

An Overview of WME

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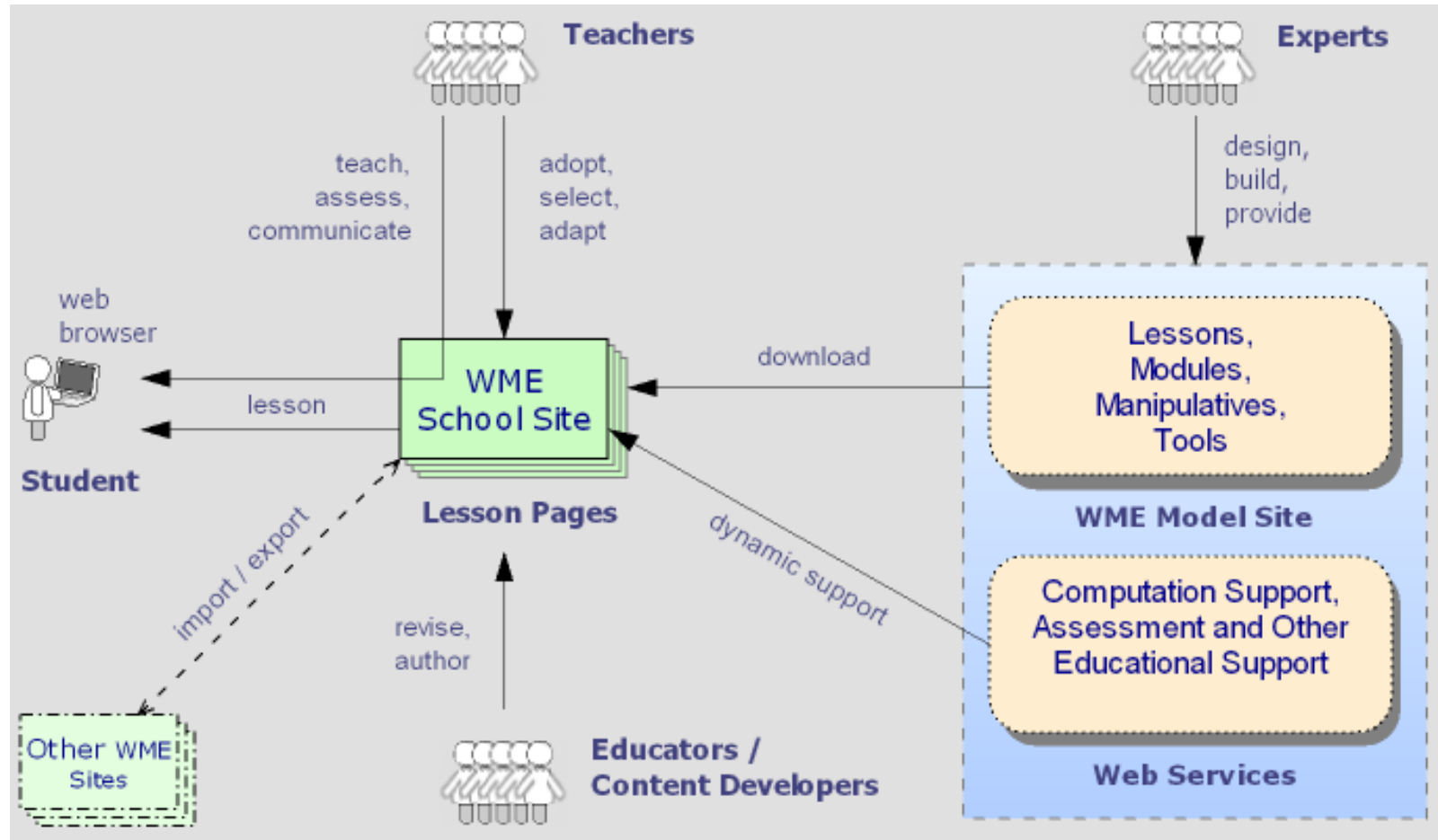
The WME Approach

- 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.

