SOUTHEAST COMPREHENSIVE CENTER
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Rapid Response Services

One of the services we provide on our Web site is Rapid Response, located in the Online Resource Center. Rapid Response provides responses to questions posed by state department of education staff. To make a Rapid Response request contact Eric Waters (ewaters@sedl.org) or the state liaison for your state to request password-protected access to our Online Resource Center.

A Note from the Director

The Southeast Comprehensive Center (SECC) is pleased to introduce you to our new e-bulletin. The SECC provides technical assistance to state departments of education in Alabama, Georgia, Louisiana, Mississippi, and South Carolina. Our primary purpose is to help these states implement the No Child Left Behind Act (NCLB). This e-bulletin is designed to provide information pertinent to the implementation of NCLB.

In this e-bulletin you will find timely notices regarding resources, changes, and/or emerging issues as they relate to NCLB. If you wish to learn more about how state departments of education may receive additional services from the SECC, or if you have a suggestion or question for the e-bulletin, please contact the state liaison for your state:

Alabama: Lou Meadows (lmeadows@sedl.org)
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The SECC is located in Metairie, Louisiana, near New Orleans. We look forward to keeping you informed on the latest developments regarding NCLB. Please feel free to contact me at mkaigler@sedl.org.

Marie Kaigler, PhD
Director, SECC

Strategies for Successful Mathematics Education

Rapid Response Request
April 12, 2006

Request

What important research-based strategies can an education system implement in order to provide effective mathematics education?

Summary

This report describes a number of different strategies designed to support and improve mathematics education. This information is organized into four sections: (1) a brief description of five areas of mathematical proficiency to be considered when selecting instructional strategies; (2) a description of three key principles of how people learn and how these principles apply to mathematics instruction; (3) a brief explanation of nine research-based instructional strategies that can be applied to mathematics; and (4) a listing of 11 instructional strategies that are key to creating an equitable classroom.

Areas of Mathematical Proficiency

In the 2001 text *Adding It Up: Helping Children Learn Mathematics*, the National Research Council identifies five strands of mathematical proficiency. These strands address the mathematical knowledge, understanding, and skills that need to be developed as part of a composite and comprehensive plan for mathematics instruction. These five interwoven, interdependent strands need to be a part of the instructional planning when teachers are selecting and applying instructional strategies in mathematics (National Research Council, 2001). The five strands are explained below.

Conceptual understanding
Conceptual understanding is the comprehension of mathematical concepts, operations, and relations.

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Procedural fluency
Procedural fluency is the skill to carry out procedures flexibly, accurately, efficiently, and appropriately.

Strategic competence
Strategic competence is the ability to formulate, represent, and solve mathematical problems.

Adaptive reasoning
Adaptive reasoning is the capacity for logical thought, reflection, explanation, and justification.

Productive disposition
Productive disposition is the habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

Key Principles of Mathematics Instruction

In the 2005 text *How Students Learn: History, Mathematics, and Science in the Classroom*, the National Research Council explores how people learn and applies this specifically to how people learn mathematics. Listed below are the three key learning principles that emerge from this analysis and a description of how they apply to mathematics instruction.

Teachers must engage students' preconceptions.
The text notes that, "the first principle of how people learn emphasizes both the need to build on existing knowledge and the need to engage students' preconceptions—particularly when they interfere with learning. In mathematics, certain misconceptions that are often fostered early on in school settings are, in fact, counterproductive. Three misconceptions identified by the National Research Council are as follows:

- Mathematics is about learning to compute.
- Mathematics is about following rules to guarantee correct answers.
- Some people have the ability to "do math" and some do not.

Three instructional strategies recommended by the National Research Council to ameliorate the challenges students face as a result of these preconceptions are as follows:

- Allow students to use their own informal problem-solving strategies, at least initially, and then guide their mathematical thinking toward more effective strategies and advanced understandings.
- Encourage math talk so that students can clarify their strategies for themselves and others, and compare the benefits and limitations of alternate approaches.
- Design instructional activities that can effectively bridge commonly held conceptions and targeted mathematical understandings.

