韓國數學教育學會誌<數學教育>
1984. 12, Vol. XXIII, No. 1

Journal of the Korea Society of Mathematical Education
Dec. 1984, Vol. XXIII, No. 1

# Objectives and Learning Activities in the Mathematics Curriculum

by Marlow Ediger
*Northeast Missouri State University, U.S.A.*

## Part One: Objectives in the Mathematics Curriculum

Teachers, supervisors, and principals need to select relevant objectives for pupils to achieve. A recommended philosophy in the teaching of mathematics is needed prior to the time that these important goals are to be chosen. With much study and thought pertaining to teaching mathematics, educators may develop a philosophy of teaching containing the following strands of thought:

1. Each pupil in the school setting must achieve to his/her optimum in the elementary school mathematics curriculum.
2. Diverse learning opportunities should be provided to allow for different learning styles which pupils individually possess.
3. Critical thinking, creative thinking, and problem solving need to be stressed in the mathematics curriculum.
4. Pupils should be guided to develop well socially in all curriculum areas in the elementary school.
5. Ample opportunities must be given to aid pupils in learning using both inductive and deductive approaches.
6. Experiences obtained by pupils should be interesting, and meaningful, as well as purposeful.
7. Each child should have feelings of success in the mathematics curriculum.
8. Pupils with teacher guidance should diagnose learner difficulties in the mathematics curriculum and thus work toward remedying these identified deficiencies.
9. There should be rational balance among understandings, skills, and attitudinal objectives pupils are to achieve.
10. The total development of the child should be emphasized such as physical, social, academic, and emotional in ongoing units of study in mathematics.
11. The mathematics curriculum must frequently be appraised by teacher, principals, and supervisors to keep the curriculum area updated. Thus, faculty meetings, workships, and departmental meetings become important in modifying and revising the elementary school mathematics curriculum.
12. Learners should experience realistic situations in ongoing units of study.

### Objectives and Mathematics

After careful study and thought, the elementary teacher may identify and implement general *understandings* objectives such as the following in elementary school mathematics for pupils to attain:

1. the commutative property of multiplication and addition.
2. the associative property of multiplication and addition.
3. the distributive property of multiplication over addition.
4. the identity elements for addition and multiplication.
5. the property of closure for addition and multiplication.
6. the inverse operations of subtraction and division.
7. relationships among operations such as multiplication pertains to repeated addition, and division refers to repeated subtraction of equal amounts.
8. the problem solving method.
9. reference sources available to solve problems in elementary school mathematics.
10. methods used to have pupils evaluate their own achievement.

It would not be adequate to have pupils achieve relevant understandings objectives in the mathematics curriculum only. Pupils also need ample opportunities to acquire important skills objectives. Thus, learners may attain skills such as the following as they progress through the elementary school years:

1. perform addition, subtraction, multiplication, and division operations meaningfully and accurately.
2. identify and diagnose difficulties in performing these basic operations and attempt to remedy deficiencies.
3. draw accurately squares, circles, rectangles, triangles, and other important geometrical figures.
4. draw and measure angles accurately in geometry.
5. use the number line when applicable to get needed content to solve problems.
6. become proficient in thinking critically and creatively in the mathematics curriculum.
7. use appropriate algorithms which harmonize with one's own style of learning in solving problems in the area of mathematics.
8. use a variety of learning aids and activities to aid in achieving optimal development in the area of mathematics.
9. be able to work well with others on committees and at diverse learning centers.
10. analyze and obtain needed content to solve work probelms.

Another kind of objective that is important to emphasize in teaching-learning situations is attitudinal, or affective objectives. If pupils achieve attitudinal, or affective objectives, they will do better in acquiring needed understandings and skills. Teachers, principals, and supervisors need to carefully select attitudinal goals which learners are to achieve. Relevant objectives pertaining to attitudes which learners are to achieve may include:

(a) respecting thinking of other learners.
(b) wanting to compute mathematics content accurately.
(c) desiring to participate effectively in committee work.
(d) appreciating orderliness of the Hindu-Arabic system of numeration.
(e) appreciating, among others, the contributions of the Egyptian, Roman, and Mayan systems of numeration.

(f) desiring to work to one's own optimal level of achievement in mathematics.

(g) apprcciating thc contributions of mathcmaticians in the arithmetic, algebra, and geometry curriculum.

(h) wanting to think creatively and critically in problem solving activities.

