Dynamic Web Tools for Trigonometry,

version 2.0

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UMATYC
St. George, 2010

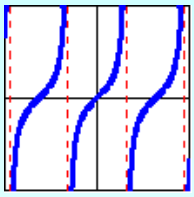
Before the Web

- 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)

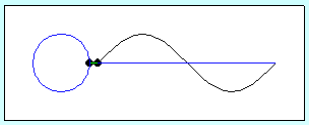


The Still Page

- No user input
  - Fixed information
  - Static page
- Not dynamic



The Animated GIF



- No user input
  - Fixed information
  - Motion on page
- Not dynamic

Dynamic ???

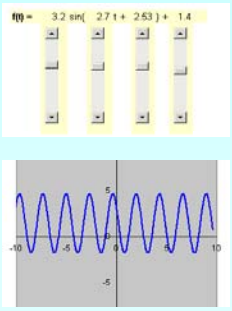
- Dictionary definition
  - relating to energy or physical force in motion
  - energetic; vigorous; forceful
- In our context
  - activity – of user

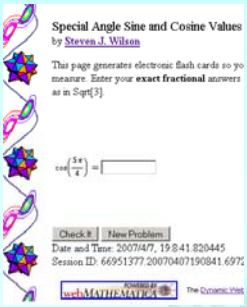
Baby Web

- 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: web*Mathematica* 1.0 appears



Excel and web*Mathematica*





Types of Tools

- Drill and Practice
- Conceptual Understanding
- Variation of Parameters

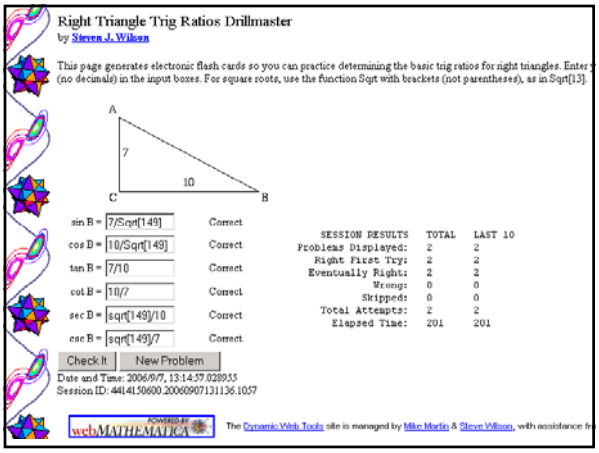
Crossroads in Mathematics, 1995

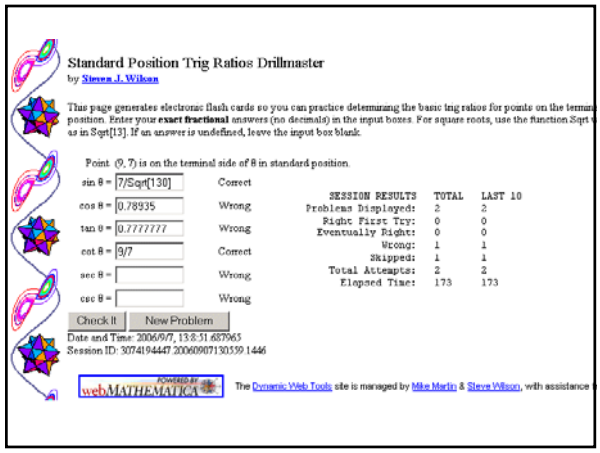
- "In fact, the use of technology, coupled with a decreased emphasis in some traditional content areas, should provide the time that is needed to implement the needed reforms in mathematics education."

