An Approach for Interoperable and Customizable Web-based Mathematics Education

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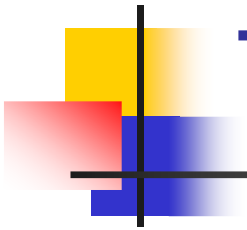
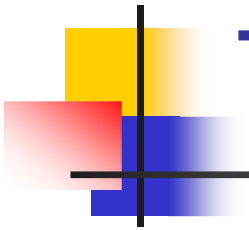


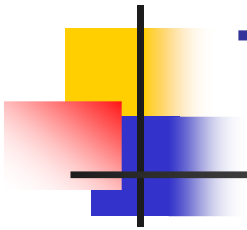
Table of Contents



The Problem

- The Web contains much content suitable for math education
  - National Library of Virtual Manipulatives
  - Calc101
  - MathForum
  - …
- Problem 1:

  Finding some content of interest and ones that could be incorporated into a lesson takes non-trivial time



The Problem (2)

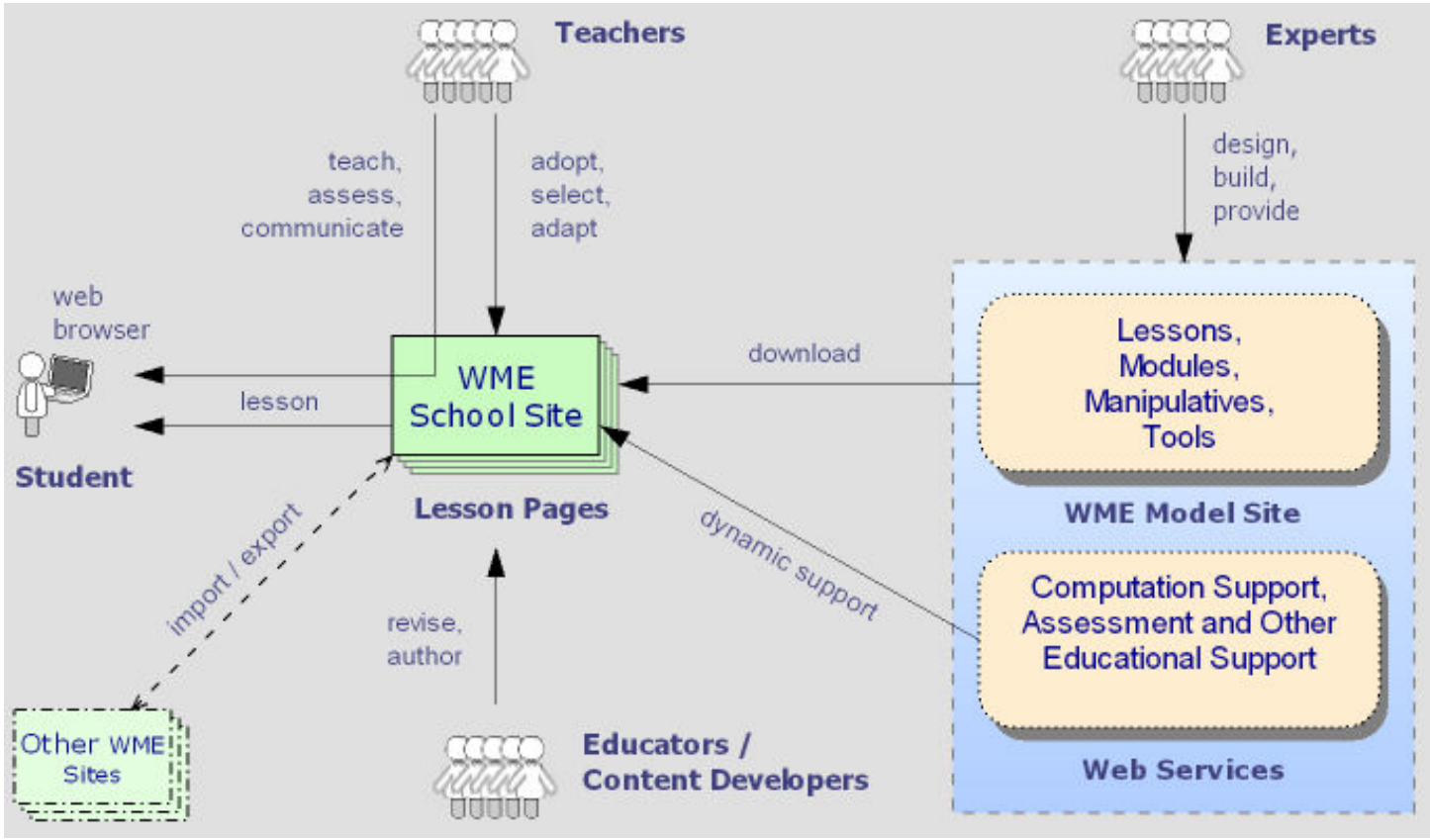
- Problem 2:

  It is difficult for any teacher to *incorporate* these materials *effectively* into a lesson.

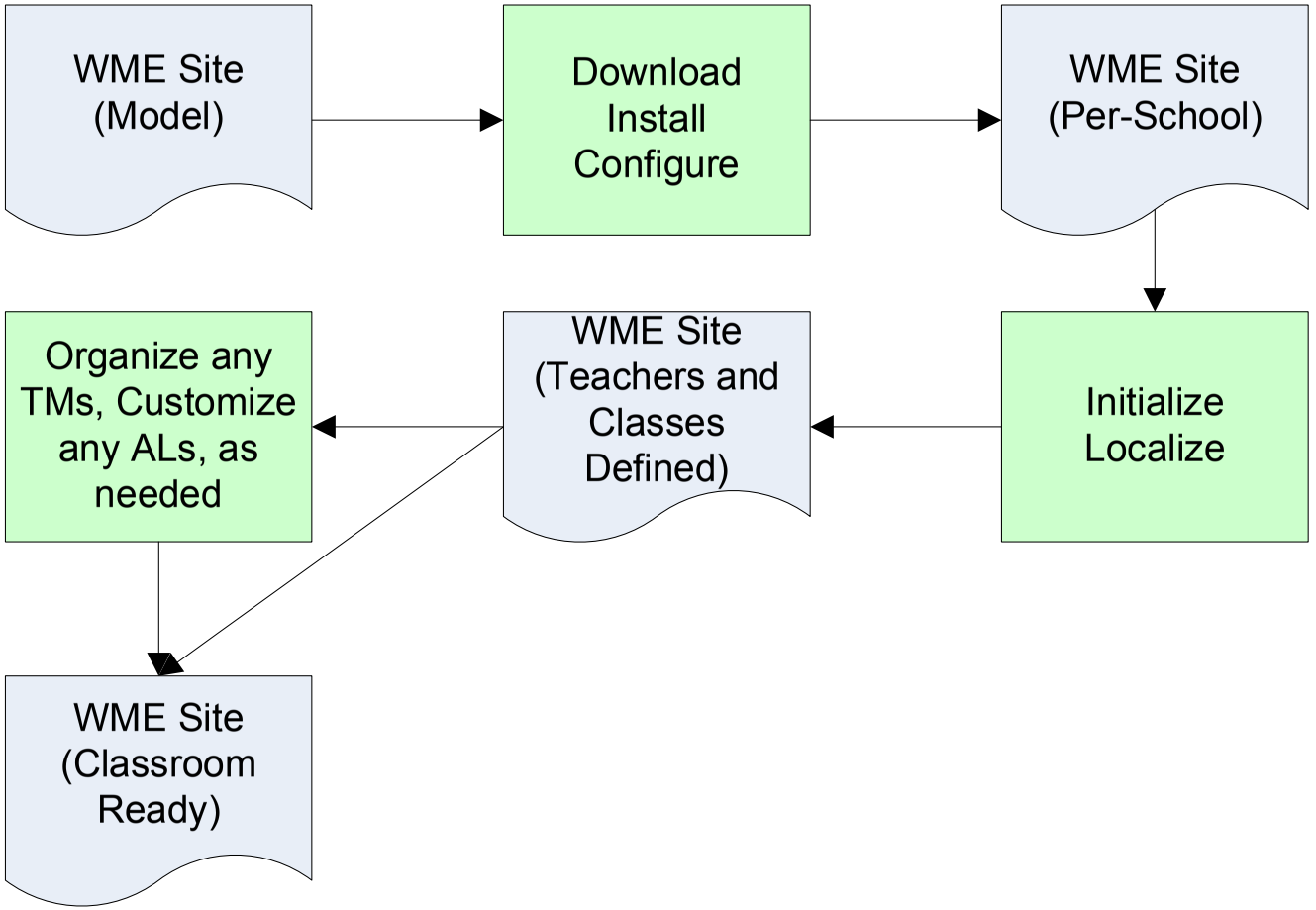
- Why?
  - Little interoperability between these components
  - Lack of customization

