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ABSTRACT

Scope and sequence in the mathematics curriculum need to be assessed regularly. Scope indicates what should be taught and becomes crucial in making curricular decisions. The first part of this paper answers how broad the scope should be in teaching mathematics. The standards to take into consideration when broadening the scope of the mathematics curriculum are listed. Techniques of the assessment may be used to appraise the quality of scope in mathematics for students and are presented for discussion. The second part of the paper focuses on the sequence of the mathematics curriculum. Methods of teaching mathematics to emphasize a psychological curriculum are included. Finally, the role of inservice education for mathematics teachers in the scope and sequence of mathematics curriculum are discussed. (ASK)

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Assessing Scope and Sequence in Mathematics

by

Marlow Ediger

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ASSESSING SCOPE AND SEQUENCE IN MATHEMATICS

Scope and sequence in the mathematics curriculum need to be assessed regularly. Scope indicates what should be taught. Scope then becomes crucial in making curricular decisions. There certainly is much to be taught in a quality mathematics curriculum. State mandated objectives continually stress more complex objectives for student achievement. High expectations for attaining these objectives have been advocated by many educators and lay people. Somehow, the criticism is there whether it be valid or not pertaining to a lack of student achievement in the public schools. Perhaps, the criticism should pertain more to what needs to be done rather than simply running negative criticisms in the news media. Diagnosis and remediation is important. Educators should try to raise standards of achievement with positive statements of how this is to be done. Thus, determining why something is occurring and then offering assistance on how the gaps are to be minimized seems like a very worthwhile task!

Scope in the Mathematics Curriculum

How broad should the scope be in teaching mathematics? The scope may be broadened or it may become narrower in terms of what is to be taught. For example, there are numerous calls for including more geometry and algebra for all students in the mathematics curriculum, especially on the high school level. If this recommendation is to be adhered to, then the mathematics curriculum for all students would be broadened in scope. A broader scope then should start with the primary grade levels. Geometry and algebra instruction on the primary grade levels provide readiness for instruction on later grade levels. It would be unwise to broaden the scope of the mathematics curriculum on the high school levels without doing it also on the primary grade levels in a developmentally appropriate way. If readiness for achievement in geometry and algebra is not in evidence in high school, then students would tend not to experience success in learning.

Scope is a very important concept to consider in curriculum development. There are definite standards to take into consideration when broadening the scope of the mathematics curriculum. These include

1. students need to be ready for the new learnings to be incorporated into the mathematics curriculum. To be ready means to have the needed facts, concepts, and generalizations in order to benefit from the new lesson or unit to be taught.

2 students need to become interested in the new learnings. Interest is a powerful factor in learning. If the new content added to the mathematics curriculum cannot be made appealing to learners, the

chances are they will not become engaged in ongoing experiences.

3. students need to become actively involved in studying the new content in mathematics through scaffolding. Scaffolding emphasizes learners being able to hurdle the gap between where they are presently in achievement with that of the new stated objectives to be achieved. It is important for each student to be able to take care of this gap between where they are in achievement presently and what is to be learned in achieving the new objective. With good teaching and learner efforts, many of these gaps can be eliminated or at least minimized. The scaffolding which occurs comes in an area known as the zone of proximal development (Vygotsky, 1978).

4. students need to have opportunities to experience success with the new subject matter to be achieved in mathematics. Experiencing failure is detrimental to the self concept of the individual. Objectives which are too easy to achieve make for feelings of boredom on the part of the learner. New content to increase scope needs to be challenging and yet achievable.

5. students need to feel that purpose is involved in learning mathematics content which increases the scope of the curriculum. With a broadened scope, the mathematics teacher needs to be certain that learners feel that purpose or reasons for learning are inherent in the learner. Thus, there are purposeful reasons for broadening the scope of student learnings in mathematics.

6. students need to feel motivated to learn when the scope of the mathematics curriculum becomes brooder. Motivation increases energy levels for learning. With a modified scope, students need to be motivated to achieve, grow, and develop in mathematics. Teaching strategies to use in teaching mathematics need to increase student energy levels for learning.

7. students need to receive developmental experiences when the scope of the mathematics curriculum is revised. New learnings need to be those which harmonize with student growth and development characteristics. When student growth and development characteristics do not harmonize with new subject matter to be presented in mathematics, learners individually fail to attach meaning and understanding pertaining to facts, concepts and generalizations being studied in mathematics.

8. students need to realize high expectations for achievement in mathematics. The high expectations need to be realistic and congruent with what a learner can be challenged to achieve. Reasonable expectations should assist students to set high goals and standards, intrinsically, that can be achieved. Feelings of frustration and disliking mathematics does not harmonize with a quality mathematics curriculum. Changing the scope of the mathematics curriculum needs to take into consideration standards pertaining to the psychology of high expectations.

9. students need to apply new learnings when the scope in mathematics is changed. Learning facts, concepts, and generalizations for the sake of doing so, is not adequate. The learner rather needs to be able to make practical application of the new content in school and in society. The concept of application is vital to emphasize in the mathematics curriculum.

10. students need to engage in mathematical reasoning and use logic in the curriculum. Logic use is a key objective in the mathematics curriculum (Ediger, 2000, Chapter Five).

The above named ten criteria for determining scope in the curriculum are valuable to use. Teachers may discuss among themselves in a committee setting how the new mathematics curriculum with a broadened scope is faring with learners. If there are definite weaknesses, the involved committee may discuss how to alleviate the identified problems. An improved scope in the mathematics curriculum should be an end result.

