CALIFORNIA STATE UNIVERSITY, NORTH RIDGE

MATHEMATICAL DEVELOPMENT
THROUGH THE USE OF
MANIPULATIVE GAMES

A project submitted in partial satisfaction of the
requirements for the degree of Master of Arts in
Educational Psychology

by

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ABSTRACT

MATHEMATICAL DEVELOPMENT
THROUGH THE USE OF
MANIPULATIVE GAMES
by
Jo Davida Rightman
Master of Arts in Educational Psychology

How can teachers make arithmetic more interesting to children? The use of group games and activities may be one solution. Group games seem to be a natural and a satisfying human activity. Through the use of group games, children are exposed to other children's ideas in various situations.

A rich variety of mathematical activities and materials should be made available to a child so that he can satisfy his various interests. These activities should all be centered around coordinated physical and mental action on objects (Labinowicz, 1980). This project gathers a variety of mathematical
activities and games that will help children explore various mathematical concepts at their own level of development. Through the use of specific games, many involving parent volunteers, the children will be participating in a desirable form of activity. This highly satisfying activity will make learning activities more compatible with children's natural development.
Chapter 1
THE PROBLEM

How can teachers make arithmetic more interesting to children? As a teacher of elementary school children, I have asked that question myself. Children seem to "turn-off" to arithmetic. They complain that it's boring and it isn't any fun. One possible solution to the problem came as I was observing the children outside at play. I found that they seemed to be enjoying themselves when they were interacting with other children, during some type of group game.

Group games seem to be a natural and a satisfying human activity. Through the use of group games, children are exposed to other children's ideas in various situations. A young child often is interested only in what he is doing. Piaget (Kamii & DeVries, 1980) refers to this as egocentrism. Children, as they get older, begin to decenter and view themselves in relation to other children. They begin to realize and be exposed to other children's opinions. They begin to compare performances. Piaget (Kamii & DeVries, 1980) also states that there is a third level, incipient cooperation, which is where each player tries to win. Rules begin to form and competition begins.
The use of games gives children the chance to interact and the opportunity to change from an egocentric child to a child that views himself in relation to others. Games involving social interactions are referred to as cooperative games. "Cooperative activities with physical materials can be devised to help children decenter from their egocentric viewpoint in order to achieve a goal" (Labinowicz, 1980, p. 173). An example of this is an activity called "Cones Through the Hole". Two children must cooperate in order to get both cones through the hole, since both cones cannot go through at the same time (Labinowicz, 1980). Piaget believes that social interactions are indispensable for both the child's moral and cognitive development. Children develop socially, morally, and cognitively through games. They also develop politically and emotionally through games involving rules (Kamii & DeVries, 1980).

Playing within the rules of a game is one characteristic of Havighurst's (1958) developmental tasks of middle childhood, defined as the years between six and twelve. During this time the child should experience a wide range of activities, including exploration and investigation especially in mathematics. These activities can take the form of group games.
The children will be able to choose what game they would like to participate in according to their interests or need in math.

A rich variety of mathematical activities and materials should be made available to a child so that he can satisfy his various interests. These activities should all be centered around coordinated physical and mental action on objects (Labinowicz, 1980). This project gathers a variety of mathematical activities and games that will help children explore various mathematical concepts at their own level of development. Through the use of specific games, many involving parent volunteers, the children will be participating in a desirable form of activity. This highly satisfying activity will make learning activities more compatible with children's natural development.
Chapter 2
REVIEW OF LITERATURE

Learning can be fun and interesting to a child. A teacher can control the environment and resources to make the learning fun. In many school programs today, the teacher, with the use of parent volunteers, makes use of educational games to motivate children and to meet their individual needs.

In the review of literature, the use of games, past and present will be presented, as well as a theoretical rationale for the use of games, and the importance of parent volunteers in carrying out the program.

Background on the Use of Games in Education

Play in education and the use of games goes back a long way. Romans believed in the saying "all work and no play makes for dullness" (Moss, 1962, p. 7). The young Roman child had many toys and objects to play with, such as wooden or clay animals on wheels to pull around. Some of these animals were made large enough so they could be attached to wooden carts. The children could then play and imagine themselves as chariot drivers. At an early age the young child was introduced to ball games. The ball was made out of a cloth and stuffed with soft material. A game similar to our handball was played. The Roman child during lesson-
time with his tutor also played a learning type game. To encourage reading and spelling, the tutor used sets of bone or ivory letters with which words could be built and spellings learned (Moss, 1962).

As time continued, the Saxons in Britain also made use of several games to pass the time. They played many board games that are similar to the games we have today. One of these board games is a game called Hnefatafl which is similar to Backgammon (Moss, 1962).

