

Manip

Big learning from little objects

Jason stands at the manipulative table stringing wooden beads. After a minute, he compares the string to the pattern card.

He frowns. Something is not quite right. He holds the string against the card and compares the beads, one to one.

“Ah,” he says. He reaches into the bead tub for two triangle beads. He removes the round beads he has strung before and re-strings the beads, this time putting the triangle beads in the place of two round ones.

“Look, I did it,” he says to Carmen, who’s working a puzzle.

“I like the yellow and green ones better,” she says.

Jason flips through the pattern cards and finds one with yellow and green beads. “I can do this one too,” he says, and starts a new string.

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At first glance, activities such as stringing beads and putting together puzzles would seem to be about improving muscle control in the hands and developing eye-hand coordination. Certainly these are important skills for preschool children. Such skills form the foundation for later hand skills, such as writing, drawing, using a computer keyboard, and playing a musical instrument.

But manipulative activities do much more. Understanding the form and function of manipulatives can help caregivers and teachers strengthen all areas of children’s development.

What are manipulative materials?

According to the ERIC thesaurus, these are “instructional materials that are designed to be touched or handled by students and which develop their muscles, perceptual skills, psychomotor skills, etc.” Another commonly used

term for these materials is “table games.”

Children manipulate objects in all areas of the classroom—as they play with blocks, sand and water, art materials, science and discovery items, musical instruments, and dramatic play props. Children also manipulate objects outdoors using gardening tools, woodworking and construction supplies, balls and nets, and push-pull toys, for example.

But preschool children need a separate learning area devoted to manipulative materials. Why? Perhaps the most important reason is the critical role of the hands in learning.

A deep learning pathway

Neurologist Frank Wilson (1998) argues that from the beginning of time, it was the increasing dexterity of the hands that pushed the expansion of the human brain and gave rise to gestures and language. Through history, the

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hands have continued to play a role in advancements in agriculture, industry, and technology.

Beginning with Pestalozzi about 1805, educators realized that children learn best not through reading and memorizing, but through hands-on activities with objects. By the turn of the next century, educators urged that science, in particular, rely heavily on observation of nature and that students as young as elementary school age do experiments. Today we know that hands-on learning is more effective than sitting and listening, even for adults.

In short, the hands represent a deep learning pathway. Children today need greater access to this pathway because of the hours they spend passively watching television and commuting from home to school.

Multiple learning goals

The manipulatives center offers opportunities for all kinds of learning: physical, cognitive, and social-emotional. (See box at right.)

A teacher can match the materials to the varied developmental needs and levels of the children in the group. For a group of 3-year-olds, for example, a teacher might start the year with puzzles of six to eight pieces. As children master those puzzles, the teacher can add ones with more pieces to provide a greater challenge.

Within a group, a teacher can also match materials to learning goals for specific children. To help Fiona gain practice in finishing tasks, for example, a teacher sets out a simple button and zipping frame and gives encouragement as Fiona works.

Setting up the center

Infant-toddler rooms typically have a carpeted area for exploratory play. This space is for

Manipulatives learning goals

Physical development

- strengthen fine-motor control
- enhance eye-hand coordination
- refine visual discrimination
- establish book handling and writing skills

Cognitive development

- develop concepts of color, size, and shape
- classify and sequence objects in logical ways
- learn number concepts
- develop matching and pairing skills
- enhance creativity

Social and emotional development

- gain experience in working in small groups
 - learn to work cooperatively with others
 - develop self-discipline
 - stick with a task to completion
 - be willing to take risks
 - develop self-esteem
- (Adapted from *Room to Grow*, 1995)

crawling, climbing, and activities to develop the large muscles. But it's also an informal area for manipulatives—rattles, stacking and nesting toys, butter tubs, and other simple materials that children can touch, grasp, and release.

By age 2, children are ready for a designated manipulative play area. Locate it in a quiet part of the room with little noise and traffic, perhaps next to the library center. Or set it up between the library center and a more active one, such as blocks.

Make sure there's plenty of light so children can see what they're doing. "Natural light from a window is best," says Pam Briggs, child development instructor at McLennan Community College in Waco.

Furnish the center with one or two child-sized tables, chairs, and storage shelves. Allow room for children to spread out materials on the table or the floor.

Use baskets, boxes, cut-down plastic milk jugs, and plastic tubs as containers for small pieces. Transparent containers allow children to see what's in them.

