their standard form and SHOW YOUR WORK! Next, graph your equation in standard form on Green Globs. To check your answer, graph the equation in the form given on Green Globs also. The graphs should match up!

1. $4y^2-9x^2-18x-8y-41=0$

2. $9x^2+4y^2-18x+16y-11=0$

3. $x^2+6x-12y+33=0$

4. $2x^2-4x+y^2-6y=9$

5. $x^2-6x+y^2-8y=0$

6. $y^2-16x-8y+80=0$

7. $x^2-y^2-4x+2y-6=0$
8. \[16x^2 + 9y^2 + 64x - 54y + 1 = 0\]

9. \[x^2 + y^2 - 4x - 36y + 184 = 0\]

10. \[x^2 + 2y - 12 = 0\]

11. \[x^2 + 16y^2 - 160y + 384 = 0\]

12. \[x^2 + y^2 - 2x + 4y + 1 = 0\]

13. \[x^2 + 4y^2 + 2x - 3 = 0\]

14. \[9x^2 - 16y^2 + 18x + 96y = 279\]

15. \[y^2 + 10y = 6x - 1\]
Overview
Hot Dog Stand *The Works* is a lot of fun to play. The player is in charge of a hot dog stand. He is in charge of checking the weather (with 'Frank the weather wiener'), ordering supplies, and setting prices. There is a 'To Do List' that will guide the user through all of the necessary steps. There are three levels; beginning, intermediate, and advanced. Depending upon which level the user chooses the software may or may not lead him through the proper steps. This software program is very user friendly and entertaining.

NCTM Standards
Number and Operations
- Students should be able to compute fluently and make reasonable estimates.
  - Students should judge the reasonableness of numerical computations and their results.

This standard is addressed throughout the software. Every time the students need to order supplies or change the prices they are estimating. There is no way for the students to know exactly how much of a product to buy or at what exact price the customers will think it is too expensive. The students have to make reasonable estimates in order for them to succeed at running the hot dog stand.

Data Analysis and Probability
- Students should be able to develop and evaluate inferences and predictions that are based on data.

This standard is addressed as the students look at certain given information. By looking at the average attendance for a certain event, the weather, and the amount of stock the students currently have, and using this data to estimate the amount of each product the students will need to buy for the next event they are developing inferences and predictions based on data.
• Students should be able to understand and apply basic concepts of probability.

This standard is broadly addressed in this software. For instance, if the weather report is for rain, the students must take into account the probability that the forecast is right or wrong. If the students want to anticipate a wrong forecast they would then order a large number of supplies, or if they anticipate a correct forecast they would then order a fewer number of supplies.

Problem Solving

• Students should solve problems that arise in mathematics and in other contexts.

This standard is clearly addressed by the general nature of the software. The premises of the software is that the students are in charge of a hot dog stand and are in charge of determining how many supplies they need to order based on some given information. This situation is a real world occurrence and so is a good example of another context in which mathematical skills apply.

• Students should monitor and reflect on the process of mathematical problem solving.

The software addresses this standard by giving the students more than one event to reach their goal profit. Students are able to learn from the previous event and see if what they learned will help them in the next event or game.

Reasoning and Proof

• Students should make and investigate mathematical conjectures.

This standard is addressed throughout the software. By trying to decide how many supplies will be necessary for the next event, the students are making conjectures. Since the software then allows for the event to 'occur' then the students are able to investigate their conjectures by seeing the results of the event.
Connections

• Students should recognize and apply mathematics in contexts outside of mathematics

The basic idea behind this software is exactly this standard. Students are applying mathematical concepts in an abstract environment that is not a classroom or textbook.

Indiana Standards

Integrated Math

• Compare real number expressions

The students are comparing real number expressions when they have to decide which supplier they want to buy products from.

8th Grade Math

• Analyze problems by identifying relationships, telling relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns

Students must listen to the weather report, see how many supplies they need, when the next event is, and other factors and then decide what is important and factor that into how many supplies they order.

Positives

• Estimating
  Students are familiarized with estimating. They are forced to recognize that there are many right answers as opposed to one right answer. Many students fall into the trap of wanting to have the right answer and they do not even notice or understand that there could be many different right answers.