(i) developing an appreciation for working in bases other than base ten in arithmetic, such as performing operations in base two, base five, and base eight.

(j) contributing fully in the selection of objectives, learning experiences, and evaluation procedures when teacher-pupil planning is utilized in the class setting.

### Specific Objectives in the Mathematics Curriculum

Selected teachers, principals, and supervisors emphasize that objectives for pupils to achieve should be stated in a specific manner. Thus, specific objectives in mathematics may follow the following criteria:

1. It can be measured if pupils have or have not attained the desired objectives.
2. Learning activities may be selected which will guide learners in achieving these precisely stated objectives.
3. Pupils and the teacher can observe if the former have achieved the desired criteria or objectives.

The following are examples of specific objectives in the mathematics curriculum:

1. The pupil will add correctly the basic number pairs of $4+4=\_\_\_$; $3+5=\_\_\_$; $2+5=\_\_\_$; $6+3=\_\_\_$; and $5+2=\_\_\_$.
2. The pupil will utilize two algorithms in solving each of these problems:

$$\begin{array}{r} 24 \\ \times\ 42 \\ \hline \end{array} \qquad \begin{array}{r} 32 \\ \times\ 23 \\ \hline \end{array} \qquad \begin{array}{r} 52 \\ \times\ 22 \\ \hline \end{array} \qquad \begin{array}{r} 34 \\ \times\ 22 \\ \hline \end{array} \qquad \begin{array}{r} 41 \\ \times\ 22 \\ \hline \end{array}$$

3. The pupil will solve correctly 90 per cent of the addition problems on page 87 of his/her textbook.
4. The pupil will solve correctly four out of five work problems on page 90 of the textbook.
5. The pupil will write five word problems and include in each an irrelevant item not needed in working toward desired solutions.

In analyzing each of the previously stated objectives, the first specific objective involves recall of content in giving sums to each basic number pair in addition. The second objective deals with a higher level of cognition other than recall of content. Pupils need to use more than one method to solve each problem. The third objective is not clear in and of itself as to what pupils are to achieve. The reader of this objective would need to look at the mathematics textbook being utilized in the class setting to determine the level of achievement being stressed in teaching-learning situations. The fourth objective could involve complex problem-solving activities when encountering the solving of word problems. The fifth objective could stress creative writing on the part of each pupil in the writing of word problems. Irrelevant content would also need to be written in each word problem. Thus, the reader may notice that objectives in mathematics may be written to emphasize

(a) recall of content.

(b) comprehension of information to solve problems.

(c) problem solving.

(d) creative thinking as well as critical thinking.

It behooves the elementary school mathematics teacher to have pupils achieve at a higher level of thinking than the recall level. Thus, critical thinking, creative thinking, and problem solving must be stressed in teaching-learning situations in the mathematics curriculum.

### In Summary

Teachers, principals, and supervisors need to develop a philosophy of teaching mathematics which make ample provision for each individual pupil to realize his/her optimal achievement.

A relevant philosophy of teaching pertaining to the teaching of elementary school mathematics will stress the importance of pupils achieving important understandings, skills and attitudinal objectives. Each objective that pupils are to achieve should be weighed against alternative goals in making the final selection so that learners truly learn what is important in the school and class setting.

Selected teachers, supervisors, and principals may wish to emphasize the use of general objectives in teaching-learning situations. Other educators may rather desire to use specific, measurable objectives. What is of utmost importance in teaching and learning is that pupils attain quality objectives which emphasize higher levels of cognition such as critical thinking, creative thinking, and problem solving. Thus, the dichotomy between general versus specific objectives may be resolved by selecting those objectives which will guide a learner in becoming a fully functioning member in society.

### Selected References

1. Bitter, G., et al., *Activities Handbook for Teaching the Metric System*, Boston, Allyn and Bacon, Inc., 1976.
2. Donald Devine, et. al., *Elementary Mathematics*, New York, John Wiley and Sons, 1977.
3. Grossnickle, Foster E., and John Reckzen, *Discovering Meanings in Elementary School Mathematics*, Sixth Edition, New York, Holt, Rinehart and Winston, Inc., 1983.
4. Marks, John L., et. al., *Teaching Elementary School Mathematics for Understanding*, Fourth Edition, New York, McGraw-Hill Book Company, 1975, Chapter One.
5. Riedesel, C. Alan., *Guiding Discovery in Elementary School Mathematics*, Second Edition, New York Appleton-Century-Crofts, 1973, Chapters One-Four.