Make two sets of labels, one for the container and the other for the shelf. This way children know to return the red-label materials to the red-label shelf, for example. Help children develop reading readiness by making labels with words and symbols or pictures of the objects.

Dawn Leach, director of the Children's Lab School, Austin Community College, recommends setting up materials as discrete activities, using trays, placemats, or carpet squares. For a bead-stringing activity, for example, place the bead tub, string, and pattern cards on a tray. A child can take the tray off the shelf, do the activity, and return the tray to the shelf when finished. This not only helps keep materials together but also defines a child's space at the table, she says.

Types of manipulatives

Manipulatives generally fall into five categories:

- **table blocks and construction toys**—interlocking plastic blocks, gears, small wooden table blocks
- **dexterity materials**—sewing cards, dressing frames, stringing beads, pick-up sticks
- **put-together and take-apart materials**—puzzles, nesting boxes, and Montessori items such as the cylinder block, pink tower, and color tablets
- **sorting and counting items**—nuts and bolts, keys, colored cubes, counting bears, plastic lids
- **simple games**—lotto, checkers, cards, and board games

Teachers can add manipulative materials from other learning centers, such as dollhouses and barns with people and animal figures. Briggs suggests setting out play dough—"but without cookie cutters and tools, so children can simply poke and squeeze and knead and roll it out."



Selecting materials

Manipulative materials are intended to be handled. This means they are likely to get dirty and battered, and some pieces will get lost. Provide materials that are washable and strong enough to stand this kind of treatment.

Remove or replace items before they get ragged. The condition of materials influences the way children use and care for them.

Don't use dangerous materials like glass or sharp, pointed objects. Make sure all materials are nontoxic. Avoid using food items like rice, beans, and macaroni; they can attract pests and send an inconsistent message about playing with food. For infants and toddlers, provide items that are too large to be a choking hazard.

Apart from safety and durability, Leach suggests at least two criteria when selecting materials:

- Can it be used in more than one way? Parquetry blocks, for example, can be used to help children learn geometric shapes and patterns as well as encourage children to make their own creative designs.
- Will it be fairly easy to replace missing pieces? You can buy extra pegs for the pegboard, for example, and small sets of counters and blocks when some of the original pieces get taken outside or swept up in the trash.

Guiding children in the center

The manipulatives center "is not as socially challenging as blocks and dramatic play," where children must talk and negotiate, says Leach. "It's often a place where a child can take a break or work alone for a while."

Completing a manipulatives activity can help a child gain confidence and feel more comfortable about entering into play with other children.

Even though manipulatives are meant to be used independently with little direction, a teacher needs to be nearby. Besides anticipating problem behavior, a

Commercial or teacher-made?

Many manipulatives can be made from household items and recyclables or donated by parents to save money and extend learning experiences. But according to Dawn Leach, at Austin Community College, certain materials are basic to the manipulatives center and should be bought from reputable educational suppliers.

Commercial

- wooden puzzles. Vary the number of pieces (six to 20) and the theme (people, activities, and animals).
- wooden pegs and pegboards. Get large pegs for younger children, and narrow ones for older children.
- plastic sorters and counters. These come in animal shapes and varied colors.
- Duplo® blocks for preschool children and Legos® for older children
- wooden table blocks in different shapes and colors
- wooden dominoes

Teacher-made or donated

- cardboard jigsaw puzzles. Parents often donate these, and you can buy inexpensive ones at thrift stores and garage sales.
- wooden or plastic beads. For string, use yarn or shoestrings.
- rubber-band boards, or geoboards. Ask a parent who's handy at carpentry to hammer brass interior (non-galvanized) nails in rows on a sanded plywood square. Make sure the nails are hammered deep enough that they won't come out easily. Collect rubber bands in different colors.
- lacing cards. Punch holes in laminated cardboard shapes, or use plastic mesh from a craft store. Use with a plastic needle and yarn.
- bingo and lotto games
- board games such as checkers
- cards for playing games such as Go Fish
- flannel boards with geometric shapes, letters, and numerals

Household objects and recyclables

- keys
- nuts and bolts
- milk jug caps in varied colors
- sea shells
- tongs, with table tennis balls to pick up and release
- plastic containers with screw-on lids
- fabric scraps
- small ceramic tiles
- paint sample squares
- coins
- small clothing items such as socks and scarves
- more—use your imagination.

teacher can lend support when Alex cries, "I can't do this puzzle." A teacher can also challenge a child: "Jena, you've sorted the keys into silver and gold. Mix them up and find another way they are alike."

