Using learning centers to teach early science

By Ithel Jones
LEARNING CENTERS ARE frequently used in the primary grades because they are effective in providing children with subject-area enrichment and giving children an opportunity to explore and experience many different fields. Teachers use learning centers, or interest centers, in a variety of ways. Some use centers as the focus of all classroom activities. Others use centers during a specific time of day. Some centers are designed to focus on acquiring a specific skill or concept, whereas others are more open ended.

This variation in how learning centers are used suggests that there isn't a "correct" way of using learning centers in the primary grades. Yet, regardless of how they are used, learning centers represent a child-centered approach for creating meaningful learning contexts in the early grades.

I have recently collaborated with teachers who successfully implemented a workshop approach for using learning centers to teach early childhood science. We find that this approach allows teachers to create an environment in which they and students work together as active learners, an approach consistent with the National Science Education Standards' Teaching Standard B: Teachers of science guide and facilitate learning, and Teaching Standard D: Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science (National Research Council, 1996).

Introducing the Model

The workshop approach is a model for organizing and using learning centers to teach science in primary grades. The approach is based on the principles of developmentally appropriate and constructivist learning practices (Bredekamp and Copple, 1996).

One of the key characteristics of developmentally based primary programs is that the environment is designed to optimize concrete learning and enable children to explore a wide variety of objects and materials. Furthermore, children are given an opportunity to work within a variety of social configurations: alone, with one or two other children, in small groups, and in large groups. Within such programs, the teacher observes, records, and assesses child and group progress and subsequently bases instruction on this information. Adopting a workshop approach enables teachers to create responsive, developmentally appropriate learning environments.

In using a workshop approach, the teacher adopts a conceptual orientation to plan and organize the curriculum. Devoting time to concept development by allowing children to construct meanings in the context of physical situations. The goal of the workshop approach is to provide students with a number of meaningful experiences centered around the same general concepts. These experiences are organized as a number of learning centers or learning stations. For example, a teacher might plan five centers—a problem-solving center, exploration center, game center, application center, and teacher center.

All of the centers are related in the sense that they focus on a related concept or topic such as studying plants or exploring magnets. For each workshop session, the student chooses a different center, with the ultimate goal of having a balanced set of experiences. The approach, therefore, provides an opportunity for small group instruction on a given concept, while it offers further opportunities for children to explore, practice, and apply the same concept; a practice consistent with the principles of constructivism.

The Constructivist Perspective

The Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993) maintains that science teaching should focus on gaining understanding and making connections, rather than simply acquiring facts. Constructivism describes a way of learning in which the child actively engages with the environment and builds his or her own knowledge and understanding (DeVries and Kohlberg, 1990).

Active learning by children has many implications for both mathematics and science education. First, it suggests that teachers should create environments and learning contexts that allow children to become actively engaged in meaningful activities and experiences that provide a
context for the development of scientific thinking and reasoning abilities. Second, the environment should be arranged to provide opportunities for children to cycle through the learning processes of awareness, exploration, inquiry, and utilization (Bredekamp and Rosegrant, 1992). Finally, the curriculum should be structured around concepts and concept development, and substantial time should be devoted to developing an understanding of concepts.

Planning the Workshop
Planning is based on five key assumptions or guidelines:

- the science curriculum should be conceptually organized,
- science teaching should be based on inquiry into authentic questions generated from experience,
- children should be actively involved in science activities,
- emphasis should be placed on developing reasoning and thinking, and
- and emphasis should be placed on the application of science.

The teacher’s first task in planning the workshop, therefore, is to structure the curriculum around key concepts. For example, in planning a unit on plants, the teacher identifies concepts such as

- seeds grow into plants;
- many types of plants exist;
- most plants make seeds;
- many of the foods we eat are seeds.

Having specified key concepts, the teacher plans the centers that will be assembled in the classroom. This entails describing each activity and specifying the objectives, concepts, and skills needed. At this stage, the teacher also lists the resources needed for the activity as well as the procedures of the activity. The workshop consists of a number of learning centers where the children can discover, explore, and develop new concepts, thereby creating a balanced set of experiences for students to progress from learning that is primarily exploratory to learning that is more goal directed. Each center addresses the same basic concepts but provides different opportunities to explore, investigate, and use the learning.

The actual number of learning centers will depend on factors including the number of students in the class, the size of the classroom, the availability of resources, and the nature of the specific concepts that are being taught. However, a minimum of four or five centers is necessary to provide a balanced set of experiences for the students.

