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Goals in the Mathematics Curriculum

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There is considerable debate pertaining to which objectives learners are to attain. The ma- matics curriculum is no exception. One hears much about a return to the basics. The ba- s generally are perceived as emphasizing the three R's (reading, writing, and arithmetic). us, the third R—arithmetic—has essential content for all learners to master. Within the mework of essentialism, which objectives, methods of teaching, and appraisal procedures ed to be in evidence?

Instructional Management Systems

nstructional Management Systems (IMS) advocate the utilization of precise, measurable ls. Vagueness and ambiguity need to be eliminated from goals of instruction according to S tenants. With clarity of intent in objectives, the teacher knows precisely which sequen- l ends students are to attain. Thus, learning activities may be selected by the teacher to ide pupils to achieve each objective on an individual basis. An objective needs to be at- ned by the student before progressing to the next sequential end. The teacher can then mea- e if a learner has/has not achieved a specific goal. Uncertainty on the teacher's part is : in evidence to determine if a student has mastered content necessary in goal attainment. The Missouri Department of Elementary and Secondary Education[1] listed the following aracteristics of IMS:

1. High expectations for learning. Teachers and administrators expect a high level of a- chievement by all students and communicate their expectations to students and parents. No students are expected to fail, and the school assumes responsibility for seeing that they don't.
2. Strong leadership by building principals. The building principal is an instructional leader who participates in all phases of instruction. The principal is a visible leader of instruc- tion, not just an office-bound administrator.
3. Emphasis on instruction in the basic skills. Since mastery of the basic skills is essential to learning in all other subjects, the effective schools make sure students at least master the basic skills.

1) Department of Elementary and Secondary Education, Jefferson City, Missouri, 1982.

4. Clear-cut instructional objectives. Each teacher has specific instructional objectives within the overall curriculum which are communicated to students, parents and the general puiblic. In effective schools, teachers and administrators—not textbooks—are clearly in charge of the curriculum and teaching activities.
5. Mastery learning and testing for mastery. Students are taught, tested, retaught and retested to the extent necessary to assure mastery of important objectives.
6. School discipline and climate. The effective schools may not be shiny and modern, but they are at least safe, orderly and free of distractions. All teachers and students, as well as parents, know the school's expectations about behavior and discipline.

The followings are definitely not emphasized by IMS:

1. open-ended general objectives in the mathematics curriculum.
2. leaway in interpretation as to which subject matter should be taught so that students may choose sequential goals to achieve in a flexible mathematics curriculum.
3. pupil-teacher planning in selecting objectives.
4. learners in a classroom achieving at a similar/same level of progress. Each student progresses as rapidly as possible in achieving objectives.

Learning Centers and Mathematics

Educators, advocating humanism as a psychology of learning, believe that students should be involved in decision-making. Thus, the mathematics teacher, alone, does not select objectives, learning activities, and evaluation procedures for students. Rather, within a flexible framework developed by the teacher, the learner may select from among alternatives which sequential activities to pursue. A learning centers approach might then be in evidence. An adequate number of centers and tasks needs to be available so that the involved student may truly choose which activities to pursue and which to omit. Continuous progress must be made by the learner in completing personal suitable tasks. Each student may then achieve at a unique optimal rate of progress. Diverse objectives in mathematics may be achieved when comparing one student with another.

Choices made by learners in tasks pursued depend upon personal interests, abilities, capacity, and motivation. The kinds of tasks chosen may emphasize individual or committee endeavors, an activity centered or subject matter emphasis, inductive or deductive methods, as well as concrete or abstract experiences.

Morris and Pai[2] wrote the following pertaining to the thinking of Carl Rogers:

> But what are the conditions for such learning, and what must the teacher do to facilitate them? Like other humanistic educators, Rogers assumes that human beings have a natural potentiality for learning and curiosity. John Holt argues that this potentiality and desire for knowledge develops spontaneously unless smothered by a repressive and punitive climate. Consequently, humanistic educators seek to remove restrictions from our schools so that the child's capacity for learning can be cultivated. They attempt to provide the child with a more supportive, understanding, and nonthreatening environment for self-discovered learning.

2) Van Cleve Morris and Young Pai, *Philosophy and the American School*, Boston: Houghton Mifflin Company, 1976, p. 367.