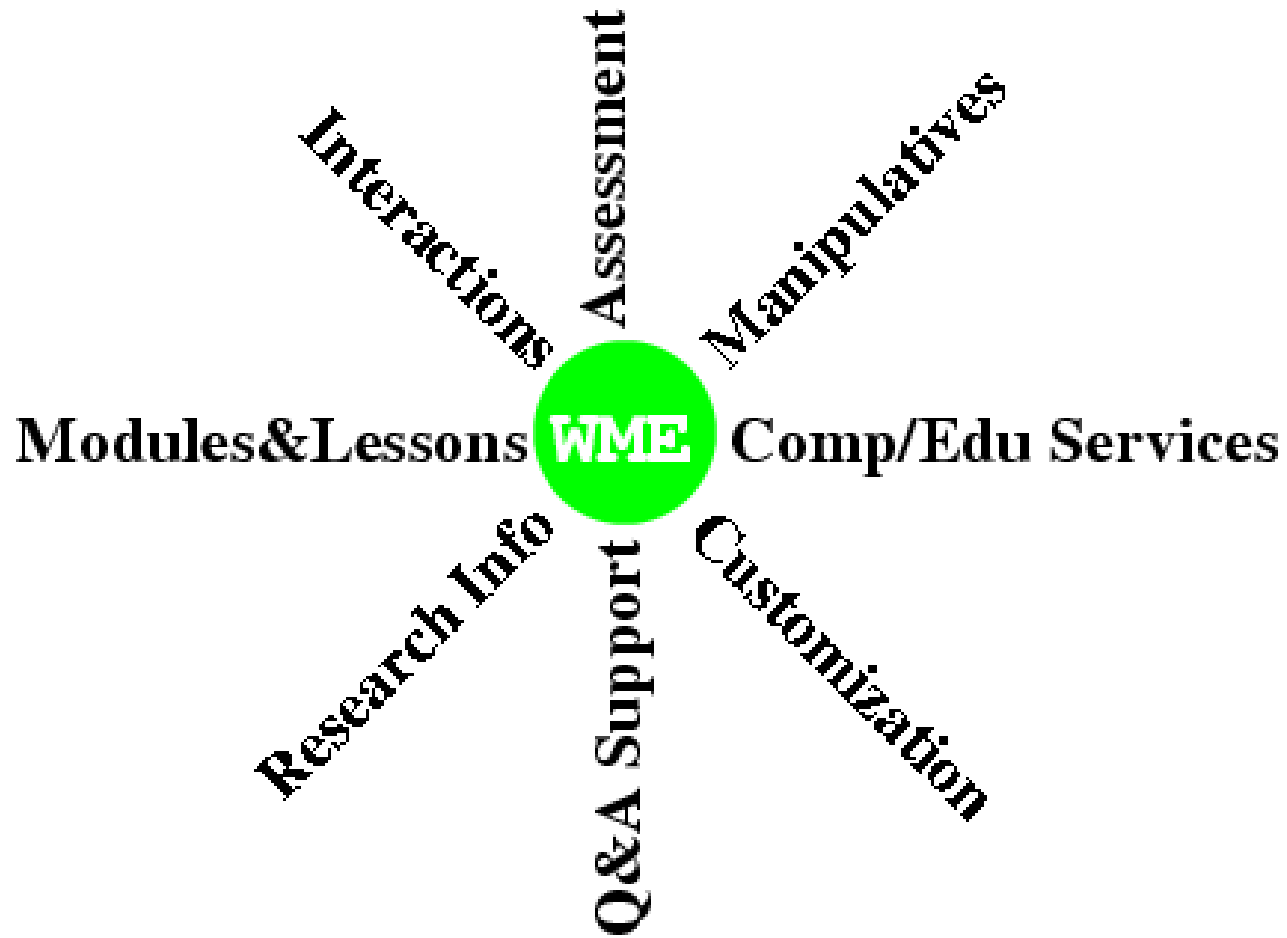
The WME Project

- 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.

