Scope in the Mathematics Curriculum

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Mathematics teachers and supervisors need to identify the scope of the curriculum. Scope answers the question of *what* pupils need to learn in lessons and units as they progress through sequential years of schooling. There are diverse means available to ascertain scope in the mathmatics curriculum.

Utilizing Basal Textbooks

Numerous mathematics teachers lean rather heavily upon the adopted single or series of textbooks to ascertain scope. The table of contents may then provide a generalized framework for what is to be taught and in which sequence. The teacher may make selected modifications and deletions in content coverage within a reputable mathematics textbook. However, the understanding, skills, and attitudinal goals emphasized in the manual section may still provide the majority of material to be learned by pupils. What, then, might selected writers of teacher education textbooks in mathematics emphasize in terms of scope? Nichols and Behr[1] discuss the following topics in a text for mathematics teachers of college/university courses:

1. numeration
2. addition and subtraction
3. multiplication and division
4. fractions
5. teaching decimals and percent
6. number patterns
7. integers, rational numbers, and real numbers
8. exploring geometric ideas
9. measurement
10. mathematical sentences
11. problem solving
12. calculators and computers in mathematics instruction
13. logical reasoning
14. teaching probability and statistics

The above-named topics may well suggest unit titles in the mathematics curriculum. A sequential program of instruction needs to be arranged so that each learner might achieve optimally in mathematics.

Learning Centres in the Mathematics Curriculum

Learning centres are a rather open-ended means for guiding student achievement. An adequate number is needed so that each learner may select which sequential tasks to pursue and which to omit. The teacher guides each student to attain optimally. No longer, then, does the teacher merely lecture and dispense subject matter, Rather, the teacher stimulates, motivates, encourages, and assists.

Student interest is an important factor in teaching and learning. If learners individually select and choose what to learn, motivation for

[1]Eugene D. Nichols and Merlyn J. Behr, Elementary School Mathematics and How To Teach It (New York: Holt, Rinehart and Winston, 1982), Preface V.

learning should be at its highest level. Each learner sequences experiences in mathematics, rather than the teacher giving assignments, lecturing, and explaining. Biehler[2] lists the following basic ideas pertaining to humanism, as a psychology of learning:

1. Individuals act to get rid of deficiency needs (for example, hunger); they seek the pleasure of growth needs.
2. Deficiency motivation leads to reduction of disagreeable tension and restoration of equilibrium; growth motives maintain a pleasurable form of tension.
3. The satisfying of deficiency needs leads to a sense of relief and satiation; the satisfying of growth needs leads to pleasure and a desire for further fulfillment.
4. The fact that deficiency needs can be satisfied only by other people leads to dependence on the environment and to a tendency to be other-directed (for example, the person seeks the approval of others); growth needs are satisfied more autonomously and tend to make one self-directed.
5. Deficiency-motivated individuals must depend on others for help when they encounter difficulties; growth-motivated individuals are more able to help themselves.

What might be the scope of the mathematics curriculum, emphasizing humanism as a psychology of learning? The following titles of learning centres in a classroom are listed as an example of scope:

1. computation centre
2. geometry centre
3. problem solving centre
4. model making centre
5. mathematics laboratory centre
6. metric centre
7. programmed learning centre
8. basal textbooks centre
9. problem writing centre
10. instructional management centre

The breadth of offerings in terms of understanding, skills, and attitudes represents the scope of the above-named centres in the mathematics curriculum.

To achieve sequence in learning, each student needs to order tasks appropriately. Thus, ideally, each task is selected by the involved learner based on personal interests, needs, and purposes. Adequate provision in tasks must be made for slow and average learners, as well as for the gifted and talented. Each student needs guidance to attain optimally in ongoing units of study.

Mastery Learning and the Student

The total number of measurably stated objectives for learners to attain represents the scope of the mathematics curriculum within the framework of mastery learning. Measurably stated ends must be arranged in ascending order of complexity. Teachers and supervisors need to determine whether or not the specific ends are truly sequential. W. James Popham[3], an advocate of behaviorism as a psychology of learning, advocates the following model in developing teaching units:

1. precise instructional objectives
2. pretest
3. day-by-day activities
4. criterion check
5. posttest

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[2]Robert F. Biehler, Psychology Applied to Teaching, 3d ed. (New York: Holt, Rinehart and Winston, 1978), p. 517.

[3]W. James Popham, Teaching Units and Lesson Plans, (Los Angeles, California: Vincet Associates), filmstrip and cassette.

