Bruce Joyce, Beverly Showers, and Carol Rolheiser-Bennett

Staff Development and Student Learning: A Synthesis of Research on Models of Teaching

We can now design staff development programs around teaching approaches with known potential for increasing student learning.

The content of staff development programs should be selected from those options that promise substantial increases in student learning and aptitude to learn. Ultimately, the motivation to engage in staff development and implement its content depends on a desire to increase the power of education and a belief that it is feasible to do so (Joyce and Showers 1987).

Staff development programs have, of course, been created with curricular and instructional improvement in mind; but we believe that both planners and participants should be striving for *particular amounts* of increase in student learning when any given program is offered. That objectives for student learning through staff development can and should be set is a result of three recent developments in educational research.

The first development is that there has been a great expansion of the number of research and development personnel in education and applied psychology, with a consequent enlargement of the output of educational research that can be applied to practice (Rolheiser-Bennett 1986). Educational research now provides an array

"Research on cooperative learning is overwhelmingly positive, and the cooperative approaches are appropriate for all curriculum areas."

of serious options for the substance of programs that can increase student learning. Part of this information has been disseminated to school personnel (Walberg 1986), but much has not.

Second, recent research on staff development and curriculum implementation has provided guidelines for the design of staff development programs that enable teachers to increase their repertoire of teaching skills dramatically and to use those skills effectively (Joyce and Showers 1987, Huberman and Miles 1984).

Third, research on innovation has indicated that sustained change in curriculum and instruction depends heavily on a shared understanding about the nature of the innovation and what it can accomplish (Fullan 1982). We believe there is no better foundation for shared beliefs than knowledge about what kinds of learning and how much learning can be expected if the content of staff development is learned well and applied effectively.

Here we present a selective review of promising areas of research, with emphasis on the amounts and types of achievement that can be expected from careful implementation of the curricular and instructional practices that have emerged. (See also "A Synthesis of Research on Staff Development: A Framework for Future Study and A State-of-the-Art Analysis" by Beverly Showers, Bruce Joyce, and Barrie Bennett, in November *Educational Leadership*, in press.)

Sources of Promising Practices

The yield from four distinct lines of inquiry has accumulated to the point where we can assess the findings and organize the results for program planning. Included are studies of (1) models of teaching or instructional strategies; (2) curriculum structure and implementation; (3) effective teaching; and (4) effective schools.

Considered together, these lines have yielded a large number of practices that promise to help students learn more effectively. These practices cannot meet all conceivable staff development needs, but can satisfy many of them and can occupy the time of the average district's staff development program for several years. In this paper we will review only the first, models of teaching. All four are addressed in *Student Achievement Through Staff Development* (Joyce and Showers 1987), from which much of this material is excerpted.

The Concept of Effect Size

We use the concept of *effect size* (Glass 1981) to describe the magnitude of gains from any given change in educational practice and thus eventually to predict what we can accomplish by using that practice. Effect size does not replace the concept of statistical significance but permits an assessment of how much practices affect the outcomes to which they are directed.

To introduce the idea, let us consider a study conducted with our assistance by Dr. Bharati Baveja in the Motilal Nehru School of Sports about 30 miles northwest of New Delhi, India. Baveja designed her study to test the effectiveness of an inductive approach to a botany unit against an intensive tutorial treatment. At the beginning of the unit all the students were given a test to assess their knowledge before instruction; they were divided into two groups equated on the basis of achievement. The control group studied the material with the aid of tutoring and lectures on the material—the standard treatment in Indian schools for courses of this type. The experimental group worked in pairs and were led through inductive and concept attainment exercises emphasizing classification of plants.

The difference between experimental and control groups was a little above a standard deviation. This difference, expressed in terms of standard deviation units, is the *effect size* of the inductive treatment. In this case, with normally distributed scores and an effect size of 1.0, the experimental group average (50th percentile) score was the same as the 80th percentile score for the control group. When a delayed recall test was given ten months later, an increase in effect size occurred, indicating that the informa-

tion acquired with the concept-oriented strategies was retained somewhat better than information gained via the control treatment.

