Experts say that good mathematics instruction engages all students as active learners (NAEYC & NCTM 2002). It begins with their current skills and builds new knowledge that is meaningful and appropriate for each child (Baroody 1998). Children construct fuller, deeper understandings of math rather than simply absorbing information put in front of them (Kamii & Housman 2000; Kamii 2003; Leinwand & Fleischman 2004). Effective math instruction allows children to develop positive attitudes toward math instead of negative ones (Clements, Sarama, & Dibiase 2004).

Many teachers agree that these are worthy goals but may run into difficulty achieving them when they are pressured to cover mandated curricula and produce high test scores. Fortunately a number of approaches support meaningful math instruction. One method, math study groups, allows flexible, small groupings of children to study particular skills or concepts. The format provides opportunities for hands-on exploration, skill development in meaningful contexts, and practice for important basic skills. Study groups add supplemental learning opportunities to fundamental teacher-led instruction.
How do math study groups work?

Study groups meet in class during math work time, with children gathering in small clusters to focus on specific goals or activities. For example, several students may use blocks to explore the concept of multiplication, while some children play a counting game involving money and their other classmates complete written math assignments. The number of groups and their composition and focus change over time. Children may finish some activities and join other groups, change or expand interests, or suggest new problem topics. Groups can become larger or smaller as more children participate and others return to polish skills or pursue a new activity.

Similar to the way reading/writing workshops function, the math study group format acknowledges children’s individual readiness to learn skills, recognizes that needs are met at different times, and confirms that the best learning takes place when children work on activities that challenge them appropriately. Not every child participates in every group, as activities and topics vary by skill level. Instead, the teacher helps children select groups that fit their interests and are suitable matches for each child’s developmental stage.

The start-up process

Teachers can start math groups at any time, creating one or two groups and gradually adding more as children get used to the idea of working together to problem solve. Eventually, several groups may meet at the same time. However much time is available for math study groups to meet, the process is the same in creating and maintaining groups. The teacher

1. identifies big ideas from the math curriculum and creates activities to explore them;
2. assesses each student’s current knowledge and skill level (see “First Grade Math Development Checklist Format,” p. 4);
3. considers how many and what types of groups to start;
4. holds individual conferences to help each child select an appropriate group (see “Conferencing with Children to Select Math Study Groups,” p. 6);
5. facilitates group meetings; and
6. observes and documents what children learn from their participation in each study group (see “Documenting Children’s Learning in Math Study Groups,” p. 8).

Big ideas

Math study groups are organized by topic. A teacher may begin by looking at the math curriculum or established learning standards or considering children’s questions or expressed interest in solving a math problem. Many math curricula are organized around big ideas that characterize content appropriate for a given age group.

First grade math curricula, for example, generally include topics such as reading and writing numbers to 1,000, solving addition and subtraction problems, and exploring three-dimensional shapes. Each child is expected to master these math concepts sometime during the school year. Although a few ideas are sequential, many can be studied any time a child is ready. To create a quick summary of math curriculum concepts that can serve as study group topics, the
One important objective is to challenge children with activities that require the use of skills and concepts they are ready to learn.

Assessment

First-graders differ in their understandings of and knowledge about math concepts. For example, several may have a good sense of numbers beyond 1,000, while others get confused as soon as they go past 20.

One important objective in math study groups is to challenge children with activities that require the use of skills and concepts they are ready to learn. To do this, a teacher needs to know what each child already understands and is able to do. She begins by observing and taking notes on students’ current work in lessons from standard math series. Who is flying through the early lessons? Who is confused right away? Who can explain a concept to another child who is confused?

In addition to using regular observations, a teacher may benefit from having a math curriculum that includes a useful set of assessment resources, like *Everyday Mathematics: Teacher’s Assessment Assistant, Grade 1* (2004). Results of these assessments help the teacher develop a more complete picture of each child’s math knowledge and skill. Without these resources, a teacher may create performance-based assessments that ask children to solve problems and answer questions based on the curriculum content (see Guskey 2003).