• Learn from mistakes
  Students are given the chance to learn from each event and decide if it is helpful to apply that new information for the next event or if it only applies to one particular event.
Entertaining
I found the software to be somewhat entertaining. I think it would hold a student’s attention quite a while. I also thought that ‘Frank the weather wiener’ was somewhat funny.

Following Directions
Students will be much more successful with this software if they read all of the available information and follow directions. It is easy to proceed without reading all of the information provided, however for those students who do read the available information and explore the software, they will find some helpful hints that could help them to be more successful than those students that do not take advantage of the available information.

Different levels
There are three different levels; beginner, intermediate, and advanced. The three levels each have their benefits. The beginner level is helpful for the beginner because the objects that the student needs to go to next flash, and there are no random events, such as appliances breaking or supplies not showing up on time. The intermediate level does not have flashing objects to direct the students and has a few random events. The advanced level also does not have the flashing objects but has many random events and is more like the real world with appliances breaking and people needing to be paid and other similar events. This is a positive for this software because if students were to start right in with the advanced level they could become frustrated, but after the other levels it would not seem so difficult.

Negatives
- Noisy
In a computer lab this software could become quite noisy; however the noise is necessary for the students to obtain the weather report for the day. I think I would recommend that each student wear headphones if they are available.
- Misleading 'To Do List'
The 'To Do List' could be misleading because it has the students ordering supplies before checking the supplies. It is much more reasonable to check the supplies before ordering more because if there are any chips or colas left for the next event it could affect how many more are ordered.

- Few calculations
At the first few events the students will want to calculate how much they are paying for each of the supplies individually so that they know how much to charge for each item; however as the events continue even though the prices of the items change it is not necessary to continue checking the actual amount each item costs the student.

- Time consuming
The first few events could take the students quite a bit of time. Gradually the students will get used to the program, but it would be difficult to get a lot accomplished unless an entire class period was used.
Hot Dog Stand
*The Works*

- I created this sheet to be used with the Hot Dog Stand *The Works* software program.

- This activity sheet could be used for any level (beginner, intermediate, or advanced) or any grade level, from middle school through high school.

- Students will use this sheet as a way to record the choices they make in the process of completing one event on the software. Students will also have to complete some calculations that are not automatically calculated for them on the software. This record sheet is a way for the teacher to see how the students are doing.

- Included here are a blank copy of the activity sheet and a sample of what a student’s activity sheet might look like when completed.
Hot Dog Stand
The Works

Goal: __________ Event: __________ Weather: __________

Ordering Supplies

Hot Dogs
- Supplier__________________________
- Price per Dozen____________________
- Price per Hot Dog__________________
- Amount Ordered____________________

Turkey Dogs
- Supplier__________________________
- Price per Dozen____________________
- Price per Turkey Dog_______________
- Amount Ordered____________________

Buns
- Supplier__________________________
- Price per Dozen____________________
- Price per Bun______________________
- Amount Ordered____________________

Colas
- Supplier__________________________
- Price per Case______________________
- Price per Can_______________________
- Amount Ordered____________________

Chips
- Supplier__________________________
- Price per Box______________________
- Price per Bag_______________________
- Amount Ordered____________________

Courtesy Kits
- Supplier__________________________
- Price per Box______________________
- Price per Kit_______________________
- Amount Ordered____________________
Prices
Hot Dogs
Turkey Dogs
Chips
Cola

Did you decorate the sign? If so with what?

Inventory
Hot Dogs
Turkey Dogs
Chips
Cola

Courtesy Kits

How did the event go?
Attendance

Weather

Hot Dogs Sold
Turkey Dogs Sold
Colas Sold
Chips Sold

Total Sales:

Was your goal met?
Hot Dog Stand
The Works

Goal: $285.00  Event: Football  Weather: Light Rain

Ordering Supplies

Hot Dogs
- Supplier: Willie's Weiner World
- Price per Dozen: $3.42
- Price per Hot Dog: $0.28
- Amount Ordered: 288

Turkey Dogs
- Supplier: Turinio's Nicco
- Price per Dozen: $4.68
- Price per Turkey Dog: $0.38
- Amount Ordered: 288