Looking at more recent times, John Dewey (1915, p. 120) a philosopher and educational theorist in the late 1880's-early 1900's stated "learning by doing is a better way to learn than by listening". Children should be involved in activities that have meaning to them and come naturally. The best success in school comes when the children's instinctive activities are linked up with natural experiences. One thing that comes naturally to children is play. Schools are making use of the child's instinct for play by using organized games based on play motives as a part of the curriculum (Dewey, 1915). With young children, simple play is transformed into more elaborate games and work. In school-age games, rules must be mastered. When a child moves from playing in a boat to making one, he is developing new intellectual skills. Play is giving
way to work. The teacher in a classroom must have knowledge and be able to provide a wide range of activities which have some meaning to the students. "An educative experience is educative only when it leads to the seeing of new meanings about the world or self, which are then incorporated so as to help one live more effectively" (Wirth, 1966, p. 96). The teacher provides the activities or environment and the students actively manipulate this environment to their own needs (Wirth, 1966).

The Montessori method is based on the principle of freedom in a prepared environment (Standing, 1970). Montessori said "play is the child's work" (Elkind, 1981, p. 107). In play the child learns through engaging in real actions involving tangible objects (Elkind, 1981). The Montessori teaching materials are materials for development. Each of the sensorial materials is a series of objects or games. By working with these materials, the child "carries out a definite piece of work, which assists and directs the development of his personality" (Standing, 1970, p. 103).

Theoretical Rationale

Learning is a continuous process. The changes in the way children learn at different age levels can be related to developmental stages. Learning begins
with observation and manipulation in the very young child. Then labeling and classification follow in early and middle childhood. In adolescence the child begins creating an order that is more formal. He begins relating things and comparing (Elkind, 1977).

Piaget believes in a series of hierarchical, sequential stages through which all children develop cognitively. Piaget has called these stages: 1) sensorimotor stage 2) preconceptual and intuitive thought 3) concrete operations, and 4) formal operations.

During the sensorimotor stage, the very young child exhibits basic reflexes when confronted by certain stimuli. If something enters his hand he will grasp it. The young child will continually explore things with his mouth, hands, and eyes. Gradually the child is building an organized view of the world or a scheme. The first two years of a child's development is the sensorimotor stage (Case, 1981).

From the age of about two to seven the child enters the preconceptual and intuitive thought stage of development. During this period the child begins forming things into classes and dividing them again. The child builds on objects to form concepts and on concepts to form classes of concepts. The child is exploring his world and making many observations about it. His thinking is beginning to become logical but
is primarily perceptually bound (Case, 1981).

The third stage of Piaget's developmental stages is concrete operations. During this period the child begins to extract higher-order features of groups that do not change, even though the groups change drastically. The child decenters, reverses and transforms. For example, if you make two rows of beads of the same number and ask the child if they have the same number, the child will say yes. Now take one of the rows and spread it out. Again, ask the child if both rows have the same number. If the child is still in the preconceptual and intuitive thought stage, he will say the longer row has more beads. If the child is in the concrete operations stage, the child will say that both rows have the same number of beads.

Piaget's final stage of development is called formal operations. The child is beginning to create an order that is more formal. "His activity in noticing the things that actually happen in the world and in producing changes, appears to enable him to begin thinking about what might happen and to envision all the changes that are possible. It enables him to reason without visual props" (Case, 1981, p. 103).

Piaget believes that a child should use visible manipulative materials until he is able to deal with abstractions or symbols. Given enough direct physical
experiences, he will assimilate enough data to build a mental picture of the essence of those experiences. Knowledge is acquired through action upon things, and the relations which exist between them (Lavatelli, 1970). This action upon things or the tendency to alter one's schema in response to environmental realities is called accommodation (Achenbach, 1978).

Havighurst, (1958) a developmental theorist, believes that every individual finds himself facing new demands and expectations from the society around him. From birth an individual is growing physically and psychologically, and as time advances the environment begins to have influences on him. "These inner and outer forces contrive to set for the individual a series of developmental tasks which must be mastered if he is to be a successful human being" (Havighurst, 1958, p. 4).

These developmental tasks arise from three sources: physical maturation, cultural expectations, and personal values. For each developmental task these three sources are always interacting and working together. One source may have more of an influence on that particular task, but the three sources are always present (Havighurst, 1958). Havighurst divides his developmental tasks into four periods: 1) infancy
and early childhood, 2) middle childhood, 3) adolescence and 4) adulthood and old age. Developmental tasks of middle childhood and their role in education are related to this project.

Middle childhood, which is from about age six to twelve years of age, is characterized by three outward pushes. These three outward pushes are "the thrust of the child out of the home and into the peer group, the physical thrust into the world of games and work requiring neuromuscular skills, and the mental thrust into the world of adult concepts, logic, symbolism, and communication" (Havighurst, 1953, p. 25).

Middle childhood is characterized as a time of activity, exploration, and investigation. The activity of the child is no longer random. It is purposeful, such as playing within the rules of a game.

The teacher of children in the middle childhood group provides:

"1. a range of activities in keeping with interests concerns and abilities of the children in her group; 2. materials that the children enjoy working with and can learn to manipulate; and 3. perhaps most important of all, an atmosphere in which she respects the different kinds of achievement that grow out of the different activities" (Havighurst, 1953, p. 68).
In a classroom situation like this, the child will have the opportunity to try different things. He may be in a group where he is practicing a particular skill or working with apparatus or materials that he enjoys (Havighurst, 1953).