6. resources
7. backup lesson

In analyzing the above named teaching unit model, James Popham emphasizes for step one the writing of measurably stated, not general, objectives. Clarity of intent as to what teachers are to teach and learners are to learn is highly significant. Vague objectives need to be eliminated. Step two emphasizes a pretest be developed by the teacher or a team of teachers. The pretest should cover all the stated specific objectives. Paper-pencil test items (true and false, multiple choice, matching, essay, and completion items) may be utilized in the pretest. However, the pretest should not consist solely of teacher-written test items. Discussion, among other informal procedures, might also be utilized to ascertain present learner achievement in terms of pretesting. Based on pretest results, each pupil might then achieve new attainable ends.

Step three in the Popham model emphasizes using vital learning activities to realize new achievable ends. Each activity chosen must match up directly with a specific objective. It might be necessary to utilize more than one learning opportunity to guide a pupil to attain a measurable objective. In step four, a criterion check is utilized. The criterion check emphasizes measuring pupil progress continually to determine whether specific objectives are being achieved. Formative evaluation emphasizes appraising learner progress *during* the time a unit is in progress. A new teaching strategy may need to be used with those pupils not achieving vital objectives.

Step five in the Popham teaching unit model emphasizes the posttest concept. Thus, at the end of a unit, the teacher wishes to ascertain what learners have accomplished from the entire unit. Summative evaluation is then in evidence. Step six (resources) advocates teachers recording which audiovisual aids, objects, and reading sources will be used within the unit. The backup lesson (step seven) provides teachers with security; if materials for any lesson in the unit do not materialize, other activities need to be available to take their place in the backup lesson.

In any unit of study in mathematics, objectives for learners to attain must possess quality sequence. Thus, objective number one needs to be achieved prior to objective number two. Objective number two needs attainment in order that end number three can be mastered, and so on. If objectives truly contain recommended sequence, each learner should be able to achieve success in learning if initial readiness was in evidence. Before any given student moves on to the next sequential goal, a prior end must be attained. The teacher can then measure if a learner has or has not achieved an objective.

Mastery learning advocates believe that:

1. proficient mathematics teachers can select vital measurable goals for students to achieve.
2. essential activities and experiences can be chosen to guide student attainment of each specific end.
3. measurable results can be obtained from each student.
4. objectives and learning activities can be ordered appropriately to guide optimal student achievement.
5. students either do or do not reveal that a behaviorally stated (measurable) end has been achieved.
6. a modified teaching strategy can be devised which assists a learner to achieve a goal not previously acquired.

Woolfolk, et al.[4] wrote the following pertaining to mastery learning:

> Mastery learning is an approach to teaching and grading based on the assumption that, given enough time and the proper instruction, most students can master a majority of the learning objectives.
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> To use the mastery approach, teachers must break a course down into small units of study. Each unit might involve mastering several specific objectives. Students are informed of the objectives and the criteria for meeting each objective. Often a variety of learning experiences is available to help students reach the objectives. In order to leave one unit and move on to the next, students usually have to attain a minimum mastery of the objectives. This may be defined as a certain number of questions answered correctly on the unit test. Letter grades for each unit can be based on levels of performance on the unit test. Students who do not reach the minimum level of mastery and students who reached the minimum level but want to improve their performance (thus raising their grade) can recycle through the unit and retake another form of the unit test.
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> Under a mastery system, grades can be determined by the actual number of objectives mastered, the number of units completed, the proficiency level reached on each unit, or some combination of these methods. Students can work at their own pace, finishing the entire course quickly if they are able, or taking a long time to reach a few objectives. Of course, if only a few objectives are met by the end of the marking period, the student's grade will reflect this.

[4]Anita Woolfolk, et al. Educational Psychology for Teachers (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1980), p. 505.

In Conclusion

There are numerous means available in developing the scope of the mathematics curriculum. The use of basal textbooks to ascertain scope assumes that textbook writers possess the knowledge and abilities necessary to determine what subject matter students need to learn. Humanism advocates that learners choose, within a framework, which activities and experiences to pursue, as well as omit. Decision making is, thus, emphasized in stimulating learners to achieve. Behaviorism emphasizes mathematics teachers writing specific sequential objectives for pupils to master. Measurable results are then significant.

Teachers and supervisors need to guide students to optimally achieve understanding, skills, and attitudinal goals in mathematics.

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