

## Evaluating Achievement in Mathematics

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Pupil achievement in mathematics must be appraised in terms of objectives for ongoing units of study. Thus, in teaching-learning situations, first of all, the teacher must select objectives carefully which learners are to attain. Secondly, learning activities must be chosen which will guide pupils in achieving desired ends. Finally, the teacher must appraise pupil progress in terms of stated objectives.

### Using Teacher Observation

The teacher through careful observation may evaluate pupil achievement. The teacher may observe traits such as the following in the area of achievement in elementary school mathematics:

1. pupils completing assigned work on time.
2. interest learners reveal in mathematics.
3. continuous progress made by pupils.
4. specific errors pupils make in mathematics.
5. pupils understanding new learnings.
6. additional practice learners may need in understanding a new process in mathematics.
7. how to group pupils for instruction.
8. the learning styles of individual pupils.

Thus, the classroom teacher can evaluate many facets of pupil achievement in mathematics using the technique of teacher observation.

### Using Checklists

The classroom teacher may wish to utilize checklists to appraise pupil performance in mathematics. Many of the teacher's observations may be forgotten unless they are recorded. With the use of a checklist the observations of the teacher can be recorded for each learner. The teacher in developing a checklist must, first of all, write out the behaviors that learners are to be appraised on. The following is an example of a checklist containing relevant behaviors in a specific ongoing unit of study:

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Name of pupil \_\_\_\_\_ Date \_\_\_\_\_

1. The pupil can satisfactorily add two one-digit addends.
  2. The learner can reproduce with markers values of two single-digit addends.
  3. The pupil appears to enjoy working on addition problems containing two one-digit addends.
  4. The learner is becoming increasingly independent in his/her school work.
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The teacher should write the pupil's name and the date of appraisal on each checklist. Thus, the teacher may notice specific weaknesses learners exhibit in an ongoing unit of study and attempt to remedy these deficiencies. Comparisons may be made of each learner's progress from past times to the present when checklists are used.

### Using Teacher Made Tests

Teacher-made tests may be utilized to appraise pupil performance in the mathematics curriculum. Teacher-made tests should be valid. Thus, the test will attempt to measure what pupils have had opportunities to learn during class sessions devoted to mathematics instruction. The tests should also be reliable. For example, if pupils took the same teacher-made test over again, results should be comparable from the first time to the second time. This would be true if circumstances were equivalent in taking the teacher-made test the second time. Thus, consistency of results is important when thinking of the concept of reliability in testing.

The following, among others, are examples of items which may be included in a teacher-made test providing pupils have opportunities to engage in previous practice of these learnings:

1. simple computation of two one-digit addends—  $9+5=$  \_\_\_\_\_,  $8+7=$  \_\_\_\_\_,  $4+8=$  \_\_\_\_\_,  $5+9=$  \_\_\_\_\_,  $7+8=$  \_\_\_\_\_, and  $8+4=$  \_\_\_\_\_.
2. word problems involving computations studied previously— John had nine marbles; he bought five more. How many marbles does he now have?
3. multiple choice items—Which of the following is NOT true:
  - a.  $17+18=18+17$
  - c.  $35-17=18$
  - b.  $35-17=35-18$
  - d.  $35-18=17$

Teacher written test items must follow criteria recommended by specialists in the area of testing and measuring of pupil progress. Thus, test items written by the teacher must be

1. valid and reliable.
2. clearly written.
3. on the understanding level of pupils.
4. properly ordered for pupils in ascending order of difficulty.

Essay items may also be written by the teacher to appraise pupil achievement in elementary school mathematics. Essay tests should only be utilized as an appraisal technique if

1. pupils have an adequately developed writing vocabulary.
2. learners possess an adequate reading vocabulary to comprehend the content of the test items.
3. pupils have had ample learning experiences to respond effectively to essay items in the test.
4. the items are properly delimited and yet do not require factual recall of information. For example, an essay item requiring the following response would be too broad—Discuss mathematics. Certainly, the pupil is entitled to know what facet of mathematics learning he/she is to respond to. The following would be too narrow in scope to be called an essay item—Write a definition for the term "sum" as used in addition. Essay items should reflect pupils' skill in problem solving: How does knowledge of the distributive property of multiplication over addition help in solving related problems in mathematics?
5. pupils can be evaluated in terms of selecting and organizing major ideas when developing desired responses to the test question. The teacher may also wish to evaluate pupils in terms

of the mechanics of writing such as

- (a) spelling and handwriting.
- (b) capitalization and punctuation.
- (c) grammar and usage.

