

# MLC Features

- Scaffolded instruction
- Vocabulary development and support
- Aligned with state and national standards
- Addresses gaps in prior knowledge
- Supplements teacher instruction at school or home
- Interactive and engaging
- Read-aloud support
- Audiovisual synchronicity
- Student progress monitoring
- Validated general outcome measures
- Teacher support tools & resource guides
- Adaptive assessments
- Custom curriculum for individualized learning
- Flash animation
- Internet delivery
- Grades 3-8

## Program Development — Year 1

### Modify Content of Math Learning Companion Modules

- 600 new NCTM and Colorado math standards-aligned summative pre-post test items (gr. 3-6). Additional foundational lessons (gr. 3-5).
- Cumulative review and practice at the start of each lesson, covering the major concepts most recently learned (15 day cumulative cycle). Cumulative review is designed to increase maintenance of skills and improve generalizability.
- Mixed review at the end of each lesson, providing systematic diagnostic feedback and an immediate opportunity to practice new concepts and skills.
- Re-labeled meta-tags in learning object repository
- Increased number of feedback loops

### Create and/or Modify Math Learning Companion Support Tools

- Customizable features, making individual student's learning environment unique, e.g., switch on/off content or assessment audio, forced linear execution (student moves sequentially through the content), calculator, Spanish support, etc.
- New Key Terms dictionary and contextual hyperlinks. A total of 814 elementary key terms and 659 middle school key terms with 102 of the terms distinct at middle school and 259 terms distinct at elementary school. Diagram examples are available for each term and each term is defined in English and Spanish (optional). Larger visual screen and font for easier readability, with audio option for every term in both languages.
- Created the first set of auto-generated diagnostic reports that were scheduled primarily in year two.

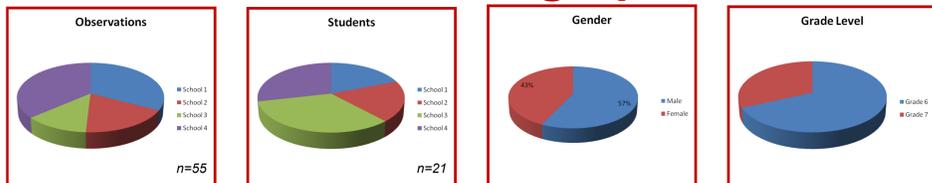
### Create and Validate Progress Monitoring Tools

- Development of General Outcome Measures (GOM) representing computational skills and all math domains, grades 5-6.
- 810 diagnostic items associated with the GOMs, enabling weekly formative testing.
- Reporting system measuring students' growth through the curriculum, including student and class level reports and teacher email alerts of key milestones.
- Initial validation of GOMs through expert panel review. Field-testing for reliability will occur late in year one.

### Redesign Adaptive Engine

- A comprehensive adaptive-prescriptive tool that auto-generates individualized learning pathways/customized curriculum based on the prerequisite skills and conceptual knowledge students need to reach sixth-grade proficiency, as identified by the summative and formative assessments. Teachers also can create custom curricula at the individual, group, or class level.
- An adaptive pretest assessing students' foundational number sense and operational fluency, grades 3-6. Tests are customizable, including audio and bilingual options.

## Student Demographics



# Math Learning Companion



Lindy Crawford, Ph.D.  
College of Education, Texas Christian University  
Pacific Coast Research Conference  
February 3-5, 2011

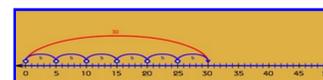


## General Outcome Measures

### Development of General Outcome Measures

Fifteen primary objectives were identified as aligned with the following standards:

- CO: Academic Standards
- TX: Texas Essential Knowledge & Skills
- CA: Content Standards
- NCTM: Focal Points

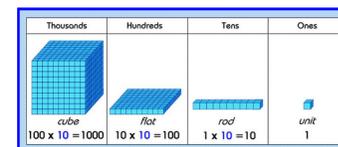


Fifteen General Outcome Measures were created for each objective. Each General Outcome Measure contained 36 items at Grade 6 (for a total of 540 items) and 18 items at Grade 5 (for a total of 270 items). Items on the General Outcome Measures represented the following math domains:

- Number Sense and Operations
- Algebraic Thinking
- Geometry and Spatial Reasoning
- Data Analysis and Probability

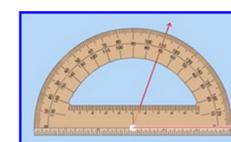
### Item Development Requirements

- Item addresses stated objective for each GOM
- Grade-level appropriate
- Mathematically correct
- Language controlled for readability
- Item assesses target skill not access skill
- Highly visual items containing graphics, charts, or tables when possible
- Content neutral to religion, politics, culture, race, and sex
- Four answer choices with one clearly correct answer and three plausible distracters



### Item Review and Evaluation

All items were evaluated for adherence to the specified objective and associated math strand, quality of item stem and plausibility of distracters. Based on this evaluation, each item was awarded a "validity rating" of 1-4 (with 4 being the highest).