What is WME?

- A distributed system for Web-based mathematics education



What is WME? (2)


WME Site (Model)
Download Install Configure
WME Site (Per-School)
Initialize Localize
WME Site (Teachers and Classes Defined)
Organize any TMs, Customize any ALs, as needed
WME Site (Classroom Ready)

So What?

- WME offers classroom-ready lessons that abide national proficiency standards

- **WME's lesson modules and components are *searchable*, *reusable*, *interoperable*, and *customizable* among any other WME site**

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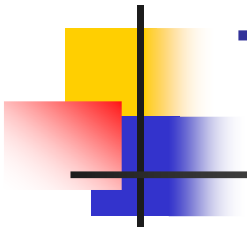
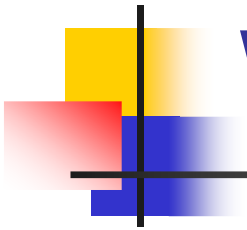


Table of Contents

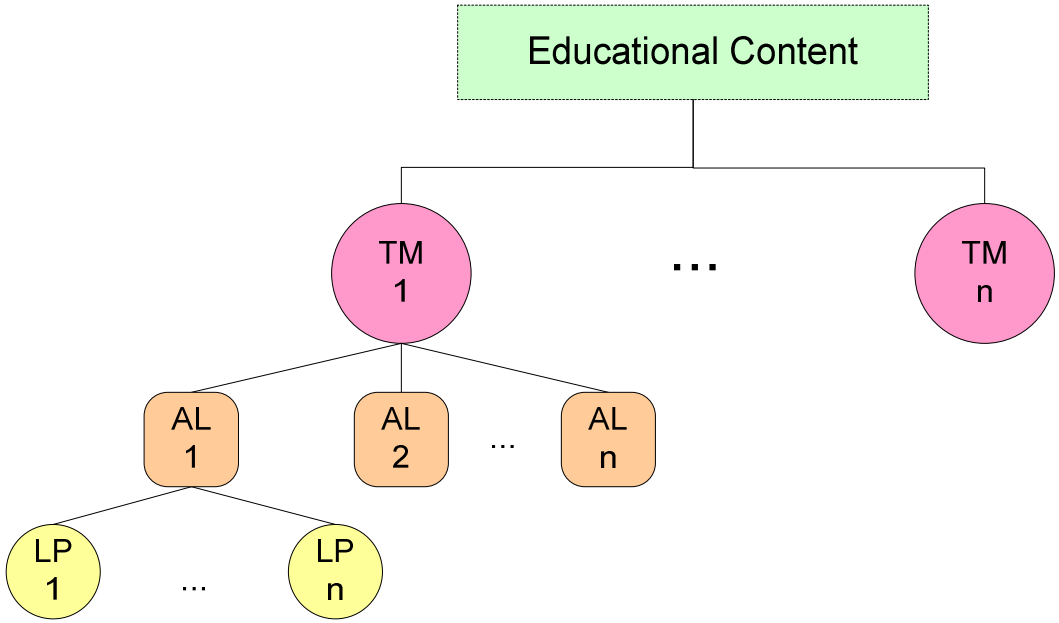


WME Interoperability

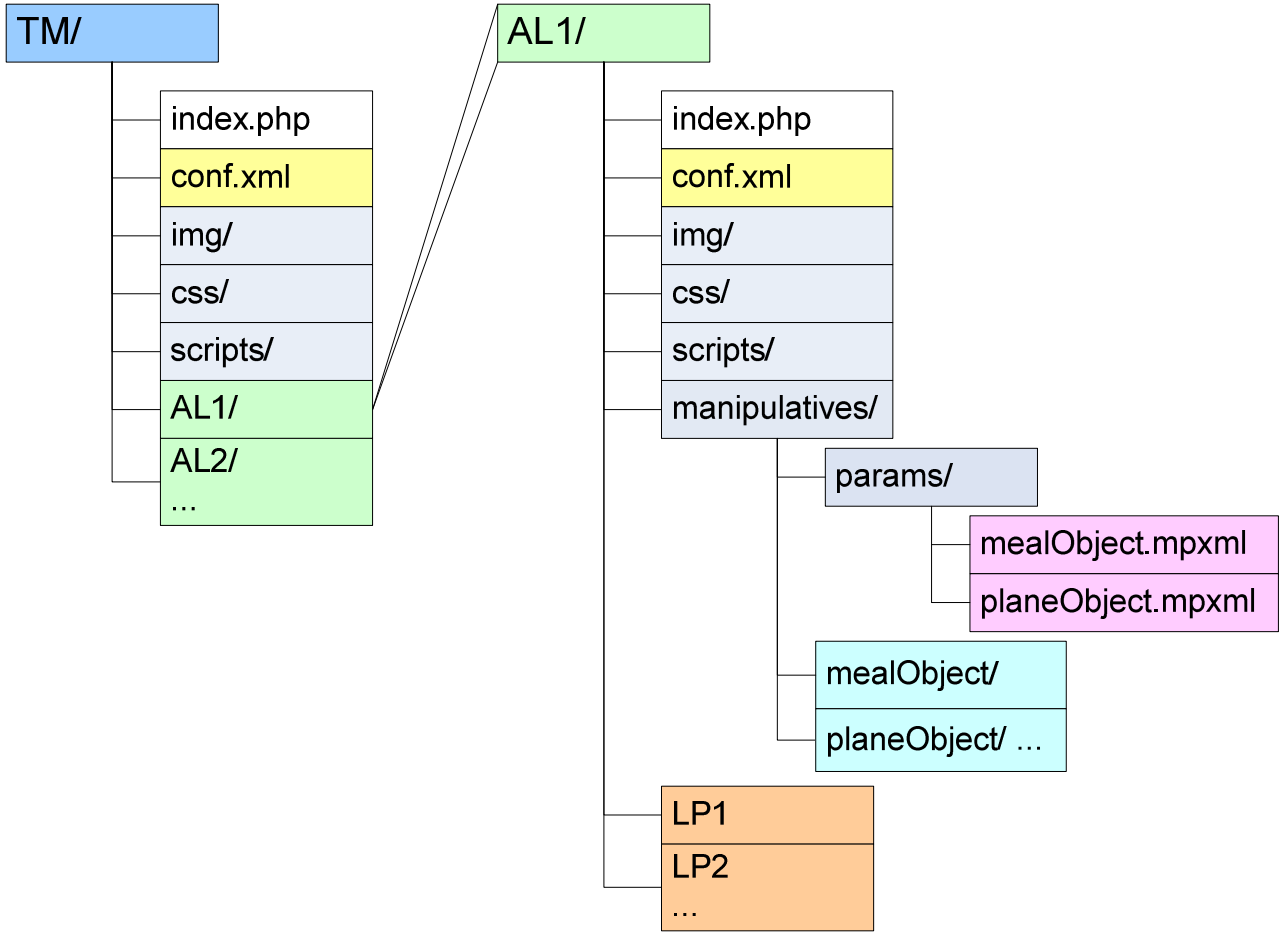
- Goal: To make WME components “plug-and-play”
- 2-Step Approach:
  - Separation of Components
  - Define Connection Interface

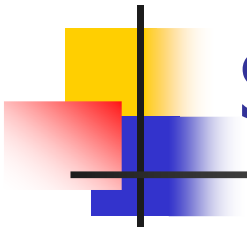
WME Interoperability
Step 1: Separation of Components

- Exploit the hierarchical nature of these components to make them independent from each other