Buns
- Supplier: Willie's Weiner World
- Price per Dozen: $2.82
- Price per Bun: $0.19
- Amount Ordered: 288

Colas
- Supplier: Willie's Weiner World
- Price per Case: $9.21
- Price per Can: $0.38
- Amount Ordered: 4 cans

Chips
- Supplier: Four Two Three
- Price per Box: $21.92
- Price per Bag: $0.45
- Amount Ordered: 5 boxes

Courtesy Kits
- Supplier: Jure Farms
- Price per Box: $29.04
- Price per Kit: $0.19
- Amount Ordered: 2
Prices
Hot Dogs $1.00
Turkey Dogs $1.00
Chips $0.50
Cola $0.75

Did you decorate the sign? If so with what?
Yes, a goal post, football, and balloons.

Inventory
Hot Dogs 60
Turkey Dogs 44
Chips 150
Cola 40
Courtesy Kits 200

How did the event go?
Attendance 4,952
Weather Thunderstorms

60 Hot Dogs Sold
44 Turkey Dogs Sold
40 Colas Sold
150 Chips Sold

Total Sales: $527.00

Was your goal met? No
National Library of Virtual Manipulatives for Interactive Mathematics
http://matti.usu.edu/nlvm/nav/vlibrary.html

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Use- Instruction, Practice, and Discovery

Overview
After typing in the web address listed above you will arrive at a page that has an interactive grid on it allowing you to select the topic and grade level you wish to address with one selection. After making your selection, you will be taken to a page that looks very similar to a search engine results page. On this page will be a list of online manipulatives that address the topic and grade level you selected. From this list you will be able to choose whichever manipulative you decide best coincides with your lesson. If one of the manipulatives could be used for various grades, it will be listed under each grade to which it applies. This website is very appealing to the eye and easy to use.

NCTM Standards
This website is designed so that when you are selecting manipulatives you are selecting them based on which NCTM standards they address. After you have chosen a specific manipulative there is also a link at the top of the page that will take you to the NCTM webpage with the standards addressed on it.

Indiana Standards
The Indiana Standards addressed will change depending upon which manipulative is used, and for what purpose it is used.

Positives
- Free
  As opposed to software programs that a school would need to purchase, any school with internet access can use this website for free. This is a wonderful benefit of using an online manipulative versus a software program.
• Variety
As with other online manipulatives, this website offers a wide variety of tools that can be used in a wide variety of settings. This also means that the one website can be used various times in a classroom to address various standards.

• Activities
There is a link at the top of some of the manipulative pages titled 'Activities.' This link will bring up an information box on the right hand side of the screen. Inside the information box, there is at least one activity, if not more. This link is extremely beneficial for an educator as they try to incorporate the manipulative into the classroom.

• Parent/Teacher
Once a manipulative has been selected there is also a link at the top of the page titled 'Parent/Teacher.' This link will bring up an information box on the right hand side of the screen that gives background information about the manipulative. For certain manipulatives this link will also bring up lesson plans, objectives, and even assessment options.

Negatives
• Internet
Since this form of manipulative is internet based, it is going to have the same problems as every other online manipulative. Mainly, that too many students online at one website could cause certain school’s internet systems to become overloaded, and perhaps slower. In order to avoid this an educator should check with the schools technology department to see what the system can handle.

• Inconsistency
One of the major problems with these manipulatives is that not all of them contain activities to go with them, but some do. Also not all of the manipulatives contain links to lesson plans and assessment, but some do. This is a negative because once a user has been introduced to that convenience they will most likely come to expect it.
Algebra Tiles

- This activity sheet was created for the Algebra Tiles virtual manipulative on the National Library of Virtual Manipulatives for Interactive Mathematics website. The activities on the activity sheet were ones that the website had corresponding with this particular manipulative.

- This activity sheet and manipulative could be used in any Algebra I class, high school or middle school.

- Students will use this activity sheet to record answers to each of the activities. The actual activities will be completed using the online algebra tiles.

- Included here is a blank copy of the activity sheet, and printouts of what the students will see and use on activities 1,2,4,5,6, and 8. Activities 3 and 7 do not have printouts because the students are not given any tiles on the screen.
Algebra Tiles

Use the instructions link in the upper right hand portion of the tool bar to familiarize yourself with the manipulative. Make sure that you can perform each of the 5 operations described in the instructions.