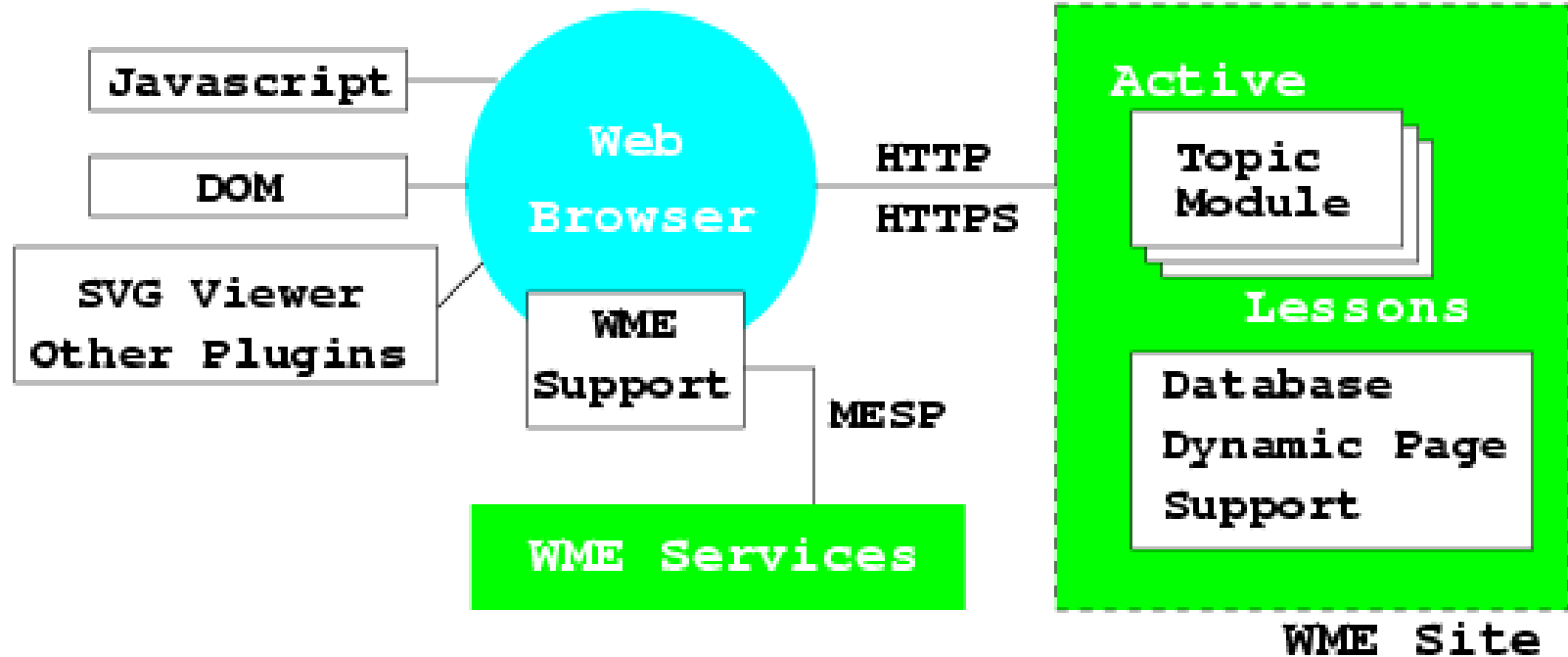
The WME Concept



The WME Integration



The WME Architecture

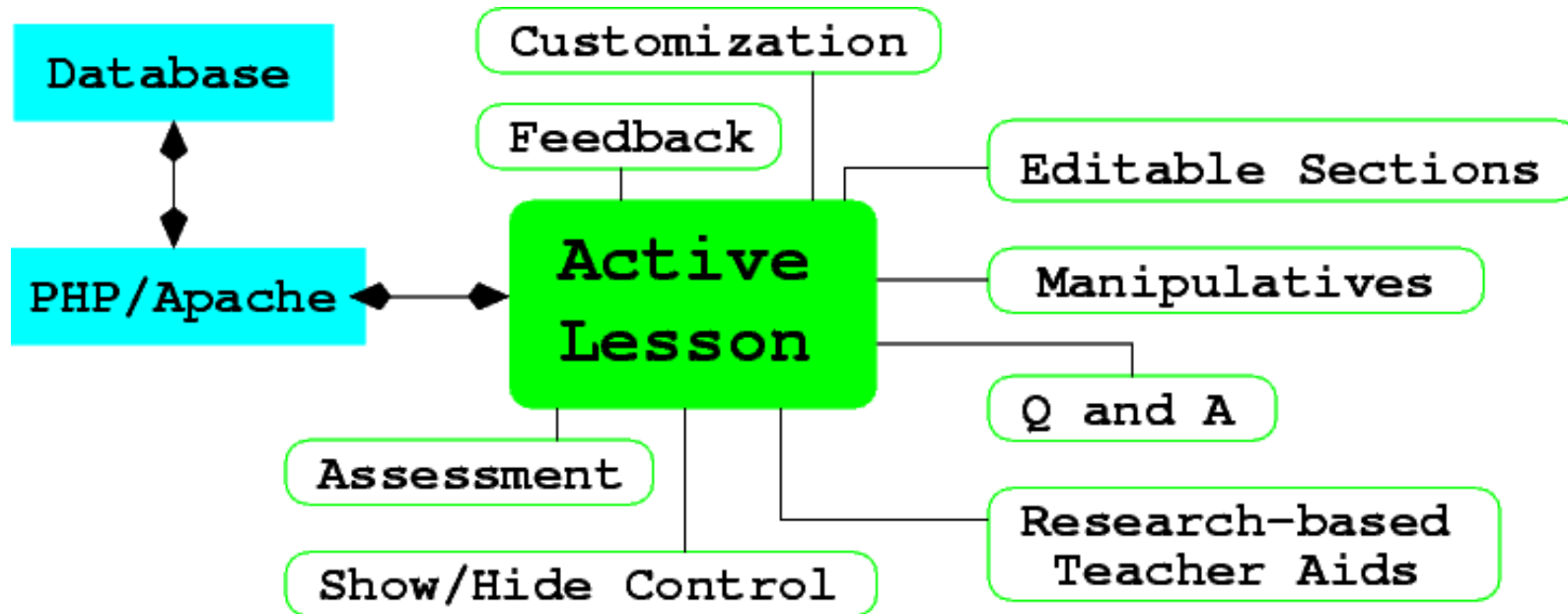


WME Components

- 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



The Kimpton Site.