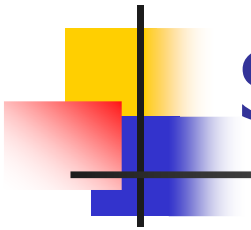
WME Interoperability
Step 1: Separation of Components





WME Interoperability
Step 2: Define Connection Interface

- Every “separated” component contains an XML-based configuration file.
- Each configuration file exposes information relating to components so that the connecting counterpart understands its interface and allows it to work properly



WME Interoperability
Step 2: Define Connection Interface

- Once the interface is understood, the WME site "installs" the component under the proper level in the hierarchy

- The newly installed component becomes immediately available and usable

WME Customization

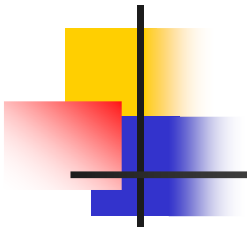
- Goal: To allow intuitive methods for customizing/tailoring a WME site and all WME components

- 2 Levels of Customization:
  - School-wide Administration
  - Lesson Management

A Sample Manipulative

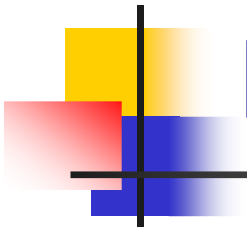
Please press the TAB key after entering a quantity.

Quantity	Item	Amount
2	Chicken Noodle Soup (1.95)	3.90
	Garden Salad (2.45)	
3	Club Sandwich (3.95)	11.85
	All Beef Burger (3.25)	
	Double Chocolate Cake (2.95)	
	Apple Pie (2.65)	
Clear Entries	**Total:**	15.75



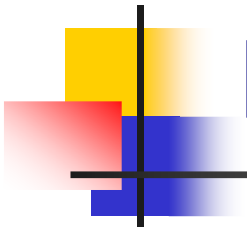
Manipulative Customization

- Object-Oriented Approach:
  - Encapsulation
  - Instantiation
  - Manipulation



Manipulative Customization (2)

- **Encapsulation**: The manipulative's object class is defined in a JavaScript file
- **Instantiation**: Deployed by object instantiation(s) into a web page via DOM
- **Manipulation**: Its behavior and appearance can be controlled by the set of *parameters* used to instantiate the object



Manipulative Customization (3)

- "A manipulative object class must be written in such a way that the designer anticipates which aspects can be customized"

- Parameters are passed to exploit these aspects the manipulative

Parameterizing

Please press the TAB key after entering a quantity.