In order to complete the following problems, you will need to click on the activities link in the toolbar. Navigate through the activities using the buttons at the top of the information box on the right hand side of your screen.

Activity 1

Show the multiplication \( x (y + 2) \) by filling in the rectangle. What is your answer? Change the value of \( x \) by dragging the \( x \)-slider.

Activity 2

Show the multiplication by filling in the rectangle. What is your answer? Change the values of \( x \) and \( y \) by dragging the sliders.

Activity 3

Multiply the following binomials using algebra tiles, and list your answers:

\[
(x + 1)(x + 2) \\
(x + 1)(y + 5) \\
(x + y)(2x + 3y)
\]
Activity 4
Fill in the horizontal and vertical axes to show that:

\[ 4x + 2y = 2(2x + y) \]

What are the factors of \( 4x + 2y \)?

Change the values of \( x \) and \( y \) by dragging the sliders.

Activity 5
Fill in the rectangle to show the multiplication:

\[ x(2y + 5) \]

This is a visual representation of the distributive law; that is:

\[ x(2y + 5) = 2xy + 5x \]

Change the values of \( x \) and \( y \) by dragging the sliders.

Activity 6
Fill in the horizontal and vertical axes to show the indicated product.

What are the factors of the product?

Change the values of \( x \) and \( y \) by dragging the sliders.
Activity 7

Square the following binomials using algebra tiles:

\((x + 2)^2\)
\((2x + 1)^2\)
\((3 + y)^2\)
\((2x + y)^2\)

Activity 8

Form a rectangle with the indicated pieces. What product is represented by your rectangle?

The Activities on this worksheet came from:
http://matti.usu.edu/nlvm/nav/frames_asid_189_g_4_t_2.html?open=activities
Activity 2
Activity 4

$$\begin{array}{ccc}
X & X & y \\
X & X & y
\end{array}$$

Clear 1 5

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## Activity 6

<table>
<thead>
<tr>
<th></th>
<th>y</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>x</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>x</td>
<td>x·y</td>
<td>x·y</td>
</tr>
<tr>
<td>x</td>
<td>x·y</td>
<td>x·y</td>
</tr>
</tbody>
</table>

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Activity 8

Clear 1 5 x y x² y³ x·y

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Overview
When you type in the web address listed above you are taken to a search by subject page. After you have chosen your subject (math) you will be taken to a directory that looks similar to a results page from a search engine. Currently there are 111 different math related manipulative and activities on this website. The activities are listed with a descriptive title that is helpful when trying to find an activity for a specific lesson. Designating specific search terms can also narrow down your search. This website is very user friendly and could be useful for many different mathematics topics.

NCTM Standards
In order to see what standards are addressed by each individual manipulative, the link entitled 'Why?' located underneath the title should be selected. After clicking on the 'Why' link, a page titled 'Slope Slider, Curriculum Context and Resources' appears. The subheadings on this page are: 'Place in the Mathematics Curriculum,' 'Standards Fulfilled,' 'Be Prepared To,' 'Classroom Resources,' and 'Associated Interactive Modules.' The standards addressed subheading shows which standards are addressed by that particular manipulative.

Indiana Standards
The Indiana Standards addressed will vary depending upon which tool is being used, and how it is being used.

Positives
- Free
  One of the major benefits of using the manipulatives on this website is that they are free. This is a major plus for this software because many schools are not in a position to buy software programs, but the most likely have some type of computer lab with internet access. That fact makes this form of manipulative very practical.
• Variety
This website offers a numerous variety of different tools to go with many different topics. Often times when software is purchased it can strictly be used for one class, or maybe even one chapter. A major benefit of using this website is that once an educator is familiar with it, they can use it in various classes for numerous topics.

• Easy to use
A major benefit of this website is that it is very teacher friendly. There is a link that will take the teacher to 'Exploration Questions,' which would definitely help an educator when trying to create some type of assessment sheet to go with a particular tool. There are also sample dialogues between a 'mentor' and a 'student' on various topics that are under the 'Why?' link. Overall, this software is very easy to navigate and to follow.