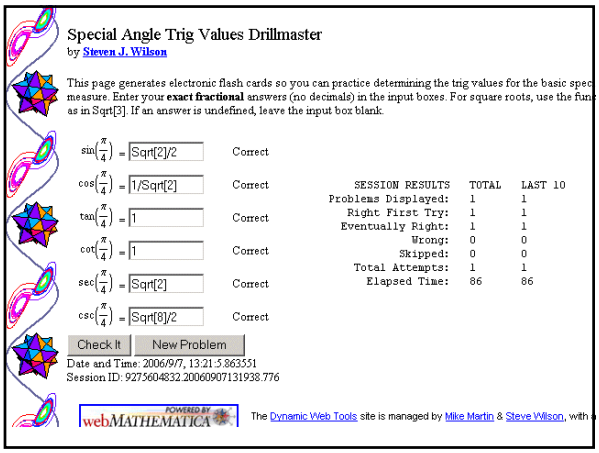
- discussion of Standard P-1, p. 16

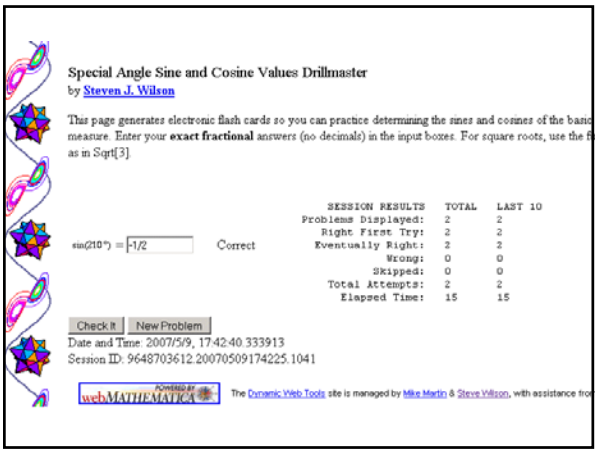
Drillmaster Examples

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







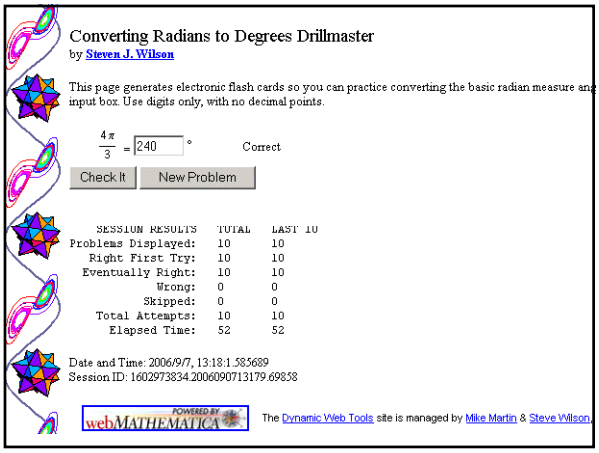


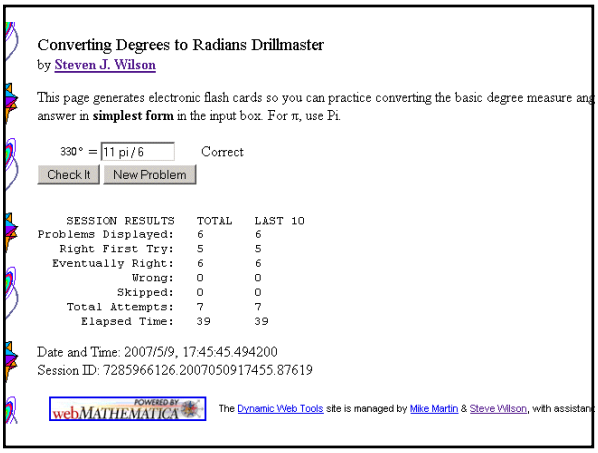
Drillmaster Features

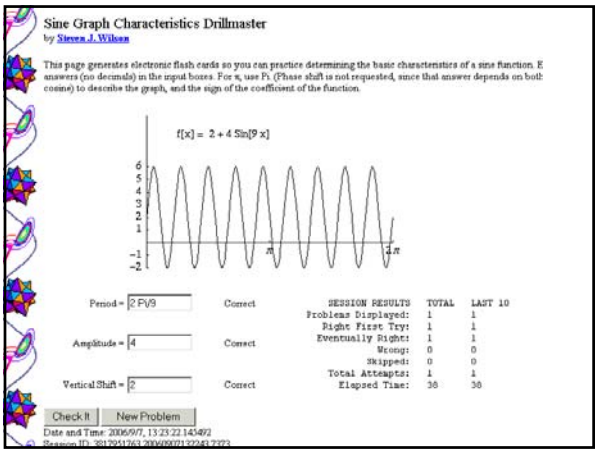
- Can use exact arithmetic
- Immediate feedback
- Printable for a grade (or screen capture)
- Detailed results
- Measure accuracy and speed