Manipulatives



Roll

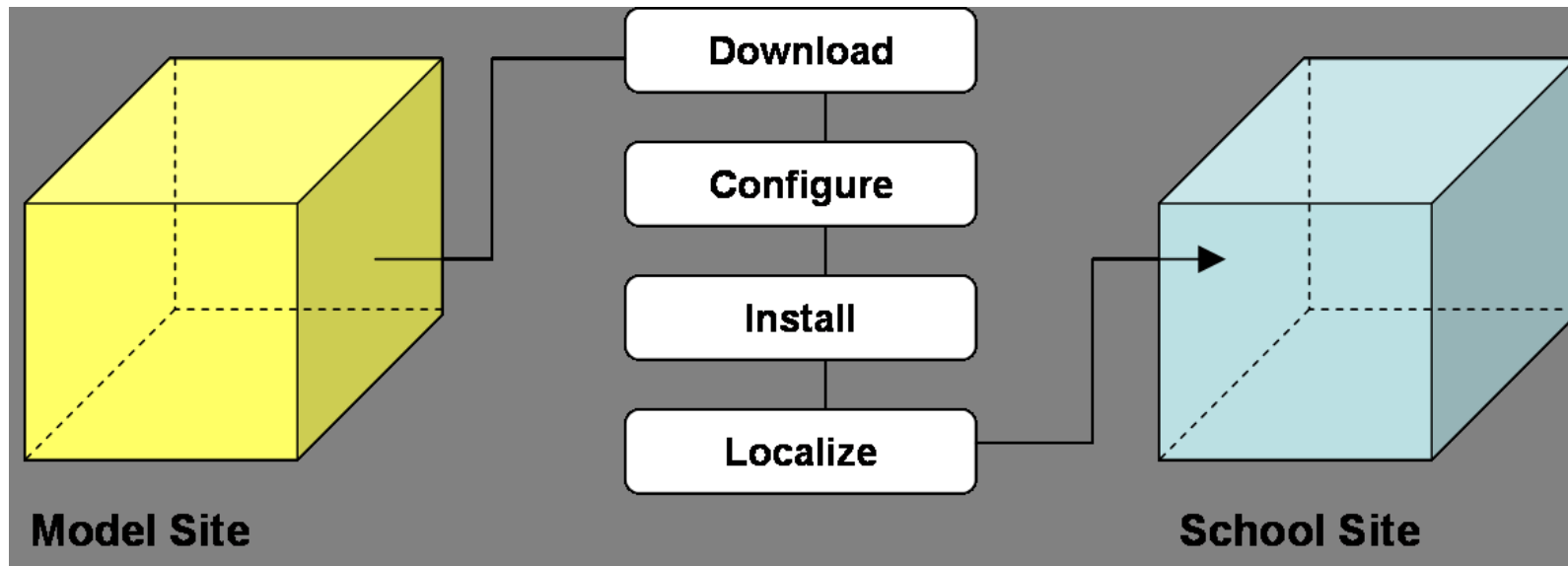
[Start Over](#)

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

Sum	2	3	4	5	6	7	8	9	10	11	12
Count	0	0	0	0	0	0	0	0	0	0	0

Dice. Equality. Straight Lines.