›r example, if Jimmy is having serious difficulty in reading, he should not be forced to cite or read aloud in front of his peers, whose reactions may strengthen his own percep- ›n of himself as a failure. Rogers believes that significant learning can be promoted by lowing children to confront various problematic situations directly. If students choose their wn direction, discover their own resources, formulate their own problems, decide their wn course of action, and accept the consequences of their choice, significant learning can e maximized. This suggests that significant learning is not possible unless the learner's elings and the intellect are both involved in the learning process.

dvocates of learning centers do not emphasize:

. precise, measurable objectives for student attainment. What is specific to measure in pupil progress may not be relevant. Interests and purposes of learners are significant, but can not by any means be precisely measured.
. teachers selecting objectives, learning activities, and evaluation techniques for students.
. a rigid, formal curriculum. Rather, input for students in curriculum development is important.
. each pupil being assigned the same/similar tasks as compared to other learners in the classroom.

Structure of Knowledge and the Mathematics Curriculum

lathematics may be perceived as having considerable structure. There are selected concepts l generalizations which hold true consistently. Thus, concepts, such as the following may stressed in teaching and learning:

. The commutative property of addition and multiplication.
!. The associative property of addition and multiplication.
i. The distributive property of multiplication over addition.
:. The identity elements for addition and multiplication.
i. The property of closure for addition and multiplication.

Key concepts and generalizations, as advocated by mathematicians on the higher education el, then become objectives for students to attain on the elementary, junior high school or ddle school, and senior high school years.

To achieve these structural ideas, the teacher of mathematics needs to have students utilize luctive methods of learning. Lecture and heavy use of explanations is not recommended. ther, the teacher identifies problems and questions. To secure content in answer to the estions and problems, a variety of reference sources need to be utilized. Answers to oblematic situations come from students. Methods of learning used by students should be nilar to those emphasized by professional mathematicians.

Woolfolk and Nicolich[3] wrote:

Jerome Bruner a well-known modern cognitive theorist…. Bruner has been especially interested in instruction based upon a cognitive learning perspective. He believes that tea-

3) Anita E. Woolfolk and Lorraine McCune Nicolich, ***Educational Psychology for Teachers***, Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1980, p. 209.

chers should provide problem situations that stimulate students to discover for themselves the structure of the subject matter. *Structure* is made up of the fundamental ideas, relationships, or patterns of the subject matter, that is, the essential information. Specific facts and details are not part of the basic structure. However, if students really understand the basic structure they should be able to figure out many of these details on their own. Thus Bruner believes that classroom learning should take place inductively, moving from specific examples presented by the teacher to generalizations, about the structure of the subject, that are discovered by the students.

Structure of knowledge advocates in mathematics do not believe in:

1. student-teacher planning as to objective the former is to attain. Rather, structural ideas need to be achieved as identified by subject matter specialists.
2. teachers presenting subject matter deductively for learners to acquire.
3. content for student attainment being chosen by others than professionals in the mathematics curriculum.
4. emphasizing abstract experiences for students as compared to the concrete and semi-concrete. Sequence in learning activities must progress from manipulative (real objects and items), to the iconic (pictures, films, filmstrips, slides, and transparencies), to the symbolic (abstract words, letters, and numerals).

The Mathematics Laboratory

Mathematics laboratories philosophy in teaching and learning believe that students are active, not passive beings. Learners need to choose and select, rather than to listen to lectures and lengthy explanations of subject matter. Concrete experiences need to be at the heart of the mathematics curriculum. An adequate number of real objects need to be in the offing to stimulate student achievement. Thus, for example, objects and materials need to be in evidence from which learners may select to weigh, measure lengths and widths, determine the volume as well as find areas, perimeters, and circumferences.

Within the framework of concrete experiences, students use abstract learnings to record weights, measurements, areas, and circumferences.

Involving the mathematics laboratory concept, Ediger[4)] wrote:

> Pupils should have ample opportunities to experience the mathematics laboratory concept of working. The mathematics laboratory emphasizes tenets of teaching and learning such as the following:
>
> (a) Pupils are actively involved in ongoing learning activities.
>
> (b) A variety of experiences is in evidence so that pupils may select materials and aids necessary for problem solving.
>
> (c) Practical experiences are emphasized for learners in that they actually measure the length, width, and/or height of selected people and things; weigh real objects and record their findings; find the volume of important containers; as well as determine areas

4) Marlow Ediger, *The Elementary Curriculum, A Handbook*, Kirksville, Missouri: Simpson Publishing Company, 1977, p. 170.

of selected geometric figures.