Thus, the calculation of effect sizes enables us to compare the magnitude of the potential effects of innovations that we might use in an effort to affect student learning. We can also determine whether the treatment has different effects for all kinds of students or just for some. In other words, effect sizes can be computed for students of average, above-average, and below-average learning histories.

Beyond High Effect Sizes

Although high effect sizes make a treatment attractive, size is not the only consideration when choosing among alternatives. Modest effect sizes that affect many persons can have a large payoff for the population. For example, some estimates suggest that each year about one million first-graders (about 30 percent) make little progress in learning to read. We also know that lack of success in reading is a dread educational disease, since for each year that initial instruction is unsuccessful, the probability that the student will respond to instruction later is greatly lowered. Would a modestly effective treatment, say one that reduced lack of success for 50,000 first-graders (5 percent) be worthwhile? We think so. Of course, we prefer a high-effect treatment, but one is not always available.

Resource-based instructional procedures, broadcast television, computers, or self-instructional packages relying on several media may be worthwhile, not so much because of greater effects, but because they offer the opportunity for self-instruction. "Sesame Street" and "The Electric Company," for example, are not dramatically more effective than first-grade instruction in reading; but they produce positive attitudes and augment instruction handsomely, enabling a certain percentage of students virtually to teach themselves to read (Ball and Bogatz 1970).

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Also, a variety of types of outcomes must be considered. Attitudes, values, concepts, intellectual development, skills, and information are just a few. If we stay with the example of early reading, two treatments might be approximately equal in the short run; but one might affect attitudes more positively, leaving the students feeling confident and ready to try again. Similarly, two social studies programs might cover similar amounts of information and concepts, but one might excel in social learning and citizenship.

Finally, effect sizes are always calculated from a comparison of treatments. In the research considered here, most effects are derived from a comparison of a curricular or an instructional practice with *the conventional ways that instruction is carried out*, because such a comparison is most meaningful for staff development practice. If a treatment has a substantial effect size compared to the way instruction is generally carried on in a district, then it has promise for improving student achievement in that setting.

Highlights of Research on Models of Teaching

School districts can now offer staff development programs in the expectation that they will pay off in higher student achievement. Research conducted in the last ten years yields impressive evidence for the effectiveness of a variety of innovative teaching practices.

- **Cooperative learning approaches, representing social models of teaching, yield effect sizes from modest to high. The more complex the outcomes—higher-order thinking, problem solving, social skills and attitudes—the greater are the effects.**
- **Information-processing models, especially the use of advance organizers and mnemonics, yield modest to substantial effect sizes; and the effects are long-lasting.**
- **Synectics and nondirective teaching, exemplifying personal models of teaching, attain their model-relevant purposes and affect student achievement in such basic areas as recall of information.**
- **DISTAR, an example of the behavioral family of models, yields modest effect sizes in achievement and, further, influences aptitude to learn.**
- **When these models and strategies are combined, they have even greater potential for improving student learning.**

"The students of teachers who had thoroughly learned the [nondirective teaching] model achieved more, felt better about themselves, had better attendance records, and improved their interpersonal skills."

Benjamin Bloom's (1984) analysis of the effects on student learning provides a clear goal for the use of educational technology. Essentially, under tutoring conditions, the median score is two standard deviations above where it is with conventional group instruction (about at the 96th percentile), and the lowest scoring students are about at the 40th percentile. Bloom's analysis concludes that *all* students can learn much more than they are presently learning under normal conditions and, further, that the least promising students can master the basic curriculum.

In the studies of mastery learning that Bloom reported, an effect size of about 1.0 resulted. Seventy-five percent of the students reached a level of mastery attained by only 20 percent of the students in the conventional classrooms.

Our challenge is to see if we can, by preparing teachers to use the results of research, provide conditions as favorable as those afforded by the tutorial. We believe that we can.

Models of Teaching

From psychology, social psychology, philosophy, therapy, and other disciplines have come experiments designed to learn whether innovative teaching strategies produce the distinctive effects for which they are intended (Joyce and Weil 1986). We will discuss several models using the framework proposed by Joyce and Weil (1986) whereby teaching strategies are classified according to their chief mechanisms: social, personal, information processing, and behavioral systems.