WME Model Site Download

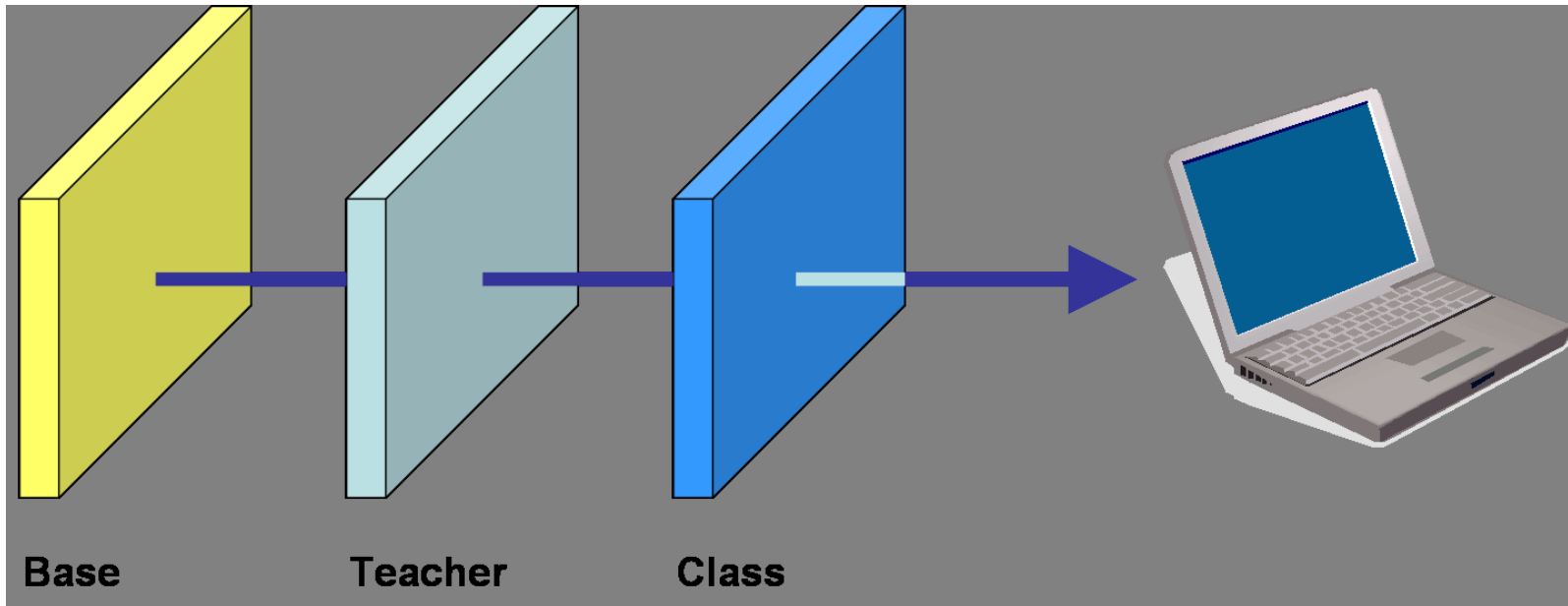


WME Customizations

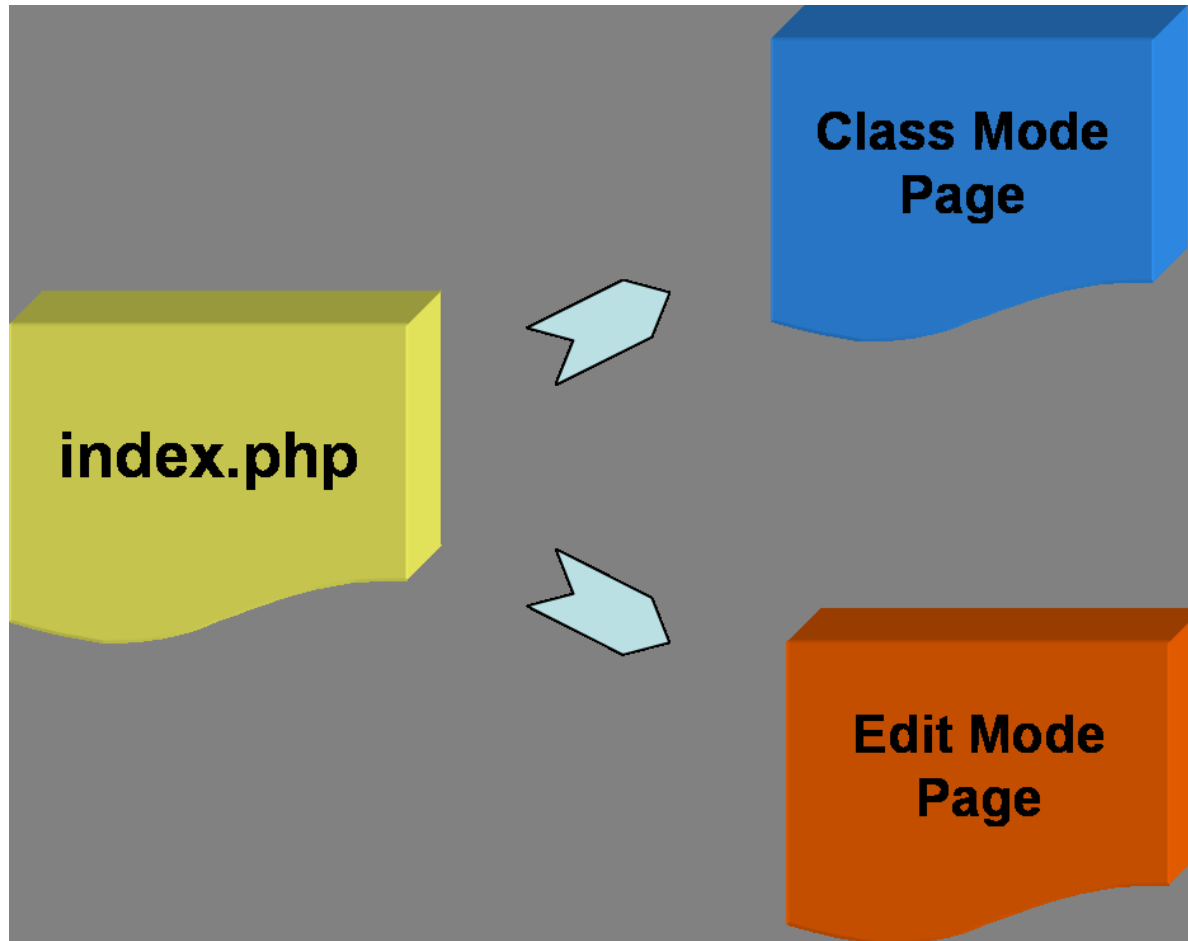
- For each school—user accounts, grade levels, course listings, course sections.
- For each course—TM and AL selection, student list.
- For each lesson—manipulatives editing: including text, presentation, and functionality, assessment and challenge questions.

Page Customization Layers

Customizations are per-teacher and per-class.



