

Correlations of CEI’s Mathematical Learning Systems (MLS) with NADE’s “Best Practices in Developmental Mathematics”

Based on “Best Practices in Developmental Mathematics (2nd Edition), edited by Thomas C. Armington (2003), NADE Mathematics Special Professional Interest Network, National Association for Developmental Education; and Creative Education Institute’s (CEI) Mathematical Learning Systems program and various publications.

Identified NADE “Best Practices”	MLS Application of Findings
<p>Motivation and Content/Skill Deficiencies “Those who have been teaching at the developmental level for some time will attest to the fact that teaching developmental mathematics differs substantially from simply teaching mathematics. Developmental instruction addresses not only the remediation of subject-specific deficiencies, but motivational and learning deficiencies as well.” (p. 1)</p> <p>“Developmental students often lack an internal sense of control.” (p. 3)</p>	<p>CEI’s MLS developers share exactly that understanding and philosophy.</p> <ul style="list-style-type: none"> • See Chapter II in <i>Why MLS Works: Its Scientific, Theoretical, and Evaluation Research Base</i> for a discussion of mathematics learning difficulties, which includes stereotype threat, math anxiety/phobia, and general motivational issues, including a lack of understanding of how effort affects performance. • See Chapter III in <i>Why MLS Works</i> for a discussion of general and specific mathematics learning disabilities. • See Chapter VII in <i>Why MLS Works</i> for the documentation of how MLS applies the research findings related to motivational issues. • See Chapters IV, V, and VII for documentation of how MLS applies research findings to address mathematics disabilities.
<p>Faculty Attitudes “While various studies have been undertaken to determine how student attitudes affect performance, work has also been done on how faculty attitudes affect student performance.” (p. 1)</p> <p>“According to Tobias, the predominant causes of math anxiety are environmental factors created by math teachers.” (p. 2)</p> <p>“Coupled with the negative influence of environmental facts is the belief that students who do well in math do so because of native ability, not effort.” (p. 2)</p> <p>“Many students who are placed in developmental mathematics exhibit math anxiety or a fear-of-math.” (p. 4)</p>	<ul style="list-style-type: none"> • See pp. 25-28 in <i>Why MLS Works</i> for discussion of “Stereotype Threat Effects on Motivation to Learn Mathematics.” • See pp. 28-32 in <i>Why MLS Works</i> for discussion of “Effects of Mathematics Phobia on Motivation to Learn Mathematics,” including how teachers contribute to math phobia. • See pp. 45-51 in <i>Why MLS Works</i> for a discussion of “Effects of Inadequate or Inappropriate Instruction on Mathematics Achievement.” • See pp. 20-25 in <i>Why MLS Works</i> for a discussion of “Cultural Effects on Motivation to Learn Mathematics.” (Please note that this section also discusses some of the issues that second-language students experience in math classes.)

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<p>Successful Teachers "Powell (2000) indicated that having a 'caring ethic,' being 'available,' conducting positive 'classroom discourse,' and providing 'clear explanations' were reported as characteristics and behaviors associated with quality teaching." (p. 4)</p> <p>"On the one hand, well meaning but untrained tutors can do more harm than good (Maxwell, 1997). On the other hand, when tutoring is delivered by trained tutors, it is the strongest correlate of student success (Boylan et al. 1994). (p. 8)</p> <p>"The in-class experience should be supportive and non-judgmental." (p. 11)</p> <p>"Education is not about teaching content, but teaching people!" (p. 11)</p> <p>"A ... common component of lab instruction involves self-paced learning." (p. 17)</p> <p>"Perhaps the newest model of instruction is Internet-based or online instruction." (p. 17)</p>	<ul style="list-style-type: none"> • See pp. 235-239 in <i>Why MLS Works</i> for a discussion of a quality MLS lab facilitator. • See pp. 175-187 in <i>Why MLS Works</i> for a discussion of the benefits of computer-assisted instruction in teaching struggling learners (including it being non-judgmental). • See again the discussion on motivating students in Chapters II and VII of <i>Why MLS Works</i>. • See discussion of tutoring and individualized/differentiated strategies on pp. 196-210 in <i>Why MLS Works</i>. • See also the description of one-on-one tutoring on pp. 161-162 of <i>Why MLS Works</i>. • See discussion of "corrective feedback" on pp. 227-229 in <i>Why MLS Works</i>. <p>See CEI's web-based activity center for web-based practice exercises that build fluency, i.e., <i>Digit's Widgets</i>.</p>
<p>Mastery Learning/Direct Instruction "The concept of mastery learning can be a great asset in developmental mathematics." (p. 9)</p> <p>"While mastery learning may not be the answer to all of the problems encountered by developmental mathematics students, it certainly can make a difference in how students progress. It also makes a difference in the knowledge base that they take with them into their future mathematical studies." (p. 9)</p> <p>"The M.Y. Math Project is based on an instructional method that consists of a steady progression through four phases: modeling, practice, transition, and independence." (p. 36)</p>	<ul style="list-style-type: none"> • See pp. 162-162 in <i>Why MLS Works</i> for a description of how MLS incorporates mastery learning and direct instruction principles in its lesson designs. • These four phases correspond with the phases in direct instruction and mastery learning described in Chapter V of <i>Why MLS Works</i>.