**Validity Ratings:** Objective raters scored 95% of the items as a 4 for validity. All items were evaluated for level of cognitive demand:

- Level 1: Knowledge and Comprehension
- Level 2: Application
- Level 3: Analysis
- Level 4: Synthesis and Evaluation

### Cognitive Demand Ratings:

\*No item had a level 4 rating which would have required a constructive response versus a selected response (which is utilized in the MLC online environment).

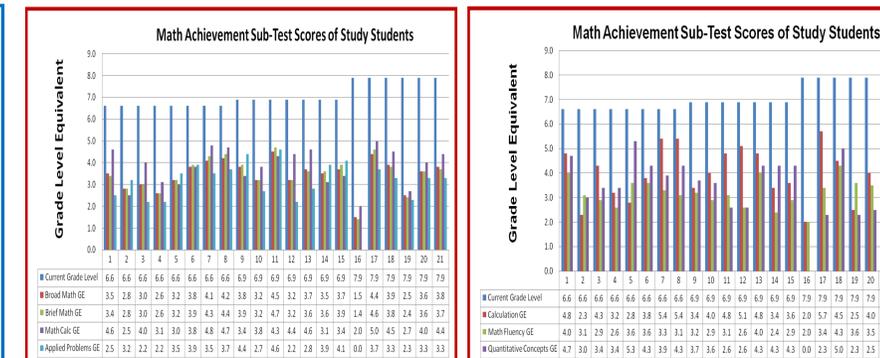
Levels of Cognitive Demand - Total Items				
Level of Cognitive Demand	1	2	3	4
Grade 6	237	276	27	0
Grade 5	174	77	19	0*

### Pilot Testing of Items for Reliability

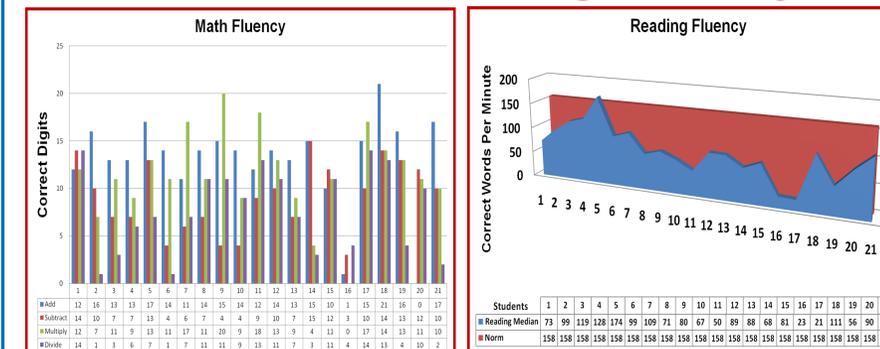
Establish and evaluate the psychometric properties of the MLC formative assessment item bank through the following steps:

- Step 1:** Design pilot test procedures to be conducted to obtain item-level data for the formative assessment item bank grade 6. Include specifications for equating design based on logistical constraints identified by MLC
- Step 2:** Based on the pilot test design, develop the test blueprint to specify the content included in pilot test protocols.
- Step 3:** Review operational test protocols and format of data output. Develop administration manual.
- Step 4:** Conduct assessment of dimensionality, equating, item analyses, and reliability coefficients.
- Step 5:** Provide recommendations on item selection based on output leading to a list of items to remain in MLC Formative Assessment Item Bank.

## Math Achievement Scores



## Math & Reading Fluency



## Iterative Research & Development Cycle

### Researchers:

- Piloted content and format in four middle schools
- Cognitive Lab (piloted in 4 schools)
  - Used splitter and wore headphones to listen in as student completed lesson
  - Stopped lesson and questioned students when deemed necessary
  - Discussed lesson with each student at its conclusion
- Observed teacher interactions during math period
- Interviewed students and teachers
- Conducted one focus group
- Collected teacher journals throughout the study
- Triangulated data from multiple sources
- Submitted recommendations to DDI based on the triangulation of data

### Developers - Digital Directions International:

- See "Field-Research Recommendations"
- DDI responds to recommendations
- Changes will be field-tested in middle schools in Yr 2
- New recommendations submitted bi-annually
- Process repeated in Year 2
- Pre-post single group study planned for Year 3