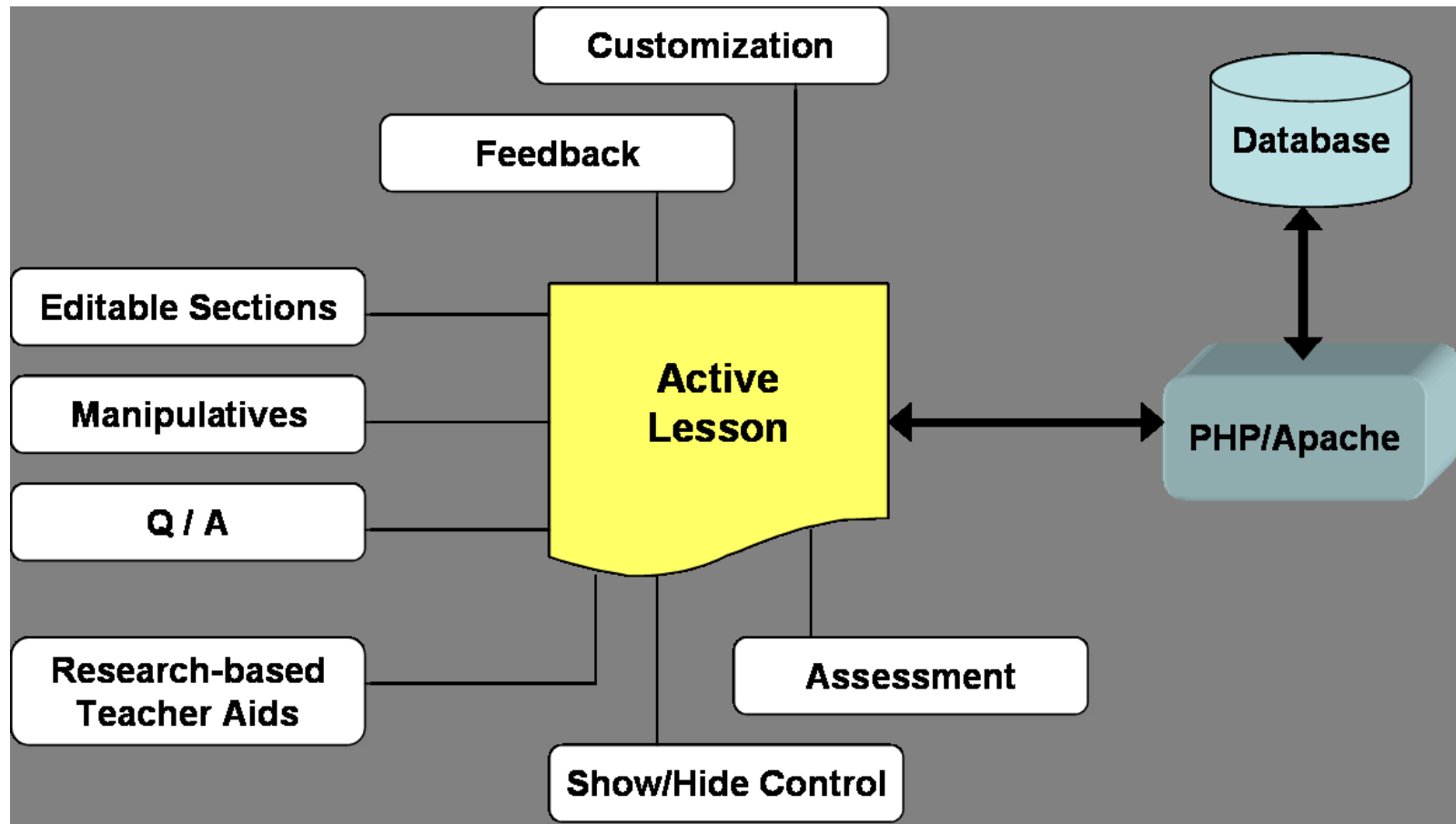
Dynamic Page Generation



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



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*
- See <http://wme.cs.kent.edu/dmad> and <http://wme.cs.kent.edu/dmad/documentation.html> for more information.

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.
- See <http://wme.cs.kent.edu/glossary/index.html> for more information.

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.