Understanding requires factual knowledge and conceptual frameworks.
The text states the following:

> The second principle of how people learn suggests the importance of both conceptual understanding and procedural fluency, as well as an effective organization of knowledge—in this case one that facilitates strategy development and adaptive reasoning. . . . Developing mathematical proficiency requires that students master both the concepts and procedural skills needed to solve problems effectively in a particular domain . . . To teach in a way that supports both conceptual understanding and procedural fluency requires that the primary concepts underlying an area of mathematics be clear to the teacher. . . . Because mathematics has traditionally been taught with an emphasis on procedure, adults who were taught this way may initially have difficulty identifying or using the core conceptual understandings in a mathematics domain (National Research Council, 2005, p. 219).

A metacognitive approach enables student self-monitoring.
According to the text, "Learning about oneself as a learner, thinker, and problem solver is an important aspect of metacognition. In the area of mathematics, many people who take mathematics courses 'learn' that 'they are not mathematical.' This is an unintended, highly unfortunate consequence of some approaches to teaching mathematics" (National Research Council, 2005, p. 239). The National Research Council identifies the following three instructional approaches that support a metacognitive approach:

- An emphasis on debugging: Metacognitive functioning is facilitated by shifting from a focus on answers as right or wrong to a more detailed focus on "debugging" a wrong answer, that is, finding where the answer is, why it is an error, and correcting it.
- Internal and external dialogue: It is important for students to communicate about mathematics and for teachers to help them to learn to do so. Students can learn to reflect on and describe their mathematical thinking, compare methods of solving a problem, and identify the advantages and disadvantages of each.
- Seeking and giving help: Students must have enough confidence not only to engage with problems and try to solve them, but also to seek help when they are stuck. The dialogue that occurs in pair or class situations can help generate self-regulating speech that a student can produce while problem solving. Such helping can also increase the metacognitive awareness of the helper.

Instructional Strategies

In the 2001 text *Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement*, the authors identify nine research-based strategies for increasing student performance. Listed below are descriptions of each of the nine strategies, which can be applied to mathematics as well as other areas of instruction. The descriptions of the nine below are from the 2004 Oklahoma teacher's edition of the Algebra I textbook published by McDougal Littell, a division of the Houghton Mifflin Company.

Identifying similarities and differences
This strategy includes comparing and classifying, and suggests representing comparisons in graphic or symbolic form.

Summarizing and note taking
This strategy includes deciding when to delete, substitute, or keep information when writing a summary and using a variety of note taking formats (e.g., outlines, webbing, or a combination technique). It suggests encouraging students to use notes as a study guide for tests.

Reinforcing effort and providing recognition
This strategy includes making the connection between effort and achievement clear to students and providing recognition for attainment of specific goals to stimulate motivation.

Homework and practice
This strategy includes making the purpose of homework assignments clear to students and focusing practice assignments on specific elements of a complex skill.

Non linguistic representations
This strategy includes creating non linguistic representations—including creating graphic organizers, making physical models, generating mental pictures, drawing pictures and pictographs, and engaging in kinesthetic activity—to help students understand content in a whole new way.

Cooperative learning
This strategy incorporates five defining elements of cooperative learning—positive interdependence, face-to-face interaction, individual and group accountability, interpersonal and group skills, and group processing—into instruction.

Setting objectives and providing feedback
This strategy includes using instructional goals to narrow what students focus on. It also suggests providing feedback that is specific to a criterion and encouraging students to personalize their teacher's goals and to provide some of their own feedback.

Generating and testing hypotheses
This strategy includes using a variety of structured tasks to guide students through generating and testing hypotheses, using induction or deduction, and asking students to explain clearly their hypotheses and conclusions to help deepen their understanding.

Cues, questions, and advance organizers
This strategy includes asking questions or giving explicit cues before a learning experience to provide students with a preview of what they are about to experience. It also suggests using verbal and graphic advance organizers, or having students skim information before reading, as an advance organizer.