• Discovery
The tools on this website lend themselves very nicely to a discovery learning method. This a positive because often times if students discover something on their own, rather than it being told to them, they will remember it better, and have a better understanding of the concept. This website has a wide range of tools that appear to be designed for the specific purpose of allowing students to discover mathematical rules and properties on their own.

Negatives
• Internet
Getting twenty to thirty students on one website at a time could cause major problems for some school internet systems. At certain schools when too many people are online, the system will get bogged down and not function as it is intended to. This could cause a problem when a class is trying to use this website.
Clock Arithmetic

- This activity sheet was created from questions that came from http://www.shodor.org/interactivate/activities/clock1/worksheet.html. The instructions at the top of the activity sheet came from http://www.shodor.org/interactivate/activities/clock1/what.html.

- This activity sheet and manipulative could be used in any class high school or middle school where modular arithmetic is being covered. This activity could also act as an enrichment activity for students that are more advanced.

- Students will use this activity sheet to write their answers on and hand in. The online manipulative will help the students to answer the questions.

- Included here is a blank copy of the activity sheet and two print outs from the website. The first printout shows the traditional 12-hour clock that is used for the first part of number 1 on the activity sheet. The second printout shows what the students should see after completing the second part of number 1.
Clock Arithmetic
http://www.shodor.org/interactivate/activities/clock1/#

Clock time can be thought of as a type of modular arithmetic. Modular arithmetic is used when we only want to consider the first N natural numbers, for some finite number N. There are two cases to consider when we add or multiply numbers in this situation:

1. When we add or multiply two numbers and the result is less than N, the final answer is just the number resulting from the addition or multiplication.
2. When we add or multiply two numbers and the result is more than N, the final answer is found by thinking of the numbers as looping back to the beginning, i.e., $N = 0$, $N + 1 = 1$, $N + 2 = 2$, etc.

We can think of clocks this way. For our usual clock, we think of the typical dial, except with $12 = 0$. So 13 hours after 0 o'clock is 1 o'clock ($13 = 12 + 1$ which is 1 on the dial).

A clock with 5 hours works the same way: 17 hours after 0 o'clock is 2 o'clock ($17 = 5 + 12 = 10 + 7 = 15 + 2$ which is 2 on the dial).

**Exploration Questions**

Answer the following questions, using the activity to check your work:

1. What is the clock time for 22 hours on a 12 hour world? on a 10 hour world?

2. What is the clock time for 54 hours on a 6 hours world? on a 9 hour world? on a 17 hour world?

3. It is 8 o'clock on our 22 hour world. What time is it on a 3 hour world? on a 5 hour world?
4. It is 15 o'clock on our 31 hour world. What time is it on a 3 hour world? on a 5 hour world?

5. Now can you find two different worlds that 78 hours is 6 o'clock? 4 o'clock?
   Explain.

6. Now can you find two different worlds that 16 hours is 4 o'clock? Explain.

7. Our school is on a twelve hour day but the military is on a 24 hour clock. Why do you think that schools use one clock and the military uses a different one? What are the advantages and disadvantages of each?
Please enter number of hours:

...and press enter to calculate.

Current clock size: 12

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Clock Arithmetic

**What?**

**How?**

**Why?**

Please enter number of hours:

[22]

...and press enter to calculate.

Calculated time is 2.

Passed zero 2 times.

[Reset To Zero]

Current clock size: 10

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Please help us by suggesting enhancements or reporting bugs in this program.

Or, send us other questions or comments about this activity.

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The Trig Explorer

Manufactured by- Cognitive Technologies Corporation
Copyright- 1996
Use- Instructional and some practice

Overview
This software program contains eight major topics. Among them are Degrees, Functions, and Pi Radians. After a topic has been selected a menu will appear that contains options such as Lesson, Real Applications, and Lesson Quick Access. This software program is extremely instructional and the students could actually learn some things that have not even been introduced to them yet.

NCTM Standards
Geometry

• Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
  o Use trigonometric relationships to determine lengths and angle measures

This standard is addressed in the ‘Right Triangles’ and ‘Inverse Functions’ portions of the software. Pythagorean’s Theorem and the use of Trig functions as ratios are addressed in the ‘Right Triangles’ section of the software, while the ‘Inverse Functions’ section of the software focuses on using inverses of Trig functions to solve for angles.