It is recommended by the writer that the mechanics of writing be assessed separately from ideas pressed by learners when responding to different essay items. Pupils, of course, can work on remedying a few deficiencies in the mechanics of writing at a given time. Objectives that pupils are to achieve should be attainable and not overwhelming.

### Using Standardized Tests

Standardized tests which are valid and reliable may be utilized periodically to appraise pupil achievement in mathematics. Pupils' results from taking of standardized tests need to be evaluated in terms of the following questions:

1. Did the learner respond correctly to important concepts or word problems? If not, what remedial measures would be important to remedy identified deficiencies?
2. Were errors made in the area of computation? If so, specifically which kinds of errors were made? What provision need to be made to correct these deficiencies on the part of learners?
3. Did it appear that pupils were interested and properly motivated in taking the test?

Pupils' results from standardized tests will generally be given in terms of the following results:

1. *grade equivalent score*. Thus, for example, a pupil in the beginning of the fourth grade may obtain a raw score equivalent to the 5.7 grade level. A different fourth grade pupil may be achieving on the 2.9 grade level as indicated by results from the standardized test. Regardless of the present grade level of the pupil, the raw score obtained by learners from taking the standardized test is converted to a grade equivalent as indicated in the manual for administering the test.
2. *percentile ranks*. A pupil, for example, in the fourth grade may have obtained a raw score of 55 (number of items responded to correctly) on a standardized mathematics test which is equivalent to the 45th percentile according to the manual for administering the test. Being on the 45th percentile would indicate that 45 percent of the pupils on the fourth grade level would score lower on the test than the previously named pupil. Fifty-five percent of the fourth graders taking the same standardized mathematics test would score higher. The 45 percent and the 55 percent figures mentioned previously would pertain to pupils whose test results were utilized as norms in developing the standardized test.

In utilizing standardized achievement tests to appraise pupil achievement in mathematics, the following facets of pupil growth are generally evaluated:

1. *computation in arithmetic*. Thus, pupils respond to test items involving addition, subtraction, multiplication, and division.
2. *concepts in mathematics*. The standardized test in mathematics may contain items pertaining to (a) the meaning of fractions, (b) inverse operations such as subtraction undoing addition, (c) place value in decimals, (d) the Roman system of numeration, (e) number system, (f) estimating, (g) understanding place value and (h) geometric terms.

3. *word problems.* Learners exhibit proficiency in analyzing which facts are needed in a problematic situation to obtain a needed solution. A family on a vacation traveled 325 miles the first day, 460 miles the second day, and 411 miles the third day. How many miles were traveled in the three days?

Thus, in the above problem, learners must glean necessary content, such as adding  $325 + 460 + 411$ , to be able to arrive at the correct answer. Word problems can contain content, of course, on different levels of complexity.

Standardized achievement tests provide different results pertaining to pupil progress as compared to teacher-made tests.

1. The teacher may notice how learners in the class setting compare with pupils in the standardization group as indicated by results from the standardized achievement test. The manual of the standardized achievement test should indicate the pupil population utilized in developing norms for the test. Thus, the teacher may compare the achievement of his/her own pupils with that of the group used to develop norms for the standardized achievement test.

2. The teacher may also notice the spread of scores, from high to low, of pupils in the class setting as indicated by results from the standardized achievement test. The spread of scores in the class setting may provide needed data to the teacher in providing adequately for each pupil in the mathematics curriculum. Each learner should, of course, be guided to achieve to his/her optimum in elementary school mathematics.