Which techniques of assessment may be used to appraise the quality of scope in mathematics for students? The teacher may observe student daily work in mathematics and notice the success of its implementation. Students do reveal how well they are achieving learnings when the scope has been broadened or intensified with increased depth teaching. Teacher observation of student daily work provides excellent opportunities to obtain feedback from learners.

Second, a questionnaire may be developed and distributed to mathematics teachers to show how the breadth and depth of content is faring with learners. Adequate space needs to be given in the questionnaire for teachers to write comments pertaining to the degree the newly defined scope is doing in helping students acquire vital mathematical facts, concepts, and generalizations. The resuits of the survey may be discussed by teachers in working toward optimal student achievement in mathematics.

Third, student test results may be examined to notice the quality of student achievement in mathematics. Particular attention should be paid to the new facets of the broadened scope in noticing how well students are doing on these test items. Diagnosis may follow. Whatever these weaknesses are, the teacher needs to notice if remedial teaching is needed.

Fourth, remedial tests may be given students pertaining to test items relating to the new subject matter, in particular, as contained in the newly defined scope. Not only subject matter needs to be achieve but also reasoning skills such as in critical and creative thinking, problem solving, as well as logic.

Fifth, students may engage in self evaluation to ascertain problems faced and experienced in mathematics (Ediger, 2000, 101-103).

Mathematics teachers need to continually assess the quality of scope in the curriculum. Can the present scope be improved upon? This is a key question for teachers and their students to answer (Ediger, 2000, 114-119).

Sequence in the Mathematics Curriculum

Quality sequence is needed in order for students to achieve well in mathematics. Sequence may be developed in a logical manner. Here, the mathematics teacher determines which objective should be stressed first, second, third, and so on in teaching and learning situations. Also, to have students achieve an objective, the teacher needs to ascertain which learning opportunities in mathematics should come first, second, third, and so on. In a logical mathematics curriculum, the teacher is the key person to arranging objectives, learning activities, and evaluation procedures in a manner which optimalize student learning. Thus, each activity provides satisfactory readiness for students to benefit from new endeavors in ongoing lessons and units of study. Programmed learning in textbook form or tutorial computerized instruction is also a good example of a top down plan of instruction developed by the programmer for student learning.

Toward the other end of the continuum, a psychological mathematics curriculum may be developed to stress good sequence. Here, learners are rather heavily involved , with teacher guidance, to determine which objectives and which learning opportunities to achieve the objectives should be taught first, second, third, and so on.
The following methods of teaching mathematics would tend to emphasize a psychological curriculum:

1. a learning centers approach whereby students individually may choose, from among others, which tasks to pursue sequentially.
2. a contract system in which the student, with teacher guidance, determines learning opportunities to pursue in contract form. The contract is signed by both the teacher and the student with the due date thereon.
3. teacher/student planning of the mathematics curriculum, including objectives, learning opportunities, and evaluation procedures. A student centered curriculum is in evidence with a psychological mathematics curriculum.

Teachers and students may sit down together and assess which procedure in teaching mathematics works best, be it a logical or psychological sequence. An eclectic mathematics curriculum may also be in evidence with a logical as well as psychological sequence (Dunn and Dunn, 1979).

Inservice Education for Mathematics Teachers

When continual study of scope and sequence in mathematics is being stressed, a variety of procedures may be used. These include workshops, faculty meetings, divisional meetings, study groups, informal discussions, and one on one evaluation with a coworker. At this point, the writer will combine scope and sequence for purposes of integrating the two concepts. What may form the basis for inservice education pertaining to scope and sequence in the mathematics curriculum?

1. viewing and discussing scope and sequence charts of different recommendable basal textbooks. Here, participants may notice how these basals are alike and how they differ. They may also assess which best meets needs of students to achieve optimally in mathematics.
2. analyzing weaknesses in current textbook use involving scope and sequence. Recommendations for remediation need also to be discussed.
3. critically and creatively evaluating current classroom situations pertaining daily work of students which involve scope and sequence concepts.
4. talking to teachers of other school buildings within the system to discuss breadth of content covered in mathematics as well as the order of subject matter presented.
5. doing an experimental study whereby the scope and sequence differs from the experimental group as compared to the control group. Here, reputable standardized tests with high validity and reliability need to be used in the pretest and the post test for both groups. The independent variable which is scope and sequence differentiation should be different for the two groups. The dependent variable is student achievement in mathematics. An additional study may be made pertaining to the experimental group having a psychological curriculum whereas the control group has a logical program of mathematics.
6. surveying literature from educational journals on scope and sequence in mathematics and how increasing the breadth of content studied as well as the order of topics pursued has made for achievement or a lack of student achievement in mathematics.
7. working with university professors in mathematics, in a democratic manner, on needed changes to be made in scope and sequence in the mathematics curriculum.
8. forming committees involving parents and teachers in working toward an improved mathematics curriculum. No doubt, scope and sequence will be involved in these deliberations. Parents may relate problems their offspring has had in scope and sequence in mathematics.

9. talking to lay people about increasing the breadth of content to be studied in mathematics as well as the order of subject matter and skills.

10. developing a mathematics club involving teachers, administrators, and parents, to discuss what is current in mathematics in school and in society (Ediger, 2000, 25-27).

Additional ways of improving the mathematics curriculum include use of mentor teachers, after school tutoring for students who face difficulties in mathematics, peer teaching, cooperative learning endeavors for students, summer school sessions, home help provided by teachers to students by telephone, instruction by means of internet, and independent studies in mathematics offered through the school .

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