## Part Two: Learning Activities in the Mathematics Curriculum

Mathematics teachers in the elementary school first of all need to select relevant objectives for pupils to achieve. These objectives should emphasize rational balance among understandings, skills, and attitudinal objectives. After these aims have been chosen, the teacher must guide pupils in attaining these objectives through learning opportunities that are

(a) challenging and interesting.

(b) rewarding and satisfying.

(c) purposeful and meaningful.

(d) individualized and provide for each learner.

(e) sequential from the learner's point of view.

(f) inquiry oriented, and yet deductive learning is also emphasized.
(g) characterized by child growth and development tenets.
(h) geared to continuous progress on the part of each learner.

### Specific Learning Activities to Attain Objectives

The teacher of elementary school mathematics must select learning opportunities which guide each pupil to achieve optimal development in arithmetic, geometry, and algebra. Possible learning experiences for pupils will now be discussed.

### Utilizing the Textbook

Reputable mathematics textbooks can and do provide valuable experiences for pupils in the school and class setting. Textbooks ultimately selected for adoption in teaching mathematics should follow criteria such as the following:

1. Proper order of learning for pupils is in evidence.
2. Adequate illustrations and diagrams are inherent to help pupils understand mathematical concepts, facts, and generalizations.
3. The textbook captures pupil interest and appeal.
4. Key structural ideas are emphasized such as the commutative property of addition and multiplcation, the associative property of addition and multiplication, identity elements for addition and multiplication, the property of closure, and the distributive property of multiplication over addition.
5. The teacher's manual section presents numerous suggestions for teaching-learning situations such as objectives or goals, learning activities, and appraisal procedures.
6. The authors are reputable from the point of identifying relevant learnings for pupils to achieve in mathematics.
7. Adequate attention is given to guide pupils to develop proficiency in problem solving and using various algorithms in computation.
8. Opportunities are given for pupils to utilize what has been learned previously.

Too frequently, all pupils are on the same page at the same time when textbooks are utilized in teaching-learning situations. The teacher needs to individualize instruction. Thus, pupils are assessed to determine their individual present level of achievement within the confines of the adopted textbooks. Each pupil may then be working at a different achievement level as compared to other learners in the class setting. For example, in a fifth grade class, a few learners may need to use third or fourth grade textbooks in order to work at their present level of achievement and thus work in the direction of experiencing continuous progress. As further examples, pupils A,B, and C as revealed by the preassessment may begin on pages 15, 80, and 100 respectively in the fifth grade mathematics textbook. A few selected learners may need to utilize sixth and seventh grade texts in teaching-learning situations since this is their present achievement level. Once each child's present achievement level in mathematics has been determined at the beginning of a school year, the teacher then needs to guide pupils to experience continuous progress. The teacher, during the time devoted to mathematics instruction, would teach, stimulate, and supervise each child to achieve optimal

growth and development.

### Utilizing the Flannel Board

Primary grade pupils, in particular, may develop many learnings in elementary school mathematics through the use of a flannel board as a learning activity. The teacher on the first grade level, for example, may place two triangles in one set and three triangles in another set. These cutouts may be made of flannel or felt. Pupils may be asked how many members there are in the first set. After responding correctly to this question, learners may be asked to give the number being represented in the second set. The two sets may then be combined with pupils stating the number of members making up this new set. The order of presenting the two previously named sets may then be changed. Pupils then realize $2+3=3+2$. Children are realizing in these learning experiences that the order of addends considered in adding does not affect the sum (commutative property of addition).

If pupils are not ready for addition of two one-digit addends, the following learnings must come in prior sequence:

1. rote counting. Here pupils say the counting numbers in their proper order such as "One," "two," "three," "four," "five," and so on.
2. rational counting. A child points to a first object like a crayon and says "one," points to second crayon and says "two," the third crayon and says "three," and so on. Rational counting is more complex for learners as compared to being able to count in a rote manner. Objectives must be arranged in proper sequence so they can be achieved by pupils.

Cutouts made of flannel or felt for the flannel board should vary in terms of the following:

1. color of cutouts. Pupils desire variety in learning experiences; thus, appealing red, blue, yellow, orange, and green cutouts should be utilized.
2. geometric form of cutouts. Triangles, circles, squares, rectangles, and parallelograms should be available for use in teaching-learning situations.