3. Specific kinds of errors that pupils reveal in elementary school mathematics, as indicated by standardized achievement test results, can provide relevant diagnostic data with the end result being to remediate deficiencies.

4. Pupil progress in mathematics may be noted as reliable and valid standardized mathematics achievement tests are given learners at selected intervals.

### **Using Anecdotal Records**

The teacher must record an ample number of observations made about each pupil's achievement in mathematics. It is recommended that observations be recorded of each pupil's progress frequently enough to notice a pattern of behavior. The teacher of mathematics may notice the following from recorded information (anecdotal records) about a particular child's progress:

1. The learner does not respond accurately to basic addition and subtraction facts, such as  $9 + 8 = \underline{\quad}$ ,  $8 + 9 = \underline{\quad}$ ,  $17 - 8 = \underline{\quad}$ , and  $17 - 9 = \underline{\quad}$ .
2. The pupil is slow in getting started on assigned work in mathematics.
3. The child is easily distracted from working in mathematics by happenings in the environment.
4. The pupil seeming does not enjoy mathematics as much as other curriculum areas in the elementary school.

It is easy for a teacher to forget how each child is progressing in mathematics unless observations are recorded systematically. The recorded items or anecdotal records should be utilized to improve instruction for each child. Viewing the above numbered items, the teacher may remedy deficiencies by (a) giving the child meaningful practice in addition and subtraction facts which need mastering,

(b) guiding the pupil to develop appropriate work study habits, (c) attempting to develop a learning environment conducive for pupils making continuous progress and (d) providing interesting, understandable, and purposeful experiences for pupils in elementary school mathematics.

The results of anecdotal records should be utilized to guide pupils to achieve continuous progress in elementary school mathematics. Anecdotal records should not be used (a) to defame pupils, (b) for gossip purposes, or (c) as a threat to involved learners.

### **Using Work Samples**

A manila folder to contain work sample of each pupil in mathematics is highly recommendable. Thus, within a manila folder for a particular child, the teacher may save representative samples of a child's work pertaining to elementary school mathematics. The completed papers should be dated before being placed in the folder. Thus, comparisons can be made by the teacher as well as the pupil of the latter's present as compared to earlier achievement in mathematics. Too frequently, the teacher has felt that a specific child is not achieving well in mathematics until comparisons are made between and among earlier and later work in mathematics.

Pupils should evaluate their own achievement in mathematics using work samples. Thus, a child can appraise his own progress by noticing if he/she is doing better than formerly when comparing results from earlier times to the present. Thus, in adapting the mathematics curriculum to the present achievement level of each learner, the pupil individually can take pride in noticing achievement from earlier times to the present when appraising completed products in this curriculum area.

### **Using Parent-Teacher Conferences**

The teacher may obtain valuable feedback from the parent or parents as to understandings, skills, and attitudes pupils have developed in elementary school mathematics. Criteria to follow in conducting parent-teacher conferences include (a) respecting the thinking of parents, (b) wishing to obtain information about a child's progress in mathematics, (c) working together with parents to develop a good mathematics curriculum for each learner, (d) keeping information obtained from parents confidential, (e) agreeing with parents as to future courses of action pertaining to a relevant mathematics curriculum for each pupil and (f) revealing positive attitudes toward parent-teacher conferences.

Work samples of pupil's completed products in mathematics may be shown and discussed with parents in a conference. Thus, parents have opportunities to notice

- (a) present achievement level of the child.
- (b) kinds of errors made by the individual pupil.
- (c) rate of progress accomplished by an individual child.
- (d) neatness of work revealed by the learner.

Conducting a parent-teacher conference is not an end result in and of itself. The results of a parent-teacher conference should aid in developing a meaningful, purposeful, and interesting mathematics curriculum for each child. Individual differences must be provided for in a modern program of elementary school mathematics!