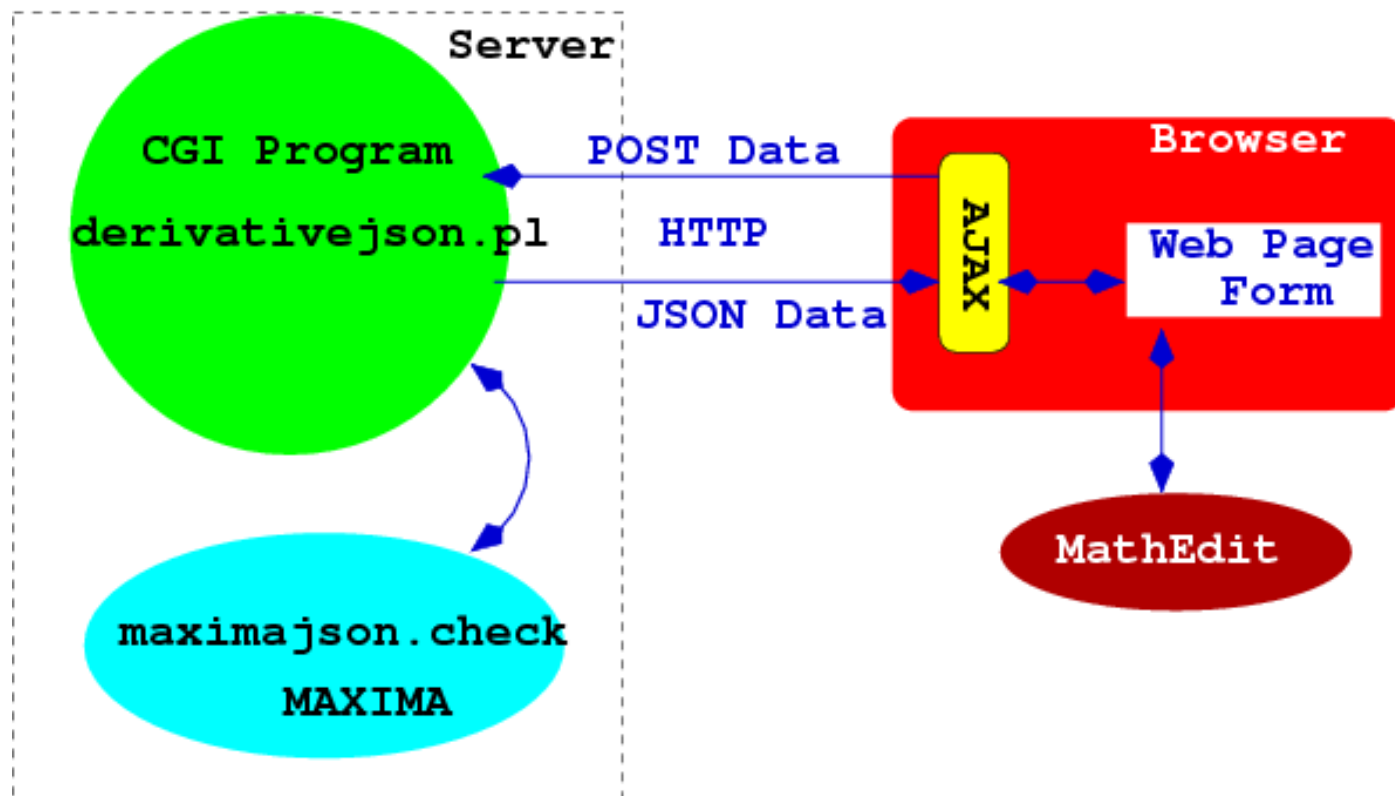
Model Site and MeML

- 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/>

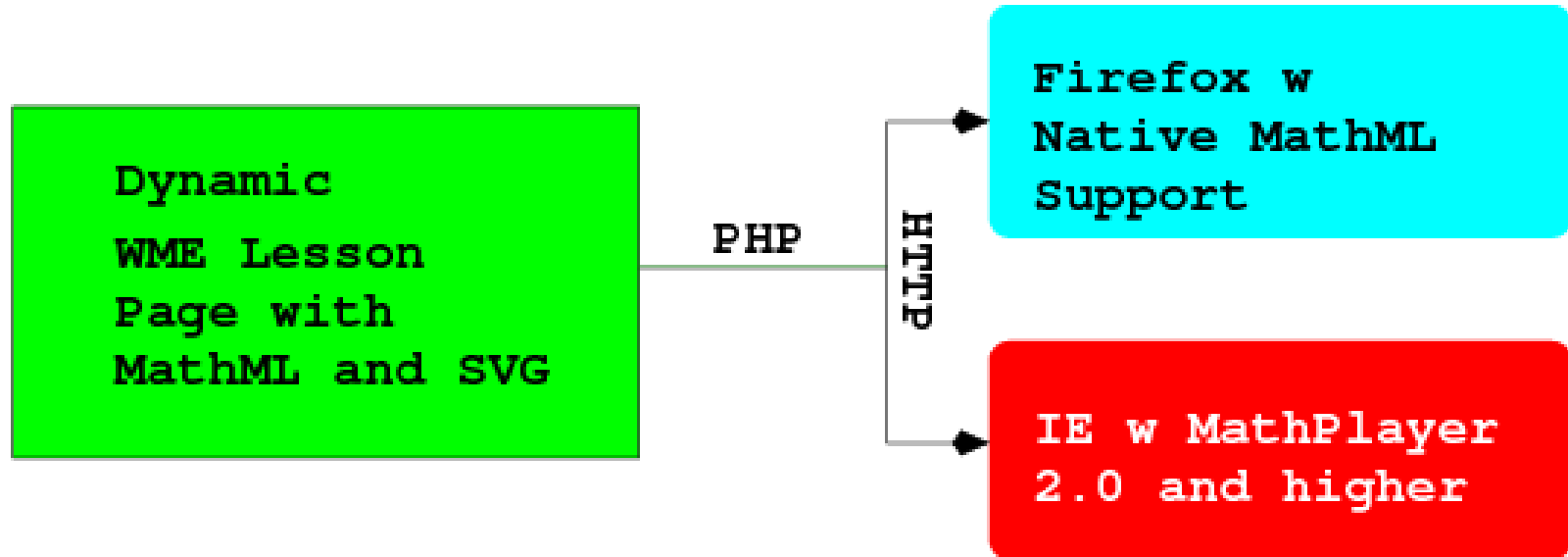
Answer Checking

- 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
- *Assessing mathematics automatically using computer algebra and the internet* by C. J. Sangwin, University of Birmingham, UK, 2003

Derivative Checking Service



Derivative Checking Example



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.