To facilitate this process, the teachers select one or more of each of the following types of learning centers:

- Exploration center (awareness and exploration). The exploration learning center consists of children using activities and materials to explore, discover, and build, thus constructing their own understanding of the general concepts being developed. The center contains a broad range of materials that are limited to those that relate to the concepts being developed; many of the activities are open ended. Children in the exploration center have minimal instruction or guidance. Students are encouraged to create a plan at the beginning of the session and report their findings upon completion of the activity. When students complete the various activities in the exploration center, they go to the reading and writing center.

- Game center (exploration and inquiry). This center consists of a gamelike activity that provides practice on key concepts. For example, the teacher uses a commercially available computer program that provides practice on specific skills or concepts. Alternatively, teachers create a board or card game that will provide students with adequate practice with science skills and concepts.

- Problem-solving center (inquiry). The problem-solving center is the central focus of the science workshop because problem solving provides the context in which skills and concepts are developed. This center includes activities such as investigations, explorations, experiments, and challenges.

- Application center (utilization). This center presents a real-life application of the concept being taught and helps children apply their learning to new situations. Students also use the specific concepts and skills that they have learned in the various centers.

- Reading and writing center (communication). Providing an opportunity for children to represent, discuss, read, write, and listen is considered a vital component of science. In the
**Science Workshop Plan**

**Problem-Solving Center Two**

**Materials**
- magnets
- paper clips, nails, washers, bolts
- card, paper, aluminum, shoe box, thin wood
- sand or dirt

**Activity**
Find out if the magnets will pick up paper clips that are covered with paper.
Try card, wood, and aluminum. Put nails, washers, and bolts in the shoe box and cover with sand or dirt.
Can you use the magnets to find the iron and steel objects?
Draw a picture and write about your findings in the science journal.

**Game Center**

**Materials**
- cardboard box
- pins, paper clips, other small steel objects
- magnet attached to a piece of string tied to a small piece of wood (i.e., fishing pole)

**Activity**
Fill the box halfway with the assorted iron and steel objects.
Children take turns “fishing” for the metal objects. First, they predict how many objects they will catch. Then, they count out loud the number of objects they pull up.

**Exploration Center**

**Materials**
- assorted magnets
- tray of assorted iron/steel objects (i.e., paper clips, nails, keys, chains, bolts, screws)
- tray of non-iron/steel objects (i.e., wood, clay, card, paper, pencil, crayon, string, rubber bands, aluminum)

**Activity**
Free exploration (what can you do with these materials?)
Find out how many of the objects the magnets will pull.
Can you find other objects that the magnets will pull?

**Teacher Center**

**Materials**
- paper clips
- small nails
- bits of steel wool
- horseshoe magnets
- bar magnets

**Activity**
Scatter bits of steel wool on the table. Children take turns to see if any of the steel is attracted to the curved part of the magnet. Next, they try the ends of the magnet.
Children take turns using the bar magnets to attract the steel wool. Use the bar magnets to attract paper clips and small nails.
Do both ends attract the same number of paper clips and small nails?
Are any attracted to the middle of the magnet?

**Creative Center** (utilization and communication). This center provides an opportunity for students to express their scientific ideas in a creative manner. Essentially, the arts are a means of thinking, learning, and communicating, and they complement other areas of the curriculum, such as mathematics and science. For example, as part of a unit on plants, a child might use the seeds that he or she used in the exploration center to create a collage. This center contains materials such as paints, coloring pencils, colored paper, crayons, chalk, fabric, and yarns.

**Teacher Center** (small group: communication, inquiry, and utilization). This learning center allows the teacher to interact with a small group of students. Here, the teacher selects various activities that facilitate teaching and reinforce the key concepts being developed.

**Reading and Writing Center**

**Materials**
- selection of books on magnets and magnetism
- paper and pencils
- drawing paper

**Activity**
Select books to read.
Draw a picture and write about the activities and findings in a science journal.

**Application Center**

**Materials**
- small magnets
- card
- glue
- pieces of wood and other odds and ends

**Activity**
Design a refrigerator magnet.
Make a device that will help you to find small nails and pins on the floor near the workbench area.

**Rearing and Writing Center**

**Materials**
- cardboard box
- pins, paper clips, other small steel objects
- magnet attached to a piece of string tied to a small piece of wood (i.e., fishing pole)

**Activity**
Fill the box halfway with the assorted iron and steel objects.
Children take turns “fishing” for the metal objects. First, they predict how many objects they will catch. Then, they count out loud the number of objects they pull up.

**Teacher Center**

**Materials**
- assorted magnets
- tray of assorted iron/steel objects (i.e., paper clips, nails, keys, chains, bolts, screws)
- tray of non-iron/steel objects (i.e., wood, clay, card, paper, pencil, crayon, string, rubber bands, aluminum)

**Activity**
Free exploration (what can you do with these materials?)
Find out how many of the objects the magnets will pull.
Can you find other objects that the magnets will pull?