Cutouts of diverse pictures may also be used with the flannel board. These pictures, for example, may also be used in helping pupils understand the operation of addition (two jet planes in one set and three jet planes in the second set make a total of how many?) Thus, pictures of animals, cars, trucks, buses, boats, and people may be used in ongoing units of study in mathematics. Each picture should have a small piece of sandpaper pasted on the back so that it will stay attached when placed on the flannel board.

### Utilizing Markers

An ample supply of markers should be available to help pupils achieve optimal development in mathematics. Markers such as the following may then be utilized in providing interesting, meaningful, and purposeful experiences:

1. bean, pea, and corn seeds.
2. beads and buttons.
3. crayons, chalk, and pencils.
4. pop caps and tongue-depressor sticks.

These markers may be utilized in the following ways:

1. have pupils count the number of markers in a set.
2. have pupils write numbers that relate to the number of members in each set in addition. The operations of subtraction, multiplication, and division, of course, may also be taught using selected markers.
3. have pupils place the number of markers in a set as specified by the teacher in a given learning experience.
4. guide pupils in understanding the process of regrouping and renaming with the use of these markers. If pupils, for example, are to understand the meaning of $22-13=\_\_\_$, then appropriate experiences should be provided. Since three markers cannot be taken from two markers in the units column, a set of ten markers may be regrouped from the two tens column and joined with the two ones. The result is a set of twelve markers in the ones column. Pupils may now take three markers from the twelve markers in the units column. Nine markers are then left in the ones column. If a set of ten is taken from a set of ten markers in the tens column, none is left. Thus, $22-13=9$.

**Using Place Value Charts**

Place value charts may be made very inexpensively in the class setting. Construction paper may be utilized here. Separate pockets may be made to hold congruent slips of construction paper. These pockets must hold the slips of paper for the ones, tens, and hundreds pockets. Thus, if paper strips for the value of twenty-three are to be represented in the place value chart, the learner may place three pieces in the ones pocket. Two sets each containing ten pieces with a rubber band around each set may be placed in the the tens column.

Uses for the place value chart may be the following:

1. Have pupils develop meaningful learnings pertaining to addition. If pupils, for example, are to add $25+16$, five single congruent strips of paper may be placed in the ones pocket; two sets of ten each enclosed with a rubber band may be placed in the tens pocket. Thus, the numeral of 25 has been represented with two tens and five ones. Next, six congruent slips of paper may be placed into the ones pocket and a set of ten fastened with a rubber band placed in the tens pocket. Thus, five ones and six ones may be joined together to represent one set of ten with a rubber band placed around this set and placed in the tens pocket. In the units pocket then there will be one member. In the tens pocket, there will now be two tens plus one ten. The final sum is then 41, or four tens and one 1.

2. Guide pupils in attaching meaning to subtraction. If learners, for example, are to attach understanding to $35-16$, five congruent slips of paper may be placed in the ones pocket. Three sets of ten with congruent slips in each set may be put into the tens pocket (each set should have a rubber band around it). The pupil notices he cannot take six ones from five ones in the problem 35-16. He may take one set of ten from the tens pocket and place these into the ones pocket. The problem now results in the minuend containing two tens and fifteen ones. Now the pupil can take six ones from fifteen ones resulting a difference of nine. Also, one ten taken away from two tens leaves one ten. Thus, $35-16=19$.

3. Have pupils achieve basic understandings pertaining to multiplication. For example, if pupils are working on a problems such as $3\times23$, three congruent slips of paper may be placed into the ones pocket and two sets of ten each placed in the tens pocket. Next, two sets of three each may be placed into the ones pocket and two sets of two tens may be put into the tens pocket. Thus, pupils may understand that $3\times3=9$; this numeral would represent how many would be in the ones columnn. Also, three sets, two tens in each set, would make six tens in the tens column. The final product of $3\times23=69$.

4. Guide pupils in attaining desired learnings in division. If pupils, for example, are developing understandings pertaining to the division problem $42\div2$, the dividend of 42 may be represented by two congruent strips of paper being placed in the ones pocket and four sets, with ten members in each set, being placed in the tens pocket. To divide the child may now place one member in each of two sets to represent the ones column. Next, the four sets of ten each on the tens pocket may be separated into two equal sets. Thus, the answer to the division problem $42\div2$ is 21.