More Drillmaster Examples

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







CUPM Curriculum Guide, 2004

"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

CUPM Curriculum Guide, 2004

"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

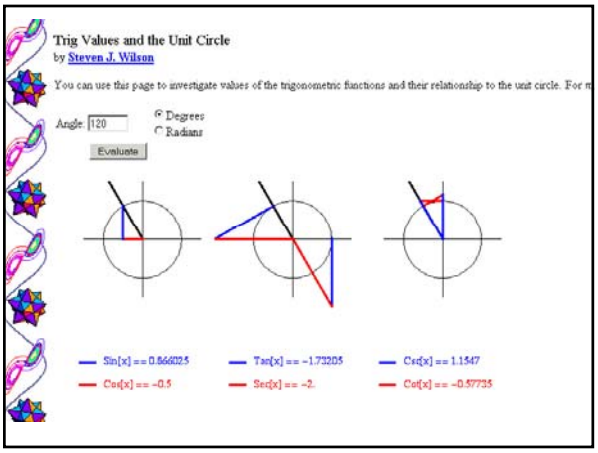
Beyond Crossroads, 2006

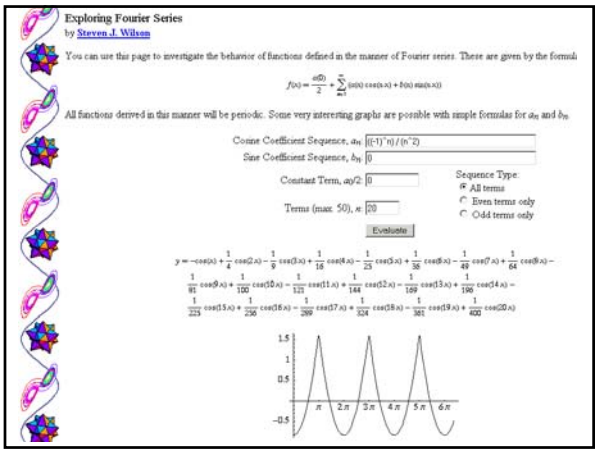
"Technology can be used by mathematics educators to enhance conceptual understanding through a comparison of verbal, numerical, symbolic, and graphical representations of the same problem."

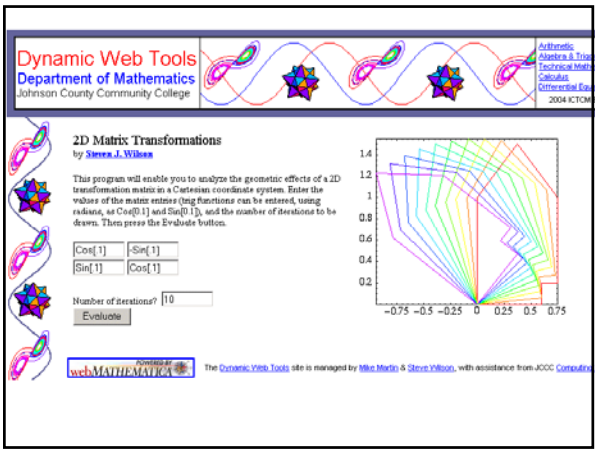
- Chap. 7, Teaching with Technology, p. 56