**Educational games** in the classroom have been shown to play a significant part. A number of studies and articles have been written on the importance of activities and games in education.

According to Sharp (1969) the games children play in school and at home may be equally important in influencing their ability to read. Reading games are an easy way for teachers and parents to grab the attention of children and avoid the 3-D (Dull-Dry-Drill) method of teaching (Barth, 1973).

The maxim "All work and no play makes Jack a dull boy," has long been accepted as a valid concept in our society (Work/Play, 1971, p. 27). By blending work and play, one can teach children more effectively. The use of games and work/play strategies in the total teaching style will make the children in the classroom become more enthusiastic learners (Work/Play, 1971). Many schools, however, do not give children the chance for discovery and growth through play. They force children to learn things that are obscure and have no relevance
to them. This causes the child to become restless and impatient. Dewey (1915, p. 21) feels the child must follow his natural growth and "the interest of pursuit leads the child of his own accord into investigations that often amount to severe intellectual discipline".

Children who have trouble understanding abstract symbols and concepts when presented in traditional paper and pencil exercises may react quite differently to learning activities included in games. The games designed to teach should be attractive to children. Learning activities in the form of games can be highly motivating, especially if the children find the activities challenging (Blankenbaker, 1976).

One approach to motivation is to make learning fun. Games offer the teacher an opportunity to make a class fun, and at the same time productive for learning. The fun is the immediate motivation and the learning takes place as a by-product, often to a greater extent than when teaching is direct. Unconsciously students learn as they consciously play classroom games involving their subject matter. Thinking, recall, and reinforcement result from the use of games in the classroom (Mehl, 1976).

The teacher in the classroom who sets up a variety of different activities, centers, and games, has a difficult time giving each child individual attention. This is one reason for the use of parent volunteers.
in the classroom.

**Importance of Parent Volunteers**

Parent involvement is a "process of actualizing the potential of parents; of helping parents discover their strengths, potentialities, and talents; and of using them for the benefit of themselves and the family" (Morrison, 1978, p. 22).

Parent involvement in the school program gives parents a feeling of importance and support in their role as parents and educators. Participation provides parents with skills which they can use at home with their children. Most important of all, parent involvement enhances the self-image and performance achievement of the child (Morrison, 1978).

Parent volunteers in the classroom are to assist teachers and other school personnel in providing more individualization and enrichment of instruction to their classes. The volunteers increase children's motivation for learning. Volunteers provide an opportunity for interested parents to participate effectively in the school's program and to strengthen school community relations through positive participation (Davis, 1979).

Parents involved in a classroom setting bring an incredible number and range of skills into the classroom. If the parents are shut out of a classroom,
this contribution is lost. There are opportunities for storytelling, sewing, baking, cooking, and many other involvements that exist by taking advantage of the talents of adults in the community.

Working in the classroom may also improve the quality of the relationship between the parent and the child. The parent attends more to the child because they now have more in common, with more to talk about and more to do (Morrison, 1978).

Parent participation can be a help to changing a child's behavior. If educators wish to modify attitudes, habits, or other areas of performance, the logical place to intervene is with the individual's parents. Having the parents at school volunteering is a beginning step.

Parents need to be involved in the educational activities of children in their early school years. Parents who learn to teach their children at an early stage of development have been shown to retain their skill and apply it over extended periods of time (Cooke, 1975).

In many classrooms, parents are beginning to take a more active role in the education of their child or other children. A teacher in Pittsburgh, Pennsylvania, found that active parent participation has been
responsible for much of the pupil success in her room. The parents brought with them various talents and interests which exposed the children to many new things. The teacher must have definite plans for using them efficiently. Parents in the classroom can be a great benefit to all concerned (Taylor, 1972).

Parents are an asset to any learning environment, and are helpful in a variety of ways within the classroom. One way to provide the individual instruction children need is to enlist the help of pupils' families. These parents can work with individual children on a particular skill, play a game with a group, record individual stories, oversee an art area where adult supervision is needed, or many other activities (Weinberger, 1976).

In a review of literature on parent participation and its long and short term effects, Grotberg (1965) found the following about IQ gains of children who had participated in Head Start: Children of parents who had a high level of participation retained their gains better than children of parents who did not have a high level of participation.

The parent plays an important role in an early intervention program. She is the primary agent of intervention. In most cases she is with the child for the greatest amount of time. The parent therefore can
reinforce the specific adaptive patterns which the child has learned. Early intervention programs help foster the development of a "child-parent relationship of reciprocal interaction centered around activities which are challenging to the child" (Bronfenbrenner, 1974, p. 24).

Children's attitudes and values were also affected by preschool participation. Those children who attended preschool gave achievement related reasons for being proud of themselves. "Mothers of children who attended preschool had higher vocational aspirations for their children than the children had for themselves" (Lazar, 1977, p. 53). The preschool experience changed parents' perceptions of their children (Lazar, 1977).