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<p>Precise Language and Notation "Other strategies for helping developmental students involve the use of precise language and notation and discouraging students from relying on a 'key word' strategy for solving word problems." (p. 3)</p>	<p><i>MLS's</i> on-screen tutor Digit uses the correct mathematical vocabulary and notation consistently throughout the program. Students hear the words, see the words, and apply the instruction so that they learn to master the vocabulary as a part of learning the concept.</p> <p>In the Abstract phase of each lesson sequence, students are taught strategies for solving word problems, going far beyond the "key word" strategy. Lessons include the identification of irrelevant information in word problems, setting up the equations, choosing appropriate operation, recalling procedural steps, etc.</p>
<p>Diversity of Struggling Students "...instructional methods have to be altered to accommodate the learning characteristics of different kinds of students." (p. 2)</p> <p>"More students are attending college from a variety of backgrounds, and higher education is experiencing greater student diversity in terms of a wide range of student characteristics such as age, ethnicity, socioeconomic status, and preparedness." (p. 4)</p> <p>"Irrespective of what placement scores may suggest about the skill levels of various students, too much disparity in student backgrounds or ability levels creates an environmental problem for the instructor." (p. 14)</p> <p>". . . meeting the needs of students with verifiable learning disabilities is entirely different from meeting the needs of underprepared students and may require professional training." (p. 45)</p> <p>"Many of the problems encountered by the LD student in learning mathematics are similar to those of the general population, only more pronounced. Thus, many of the strategies used in the LD mathematics classes are applicable to all students; they are just good teaching and learning techniques." (p. 45)</p>	<ul style="list-style-type: none"> • See Chapters II and III of <i>Why MLS Works</i> for descriptions of learning difficulties and disabilities that affect mathematics performance. • See Chapters IV, V, VI, and VII for discussions of how <i>MLS</i> designs instruction to accommodate the needs of struggling learners. <p><i>MLS</i> is totally individualized/differentiated because it employs computer-assisted instruction, eliminating the classroom management problems of traditional classrooms.</p> <ul style="list-style-type: none"> • See again Chapters II and III of <i>Why MLS Works</i>. The use of expertly designed software can eliminate the need for on-site specialists and for some professional development that would be critical if math were only taught in traditional settings.