Types of groups

With topic ideas and assessment results in place, math study groups can be formed. The teacher considers several questions: What activities will work best at the start? How many groups should there be? Which students will be involved at first?
First Grade Math Development Checklist Format
(sample page)

Performance-based assessments, unlike standardized tests designed to compare large groups of children, provide information specific to each child that teachers can use in planning instruction. Many teachers create a computer database to organize assessment information. Other teachers find that checklists work as well.

Student’s name:______________________________

Whole numbers

Math skills levels

Counts orally
1 through 100 _____________
100 through 1,000 _____________
by 2s, 5s, and 10s _____________
using ordinal numbers _____________
estimating numbers _____________
rounding numbers _____________

Reads numbers
1 through 100 _____________
100 through 1,000 _____________
greater than 1,000 _____________

 Writes numbers
1 through 100 _____________
100 through 1,000 _____________
greater than 1,000 _____________
by 2s, 5s, 10s _____________
after the one given (on a worksheet) _____________
before the one given (on a worksheet) _____________
using number words _____________
using ordinal numbers _____________

Understands the place value of
two-digit numbers _____________
three-digit numbers _____________
four-digit numbers _____________

Performance key:
+ = mastered already (school year start)
DS = developing skill (add date)
SM = skill mastered (add date)
Every class is unique in its group dynamics: some children are used to working semi-independently in small groups, others will need supervision to get started. The children’s ages and maturity levels influence the number of groups that can meet at one time without class disruption.

Other considerations include the amount of time a teacher can devote to designing and documenting study group activities. The teacher may begin with two study groups of five children each, focusing on a skill or activity and meeting on alternate days. She can then rotate different students through the study groups and coach them in the skills they will need to work well together. As more children gain experience, more groups may be formed and meet concurrently.

Group selection

Who will participate in which study group? With study group ideas and collected documentation of each child’s work in hand, the teacher meets briefly with individual children. They discuss which math concepts each child has been learning, which she needs more practice in, and what she is interested in trying next.

Study group activities need to provide appropriate challenges, focusing on concepts or skills the participants have not yet mastered but are ready to learn. Picking a group with too difficult or too easy an activity wastes a child’s time. Within these limits, the child chooses which group to join. The compositions of math groups change regularly, and the flexible nature of groups keeps them from developing any stigma, such as for “children who are smart at math” or “children who aren’t smart at math.”
Children rotate from group to group to explore topics they have not yet mastered. Some group topics may repeat as different children join or others return for more practice, introductions to new concepts, or additional skills development. The teacher also gives children opportunities to take on different roles within a group. At times, children benefit from being experts and helping others learn. For example, in a multiplication group a couple of children with a well-developed understanding could aid beginners in using blocks to uncover the concept of multiplication.

Group dynamics

How does the classroom teacher manage several groups? Ideally each group will work on different activities and meet at the same time, while remaining class members complete other individual assignments. The teacher can develop a system for keeping track of group compositions.

Teachers need to tailor their expectations to what is manageable, based on children’s ages and ability to be self-directed learners. Parent volunteers can offer valuable support during study group times, meeting with individual groups or circulating around the room and helping children with their assignments.

To help each group along, a teacher can gather children’s thoughts on their group’s processes (see “Children’s Evaluations of the Group Process,” p7). After a group has met a few times, participants can share their thinking about what is going well and what needs improvement. The teacher can help the children discuss these issues and then use their feedback to improve the group’s work. If a behavior problem occurs, the teacher can help the children identify the problem and brainstorm possible solutions. Coaching individual children, when necessary, on how to use appropriate behavior is also part of the teaching-learning process.
To help the groups to function semi-independently, the teacher thinks ahead, developing new ideas to engage group members. Even a multitalented early childhood educator cannot be in four places at once. She selects activities like games and puzzles that are interesting and challenging but not so difficult that they require constant assistance (see Kaye 1988 and Yeatts 2000 for ideas on math games).

Observation and documentation

With exciting math learning taking place each day, how does a teacher keep track of, record, and share the outcomes with families and others? Any time children are not doing the same thing at the same time in the same way, teachers need methods to document individual learning (Project Zero & Reggio Children 2001).