Social Models

There have been three lines of research on ways of helping students study and learn together, which are popularly known as "cooperative learning." First, David and Roger Johnson and their colleagues (1981) have studied the effects of cooperative task and reward structures on learning. The Johnsons' (1975, 1981) work on peer-teaching-peers has provided in-

The personal model of teaching builds self-directed, empathetic students and frees energy for learning.

In the social model, students work cooperatively and solve problems democratically, a process that has positive effects on group behavior and moral judgment.

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formation about the effects of cooperative behavior on academic achievement, values, and intergroup behavior and attitudes. Second, Slavin's extensive review (1983) includes the study of a variety of approaches where he manipulates the complexity of the social tasks and experiments with various types of grouping. Third, "group investigation" is a very complex social model in which students are organized into democratic problem-solving groups to inquire into academic and social problems with scientific tools (Thelen 1960, Sharan and Hertz-Lazarowitz 1980).

What is the magnitude of effects that we can expect when teachers learn to use the cooperative learning strategies effectively? For the highly structured

systems, on standardized tests in the basic curriculum areas (such as reading and mathematics), the average effect size is about 0.3, with some studies approaching half a standard deviation. On criterion-referenced tests the average is 0.5, with some of the best implementations reaching an effect size of about one standard deviation (Rolheiser-Bennett 1986). On standardized tests, the more elaborate cooperative learning models generated an average effect size greater than one standard deviation, with some exceeding two standard deviations on content-specific tests containing higher-order items. The average experimental student was above the 90th percentile student in the control group. Research on cooperative learning is overwhelmingly positive, and the cooperative approaches are appropriate for all curriculum areas.

The more complex the outcomes (higher-order processing of information, problem solving, social skills and attitudes), the greater are the effects. The cooperative environments engendered by these models have substantial effects on the cooperative behavior of the students, increasing feelings of empathy for others, reducing intergroup tensions and aggressive and antisocial behavior, improving moral judgment, and building positive feelings toward others, including those of other ethnic groups. Many of these effect sizes are substantial: one or two standard deviations are common, and one is as high as eight. We would not expect that the implementation of cooperative learning strategies on a wide scale would be as thorough as in the intensive treatments reported in the research literature, but solid effects should occur in schools where adequate and well-designed staff development is provided.

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Information Processing Models

A number of models of teaching are designed to increase students' ability to process information more powerfully. These include methods for presenting information so that students can learn and retain it more effectively by operating on it more conceptually; systems that assist memorization and teach students how to organize information for mastery; models to teach students to collect and organize information conceptually (such as the ones described in the Bajeva study); and models to teach students to use the methods of the disciplines, to engage in causal reasoning, and to master concepts (Joyce and Weil 1986).

Many of these models have an extensive recent research base: the number of studies ranges from about a dozen to more than 300. We will discuss just two here, advance organizers and approaches to mnemonics.

Advance Organizers

David Ausubel's formulation (1963)—that there would be greater retention of material from presentations and reading if the material were accompanied by organizing ideas—has generated more than 200 studies. Essentially, lectures, assignments of reading and research, and courses are accompanied by presentations of concepts

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that help students increase intellectual activity during and after exposure to information. The early studies involved much experimentation with ways of formulating and delivering organizers. Because of modest findings, some reviewers asserted that the line of work was not paying off (Barnes and Clausen 1975).

The technique has advanced during the 1970s, however; and current reviewers are positive (Lawton and Wanska 1977, Luiten et al. 1980). Rolheiser-Bennett's (1986) review of 18 recent investigations turned up an average effect size on lower-order achievement (such as the recall of information and concepts) of 1.4 for treatments conducted in the last dozen years. With such an effect, the average student studying with the aid of organizers learns about as much as the 90th percentile student studying the same material without the assistance of the organizing ideas. The effects on higher-order thinking (transfer of concepts to new material, for example) now average 0.4. Long-term studies obtained somewhat better results than short-term studies, presumably because the organizing ideas became better anchored in the minds of the students and had greater facilitating results.