**Teacher Center**

**Materials**
- paper clips
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**Activity**
Scatter bits of steel wool on the table. Children take turns to see if any of the steel is attracted to the curved part of the magnet. Next, they try the ends of the magnet.
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Do both ends attract the same number of paper clips and small nails?
Are any attracted to the middle of the magnet?
Learning and the Teachers' Role
Changing the classroom to accommodate a workshop approach takes considerable thought and planning. Planning the physical environment for a workshop approach involves deciding where the areas shall be created, what to place in each area, what display space can be created, and how these display spaces can be used.

The teacher's first task is to prepare the learning materials and collect the resources for the center. Next, the centers should be arranged in the classroom. Given the variation in classroom size, space, teacher preferences, and student interest, there is a variety of ways to arrange learning centers in the classroom.

Typically, the centers are arranged around the room, but they do not need to be physically separated from each other. These learning areas can either be defined by physical boundaries such as bookcases or dividers, or by more abstract boundaries such as a wall display.

The classroom environment should be well organized so that students know where things are and how to maintain their learning area. Most importantly, the teacher should arrange the centers so as to capitalize on the classroom environment's potential as a central force in stimulating intellectual activity. This means creating a dynamic, changing environment that communicates a sense of adventure and excitement and is aesthetically satisfying.

Scheduling
Once the learning centers have been established in the classroom, the teacher decides how individual centers will be used by each student. Thus, a schedule for effective use of the centers must be carefully developed. Students should know exactly what is expected of them, what they will be doing, and when they will be doing it.

One option is to post a master chart in the classroom listing names of students under the centers where they will work during a particular session. An alternative is to allow students to select their own activities. To facilitate this process, the workshop session begins with a circle meeting in which children sit in a large circle on the floor or on a seating mat to discuss arrangements for the workshop. A circular arrangement promotes attentive listening better than rows or random groupings.

During this meeting, the teacher lists the various options for the session on a large board, and the children in turn select an activity by placing a colored tag or clothes pin next to where they will be working.

Teacher/Student Interaction
Possibly the most important component of the science and mathematics workshop is the interaction between the teacher and students. The primary role of the teacher during the workshop is to facilitate learning and promote creative thinking, problem solving, and decision making.

The teacher therefore stimulates intellectual activity and fosters the development of thinking by engaging children in experiences that encourage inquiry, representation, and reflection. Beyond this, however, how children come to understand the various concepts and the development of their thinking is governed by the nature of the interaction between adult and child.

To make the learning experiences meaningful for students, the teacher creates opportunities to interact with individual students, small groups, and specific center. The teacher in turn inquires about the students' understanding of the concepts and poses questions that encourage reflective thinking. These are questions that require students to apply, analyze, and evaluate information. Guided by teachers, students continually develop the intellectual abilities of scientific inquiry.

Children often change or reinforce their conceptions by engaging in dialogue both with the teacher and with one another. Therefore, as the children work at the various centers, the teacher interacts with small groups or individual students.

The teachers circulate among the various learning centers asking thoughtful, open-ended questions to encourage student inquiry.

Assessment and Evaluation
The workshop approach provides an ideal opportunity to embed assessment and evaluation within classroom (continued on page 55)
instruction. During the workshop, teachers collect authentic assessment evidence to use in determining what individual students can do as well as to make informed instructional decisions and set learning goals.

The relevant information to facilitate this process is collected during the workshop sessions through observation of process, observation of product, and conversations with individuals and groups of students. The science workshop enables students to engage in a number of different activities that provide multiple opportunities and contexts for students to demonstrate what they know. This allows the teacher to observe children thoughtfully and systematically within the natural setting of the classroom as they interact with both their peers and materials.

Teachers also examine how children represent their thinking by observing products such as drawings, paintings, constructions, writings, graphs, and charts. Finally, during conferences and conversations with individuals and groups of students, the teacher obtains valuable insight into their thinking.

Information collected through observation is recorded in a manner that enables teachers to discover patterns and assess individual progress. Checklists are useful for recording information about student learning as well as to record individual participation in the various workshop activities. Rating scales are used to record judgments about individual performance and learning outcomes. Finally, anecdotal records, representing a comprehensive source of assessment, are used to record rich descriptions of children's behavior.

Learning Together

The science workshop approach is a method of organizing learning centers in developmentally based primary programs. The approach centers on providing a series of meaningful experiences around core science concepts. These experiences are presented in the form of learning stations or activity centers that add to the richness of the classroom and provide flexibility for both students and teachers to pursue meaningful activities.

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Resources


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