The teacher should utilize place value charts to help pupils attach meaning to understandings objectives in ongoing units of study in elementary school mathematics.

### Using Transparencies and the Overhead Projector

Overhead projectors may wisely be utilized in the class setting due to the following inherent factors:

1. The teacher may face pupils when utilizing transparencies in a class discussion.
2. Specific content that pupils are to learn only, may be put on a transparency. Thus, irrelevant content is not a part of ongoing learning experiences.
3. Transparencies may be developed which are appealing and interesting to pupils.
4. The order of discussing content in several transparencies may be arranged sequentially from the point of view of the child's own unique perception.
5. Content may be added to any transparency as the need arises.

Transparencies and the overhead projector may be utilized in ways such as the following:

1. Pupils may count how many members there are in a set as given in a specific transparency.
2. Learners may tell how many members make a new set if two previously given sets are combined or joined together.
3. Pupils may tell how many members are left if, for example, there were nine circles and two were taken away.
4. Pupils may begin initial learnings in multiplication, e.g., three sets of circles with four members in each set, $3\times4=$_____.
5. The inverse operation of multiplication (division) may be shown and discovered from the previous example, e.g., twelve circles are to be divided equally into three different sets. Thus, four members are in each of these three sets.

### Using Filmstrips

There are leading publishers of filmstrips who have excellent curriculum materials for teachers to utilize in elementary school mathematics. These filmstrips should exemplify criteria such as the

following:

1. The content must capture interests of pupils.
2. The diverse frames must follow appropriate sequential learnings for pupils.
3. Pupils should have ample opportunities to develop learnings inductively as well as deductively.
4. Problem-solving activities should be stressed adequately.
5. A manual should accompany the filmstrips to give possible suggestions as to their use.

Filmstrips may be utilized in learning experiences such as the following:

1. to introduce a new unit. If pupils, for example, are to study addition of unit fractions with unlike denominators, a carefully selected filmstrip may give learners an overview of the new unit. Pupils may then see how knowledge of unit fractions with unlike denominators can be useful in problem solving situations in class and in life outside of the school setting.

2. to develop learnings in greater depth. The content of filmstrips may guide learners in attaching meaning to fractions such as $1/4+1/6=$_____ or $1/3+1/6=$_____. Social situations would be stressed in the filmstrip presentation to guide learners in perceiving practical application of abstract learnings. In the filmstrip presentation, numerous experiences would be provided to pupils in understanding what is involved if unit fractions with unlike denominators are added.

3. to end or culminate a unit of study. In the filmstrip presentation, pupils should have ample opportunities to review what has been learned previously pertaining to adding unit fractions with unlike denominators. In reviewing what has been learned previously, pupils should have many opportunities to apply those learnings that have been developed previously. If pupils can use that which has been learned previously within the framework of purposeful learnig experiences, it will be possible to retain these understandings, skills, and attitudes for a longer period of time.

Content in the filmstrip should provide opportunities for pupils to

1. respond to questions and problems.
2. make practical application of what has been learned.
3. arrive at relevant concepts and generalization at their own unique rate of speed.
4. assess their own achievement in learning.
5. experience success and satisfaction in learning.
6. branch out in the direction of new related learnings.
7. achieve understanding of selected structural ideas in mathematics, e.g., commutative and associative properties of addition and multiplication.
8. perceive diverse operations in mathematics as being related, e.g., division undoes multiplication.

### Using Graphs

Pupils in the elementary school should experience the making and using of graphs. Graphs developed by pupils with teacher guidance should

1. emphasize content within the experiences of learners.
2. present generalizations in a simplified manner.
3. contain a heading to orientate viewers to inherent conclusions.
4. provide interesting, meaningful, and purposeful learning experiences.

Kinds of graphs which may be developed by elementary pupils with teacher assistance include

1. picture graphs (Picture graphs may be the easiest to read and develop on the part of pupils).
2. line graphs.
3. bar graphs.
4. circle or pie graphs. (The teacher should develop and draw circle or pie graphs. Pupils can be guided in reading content from this kind or type of graph.).

Situations involving the use of graphs may include:

1. recording the number of visitors during Education Week. For example, if three visitors came to the class setting on Monday, three pictures in one to one correspondence can represent these guests. For Tuesday, if five visitors visited school, one picture should represent each of these guests individually in a picture graph. The graph should, of course, also show the visitors for Wednesday, Thursday, and Friday.