According to Stone's (1983) analysis, organizers are effective across curriculum areas and across ages, being especially effective for students at the concrete operations stage, when they need more assistance formulating abstract ideas to anchor content. In addition, illustrations add to the effectiveness of organizers, and the impact is increased when they lead to activities and generalizations.

Mnemonics

Although research on memorization and mnemonic strategies has been conducted for more than 100 years, until a few years ago most of the yield for school practice offered few and very general guidelines, such as advice about when to mass and when to distribute practice. Little research had been conducted on the learning of school subjects.

In the mid-1970s a productive line of work was begun by Atkinson at Stanford University and greatly extended by Pressley and Levin at the Universities of Western Ontario and Wisconsin. They have developed a series of systems for organizing information to promote memory and have given particular attention to one known as the "link-word" method. Atkinson applied the method during experiments with computer-assisted instruction in which he was attempting to increase students' learning of initial foreign language vocabularies. He experimented with what he called "acoustic" and "imagery" links. Acoustic links were designed to make associations between foreign pronunciations and the sounds of known English words. Imagery links were used to make the connection vivid (Atkinson 1975). In the early studies the experimental group learned about 50 percent more words than the control group and maintained the advantage after several weeks.

Further work included experiments with children of various ages and across subjects. Using a link-word system in Spanish vocabulary learning, second- and fifth-grade children learned about twice the words learned by children using rote and rehearsal methods (Pressley 1977). In later work with Levin and Miller (1981), Pressley employed a "pictured action" variant of the method with first- and sixth-grade children, who acquired three times as much vocabulary as did control groups. With Dennis-Rounds (1980) Pressley extended the strategy to social studies information (products and cities); he found that students with instruction could transfer the method to other learning tasks. Pressley, Levin, and McCormick (1980) found that primary school students could generate sentences to enhance memorization. The results were three times as great as for students using their own methods. Similar results were found with kindergarten and preschool children (Pressley et al. 1981). With Levin and Miller (1981) the work was successfully extended to vocabulary with abstract meanings. Levin and his col-

leagues (1983) have also extended the application to abstract prose.

It was important to learn whether better "natural" memorizers, with practice, develop their own equivalent methods. Pressley, Levin, and Ghatala (1984) asked whether students, with age and practice, would spontaneously develop elaborated methods for memorizing material; they found that very few did. The better performers had, however, developed more elaborate methods than the majority, who used rote-rehearsal methods alone. However, the newly developed mnemonic methods enhanced learning across the range. Hence, it appears such a method can be very beneficial for most students. The consistency of the findings is impressive. The link-word method appears to have general applicability across subject matters and ages of children (Pressley, Levin, and Delaney 1982).

The effect sizes reached by many of the methods are quite high. The average for transfer tasks (where the material learned was to be applied in another setting), is 1.9. Recall of attributes of items (such as towns, cities, minerals) was 1.5. Foreign language acquisition was 1.3, with the most recent studies reporting higher effects. Delayed recall generally maintained the gains, indicating that the mnemonics strategies have a lasting effect.

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Space does not permit us to include in this paper other information processing approaches to teaching. However, the research, especially on models designed to teach thinking strategies, is instructive. Although reviews (Sternberg 1986, Sternberg and Bahna 1986) of recently developed packages for teaching elements of analytic reasoning have reported only modest effects, a number of the older models for teaching causal reasoning (inquiry training, for one) have produced evidence that the thinking strategies can be taught (Voss 1982, Elefant 1980) and that adding them to the instructional program has consistent, though modest, effects on the learning and retention of information.

El-Nemr (1979) concentrated his analysis on the teaching of biology as inquiry in high schools and colleges. He looked at the effects on achievement of information, on the development of process skills, and on attitudes toward science. The experimentally oriented biology curriculums achieved positive effects on all three outcomes. The average effect sizes were largest for process skills, 0.4 at the high school level and 0.6 at the college level. For achievement of information, they were 0.3 and 0.1 respectively; and for attitudes, 0.2 and 0.5.

Bredderman's (1983) analysis included a broader range of science programs and the elementary grades. He also reported positive effects for information (0.1), creativity (0.1), and science process (0.5). In addition, he reported effects on intelligence tests where they were included (0.5).