(d) Pupils become interested in mathematics due to reality being involved in onging learning activities.

(e) Provision is made for individual differences since there is a variety of learning opportunities for pupiles from which to select on an individual basis.

(f) Meaning is attached to what is being learned since pupils individually and in committees work on tasks adjusted to their present achievement levels.

mathematics laboratory philosophy does not advocate;

a textbook methodology in teaching and learning situations.

students being recipients of facts, concepts, and generalizations from teachers.

lecture and extensive explanation approaches in teaching mathematics.

abstract, symbolic learnings to the exclusion of using realia in the mathematics curriculum.

A Miniature Society Concept in the Mathematics Curriculum

here are selected mathematics educators who believe strongly in guiding students to acquire apply facts, concepts, and generalizations useful in society. The community becomes an ıl place then in having learners attain understanding, skills, and attitudinal goals. Thus, example, students with appropriate readiness experiences and with teacher stimulation might age in finding unit prices for soap, cereal, flour, and cake mixes. How much then does each nd name and generic brand cost per ounce or gram? Other factors also need to be evaluated, ıddition to unit pricing, and that is quality within each item.

tudents in a miniature society context, might determine the cost of:

. a given number of items from a supermarket.

. selected items purchased from a hardware store.

. items of clothing from a clothing store.

. cost of gasoline, after buying a certain number of liters or gallons.

ı miniature supermarket may be developed in the classroom. Empty cereal, fruit and vegole, as well as other containers may be placed on shelves in the classroom setting. propriate clearly labeled prices need to be attached to each food item. Play money may be d by learners in shopping for needed items. Paper and pencil, as well as the hand held culator may be used to determine cost of a given set of items purchased, as well as change be received from money given in payment.

ohn Dewey[5] wrote:

The development within the young of the attitudes and dispositions necessary to the coninuous and progressive life of a society cannot take place by direct conveyance of beliefs, motions, and knowledge. It takes place through the intermediary of the environment. The nvirenment consists of the sum total of conditions which are concerned in the execution of he activity characteristic of a living being. The social environment consists of all the ctivities of fellow beings that are bound up in the carrying on of the activities of any one

5) John Dewey, *Democracy and Education*, New York: The Macmillan Company, 1961, p. 22.

of its members. It is truly educative in its effect in the degree in which an individual shares or participates in some conjoint activity. By doing his share in the associated activity, the individual appropriates the purpose which actuates it, becomes familiar with its methods and subject matters, acquires needed skill, and is saturated with its emotional spirit.

The deeper and more intimate educative formation of disposition comes, without conscious intent, as the young gradually partake of the activities of the various groups to which they belong. As a society becomes more complex, however, it is found necessary to provide a special social environment which shall especially look after nuturing the capacities of the immature. Three of the more important functions of this special environment are: simplifying and ordering the factors of the disposition it is wished to develop; purifying and idealizing the existing social customs; creating a wider and better balanced environment than that by which the young would be likely, if left to themselves, to be infleunced.

A miniature society mathematics curriculum does not emphasize:

1. a textbook centered method of teaching mathematics.
2. a teacher initiated curriculum whereby the instructor selects objectives, learning activities, and appraisal procedures for pupils.
3. minimizing concrete, life-like experiences for students.
4. students being recipients of content in a highly structured mathematics curriculum.

In Closing

Numerous philosophies are in evidence pertaining to goals in mathematics for learners to attain. These include:

1. IMS with its emphasis upon precise, measurable ends for learner attainment.
2. Learning centers with its stress placed up students becoming quality decision makers in ongoing experiences.
3. Structure of knowledge with its advocacy of students acquiring major concepts and generalizations as identified by professional mathematicians.
4. A mathematics laboratory with emphasis placed up students using concrete materials in mathematics achievement.
5. A miniature society philosophy in which learners use mathematics in the functional real world.

Teachers and supervisors need to study and evaluate each philosophy. Ultimately, those philosophies which guide each pupil to achieve optimally should be emphasized in the mathematics curriculum.

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1. Department of Elementary and Secondary Education, Jefferson City, Missouri, 1982.
2. Dewey, John, *Democracy and Education*, New York: The Macmillan Company, 1961.
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