The Perry Preschool Project of Schweinhart and Weikart (1980) is another example of an early intervention program which had positive effects on children. The results of the early childhood intervention led to improvement in mathematics achievement from grades three to five. The study showed that parents were better satisfied with the school performance of their children. The program also enabled parents to better support the strengths in their children.

Another study looked at pre-kindergarten children and the effects of parent participation. The children were divided into three matched groups---one with no
parent involvement, another with medium parent involvement, and another with intense parent involvement. At the end of the first year there were no significant differences among children in the various groups. At the end of the second year there were significantly greater gains in IQ for the two groups with parent involvement. The researchers attributed the gains to changes in the parents' perceptions of themselves as teachers of their own children (Schaefer, 1971).

Parent involvement in the classroom affects children in another way. "The amount of parental involvement in the child's education may explain up to four times as much of the variance in the child's intelligence and achievement test scores at age eleven as the quality of the schools" (Schaefer, 1971, p. 18).

An article written by a parent volunteer at a school in New York, states that many enrichment activities for the elementary classroom cannot be carried out because the teacher has neither the time nor the talent for such a project. On the other hand, many parents have special abilities that a teacher can use in her classroom. Sewing, cooking, carpentry activities are just a few of the things that parents have special talents in (Fireside, 1972).

Besides using parents for creative arts activities like cooking, sewing, and carpentry, parents can be
a great help for the basic subjects like math and reading. Children who do not learn to read through normal approaches need personal attention and individual help. A program was set up in a school in Danville, Kentucky. The children involved received three hours of individual tutoring a week, plus two hours in the regular reading program. While formal evaluation procedures have not been stressed, it is still apparent from the observation of teachers, tutors, and parents that in almost every case improvement had taken place in pupil performance. These parent volunteers while tutoring individual children used word games and various other games to make the learning more enjoyable (Wall, 1972).

In summary, much research has been done, discussing the effects of games and play and the way it reflects or contributes to children's learning, growth, and development. One theorist, John Dewey (1915) stated that children learn by being involved in activities and play. Other researchers like Wirth (1966), Standing (1970), and Elkind (1981) believe that a child learns best when he is actively engaged in real actions involving tangible objects. Two developmental theorists, Piaget and Havighurst, also believe that a child should be exposed to a variety of activities. Both feel that the child should enjoy working with these
materials and that they can learn to manipulate them.

An equal amount of research has been done on how to involve parents in the process of their child's education and the importance of their participation. Educators have become increasingly interested in involving parents in the classroom. The origin of this increasing interest on the part of educators in parent involvement goes back to the 1960's and the Head Start Program. Since that time various studies and articles have been written up in journals on how to use parents in the classroom and the benefits of using them. Such studies as Grotberg (1965), Schaefer (1971), Taylor (1972), Bronfenbrenner (1974), Lazar (1977), and Schweinhart & Weikart (1980) have all shown positive gains and benefits to parent involvement in the classroom.

As an educator of young children, I have put together a math program that utilizes manipulative games and the activity centered approach to learning. The games are appropriate for individual children at particular stages of their development. To implement this program parent volunteers will be used to help the children with these games and activities.
Chapter 3
PREPARED MANIPULATIVE GAMES

Mathematics employs abstract concepts that children discover while using a variety of materials and manipulatives. Piaget believes that number relationships cannot be taught directly in the verbal sense but only by acting upon objects. The child gains knowledge by manipulating the objects and internally structuring his actions (Labinowicz, 1980). From this active construction on objects, "Piaget's concept of number includes the fusion of related ideas such as serial order and class inclusion into an integrated framework" (Labinowicz, 1980, p. 110). Once children have constructed a beginning concept of number, then the learning of addition, subtraction, multiplication, and division takes place simultaneously (Labinowicz, 1980).

In this last chapter, there are a number of math manipulative activities and games which I have used and found effective in helping children discover various math concepts. The activities begin with very simple concrete experiences which gradually lead to more symbolic ones. The children begin to discover the various math concepts by doing and working with familiar materials. For example, the beginning concept of what is
a number is discovered by counting, sorting, and classifying familiar objects. The first few games in my manual are relating to this.

The complete manual has games and activities for children to discover number concept, place value, addition and subtraction, multiplication, measurement, geometric shapes, and logical thinking skills. Because the manual is for the primary grades K-3, I have omitted division and fractions, which are areas covered in the upper grades. The games that I have placed in the manual have been carefully chosen from a variety of different sources. All of the games are activity-centered learning games. Activity-centered learning encourages the child's learning through manipulation of different things in his environment that have meaning for him. The activities move from concrete experiences to more symbolic ones.

In my classroom, the activities and games were made available to the children during math time during 1981-82. They were free to choose whichever activity they would like to do. The children chose activities at their ability level. The parent helpers and myself worked with individual children or small groups on these activities. Many children commented that they now enjoy math. The activities were a lot more
fun than just doing work in a math book. Some children stated that math was not their worst subject anymore.

The games and activities in my game manual are all proposed games and the effectiveness must now be empirically evaluated.