In the opening vignette, Mrs. Wells moves through the classroom during study group time, watching, listening, and asking “How did you know...?” questions. She looks for evidence that a child is developing or has mastered a certain math skill. She records the date a child works on or accomplishes a particular goal. On individual checklists Mrs. Wells keeps current information on each child’s progress. During conferences, collected information helps her guide children’s next choices.

Documentation allows the teacher to share children’s accomplishments with their families and other important stakeholders, such as principals and school board members. Mrs. Wells photographs the children working in each group. She posts photos around the classroom and regularly includes new ones in the class newsletter, with short descriptions of the children’s study group learning. These displays spark visitors’ interest and help her answer the perennial question, What do the children do all day?

When a child makes a particularly exciting math discovery, she captures it in a photo, which she sends home with the teaser, “Ask _____ to tell you about this.” This gives parents a good conversation starter.

Math study groups generate valuable portfolio information and work samples of a child’s learning and progress throughout the year (Grace & Shores 1998). Some math groups automatically produce paper records. Many math puzzles and problems, for example, are most easily solved on paper and are ready additions to portfolios. Teachers can use photos and other short forms to document activities. At the start of the year, first grade children may dictate answers about what they are learning, but later they can complete brief forms themselves.
The cycle of study groups

And so the cycle goes! The teacher periodically starts new math study groups and maintains others through the year, with changing compositions of children—even some repeating. Some groups end when a specific activity is completed or the teacher senses that the children are ready to move on. New conferences take place, and the children join different groups with new topics. Children get better at working together.

Each child begins to build a sense of him- or herself as a math learner. The conference process gets easier as children see examples of different activities going on around them and make better decisions about their next group choice. Enthusiasm for math learning pervades study group time. And with all the teacher has put into math study groups, the reward is great—children’s accomplishments and positive attitudes toward math.

References


Mathematics study groups are available fall and spring semesters for students taking developmental math courses. Must have 3 students from the same course to form a study group, contact the ELC for sign-up information. Benefits: Improve grades. Build support and sense of community. Verify with other students confusing or difficult concepts. Lower math and test anxiety: Coping with Math Anxiety. Improve lecture notes. Reinforce learning. Learn improved math study skills. Meet once/week for 60 minutes 10 minute overview of topic based on class schedule 5 minute 10 minute review of typical problem areas 5 minute question and answer period Individual work with professional tutor Session wrap up with a 5-minute review to check understanding. Related. Math Center. First grade study groups deepen math learning. Young Children 62 (4): 78–82. www.journal.naeyc.org/btj/200707 Stuber, G.M. 2007. Of Primary Interest. Math Perspectives®“This Web site supports math educators through resources, strategies, and assessments as they provide solid mathematics foundations for their students. The group offers a range of professional development services, along with resources for the classroom. www.mathperspectives.com/index.html. National Council of Teachers of Mathematics®“NCTM publishes the magazine Teaching Children Mathematics, On-Math, an online journal, and Illuminations, a resource site for teachers with activities and lessons.
Two Dozen Ways to Deepen Student Learning. Critical and higher-level thinking. Student engagement. Brain-based teaching. These buzzwords are at the top of educators’ minds these days. A prerequisite for active participation, deep processing and multimodal expression of learning is breaking direct instruction time into smaller increments, between which kids have opportunities to get hands-on with the material. (Dr. Fred Jones calls this model “Say, See, Do” teaching. A flipped classroom model also opens up class time for hands-on learning.) With that in mind, below are 24 ideas for in-class, deep-learning activities that involve the verbal and written modalities, among others. Educators might also use some of these activities as student assessments. Verbal Modality. Create Learning Activities That Are Complex. Students need a reason to collaborate. If the assignment is too simple, they can more easily do it alone. Create small groups of no more than four or five people. When there is less room to hide, nonparticipation is more difficult. Ensure a high degree of individual accountability (Johnson, Johnson & Holubec, 2008) by assessing students both individually and as a group. For example, at the end of the day give students an individual quiz based on the intended outcome of their collaborative activity. Design meaningful team roles that relate to the content and to the task.