As in other areas of the classroom, guidance issues can be avoided by the way the space and materials are organized. See box below.

Get parents involved

To help parents understand the importance of manipulatives, set up an activity on a small table in the foyer or hall. When parents drop off or pick up children, invite them to take a minute to

watch or do the activity with their child. Explain briefly what children are learning.

"Even though most parents are busy, I've found that they will often take the time to learn about the purpose of games," says Briggs.

Select a few manipulatives that you can package and send home with parents. Use small canvas bags or recycled potato chip cans with lids as containers. Set up a check-out system like a lending library. Parents can do the activity at home with their children and return it after a couple of days.

Encourage parents to turn off the TV and play simple games like checkers or Go Fish. "Board games are a wonderful family

activity because they encourage time together and teach rules and turn-taking," says Leach. Parents can also set out parquetry blocks or tangrams and say: "You make a design and I'll copy yours."

Many parents will feel more involved by donating household items and recyclables. Post a list on the bulletin board or include it in the parent newsletter.

Manipulative activities

Try the activities below with your children. Pay close attention to their hands and how the hands enable learning.

For more manipulative activities that help children develop math concepts in particular, see two articles on building numeracy with homemade materials in the Fall and Winter 1999 issues of *Texas Child Care*. See also the resources at the end of this article.

Pot scrubbers

(2 years)

Use this activity to provide sensory learning as well as to develop fine-motor skills.

Here's what you need:

- clear plastic container with lid, 4 1/2 by 11 inches
- 6 new plastic pot scrubbers in varied bright colors

1. Put the scrubbers into the container and screw on the lid.
2. Encourage a child to take the lid off and put it back on, and take out the scrubbers and put them back in.
3. Talk about the texture and name the colors. Use the concepts *in* and *out*, *off* and *on*.

Variation: Instead of scrubbers, use tennis balls.

Guidance tips for teachers

Pam Briggs, child development instructor at McLennan Community College in Waco, recommends the following:

- At the beginning of the year, observe children to determine their developmental needs and behavior. If they are not accustomed to handling manipulatives, explain proper use and care in small groups or at group time.
- Model respect for materials and appropriate behavior. When children see you taking out the table blocks slowly and carefully, they will be more likely to do the same.
- Let children work where they feel comfortable, whether at the table or on the floor. "Some younger children go straight to the floor, or push away the chair to stand at the table," says Briggs. "They're not ready yet to sit in a chair for an extended time."
- If groups are large, limit the number of children so there's enough space for all of them to work comfortably. "If children feel crowded, they may get discouraged and leave."
- Provide duplicates of the most popular items. Have enough blocks and other items so that all children can use them at the same time if they want. Not having enough can cause a guidance issue, even for 4- and 5-year-olds.
- Rotate items periodically to provide variety, but always have familiar items, such as Bristle Blocks™ and puzzles, on the shelf. "Children need to feel comfortable," says Briggs. "If all the materials are new, children might feel reluctant to try any of them."
- Plan for each child to feel successful. If Samantha can't work a 12-piece puzzle, she will either go away or cause problems, so provide one with fewer pieces.

Nesting bowls

(2 to 3 years)

This activity will help children refine visual skills and begin problem solving.

Here's what you need:

- a set of four plastic mixing bowls with lids, with diameters ranging from 6 to 10 1/2 inches

1. Allow children to match lids to bowls and practice putting on and taking off the lids.
2. Place the lids on the bowls. Invite a child to stack the bowls, with largest on the bottom and smallest on the top.
3. Take off the lids. Invite a child to fit the bowls inside each other. Do the same with the lids.

Bear in a chair

(3 to 5 years)

This activity can be done by a single child or made into a game for two.

Here's what you need:

- box lid, 11 by 17 inches
- 24 plastic jug tops from milk or juice, 6 green, 6 yellow, 5 blue, 7 red
- 24 small counting bears, 6 green, 6 yellow, 5 blue, 7 red
- glue

1. Arrange the tops inside the box lid to make four rows of six tops in each row. Colors can be random. Glue the tops, flat side down, to the lid.
2. Invite a child to match the bears to the tops by color.
3. Give half the bears to one child and half to another child. Encourage them to match the bears to the tops.
4. Talk about how one bear goes to one top. As children learn this one-to-one correspondence, begin counting the bears and tops.