GAME MANUAL
SET ACTIVITIES

RATIONALE: Practice in identifying sets of items.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: A variety of objects such as cans, silverware, blocks, toys, etc.

PROCEDURE: A variety of activities can be done with the various objects. I will name a few suggested activities.

1. Have the children separate the objects into groups according to size, color, shape, etc. Discuss with them why each object would be placed in each section.

2. Compare the sets by discussing how they are alike or different.

3. The teacher or group leader should divide the objects into various groupings. The children should look at the various groupings and decide what rule or concept is being discovered. Have the children make their own groupings, and have the other children decide what the rule is.

4. Using the objects in the sets, the children can count the number in each set and then determine how many objects in all of the sets together. This gives them practice with addition.

SOURCE: (Dumas, 1971)
MATCH IT

RATIONALE: Experience in discovering relationships.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Cuisenaire rods.

PROCEDURE: Select any color rod, for example the brown rod. Ask the children if they can find what other colored rods can be put together to make the same length or size as the brown rod. The first child to find the rods that can be put together to make the brown rod earns a point. This same procedure with the other colored rods should be continued.

SOURCE: (Dumas, 1971)
HIDDEN OBJECTS

RATIONALE: Practice in counting.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: A variety of small objects such as beans, peanuts, buttons, etc. Clean plastic pill boxes or film containers are also needed.

PROCEDURE: Before the game starts the teacher places varying numbers of objects into the various containers. The children take turns counting the objects in each container. After they count the objects they are to write down the correct number on a piece of paper and place it in the container. The child who is able to do the most tasks correctly is the winner.

VARIATION: The teacher can write a number and place it on the container. She will write different numbers for each container. The child must be able to read the number on the container and place the right amount of objects in the container.

SOURCE: (Dumas, 1971)
SET SEE

RATIONALE: Practice counting and grouping.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: none.

PROCEDURE: The teacher or group leader has the children sitting on the floor in a small circle. The teacher asks the children to identify a group of objects in the room on the basis of their color, shape, or location. For example the teacher might ask the children to count how many red circles they can find in the room. The first child with the right answer can then make up the next problem for the next round.

SOURCE: (Metzner, 1968)
GUESSTIMATION

RATIONALE: To develop the skill in estimation and counting strategy.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: A variety of different objects.

PROCEDURE: Take a variety of objects and place them on a table. Let the children look at the objects for about five seconds. Cover up the objects, and then ask the children to guess how many objects were on the table. Start with large objects to begin with. Each time use smaller and smaller objects. After the child has guessed, have him prove his answer by counting. The child that makes the most correct guesses is the winner of the game.

SOURCE: (Blaine & Chilcote, 1972)
AIRPLANE RIDE

RATIONALE: Provide practice in using ordinal numbers.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: A set of chairs placed as seats on an airplane.

PROCEDURE: Select one person to act as the hostess to direct the passengers or children to their seats. The hostess will say to the passenger that he has the fourth seat. The passenger must then count and find the correct seat. The hostess continues until all the passengers are seated.

SOURCE: (Dumas, 1971)
TAPS

RATIONALE: Practice in counting and one-to-one correspondences.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Beans or other markers.

PROCEDURE: Each child is given at least fifteen markers. The child is told to lay out as many markers as he hears tapped out by the leader. The leader, for example, will tap the table six times with a pencil. The children will then count out six markers and lay them in front of them. The first child who has the right amount of markers in front of him wins the first round. The leader will continue as long as the time allows.

SOURCE: (Dumas, 1971)
BEAN GUESS

RATIONALE: Provide practice in subtraction facts.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: A supply of beans.

PROCEDURE: Each child is given a number of beans to begin the game. The first player takes a certain amount of beans and divides them into two piles. He covers both of these piles with his hands. The other player asks the child how many beans he has altogether. After the child tells how many beans he is using, he then takes his hand off one of the piles that he was covering. The other child must guess or figure out how many beans the child is still covering with his other hand. If the child guessing gives the correct answer he gets one point, and then it is his turn to make the problem for the other child.

SOURCE: (Dumas, 1971)
NUMBER LINE HOP

RATIONALE: Number line is used for addition and subtraction.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: A large number line needs to be drawn on the playground using chalk. The unit marks should be about eighteen inches apart.

Example:

```
0 1 2 3 4 5 6 7 8 9 10
```

PROCEDURE: Divide the children into two teams. The first player on one team will give directions to the first player on the other team. For example the directions might be to start on number four; hop four spaces to the right; now hop two spaces to the left. Where are you? If the hopper is able to give the correct answer, then he is able to give the directions to a person on the other team. If he gives the wrong answer, then he must sit down and be out of the game. The winner of the game is the team with the most players at the end of the time period.

SOURCE: (Dumas, 1971)
FIFTEEN

RATIONALE: To find patterns and to develop strategies.

NUMBER OF PLAYERS: Two.

MATERIALS NEEDED: Fifteen objects such as beans or counters.

