MEBA™

Mathematics Experience-Based Approach

Rote instruction in mathematics relies on the mere memorization and manipulation of symbolic expressions and procedural rules with limited, if any, conceptual understanding. Many reports on how mathematics is taught in this country state that instruction is based on the use of one textbook and unconnected instruction. Other instructional resources are seldom used and instruction tends to be formal and rote. Classroom time is primarily devoted to listening to the teacher describe how to complete textbook/workbook pages and taking written tests. According to these reports, teachers cover a wide range of topics. However, these topics are often dealt with superficially and are not related to other topics and concepts. The data from these studies indicates that, in general, most teachers attempt to "cover ground" rather than promote understanding for applications and long-term memory. Although there have been recent national and state attempts to change these practices, the learning of mathematics today continues, for the most part, to be based on students' ability to memorize information and store it in small fragments through repeated drill exercises and reinforcement.

Often parents, teachers, and administrators will identify their school's mathematics program by the publisher's name of the adopted textbook. This behavior is symptomatic of the assumptions which underlie rote instruction: textbook and paper and pencil exercises are all that are needed to effectively communicate mathematics! The classroom environment further accentuates these assumptions by providing insufficient space for the investigation of mathematical concepts using physical/pictorial models and group problem-solving work. Instead, a learner in a typical classroom which stresses textbook instruction is provided with an individual desk suitable for reading and writing only.

In contrast, our recommendations for instructional practices are based on a specific philosophy of mathematics instruction and developmental psychology. The framework that we have constructed, based on these philosophical and psychological ideas, provides guidelines for developing and sequencing meaningful mathematics experiences. It also provides a management system for program implementation and an evaluation design that serves as a basis for assessing mathematics learning. The adoption and usage of this framework and associated instructional strategies has come to be known as Mathematics Experience-Based Approach (MEBA™).

An underlying premise of MEBA is that a mathematics program involves much more than an adopted textbook and/or other selected resources. Although such resources may be varied and include manipulatives, instructional games, calculators and computers, such materials do not, in and of themselves, foster mathematics understanding nor do they provide the experiences necessary to promote mathematics literacy. Our approach is based on the belief that if we wish a learner to understand a mathematical concept, first-hand experiences with a physical model of the concept is essential.

 Mary Gilfeather & John del Regato

The focus of MEBA™ is on how we, as educators, effectively communicate mathematical concepts, strategies, and skills. In essence, MEBA fosters mathematical understanding by building deliberate connections between and among physical models, pictures, and symbols/algorithms to associate conceptual and procedural knowledge. Moreover, MEBA's framework facilitates students' ability to image mathematics concepts in the mind's eye. It consistently incorporates the use of two basic problem-solving strategies: building a model of the problem and drawing a picture of the problem. As an instructional approach, MEBA makes use of a framework that integrates teaching and assessing mathematics from a conceptual and problem-solving perspective. Teachers implementing MEBA integrate a variety of mathematics resources in a developmentally appropriate and sequenced manner to promote students' computational/arithmetic, spatial/geometric, and logical/scientific reasoning skills. Routine and nonroutine problem solving experiences coupled with developing the ability to describe mathematical relationships orally and in writing are critical components of this approach.

MEBA™ Framework

MEBA™ uses a framework that consists of seven components. Some of these components are further elaborated in the following pages.

I. Sequenced Instructional Modes (SIMS™) & Instructional Phases
One of the basic components of the MEBA framework is a sequence to systematically and developmentally connect mathematics concepts using concrete, pictorial, and symbolic representations. This process develops an understanding and memory of mathematics that lasts a lifetime and can be applied in numerous real-life contexts. Instruction is organized around three instructional phases. (See pages 11 - 16.)

II. Spatial Imagery Development & Harmonic Thinking
MEBA stresses the importance of linking arithmetic ideas with corresponding spatial/geometric relationships. Concrete and pictorial models are arranged in particular patterns so that students learn to visualize and solve mathematics problems to facilitate "mental math." (See pages 18 - 19.)

III. Routine & Nonroutine Problem Solving
Beginning with the concrete level, word problems are presented and simulated with physical models. This process continues through the symbolic level. Students are continually called upon to use oral and written language to describe their thought processes. Building a model and drawing a picture of a problem are two basic problem-solving strategies. MEBA incorporates these strategies as an ongoing part of instruction. Through the series of interactive **Mathematics Pentathlon**® games, students develop strategic thinking and learn to deal with problems that continually undergo change. This results in students' ability to consider alternative solutions and formulate plans many steps in advance. (See pages 19 - 22.)

IV. Connecting Arithmetic, Spatial/Geometric, & Logical Reasoning

Mathematics involves much more than arithmetic skills. The ability to reason geometrically, spatially, and logically through the processes of observation, classification, hypothesizing, experimentation, and the ability to use inductive and deductive thought are critical characteristics of mathematical thinking. MEBA™ develops arithmetic concepts by connecting them to related spatial and logical ideas. It also incorporates the **Mathematics Pentathlon**® games, which integrate computational, spatial/geometric, and logical/scientific thinking.

V. Cooperative Learning & Use of Spoken Language

MEBA stresses shared communication of mathematical ideas, strategies and relationships. To foster this, students are organized into groups designed to develop a positive interdependence among group members so that each individual will grow in flexibility, persistence, and a spirit of inventiveness. Whether instruction takes place in large groups, small groups, or individually, MEBA stresses that spoken language always precedes written language. Throughout SIMs™ instruction, students are encouraged to describe mathematical ideas in a variety of ways. At the concrete, concrete-pictorial, and pictorial levels of instruction, students are encouraged to orally provide the correct mathematical terminology and to create their own story problem situations. As they advance to the concrete-symbolic, pictorial-symbolic, and symbolic levels of instruction, students are encouraged to transfer these orally communicated ideas into written form.

VI. Classroom Management, Organization & Teacher Questioning

Organizing and managing an experience-based classroom requires more planning than classroom teaching that stresses textbook and workbook instruction. Also, the ability to ask good questions and know when to incorporate them in the instructional process is a complex matter. MEBA assists teachers in organizing and managing an experience-based classroom. It also provides teachers with a practical guide for asking good questions and coaching students to understand concepts, to think analytically, and to pose good questions to their teachers and peers.

VII. Alternative Assessment & Evaluation

MEBA assesses students' conceptual understanding and problem-solving skills through their ability to represent and connect concepts with concrete models, pictures and symbols and to describe these representations orally and in writing. Portfolios, performance based assessment tasks and observational criteria are used on an ongoing basis to evaluate students' progress. (See page 29.)