Dynamic Web Tools for Trigonometry,
version 2.0

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Before the Web
• 1969: ARPANET
• 1974: TCP/IP (internet protocol)
• 1977: Commodore PET, Apple II
• 1981: MS-DOS
• 1982: Timex Sinclair 1000 (under $100)
• 1985: Microsoft Excel appears
• 1988: Mathematica version 1
• 1990: first description of HTML (for web pages)

The Still Page
◆ No user input
  ▪ Fixed information
  ▪ Static page
  ◆ Not dynamic

The Animated GIF
◆ No user input
  ▪ Fixed information
  ▪ Motion on page
  ◆ Not dynamic

Dynamic ???
◆ Dictionary definition
  ▪ relating to energy or physical force in motion
  ▪ energetic; vigorous; forceful
◆ In our context
  ▪ activity – of user

Baby Web
◆ 1990: first description of HTML (for web pages)
◆ 1990: Windows 3.0 (first successful Windows)
◆ 1991: WorldWideWeb (first browser)
◆ 1993: Mosaic browser (first with inline images)
◆ 1993: CGI scripts (first custom web pages)
◆ 1995: JavaScript (first client-side script)
◆ 1999: “Web 2.0” coined (as platform, interactive)
◆ 2001: webMathematica 1.0 appears
Excel and webMathematica

Types of Tools
- Drill and Practice
- Conceptual Understanding
- Variation of Parameters

Crossroads in Mathematics, 1995

"In fact, the use of technology, coupled with a decreased emphasis in some traditional content areas, should provide the time that is needed to implement the needed reforms in mathematics education."

- discussion of Standard P-1, p. 16

Drillmaster Examples
- Right Triangle Trig Ratios
- Standard Position Trig Ratios
- Special Angle Trig Values
- Special Angle Sine and Cosine Values
Drillmaster Features

- Can use exact arithmetic
- Immediate feedback
- Printable for a grade (or screen capture)
- Detailed results
- Measure accuracy and speed

More Drillmaster Examples

- Converting Radians to Degrees
- Converting Degrees to Radians
- Sine Graph Characteristics

Converting Radians to Degrees Drillmaster

by Susan A. Wilson

This page generates electronic flash cards so you can practice converting the basic radians measure as input into degrees only, with no irrational points.

Check # | New Problem

SESSION RESULTS | TOTAL | LAST 10
Problem Displayed: | 0 | 0
Right First Try: | 0 | 0
Eventually Right: | 0 | 0
Wrong: | 0 | 0
Skipped: | 0 | 0
Total Attempts: | 0 | 0
Elapsed Time: | 0 | 0

Check # | New Problem

Date and Time: 20/3/20, 17:45:45 042009
Session ID: 725946120.20070591345078419

Converting Degrees to Radians Drillmaster

by Susan A. Wilson

This page generates electronic flash cards so you can practice converting the basic degrees measure as input into radians in simplest form as the input box. For e.g., 90°.

Check # | New Problem

SESSION RESULTS | TOTAL | LAST 10
Problem Displayed: | 0 | 0
Right First Try: | 0 | 0
Eventually Right: | 0 | 0
Wrong: | 0 | 0
Skipped: | 0 | 0
Total Attempts: | 0 | 0
Elapsed Time: | 0 | 0

Check # | New Problem

Date and Time: 20/3/20, 17:45:45 042009
Session ID: 725946120.20070591345078419
Of course faculty in other disciplines want students to possess the computational skills required for their subjects. But they especially want students to possess conceptual understanding ... experience with mathematical modelling ... and to have the communication skills ...

- discussion of Recommendation 1, p. 12

At every level of the curriculum, some courses should incorporate activities that will help all students progress in learning to use technology

- Appropriately and effectively as a tool for solving problems;
- As an aid to understanding mathematical ideas.

- Recommendation 5, p. 22

Technology can be used by mathematics educators to enhance conceptual understanding through a comparison of verbal, numerical, symbolic, and graphical representations of the same problem.

- Chap. 7, Teaching with Technology, p. 56

- Trig Values and the Unit Circle
- Exploring Fourier Series
- 2D Matrix Transformations
- Complex Exponential Function
Students should ... see the graphical effects of varying parameters."

"Students can be encouraged to ask ‘what if?’ questions, ... Specific examples include studying the effects of manipulating parameters on classes of functions ...”

- discussion of Recommendation 5, p. 24

Exploring Parameters: Examples using Excel

- Exploring the Graph of the Sine Function
- Curvilinear Coordinates and the Sine Function
- Curvilinear Coordinates and the Tangent Function
Creation of an *Excel* tool

- Use formulas to create the data table
- Add the graph, generated from the table
- Attach controls to appropriate table elements

Characteristics of an *Excel* tool

- Uses decimal approximations
- User must have MS Excel
- Immediate response with an ActiveX slider (delayed with Control slider)
- Macro Security Level ≤ Medium if ActiveX is used

Exploring Parameters: Examples using *webMathematica 2*

- Rose Analyzer
- Limacon Analyzer
- Lissajous Curve Analyzer
But in 2007
- MS Office was being shipped with higher default security settings
- MS Excel no longer offered ActiveX controls
- Mathematica introduced the Manipulate command
- Two years later, a web version of the Manipulate command was available

Creation of a webMathematica tool

Version 1 (2001)
- Write Mathematica code
- Embed into HTML using MSP tags
- Add HTML form commands for interaction

Version 3 (2009)
- Write Mathematica code (Flash objects are generated)
- Embed into HTML using JSP tags

Characteristics of a webMathematica tool
- User requires only a web browser
- Interaction via HTML form components or Flash technology
- Can use exact or approximate arithmetic
- Mathematica, webMathematica, and a Java servlet container are on server
Conclusions – for the instructor

- Higher standards for drill and practice with less time
- Foster conceptual understanding by relating numerical, graphical and symbolic representations
- Real-time variation of parameters is visually very effective

Web Pages

- Topics in Trigonometry
  - staff.jccc.edu/swilson/trig/index.htm
- Dynamic Web Tools using webMathematica
  - staff.jccc.edu/mmartin/webmath.html
- Steven J. Wilson
  - staff.jccc.edu/swilson/index.htm