Features and Advantages of

WME: A Web-based Mathematics Education System

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The WME Concept

The WME Pilot Project
An Idea Whose Time Has Come

- Symbolic and numerical computation systems, have matured and become *Internet Accessible*.
- Mathematics teachers and students need help especially in the US.
- Availability and standardization of the Web and the Internet have grown and evolved sufficiently.
- Maturing technologies: MathML, ECMAScript, DOM, SVG, XML, CSS, Web Services, ...
- Increasing number of school districts have already deployed Internet/Web in classrooms.
- Web has begun to offer helpful materials for Mathematics teaching/learning.
The Ohio Resource Center for Mathematics, Science, and Reading provides online resources for mathematics education.

*Mathematics* section of the US Department of Education site.

The National Science Foundation’s *Math Is Power*.

The IES sponsored Education Resources Information Center, an extensive literature database.

The Eisenhower National Clearinghouse for Mathematics and Science Education (ENC) links to lesson plans and activities.

The NCTM *Illuminations Project* supplies applets for hands-on learning.

The PBS *Mathline* site.
• The National Library of Virtual Manipulatives for Interactive Mathematics (applets)

• Mathforum at Drexel University provides *Problem of the Week* and *Mathforum Math Library* among other useful materials.

• Other efforts: Internet4Classrooms, WIMS, Livemath, Mathwright, geometry.net, WebMathematica, Calc101, AcitveMath, Maple, and MathWeb.

• Also e-learning and e-education support infrastructure systems such as WebCT and Blackboard.
The WME Integration

- Modules & Lessons
- Interactions
- Research Info
- Q & A Support
- Assessment
- Remedial Lessons
- Manipulatives
- Comp/Edu Services
WME is Different

- Classroom-ready TLPs and TMs rather than assortments of teacher enabling materials.
- Lessons are interactive, integral, self-contained, and interoperable.
- Lessons are built by experts, conform to curriculum standards, and can cover entire grade levels.
- A WME site can be easily deployed to different schools and configured for local use.
- Lesson pages and modules can easily be customized by individual teachers for different classes.

- Interactive control and management by the teacher during classroom delivery.

- WME integrates lessons, manipulatives, assessment tools, and teacher-student interaction for effective teaching and learning of mathematics.

- WME pilot at Kimpton Middle (Stow Ohio) has demonstrated its practicality and popularity with teachers and students.
The WME Architecture

- Javascript
- DOM
- SVG Viewer
- Other Plugins

- Web Browser
- MeML Plugin
- WME Services

- HTTP
- HTTPS
- MESP
- SOAP

- Lesson
  - Topic Module
  - Pages
    - Database
    - Active Page
    - Support

- WME Site
WME Components

- Interoperable Manipulatives, Topic Lesson Pages (TLPs) and Topic Modules (TMs)
- Assessment Support—assessment question database, test construction, grading, evaluation, and online tests.
- Client-side Support—regular browsers, javascript, SVG viewer, DOM, browser plug-in.
- Server-side Support—using active pages (PHP) and database (MySQL).
- Content-markup Support—MeML and Woodpecker
- WME Services—MathChat, MathBoard, MESP, MCP, and SOAP.
Kimpton Pilot Project

The Kimpton Site.
Manipulatives

Roll count (the number of rolls you made): 0.

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Example 1, Example 2, Example 3.
WME Model Site Structure

- homepage
  - grade 7
  - grade 8
- Standards
  - number & op
  - geometry
  - algebra
  - percents
  - fractions
  - proportions
  - areas
  - equations
- Topic Modules
  - TLPS
WME Model Site

Model Site

Download
Configure
Install
Localize

School Site
WME Model Site

- In-School customization—user accounts, grade levels, course listings, course sections.
- In-class customization—TM and TLP selection, management, page content modification, page questions management.
- In-page customization—manipulatives editing: including text, presentation, and functionality.
Page Customization Layers

Base  Teacher  Class
Customizing Pages

- Classroom-ready lessons and modules can be modified by teachers to suit their particular needs and requirements.
- Adding questions, modifying test, changing parameters, and adjusting manipulatives are done through password controlled simple on-Web tools attached to each page.
- Customizations are per page, per teacher and per class.

Customization Demo
Mathematics Chat and Bulletin Board

- MathChat encourages student participation in topic discussions.
- MathChat simulates classroom teacher-student interactions.
- MathBoard encourages student-student interactions and generally facilitates communication among all in the class.
- Both must support Math input and display.
SVG-Based Manipulatives

- Scalable Vector Graphics is an emerging W3C standard.
- Compactly delivers interactive graphics to support authoring and running manipulatives.
- Geometry-aware manipulatives support constraint-preserving user operations.
Base = 4.70    Height = 2.16
Area of the Parallelogram = 10.14
Area of the Rectangle = 10.14
Assessment

- Test authoring, construction, and editing
- Online test taking
- Importing and exporting test questions
- Automatic grading and test data management
- Results evaluation and leads to interventions
Top 10 Advantages

10 Accessibility
9 Compatibility and interoperability
8 Richness and variety
7 Integrated, dynamic, and classroom-ready
6 Efficient communication
5 Concepts not steps
4 Educator support, convenience, and control
3 Real-world motivations
2 Practical and flexible
1 Interactive, hands-on and self-paced
Research and Collaboration

- Research and development challenges arise in computing and in education.
- System architecture, component interoperability, portability, usability and customization.
- System interfaces, markup language design, protocols, manipulatives, and tools.
- Educational effectiveness, practicality, and teacher/student acceptance, in-class trials, and effects evaluation.
- A research team ought to involve computer scientists, mathematicians, mathematics education researchers, school teachers, and education evaluation experts.