• Specify locations and describe spatial relationships using coordinate geometry and other representational systems
  o Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations

Cartesian coordinates are used throughout most of the lessons in this software. However, in the ‘Inverse Functions’ selection of the program, there is a portion that covers polar coordinates.
• Use visualization, spatial reasoning, and geometric modeling to solve problems
  o Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture

Every topic in this program addresses this standard. Each topic has a selection on how the topic relates to something other than math. For instance, the 'Triangles' portion of the software has information on trusses and how they are used in engineering and architecture.

Measurement
• Apply appropriate techniques, tools, and formulas to determine measurements

In the 'Angles' portion of this software students can practice measuring angles with a virtual protractor. Throughout the remainder of the software, different techniques and formulas are discussed that determine angle measurements.

Connections
• Recognize and apply mathematics in contexts outside of mathematics

Each portion of the software has a segment about how the topic applies to something outside of mathematics.

Indiana Standards
Geometry
• Identify and describe triangles that are right, acute, obtuse, scalene, isosceles, equilateral, and equiangular

The definitions of triangles are given in the 'Triangles' portion of the software.

  • Prove and use the Pythagorean Theorem

The Pythagorean Theorem is explained and used in the 'Right Triangles' portion of the software.
Pre-Calculus

- Define sine and cosine using the unit circle

- Define and graph trigonometric functions (i.e., sine, cosine, tangent, cotangent, secant, cosecant)

The trigonometric functions are defined in the 'Functions' part of the software, while the graphs are covered in the 'Plotting' portion of the software.

- Find domain, range, intercepts, periods, amplitudes, and asymptotes of trigonometric functions.

These topics are covered in the 'Plotting' section of the software.

- Find values of trigonometric and inverse trigonometric functions

Students find the values of trigonometric functions in the 'Functions' section of the software, and find the values of inverse trigonometric functions in the 'Inverse' section of the software.

Positives

- Informative
  The lesson portion of each section is very informative. They could get lengthy, however the "Quick Access" portion of the software allows students to skip ahead if they are looking for a particular piece of information, or have already completed the lesson and need a quick review.

- Variety of Topics
  This software could be used in various lessons throughout a trig classroom because it covers so many topics. The topics include: Degrees, Angles, Pi, Triangles, Right Triangles, Functions, Plotting, and Inverse Functions.

- Interactive
  The software encourages students to move this point, or make this line longer, when possible so that they may see the results that appear in the computations.
Negatives

- Noisy

The verbal instructions that are given are very helpful, however they are noisy, and if in a computer lab it would be distracting to other students.
The Trigonometry Explorer
Right Triangles

- I created this activity for use with the right triangles portion of The Trigonometry Explorer.

- This activity could be used at any level where the Pythagorean Theorem is being introduced, middle school or high school.

- Students will follow along with the program and fill this sheet in based solely on what they learn from the software.

- Included here is a blank copy of the activity sheet.
The Trigonometry Explorer
Right Triangles

Label the right triangle below with variables and state the Pythagorean Theorem.

How did Pythagoras treat the sides of the triangle, and why did this work?

Find c.

\[ c = \_\_\_\_ \]

Find a.

\[ a = \_\_\_\_ \]
Define:

Reference Angle

Hypotenuse

Adjacent Side

Opposite Side

Changing the reference angle changes what else?

When are the ratios of trigonometric functions constant?

When do the ratios of trigonometric functions change?

Show how you found the height of the statue of liberty with a labeled picture, and write in words why this worked.
Conclusion

Throughout this project, I evaluated various educational mathematics technologies. I applied the technologies to standards, both NCTM and Indiana as they applied. I also stated my opinions about the positives and negatives for each piece of technology.

By completing my thesis over this topic, I learned that not all technology is good for every mathematics lesson. The technology used is only as good as the lesson prepared to go with it. I learned that it takes a great deal of time to become very familiar with a piece of technology, and even then, there is always more to learn. Most importantly, I feel that I learned how to make the software useful to my students. Through the experience of creating this thesis, I learned that when used properly, technology is a wonderful tool that can enhance and enrich a student’s mathematical knowledge.
Bibliography