2. showing population figures of selected countries being studied in a social studies unit. The result could be recorded in a picture, line, or bar graph. Thus, if pupils are studying a unit on Common Market Countries of Western Europe, each country such as West Germany, Italy, France, and other members must be represented on the graph. Pupils with teacher direction should determine how many people will be represented by a picture on a picture graph. Or, in using line and bar graphs, the size of interval must be determined in terms of how many people will be represented therein. Each interval should be congruent in size. Thus, for example, in a bar graph, (horizontal or vertical bars) each one inch* bar may represent five million people. Pupils may then see that situations involving reality may be put in graphic form.

If pupils are studying a unit on Weather, a line graph may be developed pertaining to temperature readings for each of the days of the week during the time the unit is being taught.

### Using Songs

There are numerous recordings which can help pupils to develop increased proficiency in rote counting. Learners in the early primary grade years generally enjoy singing selected songs. In learning to sing the song, "Ten Little Indians," pupils learn to use selected counting numbers in proper order or sequence. Thus, in singing "One little, two little, three little Indians; four little, five little, six little Indians; seven little, eight little, nine little Indians; ten little Indian boys," pupils are learning the correct order or sequence of counting numbers. Later on, pupils should attach meaning to rational counting; here, a learner points to an object and says "one", he points to a second object and says "two". Other sets, of course, may also be counted in sequence such as "three", "four", five", and so on.

Pupils with teacher guidance may develop songs dealing with saying the counting numbers in proper sequence.

### Using Money

Real coins and play money should be utilized in teaching-learning situations to help pupils under-

* or one centimeter

stand not only money values but other relevant learnings.

Thus, real and play money may be used in the following ways:

1. counting members given in a specific set, such as five coins pertaining to the cardinal number of five. Pupils may also develop learnings here pertaining to the cardinal number of five. Pupils may also develop learnings here pertaining to ordinal numbers, such as which coin is the third member in a specific set.

2. joining two sets together to make a new set, such as a child spending fifteen cents* for a candy bar and ten cents for a package of chewing gum. Thus, the learner can see practical application in the use of money when items are purchased.

3. subtracting when regrouping is involved such as a child having thirty-two cents and spending fifteen cents for a candy bar. The learner can be guided in understanding that a set of ten needs to be taken from the tens column in the value of three tens. These ten pennies may then be added to the two ones making a total of twelve cents. Now the pupil may take five ones from the twelve ones leaving seven cents. One ten may be taken from the two ten leaving one ten. The answer to the problem 32-15 is 17.

4. multiplying a factor times a factor. If a pupil, for example, had 10¢ and needed four times that amount to buy candy, the learner could be guided to think about four distinct sets, each having ten members. Thus, $4 \times 10 = 40$.

5. dividng, such as twenty-five cents being divided among five boys. How many cents then would each receive?

In using real money as a learning activity in the mathematics curriculum, the following criteria should be followed:

1. Pupils should notice that money can buy needed goods and services.
2. Learners should apply what has been learned previously.
3. Pupils need to attach meaning to ongoing learning activities involving the use of money. Thus, pupils, for example, may count the number of coins in a set emphasizing the one to one correspondence concept. Learnings acquired by pupils must make sense and be comprehendable.
4. Learners need to be involved in determining learning experiences involving the use of money.

### Using the Geoboard

In a modern program of elementary school mathematics, adequate emphasis must be given to the study of geometry. This would be true for the following reasons:

1. The world of geometry is all around us. Pupils may see squares (such as in tile on the floor), rectangles (such as in doors and window panes), circles (such as in circular windows and circle drives), and triangles.

2. Geometry can be interesting to pupils. Many learning experiences involving creative endeavors may be provided for pupils such as developing geometrical designs.

The geoboard made by the teacher or purchased commercially can provide interesting learning

* Currency used depends upon nation involved.

experiences for pupils. The base of a geoboard may consist of plywood. The size of the base can vary; eighteen inches by eighteen inches can provide a suitable size geoboard for teaching-learning situations. Small finish nails about a square inch apart may be driven into the geoboard. These nails should be driven in far enough to make for stability and yet protrude adequately to stretch around these protrusions using rubber bands to form triangles, squares, rectangles, and other geometric forms.