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<p>Manipulatives "It is better for students to draw pictures or diagrams, or to use manipulatives to understand what a problem is asking and how to find a solution." (p. 3)</p>	<ul style="list-style-type: none"> • See pp. 167-174 in <i>Why MLS Works</i> for a description of the concrete – semi-concrete – abstract lesson sequence model used to teach concepts; for a discussion of how manipulatives are used in the concrete phase; and how <i>MLS</i> applies these research findings.
<p>Content of Successful Programs "The most common description of the developmental mathematics core tends to be the body of material ranging from Arithmetic through Intermediate Algebra." (p. 6)</p> <p>"At the arithmetic level, this involves a primary focus on teaching the mechanical techniques for performing integer, decimal, fraction, and percent operations." (p. 6)</p> <p>"What distinguishes an innumerate student from any other developmental student? It is not completely clear. Nevertheless, research indicates that innumerate students struggle with basic concepts, such as place value or rounding, and they struggle with different number forms." (p. 26)</p> <p>"Low self-esteem is another common characteristic of developmental mathematics students that may be relieved by the use of algorithms. Algorithms are reliable guides to problem-solving which, if developed and used correctly, result in correct solutions and conceptual understanding." (p. 36)</p> <p>"Instead of seeing courses as a list of many, unrelated topics, instructors can teach students to see mathematical topics as parts of a branching tree of patterns and procedures." (p. 39)</p>	<p>The full range of <i>MLS</i>'s content is described in Chapter IV of <i>Why MLS Works</i>. See also the special issue of <i>SHARE</i>, CEI's newsmagazine, for more information. <i>MLS</i> topics include (1) those identified by research as the ones most likely to cause students to struggle; and (2) those identified by research to be the ones most critical for later success in mathematics (e.g., mastery of fact fluency and fractions for success in algebra). See article on p. 8 of November/December 2006 issue of <i>SHARE</i> for an explication of how <i>MLS</i> prepares students for success in algebra.</p> <ul style="list-style-type: none"> • See pp. 118-122 in <i>Why MLS Works</i> for a discussion of how <i>MLS</i> teaches algorithms. • See pp. 104-108 in <i>Why MLS Works</i>.

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<p>Word Problems “Teaching students to solve word problems is not easy. One of the reasons students do not do well with these types of problems is their weak reading skills.” (p. 19)</p> <p>“Word problems are difficult for many students, not just developmental students.” (p. 27)</p>	<ul style="list-style-type: none"> • See pp. 80-88 in <i>Why MLS Works</i> for a discussion of how language system disabilities and dyslexia can affect mathematics performance. • See pp. 126-130 in <i>Why MLS Works</i> for a description of the ways in which <i>MLS</i> teaches problem solving. • See pp. 146-148 in <i>Why MLS Works</i> for a summary of the ways in which <i>MLS</i> can help second-language students overcome the barriers to learning mathematics in English. • See <i>SHARE</i> article, “Double Your Treasure: Dyslexics Need <i>ELS</i> and <i>MLS</i>.”
<p>Instructional Strategies “Studies in learning styles have shown that different students learn through different sensory modalities.” (p. 18)</p> <p>“Concept repetition is the most important strategy.” (p. 26)</p> <p>“Equivalencies are central to mathematics. Developmental students, especially innumerate students, need to understand the importance of equivalent amounts or values.” (p. 26)</p>	<ul style="list-style-type: none"> • See pp. 190-196 in <i>Why MLS Works</i> for a description of how <i>MLS</i> employs multi-sensory processing strategies in both its teaching of concepts and of fact fluency. • See pp. 211-219 in <i>Why MLS Works</i> for a description of why and how <i>MLS</i> employs varied repetition/practice exercises. • See lessons in <i>MLS</i> on money and time in Unit 3; lessons on equivalent fractions in Unit 4; and other equivalency lessons in Unit 5 on fraction operations.
<p>Assessments “[Tobias] emphasized the importance of good diagnostic and placement procedures.” (p. 2)</p> <p>“Student performance should be evaluated constantly and using various assessment tools. Developmental mathematics students need several opportunities to demonstrate that they understand the content. Both formal and informal evaluation should take place.” (p. 35)</p>	<p>CEI’s <i>MLS</i> has a comprehensive assessment program:</p> <ul style="list-style-type: none"> • Two third-party assessments to diagnose students’ academic needs and their learning characteristics. • An <i>MLS Placement Test</i> designed by CEI to assist lab managers in appropriate placement of students into the program. • Each third lesson of a lesson phase includes a formative assessment to determine mastery. • Each tenth lesson is a mastery lesson of the concepts and procedures that have been taught. Students not mastering are automatically recycled. • Third-party post test to measure value-added. <p>See pp. 223-233 in <i>Why MLS Works</i> for a more comprehensive description of assessments.</p>