Encouraging Planning for Problem Solving

Why Is This Strategy Useful?

Effective use of problem-solving strategies is particularly problematic for students with learning difficulties and especially important in mathematics, where careful analysis and systematic execution of procedures is required. To facilitate student performance in mathematics, both content area instruction and cognitive strategy instruction are recommended. Cognitive instruction improves the mathematics performance of students who are poor in planning when they are given instruction that meets their cognitive needs. One theoretical view of human cognitive functioning is the Planning, Attention, Simultaneous, and Successive (PASS) model. Planning is a mental process that provides cognitive control and comprises development of strategies and plans, self-monitoring, and self-regulation to achieve a goal. Planning is especially important for successful math performance. This model illustrates the importance of planning instruction in conjunction with math pedagogy. Research shows that teaching students to plan problem solving improves their problem solving ability. This planning instruction strategy is appropriate for all secondary school students and is especially well-suited for those with learning disabilities.

Description of Strategy

Planning processes provide for the programming, regulation, and verification of behavior and are responsible for behavior such as asking questions, problem solving, and self-monitoring. Teaching these components is essential. Self-regulated or self-instructional strategies involve learning a list of solution steps. It is useful to provide a set of corresponding prompts in the form of questions, such as “What does the problem say?” Students should be taught to ask themselves the questions aloud and continue thinking aloud while answering them. In the beginning, teachers model the use of the steps and apply the steps to a problem. Gradually, the teacher transfers responsibility for using the strategy to the student. Over time, the student internalizes the prompts and self-instruction so that he or she no longer verbalizes them aloud and the student independently uses the steps to solve problems. The self-reflection approach is designed to facilitate the student's recognition of the need to be planful and utilize an efficient strategy when completing the math problems. To help children achieve this goal, teachers should encourage them to (a) determine how they completed the work sheets, b) verbalize and discuss their ideas, (c) explain which methods worked well and which worked poorly; and (d) be self-reflective. To aid their students, teachers can use some of the following probes. Can anyone tell me anything about these problems? Let's talk about how you did the work sheet. Why did you do it that way? How did you do the problems? What could you have done to get more correct? What did it teach you? What else did you notice about how this page was done? What will you do next time? I noticed that many of you did not do what you said was important. What do you think of that?

Research Evidence

At least two quasi-experimental studies support the use of this strategy. Twelve second-grade students participated in the first study. Students were administered the standardization edition of the Cognitive Assessment System (CAS) to measure their level of competence in planning, attention, simultaneous, and successive processes. Baseline scores were collected. After the invention, during which students were taught and encouraged to plan and self-reflect, they filled out 21 math worksheets. Findings indicated that there was improvement for most students. Those students with low planning scores improved from 44% to 205% over baseline, and those with high planning scores improved from 6% to 159% over baseline. Results suggested that the
students with low planning scores improved more than those with high scores in planning because this instruction met their need to be more planful and because planning has been shown to be important for mathematics computation.

The second study involved 19 middle school students with mild learning disabilities in southern California. Cognitive instruction based on the students’ individual PASS characteristics was provided as an intervention. Students were also encouraged to self-reflect and verbalize the strategies they use during arithmetic computation. Results indicated that children with a cognitive weakness in Planning improved considerably due to the cognitive instruction, as compared to people with cognitive weakness in Attention, Simultaneous, or Successive. Thus, students with a weakness in Planning benefitted from instruction that taught them to be planful. For this population, an intervention that facilitated planning proved to be very effective.

Sample Studies Supporting this Strategy


The purpose of this study was to determine if an instruction designed to facilitate planning, given by teachers to their class as a group, would have differential effects depending on the specific cognitive characteristics of the individual students. A cognitive instruction that facilitated planning was provided to a group of 12 students with learning disabilities. All students completed math worksheets during 7 sessions of baseline and 21 sessions of intervention (when the instruction designed to facilitate planning was provided). During the intervention phase, students engaged in self-reflection and verbalization of strategies about how mathematics problems were completed. The class was sorted according to planning scores, obtained using the Cognitive Assessment System, which is based on Planning, Attention, Simultaneous, Successive (PASS) theory; and low- and high-planning contrast groups were identified. The results, consistent with previous research, showed that teaching control and regulation of cognitive activity had beneficial effects for all students but was especially helpful for those who were poor in planning, as defined by the PASS theory. Implications of these findings are provided.


The purpose of this study was to determine if an instruction designed to facilitate planning, given by teachers to their class as a group, would have differential effects depending on the specific Planning, Attention, Simultaneous, Successive (PASS) cognitive characteristics of each child. A cognitive strategy instruction that encouraged planning was provided to the group of 19 students with learning disabilities and mild mental impairments. All students completed math worksheets during 7 baseline and 14 intervention sessions. During the intervention phase, students engaged in self-reflection and verbalization of strategies about how the arithmetic computation worksheets should be completed. The sample was sorted into one experimental and four contrast groups after the experiment was completed. There were four groups with a cognitive weakness in each PASS scale from the Cognitive Assessment System and one group with no cognitive weakness. The results showed that children with a cognitive weakness in Planning improved considerably (large effect size of 1.4), in contrast to those with a cognitive weakness in Attention (small effect size of 0.3), Simultaneous weakness (a slight deterioration and effect size of -0.2), Successive weakness (medium effect size of 0.4), and no cognitive weakness.
(small effect size of .2). These data showed that children with a Planning weakness benefitted from the instruction designed to help them be more planful. Those children who received the planning-based instruction who were not low in planning did not show the same level of improvement.

Additional Resources


Math Problem Solving for Primary Elementary Students with Disabilities. Available at: http://www.k8accesscenter.org/training_resources/mathprimaryproblemsolving.asp