PROCEDURE: The fifteen objects are placed on a table in front of the two players. The players can pick up one, two, or three objects with each turn. The object of the game is to make the other player pick up the last object. The teacher or leader should encourage the children to see if they can find a pattern or strategy to win the game.

SOURCE: (Blaine & Chilcote, 1972)
BANKER'S CHOICE

RATIONALE: Provide practice in place value.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: Plastic chips of different colors, and dice.

PROCEDURE: One player is the banker and the other children are the people going to the bank. The first player rolls the dice, and then goes to the bank to get the correct number of chips shown on the dice. The game continues in this manner, until the children start accumulating chips. As soon as the player has ten chips, he must trade it in at the bank for one chip representing one ten. As soon as the player obtains ten tens, he must trade it in for one hundred which is represented by another colored chip. The first player who gets the one hundred chip first is the winner and becomes the next banker.

SOURCE: (Dumas, 1971)
BEAN STICKS

RATIONALE: To learn place value, addition, and subtraction.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Beans, glue, tongue depressors, and cardboard squares.

PROCEDURE: The children can make the parts to the game or they can already be made. Each bean stick should have ten beans glued on it, and a cardboard square should have one hundred beans on it. To teach place value have the children form numbers such as 35 by collecting the proper number of bean sticks and beans. The child who does it first is the winner. The children can use the bean sticks and squares to do addition and subtraction problems.

SOURCE: (Ooten, 1978)
COUNTO

RATIONALE: Provide practice in counting, ordinal numbers, place value, sets, and concepts of addition and subtraction.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: Several hundred small, interesting items such as bottle caps, miniature toys, seeds, shells, etc.

PROCEDURE: Use the various items to teach counting. Place a number of objects in front of the child, and have him tell you how many are there. Also have the child write down the number. Using the same items, the teacher can make a row of objects and have the child point to the fourth object, sixth object etc. This is teaching him ordinal numbers. Place value can be taught or discovered by grouping the objects into sets of ten. The number 34 would be represented by three sets of ten items and a set of four. Let the child experiment with the objects and come up with his own ideas.

SOURCE: (Baratta-Lorton, 1979)
TRICK OR TREAT

RATIONALE: Provide practice in counting and the operation of subtraction.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: Small objects such as seeds or plastic discs, and a paper bag.

PROCEDURE: Each of the players should have a handful of the objects. One of the players will go to each player and ask for a certain number of objects. The correct number of objects are placed in the bag. After the objects are taken from the one player, he must also tell the visitor how many objects he has left. If the child who has placed the objects in the bag can tell how many objects he has left, then he is still in the game. If he cannot, then he is eliminated from the game. The winner of the game is the last person in the game who then becomes the visitor.

SOURCE: (Dumas, 1971)
SNAP

RATIONALE: Provide practice in addition and subtraction facts.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Each player needs clothespins, and a coathanger inserted upside down in a piece of wood.

PROCEDURE: The teacher or leader of the group says I am thinking of a number that is three plus two. The children must arrange the clothespins to show the answer. The child who gets the answer first is the winner. The difficulty of the problems depends on the group of children and their needs.

SOURCE: (Dumas, 1971)
MATH-A-FOLD

RATIONALE: Practice in addition.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Need 15-20 sheets of construction paper, each sheet folded in half. On the front draw one to ten dots on each half. On the back place the correct sum.

PROCEDURE: In a small group or individually, the teacher will hold up a card only showing half of it. The children should tell how many dots they see. The teacher will then show the other half of the card, and the children will tell how many dots they see. The teacher will ask the children how many dots on the card or the total number of dots seen. The first child to give the correct answer gets a point. The correct answer should be written on the back of the card. The player who receives the most points at the end of the game time is the winner.

SOURCE: (Bitter, Mikesell & Maurdeff, 1976)
CIRCLE ADDITION

RATIONALE: Practice addition combinations.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: Chalkboard and chalk.

PROCEDURE: On the chalkboard, write something like this:

```
2 5 1 7 6
3 7 9 2 4
6 4 8 7 1
```

The children playing the game are to copy the numbers on a piece of paper. To make it easier, a ditto can already be made with the numbers to give out to the children. The teacher then calls out a number. The children are to circle any two numbers that add up to the number called. The two numbers can be circled horizontally or vertically. The teacher will call out five or six different numbers. The first child to make all the correct combinations is the winner.

SOURCE: (Metzner, 1968)
BEAN BOX MATH

RATIONALE: Practice in addition and subtraction.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Beans or markers for each player, number cards, and a game board.

PROCEDURE: The leader or teacher begins by making up a problem such as $4 + 3$. She places four beans in the first box, then three beans in the second box. She asks the child how many beans should be placed in the last box. The first child to give the correct answer by placing the right number beans in the box and the right number card underneath it gets a point. It continues with the leader giving various addition and subtraction problems. The children can also make up their own problems and quiz each other on the answers. The game board should look as follows:

SOURCE: (Bitter, Mikesell & Maurdeff, 1976)
NUMBER BINGO

RATIONALE: Give practice in recognizing numbers.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: Duplicated grids and markers.