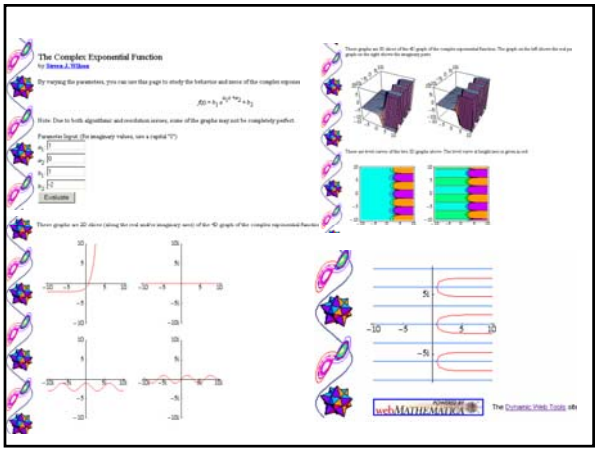
Conceptual Understanding Examples

- Trig Values and the Unit Circle
- Exploring Fourier Series
- 2D Matrix Transformations
- Complex Exponential Function









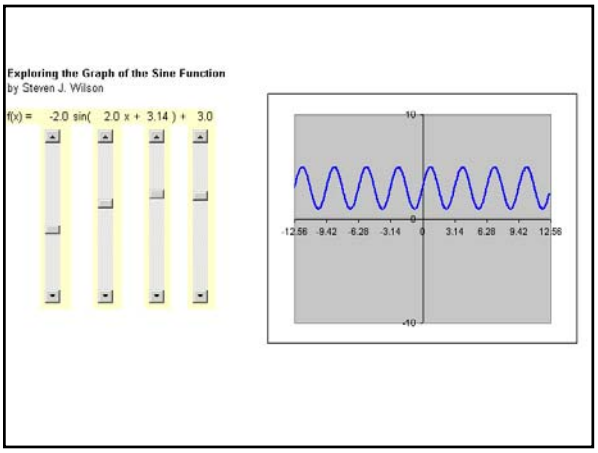
CUPM Curriculum Guide, 2004

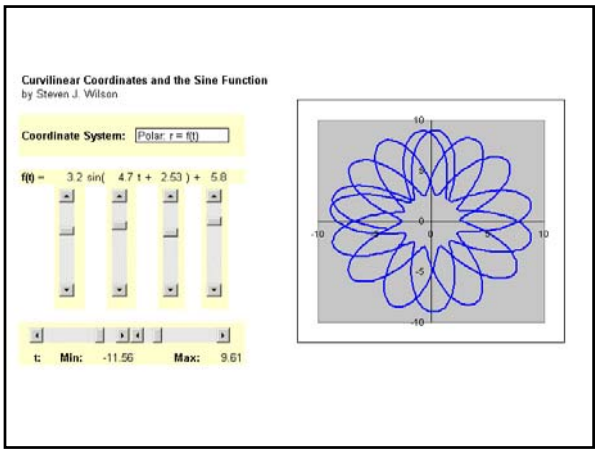
- "Students should ... see the graphical effects of varying parameters."
- "Students can be encouraged to ask 'what if?' questions, ... Specific examples include studying the effects of manipulating parameters on classes of functions ..."