Ages and stages of manipulative play

Child's age: infants

Typical materials: rattles, large plastic lids, Whiffle® balls, squeeze toys, wooden spoons, butter tubs, nesting and stacking toys

Comments: Wash and disinfect daily. Vary textures for sensory stimulation. Caution: No beads or small items that can cause choking.

Child's age: 1 to 2 years

Typical materials: nesting and stacking toys, puzzles of 2 to 5 pieces with knobs, pegboards with a few large pegs, lightweight blocks 2 to 4 inches on a side, plastic containers with screw-on lids, baskets and other containers with handles to carry around, little trucks and other small toys to fill and dump from containers, simple matching and sorting materials, play dough

Comments: Wash and disinfect daily if toys are explored by mouth. Provide multiples because children cannot share. Caution: No beads or small items that can cause choking.

Child's age: 3 years

Typical materials: button and zipping frames, 1-inch beads to string, pick-up sticks, magnetic boards, Duplo® and Bristle Blocks™, small wooden blocks, puzzles of 6 to 12 pieces, colored cubes, pegboards, counting bears, keys, large buttons, nuts and bolts, collections of natural materials such as shells and rocks, matching and lotto games

Comments: Check materials regularly for signs of wear. Limit number concepts to 1 through 5. Encourage children to match and sort items by color and shape.

Child's age: preschool 4 to 5 years

Typical materials: same as for 3-year-olds but also sewing and lacing cards, 1/2-inch beads to string, puzzles of 12 to 50 pieces, number and letter puzzles, parquetry blocks, geometric shapes, dominoes, color and picture bingo, card games like Concentration™, board games like checkers

Comments: Expand number concepts up to 10. Encourage children to sort items by size and order them in sequence. Offer card and board games based more on chance than strategy with few, simple rules. Consider that children bring a wide range of abilities and interest because of differences in development and home environment.

Shapes that are alike

(3 to 6 years)

This activity can help children identify geometric shapes and sequence them by size.

Here's what you need:

- felt, all one color or in varied colors
- scissors
- basket or plastic container for storage

1. Cut the felt into four geometric shapes—square, circle, triangle, and rectangle—roughly 2 inches across.
2. Cut out successively larger sizes of each shape. For example, cut circles with diameters of 3, 4, and 5 inches.
3. Name the different shapes and talk with children about them. Ask a child to pick up a shape and name it. Find other pieces the same shape but larger or smaller.
4. Ask a child to pick out all the triangles and arrange them from smallest to largest.

Nut sort

(3 to 6 years)

Fall and winter is a good time for children to collect nuts under trees on your playground or at home. Plan to buy a variety of unshelled nuts at the supermarket. Expect children to crack and eat some.

Here's what you need:

- an assortment of unshelled nuts, such as pecans, walnuts, almonds, hazelnuts, and Brazil nuts
- basket or tub to hold the nuts
- small plastic tubs for sorting

1. Invite children to find nuts that are alike and put them into separate tubs.

2. Ask: Why do these nuts go together? Which tub has the most nuts?
3. Mix up the nuts and ask children to find another way they are alike. They might sort by color, size, texture, or worm holes, for example.

Safety note: Avoid peanuts because some children are allergic to them. Peanuts are not true nuts anyway; they're legumes.

Clothespins and note clips

(3 to 7 years)

Allow children plenty of time to practice squeezing open the clips, attaching them, and removing them.

Here's what you need:

- assortment of 30 or more clothespins, chip clips, and paper clips in different sizes, colors, and materials (metal, wood, plastic)
- shelf extender rack, box with lengths of clothesline strung across it, or another structure for attaching clips
- tray or basket for storage

1. Invite children to find clips that are alike and clip them together on the rack or clothesline.
2. Ask: Why are these clips together? Which row has the most clips? What is each type used for?
3. Invite children to remove the clips and sort them by another attribute. If they have sorted by color, for example, they might sort by size, material, or another attribute of their own choosing.

Block cube match

(3 to 7 years)

For 3 year-olds, make a set of cards for the numbers 1 through 5. For older children, add cards for the numbers up through 10.

