An Overview of WME

Paul S. Wang 王士弘
Institute for Computational Mathematics
Kent State University
pwang@cs.kent.edu
The WME Approach

- Apply and develop Web technologies to connect experts, teachers, and students in mathematics education.

- Deliver standard-compliant, dynamic, engaging, hands-on, Web-based mathematics lessons (and curricula) prepared by experts yet easily customizable by teachers.

- Provide educational and assessment help for teachers, and problem solving and exploration environment for students.

- With open Web standards and component interoperability, establish a positive feedback system making WME grow with time and use.
The WME Project

- Started as part of our NSF funded project on *Internet Accessible Mathematics Computation*. Got OBR Research Challenge funding in 2004.

- Interdisciplinary team: Paul Wang (Math and CS) and Michael Mikusa (Math Education), and many others.

- Worked with local school teachers and conducted classroom trials.

- [The WME Project Web Site](wme.cs.kent.edu)
The WME Concept

The diagram illustrates the WME Concept, focusing on the relationship between teachers, experts, students, and other WME sites. Teachers teach, assess, and communicate, while experts design, build, and provide. Students access the WME School Site through a web browser to download lesson pages. Educators/content developers import/export lessons, revise, and author. The WME Model Site offers lessons, modules, manipulatives, tools, and computation support, assessment, and other educational support. Web services provide dynamic support.
The WME Integration
The WME Architecture
WME Components

- On-Web educational content—*Active Lesson Pages* (ALs) and *Topic Modules* (TMs)
- In-lesson *Manipulatives*— interoperable, reusable, and user customizable objects.
- Assessment Support—assessment question database, creating tests, grading, evaluation, and online test taking.
- Client-side Support—regular browsers, javascript, SVG viewer, DOM, browser plug-in.
• Server-side Support—using active pages (PHP) and database (SQLite or MySQL).

• Content-markup Support—MeML and MeML processor, MathGraph.

• WME Services and Tools—GeometryEditor, MathEdit, MathPlot, MathGlossary, MathChat, MathBoard, TISM and more.
Kimpton Pilot Project

Database

PHP/Apache

Active Lesson

Customization

Feedback

Editable Sections

Manipulatives

Q and A

Research-based Teacher Aids

Assessment

Show/Hide Control

The Kimpton Site.
Manipulatives

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

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</table>
WME Model Site Download

Model Site

Download
Configure
Install
Localize

School Site
WME Customizations

- For each school—user accounts, grade levels, course listings, course sections.
- For each course—TM and AL selection, student list.
- For each lesson—manipulatives editing: including text, presentation, and functionality, assessment and challenge questions.
Customizations are per-teacher and per-class.
Dynamic Page Generation

index.php

Class Mode Page

Edit Mode Page
Assessment Help and Automation

- Test authoring, construction, and editing
- Online test taking
- Importing and exporting test questions
- Automatic grading and test data management
- Results evaluation/grading, diagnoses and suggested interventions
Interoperable Modules and Lessons

Customization
Feedback
Database

Active Lesson

Editable Sections
Manipulatives
Q / A
Research-based Teacher Aids
Assessment
Show/Hide Control

PHP/Apache
Interactive Geometry Manipulatives

- GeometryEditor is an authoring and delivery system for interactive 2-D geometry manipulatives
- Xun Lai’s Ph.D. work on Web-based SVG+Javascript tool.
- GeoSite allows creation and sharing of GeometryEditor manipulatives
- See Model Site geometry module for example lessons with GeometryEditor manipulatives.

Area of Parallelogram.
Test Database and Online Testing

- Saleh’s Ph.D. work on *WEB-BASED DISTRIBUTED AND INTEROPERABLE TOOL FOR SHARING MATHEMATICAL ASSESSMENTS AND SUPERVISING ONLINE TESTS*

MathEdit

- Su Wei’s work on browser-based Mathematics Formula Editor.
- Both WYSIWYG and infix input
- Based on MathML but Supports multiple representations.
- Used in WME and MathPASS already.
- Offers well-defined API for Web page interface with Javascript code.
- See MathEdit Homepage for more information.
Math Glossary

- Adnan Eshaque’s Master Degree work.
- An on-Web database of math terms with definition, description, and examples.
- Allows everyone to contribute to new terms and comments on terms defined by others.
- Control over release of terms.
- Web service for retrieval of terms.
- Implemented in PHP and MySQL.
Math Chat

• Master Degree work by David Chiu.
• Offers classroom setting for Math-enabled chat.
• Need to be integrated with new MathEdit tool.
• See http://wme.cs.kent.edu/kimpton/chat for more info.
Model Site and MeML

- Xiao Zou’s on-going Ph.D. work.
- Supports WME teacher and students learning from a site of WME lessons and modules.
- Provides configuration, administration and customization of lessons and modules
- Supports authoring of new lessons and modules and sharing/revising of existing lessons and modules.
- Supports model site needs with Mathematics Education Markup Language.
- See draft model site at: http://wme.cs.kent.edu/ModelSite/ and the next version at http://boar.cs.kent.edu/WME/ModelSite/
Answer Checking

- The usefulness and challenges of automatic checking (grading/marking) of mathematical answers have been investigated before.

- *SAGE: a Homework on the Web System* by Brad Lucier, Purdue University, USA, 2005

Derivative Checking Service

Server

CGI Program

POST Data

HTTP

JSON Data

Browser

AJAX

Web Page Form

MathEdit

maximajson.check

MAXIMA

derivativejson.pl
Derivative Checking Example

Dynamic
WME Lesson
Page with MathML and SVG

PHP
HTTP

Firefox w
Native MathML Support

IE w MathPlayer 2.0 and higher

Sample Cross-browser Page
Further Research Areas

- Defining the exact structure of WME lessons and modules to be ready for Ohio schools
- MathGraph, and extension to MathML
- 3D geometry manipulatives
- Learning/teaching mathematics using games and virtual-reality environments
- Extending Math Glossary to become a fully working and rich-content source resource.
- WME classroom trials.
- Extend DMAS to have a substantial bank of tests and use it in actual school settings.
Creating a suite of lessons and modules to cover a specific set of education benchmarks for 7th grade math.