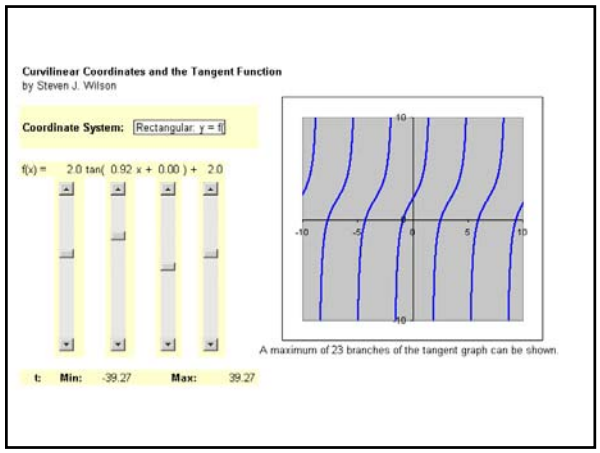
- discussion of Recommendation 5, p. 24

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

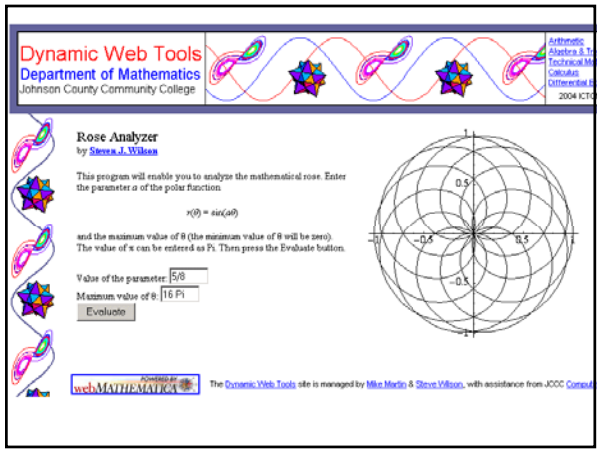
- Use formulas to create the data table
- Add the graph, generated from the table
- Attach controls to appropriate table elements

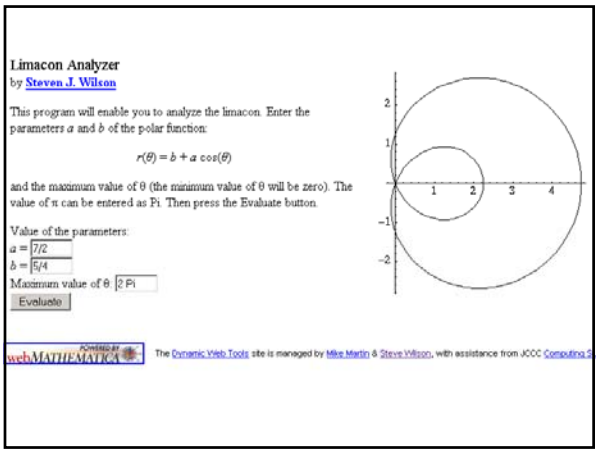
Characteristics of an *Excel* tool

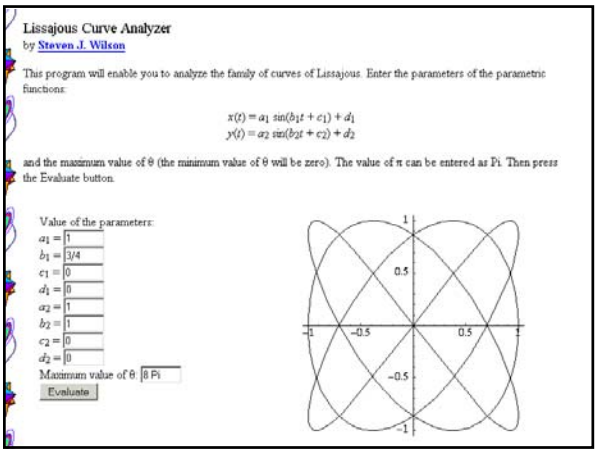
- Uses decimal approximations
- User must have MS *Excel*
- Immediate response with an ActiveX slider (delayed with Control slider)
- Macro Security Level ≤ Medium if ActiveX is used

Exploring Parameters: Examples using web*Mathematica 2*

- Rose Analyzer
- Limacon Analyzer
- Lissajous Curve Analyzer

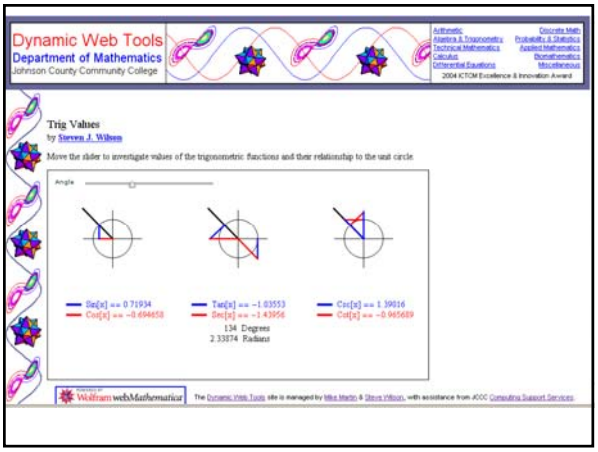






But in 2007

- 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 web*Mathematica* 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 web*Mathematica* tool

- User requires only a web browser
- Interaction via HTML form components or Flash technology
- Can use exact or approximate arithmetic
- *Mathematica*, web*Mathematica*, 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