As in the case of the cooperative learning models, the information processing models are quite promis-

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ing. Also, there is no reason why cooperative study cannot be accompanied by teaching students to process information more efficiently by responding to organizers and using mnemonic strategies.

Personal Models

Student-centered models are numerous and controversial. Despite the resounding evidence of the Eight-Year Study (Chamberlin and Chamberlin 1943), critics of these models argue that person-centered education may neglect the development of academic outcomes. Here we will briefly discuss synectics and nondirective teaching.

Synectics

Synectics (Gordon and Poze 1971) is designed both to enhance personal flexibility and creativity and to teach students to generate alternative and relevant solutions to difficult problems. The research on synectics is noteworthy because of its combination of expected and unexpected results. Research on synectics indicates that it achieves its "model-relevant" purposes, increasing student generation of ideas. Effect sizes average 1.5 for generation of ideas and problem solving; this finding was predicted. However, by helping students develop multidimensional perspectives, synectics also increases recall of material from written passages by an effect size of 2.0; and the information is retained at an even higher level. This finding was unexpected.

Nondirective Teaching

Carl Rogers' *Freedom to Learn in the Eighties* (1982) includes a chapter summarizing much of the research from the humanistic perspective. Over the last 15 years, Aspy and Roebuck, Buhler, and Aspy (1976) have explored several major theses of the personal family of models, particularly that the building of self-directed, empathetic communities of learners will have positive effects on students' feelings about themselves and others and consequently will free energy for learning. Roebuck, Buhler, and Aspy's (1976) work with students having learning difficulties produced positive effects on self-concept, intergroup attitudes and interaction patterns, and achievement in reading and mathematics; students' scores on intelligence tests also increased. The students of teachers who had thoroughly learned the model achieved more, felt better about themselves, had better attendance records, and improved their interpersonal skills (Aspy et al. 1974).

Teaching that instructs students to think divergently and that keeps the self-concept of the student clearly in view can contribute favorably to student achievement in the most conventional of terms, while also achieving the specific goals of those models. The models can easily be combined with the kinds of cooperative and information processing methods described earlier.

Behavioral Systems Models

The behavioral family of models, based on the work of B. F. Skinner and the cybernetic training psychologists (Smith and Smith 1966), has given us the largest body of literature. Studies range from programmed instruction to simulations; they include training models (Joyce and Showers 1983) and methods derived directly from therapy (Wolpe and Lazarus 1966). Research abounds on the application of social learning theory to instruction (Becker and Gersten 1982), training (Smith and Smith 1966), and simulations (Boocock and Schild 1968). The behavioral technologists have demonstrated that they can design programs for both specific and general goals (Becker and Gersten 1982).

White (1986) recently examined the results of studies on the application of the DISTAR program to special education. The average effect size for methematics and reading ranged from about one-half to one standard deviation. The effects for moderately and severely handicapped students were similar. Perhaps most important, a few studies included the effects on aptitude (measures of intellectual ability); where the DISTAR program was implemented for several years, effect sizes were 1.0

or above, representing an increase of about 10 points in the standard IQ ratio. Generally speaking, we believe that most teaching methods that increase student achievement substantially do so by increasing aptitude to learn, which will be reflected in measures of learning ability as well as tests of achievement.

Specific Teaching Practices Applicable Across Models and Styles

A number of research and development teams have developed particular aspects of instructional practice that, if used regularly, might reasonably facilitate student achievement and feelings of self-worth, regardless of the instructional model used. While these are not holistic models of teaching, they are relevant to the attempt to improve instruction because they generate fresh stances toward the act of teaching.

We will deal with just two of these here: first, the concept of "wait-time," because of its long research history; and second, "Teacher Expectations and Student Achievement" (TESA), because its wide dissemination in workshops sponsored by Phi Delta Kappa has made it one of the most popular options in staff development programs in the country.