Instructional Strategies for Creating an Equitable Classroom

In the 2002 publication *EDThoughts: What We Know About Mathematics Teaching and Learning*, 11 instructional strategies are identified as important in creating an equitable classroom where teachers use a variety of strategies to reach all students with high-quality content. These strategies are as follows:

- Clearly identifying the knowledge students need to master
- Addressing different student learning styles
- Encouraging the participation of underrepresented students
- Challenging all students
- Diagnosing where students are struggling to learn and providing appropriate instruction
- Embedding a variety of assessment types throughout units of study
- Engaging all students in higher-order thinking skills (e.g., data analysis, synthesis of results, and evaluations of potential solutions)
- Helping students make connections among related mathematics concepts across other disciplines (e.g., science, reading, and social studies)
- Encouraging participation by all students
- Fostering the use of inclusionary language in all classroom communication
- Involving parents in student learning

References and Additional Resources

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Strategies for Successful Science Education

Rapid Response Request
April 12, 2006

Request

What important research-based strategies can an education system implement in order to provide effective science education?

Summary

This report is organized into two sections. First, the report describes the state of research in science education, noting a lack of rigorous scientificallybased research in this area. Second, the report describes nine practices that research suggests help improve science teaching and learning.

Scientifically-Based Research in Science Education

Established by the Education Sciences Reform Act of 2002, the Institute of Education Sciences (IES) is the research arm of the U.S. Department of Education. In a recent presentation at the Secretary's Science Summit titled "Research on Science Education," Russ Whitehurst, director of IES, reported as part of a discussion on recommended research-based strategies that science education has by far the least amount of research on the effects of programs and practices in use. IES could not find a single rigorous study that evaluated the effects of currently available science curricula. According to Whitehurst (2004) "Much of the experimental work is poor quality quasi-experimental research in which information about comparison students is minimal (that is, often not enough evidence is presented to allow the reader to determine whether the comparison group is comparable to the intervention group). In addition, information about the instruction given to the comparison group is minimal or missing. Most of the experimental research is presented as 'proof-of-concept' work demonstrating pre-post differences for a single group of students."

The following section highlights nine practices that existing research suggests are most effective in science education.

Best Practices in Teaching and Learning Science

Leaders in science education advocate nine practices to improve science teaching and learning. These best practices, described below, are strategies that existing research indicates help improve student achievement in science education.

Explore the significance of science

Students need opportunities to explore the significance of science in their lives. An investigational approach should be utilized as a method for learning science content and focusing on important subject matter or big ideas in science. Instruction needs to include an emphasis on active science learning rather than memorization of information. This approach helps students see science education in a larger context of thought and inquiry. To accomplish this, the instruction should do the following:

- Focus on what the students bring to the classroom and engage the students' ideas so that they may be examined, reshaped, and built upon
- Foster student understanding, interest, and appreciation of the world
- Encourage curiosity
- Organize students to work in groups as real-world scientists in a problem-solving situation

Know what it means to "do science" and model an investigative approach.

Teachers should have knowledge of what it means to "do science" and model an investigative approach. To accomplish this, teachers should include the following strategies as a part of their instructional planning:

- Create contextual, natural situations and puzzles to invite investigation
- Implement effective hands-on inquiry that builds students' scientific content knowledge and skills of investigation
- Build understanding of the nature of science through the development of problem-solving skills
- Have students "do science" by developing questions and using evidence to propose explanations
- Have students use process skills that avoid a rote lock-step formula for following the scientific method but rather, pursue opportunities to learn science as a process of investigation and deduction that involves observation, imagination, and reasoning about the phenomena under study
- Create situations where students experience multiple examples of the same science concept
- Provide opportunities for students to make connections to other contexts

Use unifying themes to organize learning

The National Science Education Standards suggest that learning should be organized with the unifying themes connecting the learning objectives. Unifying themes also facilitate integrating science with reading, writing, math, and social studies. Unifying themes explain science topics in a context that encourages the learner to explore the concepts at greater depth and complexity. There are many unifying themes; some of the most commonly utilized are from the National Science Education Standards, and they include the following:

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement

- Evolution and equilibrium
- Form and function

Explicitly address misconceptions
Russ Whitehurst at the Institute of Education Sciences recommends that teachers should explicitly research and address misconceptions and then actively engage students in investigations to confront identified misconceptions and naive theories. Lectures alone have very limited impact on student beliefs. Multiple carefully designed instructional experiences that specifically confront a misconception are necessary to overcome these fallacies. To accomplish this, teachers need to do the following:

- Develop a knowledge of the common misconceptions for the subject and age group of students with which they are working
- Create a disequilibrium with the students through contextual situations or puzzles
- Directly address the misinformation with new information
- Provide multiple experiences to confront the misconception
- Build in time for students to reflect and discuss their thought processes and new beliefs resulting from the new information

Consider issues of application of science and technology
Science instruction should place students in situations where they consider issues and current debates on the application of science and technology. Students should evaluate the impacts and gains of implementing technology in given situations. Examples of current issues include cloning and stem cell research.

Incorporate activities that are developed and organized
Activities used in science education need to be well developed and organized in order to help children acquire a deep understanding of science concepts, a range of process skills, and an understanding of when to apply those skills. These activities should give students the means to study the main concepts of science in depth. Activities should also follow a learning cycle that includes the following components:

- Observation that is at first exploratory, then focused on testing a hypothesis developed during the questioning period
- Questioning that stems from an observed phenomena, personal experience, or problem
- Use of appropriate tools and procedures in the context of authentic inquiry
- Organization of data with a focus on differences and patterns
- Explanation by the student of a theory or causal factor based on the collected data
- Reflection on the process, obstacles, solutions, and metacognition students encounter. This helps students explore higher-order thinking, learn from mistakes, and connect the phenomena in a variety of settings.

Provide metacognition strategies
Metacognition is the awareness and understanding of one's thinking and cognitive process. A metacognition strategy is one that helps students take a step back and think about how they think about science. To encourage metacognitive thinking, teachers should employ strategies that include facilitation and collaborative group work with limited information giving so that students have to think through the problem and work out how to find the solution to a problem. Students can then reflect on how they contributed or detracted from group processes. By exploring their strategies and communication efforts, students uncover "holes" in a particular way of thinking and build new problem-solving strategies. A teacher can help reinforce this by comparing the students' experience of changing what they "know" to what scientists "knew" in the last few centuries and how this knowledge changed. Additional metacognition strategies that can help students develop a deeper understanding of science concepts include the following:

- Talk about thinking before and after investigations
- Create graphic organizers or physical models
- Analyze and synthesize data to summarize
- Make connections to the real world
- Provide appropriate tools and strategies to assist with personal decisions on science-based issues

Explore fewer topics in greater depth
Research suggests that science instruction is more effective when it explores fewer topics in greater depth and builds on a knowledge base that is focused on essential concepts rather than disconnected facts or trivia.

Conduct meaningful assessments
A meaningful assessment of student learning should promote the objectives of the science curriculum and be used to provide feedback to teachers and students as well as inform decisions about what to do next. Assessments should determine what students know and focus on what and how science is learned rather than on the body of knowledge in science. Regularly posing questions as a part of the instruction process is a key part of assessing students' knowledge. When interacting with students, teachers should listen carefully, pose questions in a form that elicits a variety of answers, and use enough wait time so that students can consider and form thoughtful answers. Additionally, any quality assessment tool in science should initially identify the following for the learner and teacher:

- The knowledge students must master
- The kinds of investigations and performance tasks students need to know and be able to do
- The skills students must demonstrate
- The products students must be able to create

References and Additional Resources

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Literacy for All

By Kathleen Theodore

This school year, Louisiana began piloting a literacy plan titled "***Literacy for All***" in five school districts. In order to improve the literacy rates of students in the state and to develop a more literate citizenry, ***Literacy for All*** is designed to address the learning needs of all students from pre-kindergarten to adult. Louisiana has aligned its literacy plan to the No Child Left Behind Act while seeking to close the achievement gap between all student subgroups. The plan calls for increasingly high levels of district and state support. It integrates powerful research-based instructional programs and strategies that are supported by high- quality, job-embedded professional development for teachers as well as school and district leaders. The goals of the professional development are to build educators' foundational knowledge in the delivery of reading instruction and to build their capacity to implement key components of the literacy plan.