### Using the Tape Recorder

A tape recorder can be wisely used in class setting to appraise pupil achievement in mathematics. The following, among others, are major ways in which tape recorders may be utilized to appraise pupil performance:

1. Have pupils listen to a playback pertaining to their involvement in a discussion of a new process in elementary school mathematics.
2. Date and file tape recordings of pupils' discussions in learning a new process in elementary school mathematics. Periodically, pupils with teacher guidance may notice growth in mathematics achievement when comparing earlier with later recordings.
3. Have pupils discuss ways to improve the mathematics curriculum. Pupils may listen to a replay of the recording to evaluate criteria given. The teacher may obtain valuable feedback from the recording in terms of content for improving the mathematics curriculum.

### Diagnosing Pupil's Responses in Mathematics

The teacher must be a good diagnoser of pupil achievement in elementary school mathematics. Thus, the teacher identifies specific kinds of errors that pupils individually are exhibiting in elementary school mathematics. If a pupil, for example, continually responds incorrectly to the sum of  $6+5$ , the following reasons may be inherent:

1. The pupil may need to attach meaning to concepts pertaining to a set of six and a set of five. Crayons, beads, chalk, books, bean and corn seeds, as well as buttons may be utilized to have pupils see and duplicate a set of six markers and a set of five markers. The two sets may then be joined together to form a new set of eleven members.
2. The learner may need practice in committing the addition fact " $6+5=11$ " to memory. A variety of experiences should be utilized in providing practice for pupils pertaining to selected learnings in elementary school mathematics. Dull, boring, and routine learning activities are to be avoided.
3. Pupils may even need to work on learnings in elementary school mathematics where they are at a less mature level than what is called for in the problems " $6+5=11$ ". Thus, for example, the pupil may need guidance in rational counting. The teacher could help the individual pupil to utilize the concept of one-to-one correspondence when counting six members in a set. The proper counting number as it is said would then correspond with the object being counted in the set consisting of six members, i.e., count "one" as the first object is being touched, "two" for the second object, "three" for the third object, and so forth, until all six members have been counted.

The teacher of elementary school mathematics must be a good diagnoser of specific difficulties that pupils face in ongoing units of study. Only then can remediation efforts be applied to guide pupils to overcome identified problems in the mathematics curriculum.

### Using Conferences to Appraise Pupil Progress

The teacher may conduct conferences with elementary school pupils in order to evaluate achievement in mathematics. Criteria to follow in conducting these conferences include the following:

1. Respect the contributions of each pupil.
2. Permit free expression of ideas so that the teacher may obtain feedback from each pupil's thinking about ways to improve the curriculum.
3. Try to find out specific help that pupils need in order to achieve optimal development in mathematics.
4. Agree upon a plan of action to help each pupil achieve relevant understandings, skills, and attitudinal objectives in elementary school mathematics.

After the conferences has been completed with a pupil, the teacher should (a) briefly record important ideas gained from the learner, and (b) determine how ideas gained from the conference can provide input for an improved mathematics curriculum for the involved learner.

The teacher may conduct a conference lasting, approximately, five to ten minutes for a pupil each day. It does not take long before all pupils in the class setting have been involved in a conference. For example, if there are 25 pupils in a class, the first conference could be completed for each pupil in five weeks' period of time. The conference approach can be one method, among others, utilized to appraise learner achievement in elementary school mathematics.

### In Summary

There are numerous techniques available to appraise pupil achievement in elementary school mathematics. The teacher must utilize a variety of approaches to assess pupil growth in the mathematics curriculum. Each evaluation technique has its strengths as well as weaknesses. Thus, a specific evaluation technique may be utilized as a check on other approaches to appraisal. Pupil achievement must be assessed in terms of stated relevant understandings, skills, and attitudinal objectives. It is not adequate to appraise pupil growth in terms of understandings objectives only. Pupils must also be assessed in terms of skills objectives. The understandings acquired by learners must be utilized; thus, skills objectives need to be stressed adequately in ongoing units of study in elementary school mathematics. Adequate emphasis also needs to be placed upon pupils achieving attitudinal goals. Desirable attitudes on the part of learners aid in achieving understandings and skills objectives. A defensible program of evaluation would then stress that pupil achievement be adequately appraised in terms of understandings, skills, and attitudinal objectives.

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