Wait-Time

The concept of wait-time was formulated by Mary Budd Rowe (1974). Rowe had observed, as had other students of teaching, that classrooms are often characterized by brief statements or questions by teachers and students densely packed into the periods of instruction. She theorized that such density fragments thought processes, not allowing students enough time to process the information contained in one communication before another is upon them. The pattern also leaves the students cognitively and socially powerless; if a student thinks for a few seconds and has something important to say, the time for appropriate communication has passed. Rowe speculated that if instructors slowed down the pace by *waiting more between communications*, then the students would be able to think over what was being discussed, would have more to say, would become more involved, and would be empowered to bring their cognitions into the discourse to a higher degree. Also, they would be more inclined to listen to one another and to comment on one another's ideas.

"... the increased engagement of all students has an effect on student learning of about the same magnitude as wait-time."

A recent study by Kenneth Tobin (1986) lends the best support thus far to Rowe's theory. Tobin successfully trained teachers to use wait-time in teaching mathematics and language arts lessons. He found that the students were more often able to respond to questions, presumably because they had time to think about them and formulate their responses; their utterances became longer; and they were more likely to respond to one another. The teachers became generally more positive; in language arts they asked more questions that dealt with comprehension rather than simple recall of what had been read. The differences were actually manifested in student achievement with a modest effect size (about 0.2).

That the effect is modest should not disqualify wait-time from being considered as an option for staff development. A modest behavioral change that improves the quality of classroom discourse, increases student involvement, and pays off regularly in achievement is, from our perspective, a fine option for our attempts to improve our teaching.

Teacher Expectations and Student Achievement

Sam Kerman (1979) and his associates developed the Teacher Expectations and Student Achievement program from their observation that students in the same classroom are often treated differently, frequently without the teacher's being aware of the differences, in ways that can affect their engagement and achievement. Specifically, the students with poorer learning histories are often called on less; thus, they are given less opportunity for involvement. Often their responses are treated more negatively. Gradually the students become less involved and feel less valued. In discussions with teachers, Kerman found that many had rational explanations for the differential treatment, citing a desire not to embarrass the low achievers and also to allow the higher achievers to talk more to bring out better and more nearly correct ideas. Hence, Kerman and his colleagues developed observation and feedback procedures to help teachers get a picture of the distribution and the nature of communications in their classrooms. They used a large body of research on teaching for ideas on involving all students affirmatively, helping students respond, treating varieties of responses, maintaining a high level of respect and courtesy in the classroom, and so on. Their training has been successful; their formal studies indicate that the increased engagement of all students has an effect on student learning of about the same magnitude as wait-time.

These are not the only procedures that have cross-model implications. Mastery learning is also not model-

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specific. Its procedures—organizing instruction clearly, providing direct and diagnostic feedback to students, and allowing differentiated time for mastery of objectives—ensure substantial effects by modifying conventional instruction. It has much in common with the models described above by focusing instruction and selecting methods designed to accomplish the goals.

Designing Staff Development to Increase Student Learning

In this paper our message is that a number of educational practices can affect student learning and are options for the substance of staff development programs. However, very few practitioners have mastered the teaching models and curricular practices described here, which is why they are not currently in regular use. Most teachers use a very narrow range of practices (Sirotnik 1983, Goodlad and Klein 1970, Medley 1977); they expand that repertoire only when they are provided substantial and carefully designed training.

Now we have the means for designing effective programs, and there is ample content. Meager programs populated with "one-time" weak treatments will not hold the strong content, however. We hope that the available repertoires of teaching practices and the possibility of using curriculums, all of which can dramatically increase student achievement, will be taken seriously. If we use the projects of research seriously and powerfully, we have the promise of increasing the learning of *all* students. Not to do so is to place all students "at risk."

Also, the mass of accumulated research should effectively dispel the notion that the attention paid to convergent or divergent thinking, cooperative social behavior, or the self-concepts of students will perversely decrease the learning of "basic" information and skills. As we design and implement more substantial staff development systems, what will sustain us will be the shared vision of schools where the effects of teaching and curricular practices are pyramided to generate learning energy vastly above what has ever existed in this nation or any other.□

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Bruce Joyce and **Beverly Showers** are Directors, Booksend Laboratories, Eugene, Oregon. **Carol Rolheiser-Bennett** is Acting Assistant Principal, St. Matthew's School, Edmonton Separate School District No. 7, Edmonton, Alberta, Canada.