Here's what you need:

- 15 1-inch-square blocks of the same color
- posterboard
- scissors
- ruler
- pencil and markers
- clear self-adhesive plastic or laminate
- basket or box for storage

1. Measure and cut posterboard into five rectangular cards, 5 inches wide and 11 inches long.
2. On the first card, use the marker to print the word *one* and the numeral. Draw an outline around one cube.
3. Make similar cards for the numbers 2, 3, 4, and 5, drawing the appropriate number of cube outlines for each.
4. Cover cards on both sides with plastic or laminate.
5. Invite children to choose a card, say the number, and place the appropriate number of cubes in the outlines.



Leaf grid

(3 to 7 years)

Find leaf stickers in nature and craft stores. Choose posterboard in an autumn color.

Here's what you need:

- posterboard
- scissors
- ruler
- marker
- 6 different types of leaf stickers
- 21 acorns, squirrel figures, or other objects as counters
- die with numbers 1 through 6
- basket for storage

1. Measure and cut the posterboard to make a 12-inch square.
2. Draw lines from one side to the other to create six rows at 2-inch intervals.
3. Apply stickers to make rows of 1, 2, 3, 4, 5, and 6 leaves, with a different type leaf in each row.
4. Invite children to take turns rolling the die. The side landing on top indicates the number of counters the child gets. The child places the counters on leaves beginning with the first row. If Alicia rolls four dots, for example, she will place one counter on the first row, two on the second, and one on the third. The next child starts where the previous left off, until all leaves are covered.

Resources

- Briggs, Pamela S., Theo L. Pilot, and Janet H. Bagby. 2001. *Early Childhood Activities for Creative Educators*. Albany, N.Y.: Delmar Thomson Learning.
- Charner, Kathy, ed. 2001. *It's Great to be Four: The Encyclopedia of Activities for Four-Year-Olds*. Beltsville, Md.: Gryphon House.

Copley, Juanita V. 2000. *The Young Child and Mathematics*.

Washington, D.C.: National Association for the Education of Young Children.

Moomaw, Sally, and Brenda Hieronymus. 1995. *More than Counting: Whole Math Activities for Preschool and Kindergarten*. St. Paul, Minn.: Redleaf Press.

Schiller, Pam, and Lynne Peterson. 1997. *Count on Math: Activities for Small Hands and Lively Minds*. Beltsville, Md.: Gryphon House.

Williams, Bob, Debra Cunningham, and Joy Lubawy. 2005. *Preschool Math*. Beltsville, Md.: Gryphon House.

References

- Bronson, Martha B. 1995. *The Right Stuff for Children Birth to 8*. Washington, D.C.: National Association for the Education of Young Children.
- Dodge, Diane Trister, and Laura J. Colker. 1996. *The Creative Curriculum, 3rd ed.* Washington, D.C.: Teaching Strategies, Inc.
- McManus, Chris. 2002. *Right Hand Left Hand: The Origins of Asymmetry in Brains, Bodies, Atoms and Cultures*. Cambridge, Mass.
- U.S. Department of Education. ERIC Thesaurus. www.eric.ed.gov/.
- Wilson, Frank. 1998. *The Hand: How Its Use Shapes the Brain, Language, and Human Culture*. New York: Random House.
- Wyde, Joan. 1995. *Manipulatives. Room to Grow: How to Create Quality Early Childhood Environments, rev. ed.* Austin: Texas Association for the Education of Young Children.

Lend a hand—to left-handers

Children typically begin to show whether they are right-handed or left-handed between ages 2 and 3. Most won't be able to distinguish right from left hand until they are about 7.

Usually, 10 percent of the children in your class will be left-handed. This means they will use the left hand for tasks like writing, drawing, and eating with a spoon.

To avoid behavior problems at the manipulatives table, encourage children to sit so their elbows won't bump. At a square table, for example, a right-hander might sit at a right corner, and a left-hander at a left corner.

Of all school tasks, cutting with scissors can be the hardest to learn, especially for left-handers. Blade design on right-handed scissors makes it hard for left-handers to see what they are cutting. Many scissors are advertised as suitable for right or left hand, which means they have handle loops of equal size so they can be held in either hand. But many of these have a right-hand blade design.

Fiskars®, which has been making scissors for 130 years, offers a true left-handed scissors with pointed tips for school-agers. An online supplier is <http://theleft-hand.com/leffisscisfo.html>. (McManus, 2002)