PROCEDURE: Each child is given a number grid. The leader or teacher of the group calls out numbers to the children. Each child must see if that number is on his grid. If it is, then the child covers the number with a marker. When a player has five in a row, either vertically or horizontally, he calls out Bingo. The first child to call out Bingo is the winner.

<table>
<thead>
<tr>
<th>B</th>
<th>1</th>
<th>N</th>
<th>G</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>6</td>
</tr>
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<td>6</td>
<td>7</td>
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<tr>
<td>5</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

SOURCE: (Dumas, 1971)
STAY OUT OF THE HOLE

RATIONALE: Provide practice in adding integers.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: Need three small bean bags, and a cardboard grid 24" x 24" with four-inch squares. Each square should have a number written in it. Example of a grid:

```
<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
<th>6</th>
<th>0</th>
<th>3</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>9</td>
<td>4</td>
<td>6</td>
<td>5</td>
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<td>7</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>
```

PROCEDURE: The grid should be placed on the ground a reasonable distance away from the players. The player must add up the numbers that his bean bag lands on. The player must toss three bean bags onto the grid. The leader of the group keeps a record of each person's scores. The players take turns throwing the bean bags and adding up their scores. If a player is unable to correctly add up his score, then the score keeper will not add any points to his tally for that player. The person with the most points at the end of the game time is the winner.

SOURCE: (Dumas, 1971)
ADDING TO TEN

RATIONALE: Practice in addition.

NUMBER OF PLAYERS: Two.

MATERIALS NEEDED: Playing mat, two sets of eight discs or squares to fit the playing mat.

PROCEDURE: Each player should have his own set of playing discs. The game begins when one player puts out one of his playing discs on the board. The other player then has a turn to place out one of his playing discs. The object of the game is to have each row, diagonal, and column add up to 10. The game continues with each of the players taking turns placing a disc on the game board. The player loses a turn if he is unable to put out a disc on the game board because if he places a disc the row, column, or diagonal will add up to more than 10. The winner of the game is the player who gets rid of all his playing discs first, or the player with the fewest discs at the end of the game.

SOURCE: (Bitter, Mikesell & Maurdeff, 1976)
PEGBOARD MATH

RATIONALÉ: Teaching basic math facts.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Need brightly colored pegs and a board with twenty ½" holes at one inch intervals. The board should be one inch by two inches.

PROCEDURE: Using the board and the brightly colored pegs, the leader can show the children different addition and subtraction problems. For example six blue pegs and four yellow pegs make ten pegs all together. The leader of the group can give a variety of problems to the children, having them take turns doing the problem. The child who gets the most correct, is the winner.

SOURCE: (Dumas, 1971)
BOXOLOGY

RATIONALE: Practice in addition, subtraction, and number writing.

NUMBER OF PLAYERS: 4 or more.

MATERIALS NEEDED: Need three boxes labeled box 1, 2, and 3. Also need counters such as beans or coins.

PROCEDURE: To begin the game, the teacher or leader places a certain amount of counters in box 1. She announces the amount to the whole group. The leader then instructs one child to take some of the counters out of box 1 and place them in box 2. After this is done, the leader then instructs another child to take some counters out of box 1 and place them in box 3. The leader then chooses one more child to pick up box 2 and box 3 and announce to the remaining children how many counters are in box 2 and box 3. The children write down the numbers and must then figure out how many counters are left in box 1. The first child to get the first answer gets a point. All of the counters are returned to box 1 and a new round begins. The child with the most points at the end of the game time is the winner.

SOURCE: (Metzner, 1968)
HOLD-UP

RATIONALE: Review basic facts.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: Have the children cut paper into ten squares and write the numerals from 0 to 9 on the squares, one numeral to a square.

PROCEDURE: The children playing the game should place all of the number pieces in front of them, preferably in order. The teacher or leader of the game, will ask, "If I add three plus two, what is the answer?" The first child to hold up the correct number on the paper gets a point. The game continues with the leader giving a variety of problems. The children can use beads or objects to figure out the correct answer.

SOURCE: (Metzner, 1968)
NUMBER CHECKERS

RATIONALE: Give practice on addition or subtraction facts. Also to develop thinking skills while playing a game.

NUMBER OF PLAYERS: 2 people.

MATERIALS NEEDED: Checker game.

PROCEDURE: The teacher should put addition or subtraction facts on each square of the checker game. The children play the game as usual but they must answer the problem on each square correctly before being allowed to move onto that square.

SOURCE: (Kahi & Gast, 1974)
INVICTA BALANCE

RATIONALE: Manipulative way to multiply.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Invicta balance and washers.

PROCEDURE: To find $4 \times 3$, put 4 weights on the number 3 peg. Put weights anywhere on the other side to make it balance. Add the numbers corresponding to those weights to find the product.

SOURCE: (Ooten, 1978)
THROW A FACT

RATIONALE: Provide practice on multiplication facts.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: A gameboard drawn on the floor consisting of nine squares in each of which is a numeral appropriate to the practice needed. Also needed are several numbered bean bags.