### Using Drill and Practice in Mathematics

Once pupils understand in a meaningful, purposeful, and interesting manner basic addition, subtraction, multiplication, and division facts, drill procedures may be utilized in teaching-learning situations. Varied procedures must be used to provide drill sessions for pupils pertaining to the basic facts. The interests of pupils must be developed and maintained in the elementary school mathematics curriculum. The following procedures may be utilized to fix basic addition, subtraction, multiplication, and division facts in the mind of the learner:

1. flash cards (pupils are given the time they need to respond to facts such as the following, each on a three by five-inch card):

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | 5 | 4 | 4 | 5 | 6 | 3 | 2 | 6 |
| + 5 | + 3 | + 4 | + 5 | + 4 | + 3 | + 6 | + 6 | + 2 |

2. games (these may be made by the teacher); pupils move forward a certain number of squares on a board if they respond correctly to a basic addition, subtraction, multiplication, or division fact. The fact to be responded to would be on a small card, face down, drawn in the order of players taking their turns playing the game. Penalties such as losing a turn or moving back a space or more may be inherent in the game.

3. fishing for fish (small "fish" may be cut from different colors of construction paper--each fish has a paper clip in its mouth.) The child uses a "fishing pole" consisting of a stick, attached string, and a magnet to catch fish; each fish has a number pair printed on it such as

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 4 | 3 | 5 | 6 | 6 | 7 |
| − 3 | − 3 | − 2 | − 4 | − 3 | − 2 | − 5 |

A child may keep the fish caught if he gives the correct answer to the number pair.

4. slides and transparencies. The teacher may write basic number pairs on individual slides. Pupils can then respond to these number pairs by attempting to give the correct answer. Basic number pairs may also be written on transparencies; pupils may then given correct answers to these problems.

Practice would involve guiding pupils to use previously developed learnings in new situations. Learners must be aided to transfer learnings obtained from one situation to the next problematic area. Thus, if pupils have learned that $10+5=15$ in a meaningful, purposeful, and interesting manner, they should be able to apply these learnings to a new situation such as determining the cost of items that costs 10 cents and 5 cents, respectively. Thus, facts, concepts, main ideas, and generalizations that have been acquired may be utilized in functional situations. Content learned previously that is used in functional everyday life situations generally is not forgotten by pupils.

The following criteria should be followed by teachers of mathematics when teaching for a trans-

fer of learning:

1. Have pupils attach meaning to new learnings being acquired.
2. Point out to learners or have them discover how previously attained learnings may be used in new situations.
3. Have pupils perceive reasons or purpose for learning content in elementary school mathematics.
4. Guide pupils in perceiving essential understandings when learning a new process.

### In Summary

Teachers need to provide a variety of learning experiences for pupils in elementary school mathematics. This is necessary due to pupils

(a) achieving at diverse levels of accomplishment in the mathematics curriculum.

(b) individually possessing different learning styles.

The following, among others, can be relevant learning activities to present to pupils:

1. using a selected series of elementary school mathematics textbooks.
2. utilizing the flannel board to guide individual pupil achievement in mathematics.
3. helping pupils attach meaning to learning through the use of markers.
4. guiding pupils in learning by using place value charts.
5. aiding learner achievement through the use of transparencies and the overhead projector.
6. stimulating learner interest in mathematics with the use of selected filmstrips.
7. using graphs in functional situations.
8. helping young pupils to develop interest in numbers by singing songs directly related to ongoing units of study in elementary school mathematics.
9. using the geoboard to help pupils experience the world of geometry.
10. providing drill and practice for pupils so that previous developed learnings will not be forgotten.

### Selected References

1. Copeland, Richard W., *How Children Learn Mathematics*, Second Edition, New York, Macmillan Publishing Company, 1984.
2. Copeland, Richard W., *Diagnostic and Learning Activities in Mathematics for Children*, New York, Macmillan Publishing Company, Inc., 1974.
3. Devine, Donald and Jerome Kaufman, *Elementary Mathematics for Teachers*, New York, John Wiley and Sons, 1983.
4. Grossnickle, Foster E., *Discovering Meanings in Elementary School Mathematics*, Sixth Edition, New York, Holt, Rinehart, and Winston, Inc., 1983.
5. Hicks, William Vernon, et. al., *The New Elementary School Curriculum*, New York, Van Nostrand Reinhold Company, 1970, Chapter Three.
6. Marks, John L., et al., *Teaching Elementary School Mathematics for Understanding*, Fourth Edition, New York, McGraw-Hill Book Company, 1975, Chapters Four-Eleven.