Quantity	Item	Amount
2	Chicken Noodle Soup (1.95)	3.90
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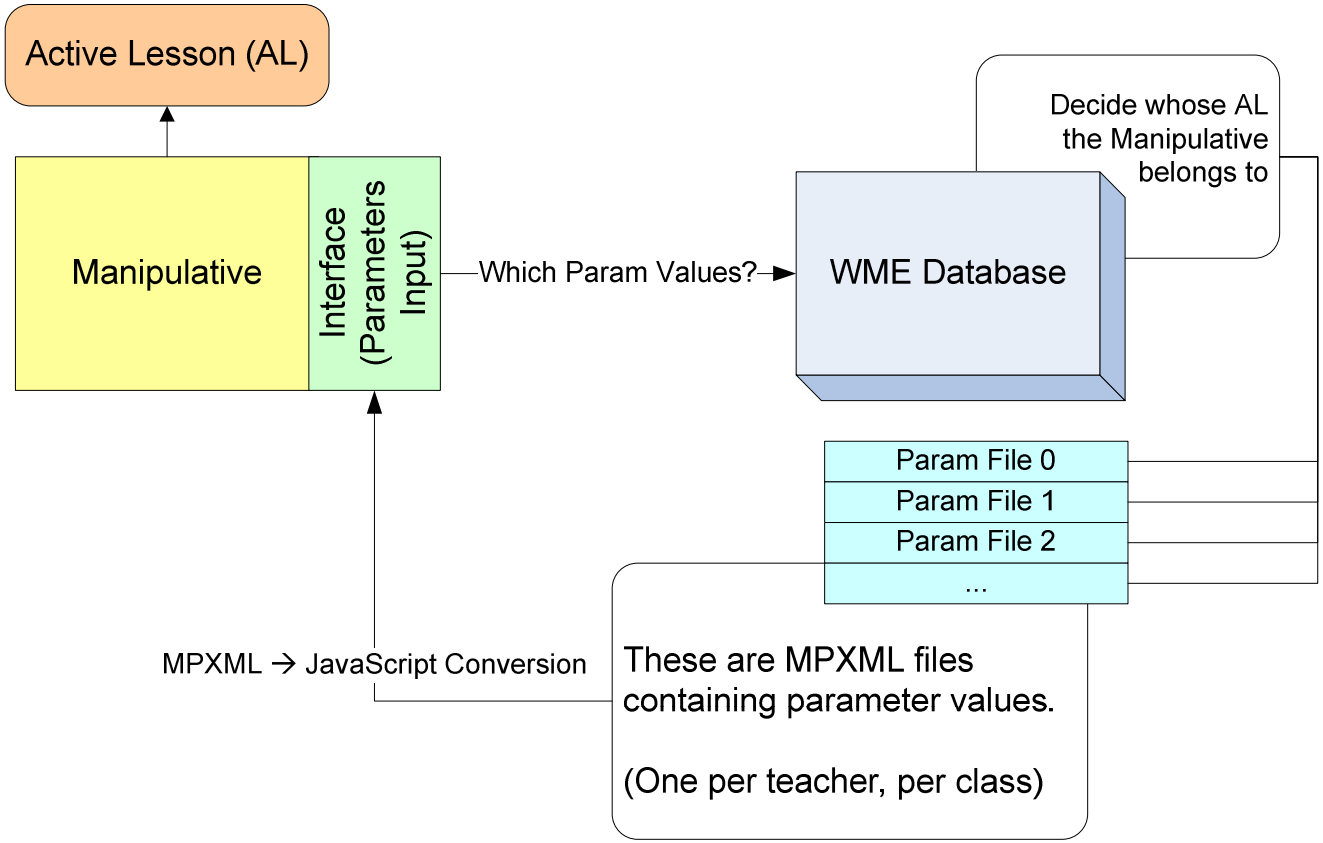
Clear Entries	**Total:**	15.75

Manipulative Parameter Files

- Manipulative parameters defined per-class and per-teacher in MPXML



Customized Menu Manipulative

Please press the TAB key after entering a quantity.

Quantity	Item	Amount
☐	Italian Wedding Soup (2.25)	
☐	Caesar Salad (3.45)	
☐	Macaroni and Cheese (3.45)	
☐	spaghetti with Meat Balls (4.65)	
☐	Tiramisu (2.95)	

Clear Entries

Total:

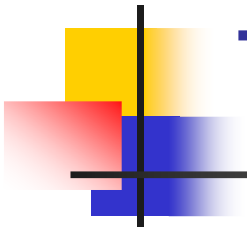


Table of Contents

- Introduction and Overview
- The WME Approach
- Demonstration
- Conclusion

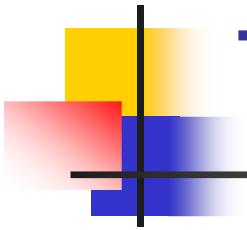
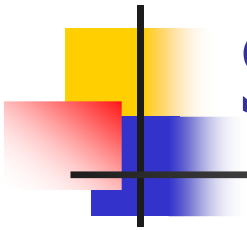


Table of Contents

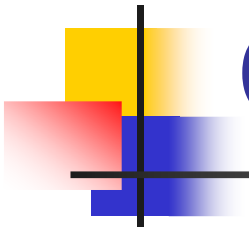


Summary

- WME is a distributed web-based system that specializes in mathematics education
- WME offers classroom-ready lesson content that can be customized
- Any component written to specifications is expected to interoperate with any WME system

Future Opportunities

- Other WME Projects
  - Interactive Geometry (GeoSVG)
  - Assessment Database (DMAD)
  - …
- Other WME Advances
  - Further expansion and collaboration
- **Ultimately, WME seeks to create a *Web for Mathematics Education***



Questions/Comments?

- WME Project Site
  http://wme.cs.kent.edu

- WME contact list:
  wme@cs.kent.edu