Literacy for All is highly aligned with the Louisiana Reading First model, but is more grade-level specific in order to meet the needs of learners at various stages of their education.
The key components of the Louisiana literacy plan include a three-tiered Iinstructional model, research-based programs and strategies, extended time for reading and literacy instruction, ongoing formative and summative assessments, and high-quality teachers.

In addition to the key components of Reading First (systematic, explicit instruction and the five essential components of reading instruction), ***Literacy for All*** focuses on the 10 key instructional components of an effective adolescent literacy program for grades 4 -12. Each pilot site has a reading/literacy coach, faculty study groups focused on examining student work and data to plan for instruction and intervention, annual literacy institutes to build knowledge, and quarterly leadership academies to build capacity at the district and school level.

Prior to implementing the literacy plan, SECC staff consulted and assisted the Louisiana Department of Education's staff in reviewing criteria and rubrics for grant applications.

Kathleen Theodore is a Program Specialist with the Southeast Comprehensive Center.

Southeast Comprehensive Center Helps Provide Training on Response to Intervention

By Ada Muoneke. Ph.D.

In October, the SECC joined the Southeast Regional Resource Center (SERRC), the Mid-Continent Comprehensive Center (MC3), and the Texas Comprehensive Center (TXCC) in providing training on Response to Intervention (RtI). Leadership teams from 11 states education agencies gathered in Austin, Texas, to attend 2-day conference, titled "***Response to Intervention (RtI): Moving Toward Implementation***." The purpose of the conference was to provide assistance to states in their efforts and plans to build capacity for statewide implementation of RtI. Dr. Elizabeth Beale of the SERRC and Kathy Clayton of the Texas Education Agency, opened the conference with welcoming remarks.

Dr. Jack Fletcher, of theTexas Center for Learning Disabilities, at the University of Houston, discussed recent changes in the identification of Specific Learning Disabilities (SLDs) highlighted in the Individuals with Disability Education Improvement Act of 2004 (IDEA 2004) and provided participants with an overview of research findings supporting the need for RtI. In a teleconference session, Larry Wexler, of the U.S. Department of Education's (USDE's) Office of Special Education Programs (OSEP), pointed out and discussed recent changes in the IDEA 2004 regulations pertaining to SLD identification and Early Intervening Services (EIS).

He answered questions to explain the USDE's position and clarify participants' knowledge on these topics. Sharon Shultz, of the IDEA Partnership, reviewed the materials and compendium of resources created to support efforts at the state level to implement RtI. Dr. Sharon Vaughn, of the Vaughn Gross Center for Reading and Language Arts, at the University of Texas at Austin, presented on the positive findings of research interventions in K-3 reading using a 3-tier model approach to RtI. Dr. George Batsche, of the Institute for School Reform, at the University of South Florida, described a state-level implementation of a problem-solving and RtI process that is helpful to states as they strive to improve student outcomes to meet the goals of No Child left Behind (NCLB). State team leaders from Georgia, Texas, and Louisiana shared their successes and lessons learned from their statewide implementation efforts of a multi-tiered intervention and RtI with conference participants.

During small group sessions, facilitators engaged state teams in dialogues that grounded the new provisions of RtI and EIS within the vision and strategies pursued in their state and districts under NCLB using ***A State Dialogue Guide to Build Understanding, Commitment and Strategy***. Originally designed to renew the IDEA/ Title I Collaboration Community around School Improvement under NCLB, the tool was edited to address the role of Response-to Intervention and Early Intervening Service provisions of IDEA 2004. Each state team then used this document to work together to begin the planning process and identify issues that should be explored as the states move forward with RtI.

Belinda Biscoe, of MC3 wrapped up the conference by inviting each state team to share their reflections and next steps and then adjourned with closing comments.

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The Southeast Comprehensive Center (SECC) is one of 16 regional centers established by the U.S. Department of Education. The primary goal of the regional centers is to build the capacity of the state education agencies and statewide systems of support to implement NCLB. Links to the other regional centers, the content centers, and the U.S. Department of Education may be found on the SECC Web site (http://secc.sedl.org). The contents of this newsletter were developed under grant number S283B050033 from the Department of Education. However, those contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government.