<table>
<thead>
<tr>
<th>9</th>
<th>4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

PROCEDURE: Each player is given two bean bags to throw onto the gameboard. The player must stand behind a mark already decided upon by the leader of the game. The player must give the product of the two numbers that the bean bags land on. If the player gives the correct answer then he receives a point, and the next player gets his turn. The game continues until one of the players reaches 10 points. At 10 points the game is over. If only one player, he may try to beat his best score.

SOURCE: (Dumas, 1971)
MULTI-BINGO

RATIONALE: Practice multiplication facts.

NUMBER OF PLAYERS: 2 or more.

MATERIALS NEEDED: A box with paper counters numbered from 1 through 81. Each player should have a game board with 16 squares and the numbers 1 through 9 randomly placed on the board. Only one number in each square.

PROCEDURE: The leader of the group or teacher will draw a counter from the box and call the number on it. The players are to cross out any two numbers next to each other, vertically or horizontally, whose product is the same as the number called. The first player to have a row crossed out either vertically, horizontally, or diagonally calls out Bingo and is the winner. The leader must check his card to make sure there aren't any mistakes. Counters or markers can be used instead of crossing out squares on the card if the teacher wants to use the cards over again.

SOURCE: (Metzner, 1968)
WHAT'S MY MEASURE?

RATIONALE: To understand the need for a standard unit of measure.

NUMBER OF PLAYERS: 1 or more.


PROCEDURE: Have the children use their hands to measure their desks or tables. Be sure they understand that they begin at one edge and measure how many hands it takes to get to the other edge, rounding off at the end. Children next measure their desks using a book, then a shoe, a pencil, and last, a ruler. Have them compare their measurements and discover what the easiest unit of measure is. Hopefully they will come up with the ruler.

Sample Worksheet:

```
My Desk Measures

_____ hands
_____ books
_____ shoes
_____ pencils
_____ arms
_____ rulers
```

SOURCE: (Chilcote & Blaine, 1972)
GROOVE

RATIONALE: Practice recognizing geometric shapes.

NUMBER OF PLAYERS: Three teams with two or three players each, plus a leader.

MATERIALS NEEDED: One gameboard for each team. Each team should also have a set of three squares cut into four pieces as shown below.

![Diagram of Groove Gameboard]

PROCEDURE: The leader begins the game by giving each team a gameboard and an envelope containing three cut-up squares. The leader gives the signal for the game to begin. Each of the teams tries to put together the three squares and place them correctly on the gameboard. The first team to correctly place the three squares on the gameboard is the winner. During the game the players are not allowed to talk. They may point or signal.

SOURCE: (Sharp, Sharp & Solza, 1974)
GEBOARDS

RATIONALE: Make geometric shapes; make comparisons of greater than and less than; practice counting.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Colored rubber bands, and wood squares (approximately 10 x 10 inches) and 100 1½ inch nails (to be nailed in a pattern on the wood 1" apart).

PROCEDURE: A variety of activities can be done with the geoboard. I will list a few. The children can make different geometric shapes on their geoboard. Comparisons of the different shapes can be discussed according to shape and size. The geoboard can also be used to discover perimeter and area.

SOURCE: (Kahl & Gast, 1974)
TANGRAMS

RATIONALE: To build visual perception skills, and to develop creative thinking.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Tangram pattern square, scissors, and tangram designs.

PROCEDURE: Have the children cut out the original tangram pieces and place in a small envelope. Have them take out the pieces and see if they can make a square again. Have them use the pieces to make the tangram designs on the worksheets. Some children will want to make designs of their own.

SOURCE: (Chilcote & Blaine, 1972)
LINE DESIGNS

RATIONALE: To use a straight edge and to discover the illusion of straight lines.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Rulers, pencils and worksheets.

PROCEDURE: Give children a straight edge and have them connect the dots that have matching numbers. See if they can discover what makes their designs different. Older children will want to make designs of their own.

SOURCE: (Chilcote & Blaine, 1972)
PEG GAME

RATIONALE: To encourage and develop logical thinking.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Peg Game.

PROCEDURE: The object of the game is to interchange the red and white pegs according to a few rules. The rules are as follows: The white pegs must move only to the right; the red pegs must move only to the left. You can only move one peg at a time. You can move a peg into an adjacent hole. You can jump, but only a single peg of the opposite color (you can't jump two pegs).

SOURCE: (Ooten, 1978)
TOWER PUZZLE

RATIONALE: To encourage and develop logical thinking and distinguish the difference between small and large.

NUMBER OF PLAYERS: 1 or more.

MATERIALS NEEDED: Tower Puzzle Game

PROCEDURE: The object of the puzzle is to transfer one disc at a time from the center peg to either of the other two pegs, ending with the discs arranged in the same order as the start (smaller discs on top of larger discs). There are only two rules in moving the discs: 1) only one disc may be moved at a time and 2) a larger disc may never be placed on top of a smaller disc.

SOURCE: (Ooten, 1978)
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