Strategy Training and Attributional Feedback With Learning Disabled Students

By: Dale H. Schunk, Paula D. Cox

Schunk, D. H., & Cox, P. D. (1986). Strategy training and attributional feedback with learning disabled students. *Journal of Educational Psychology, 78*, 201-209.

Article:

According to Bandura (1982a, 1982b), psychological procedures change behavior in part by creating and strengthening self-efficacy , or one's perceived performance capabilities in a given activity. Self-efficacy is hypothesized to influence choice of activities, effort expended, persistence, and task accomplishments. Although self-efficacy originally was used to help explain coping behaviors in fearful situations, its use has been extended to other contexts, including cognitive-skill learning (Schunk, 1985).

In the present study, we tested some predictions of the self-efficacy model with learning disabled students, who perform below their measured abilities but do not possess intellectual deficits. Especially when facing difficult tasks, they often are inattentive and display lackadaisical efforts (Licht, 1984 ; Torgesen & Licht, 1983). These behavioral deficits may occur in part because such students hold self-doubts about their capabilities to perform well (Boersma & Chapman, 1981). Interventions that promote students' perceived capabilities (i.e., self-efficacy) might help to remedy behavioral dysfunctions (Schunk, 1985).

Much classroom learning involves understanding how to apply task strategies. In mathematics, students who fail to acquire algorithmic knowledge through normal instructional procedures may benefit from explicit strategy training that includes verbalizing aloud the solution steps and their application to problems. Such overt verbalization is a form of private speech , which refers to the set of speech phenomena that has a behavioral self-regulatory function but is not socially communicative (Vygotsky, 1962 ; Zivin, 1979). Overt verbalization can facilitate learning because it directs students' attention to important task features and, as a type of rehearsal, assists strategy encoding and retention (Schunk, 1982). As a means of regulating one's task performance, verbalization also can convey to students a sense of personal control over learning, which promotes self-efficacy (Bandura, 1982a ; Schunk, 1982).

Verbalization seems most beneficial for students who typically perform in a deficient manner (Denney & Turner, 1979). Positive effects of verbalization on performance have been obtained with children who do not spontaneously rehearse material to be learned (Asarnow & Meichenbaum, 1979), impulsive subjects (Meichenbaum, 1977), and remedial students (Schunk, 1982). Verbalization has also helped mentally retarded and emotionally disturbed students acquire mathematical skills (Grimm, Bijou, & Parsons, 1973 ; Johnston, Whitman, & Johnson, 1980 ; Whitman & Johnston, 1983). Learning disabled students, who often do not use efficient plans while learning, might benefit from verbalization to the extent that it helps them work at tasks in a systematic manner (Hallahan, Kneedler, & Lloyd, 1983 ; Wilder, Draper, & Donnelly, 1984).

One purpose of the present study was to determine how verbalization during cognitive-skill learning influenced students' self-efficacy and skills. Students received subtraction training over six sessions. One group of students verbalized aloud while solving problems during all sessions, the second group verbalized aloud during the first half of the training program (first three sessions) but not during the second half, and the third group did not verbalize. It was expected that the two verbalization conditions would develop higher self-efficacy and skills than the no-verbalization condition, but the present study tested the hypothesis that continuity of verbalization would be less important than verbalization itself (i.e., the two verbalization conditions would not differ). It was expected that overt verbalization during the first half of training would help students learn how to work subtraction problems in a strategic (algorithmic) fashion. To the extent that students could then shift this means of regulating their task performance to a covert level, we felt that continued verbalization would offer no benefits. Researchers have shown that once strategic task behaviors are instilled, overt verbalization may be discontinued with no performance decrement (Harris, 1982 ; Meichenbaum, 1977).[1]

The second purpose of this study was to investigate how the sequence of effort-attributional feedback affected students' self-efficacy and skills. Attributional theories postulate that individuals form causal attributions (i.e., perceived causes) for the outcomes of their actions (Kelley & Michela, 1980). In achievement contexts, students often attribute their successes and failures to ability, effort, task difficulty, and luck (Weiner, 1979). Effort is presumably under volitional control and amenable to change. Researchers have shown that linking past failures with insufficient effort promotes effort attributions and persistence (Andrews & Debus, 1978 ; Dweck, 1975) and that effort feedback for prior successes enhances children's motivation, self-efficacy, and skills (Schunk, 1985).

In the present study, students either periodically received attributional feedback linking their successful problem solving with effort during the first half of the training program, received effort feedback during the second half of training, or did not receive effort feedback. It was expected that effort-attributional feedback would promote students' self-efficacy and skills. Effort feedback might be especially beneficial with learning disabled students, who often do not place sufficient emphasis on effort as a cause of outcomes (Butkowsky & Willows, 1980 ; Licht, 1984 ; Pearl, Bryan, & Donahue, 1980).

A condition in which students received effort feedback throughout training was not included because our central concern was to determine how the sequence, rather than the amount, of effort feedback affected achievement outcomes. It was predicted that effort feedback during the first half of training would raise self-efficacy and skills better than later effort feedback. We expected that effort feedback for early successes would be viewed as credible by students, given that they lacked skills and needed to expend effort to perform well. As students improve their skills and perceive that they are becoming more competent, decreasing the salience of effort as a cause of success by discontinuing effort feedback may better substantiate their perceptions of competence (Schunk, 1984). The belief that one can perform well with less effort builds self-efficacy more than greater effort being required does (Bandura, 1982b). Conversely, effort feedback for later successes could lead students to doubt their capabilities. They might wonder why they still have to work hard and whether they can sustain the level of effort needed for success (Schunk, 1984).

Method

Subjects

The sample included 90 students drawn from six middle schools (Grades 6 through 8). Ages ranged from 11 years 2 months to 16 years 2 months (M = 13 years 7 months); 12% of the subjects had repeated at least one grade. The 51 boys and 39 girls represented different ethnic backgrounds as follows: 68% white, 15% black, 11% Hispanic, and 6% Asian. The socioeconomic status of the children, as gauged by school personnel, was 65% middle class, 28% lower middle class, and 7% lower class. These ethnic background, socioeconomic status, and gender percentages approximated those of the school district's middle-school learning disabled population.

All students had previously been classified by the school district as learning disabled in mathematics according to state guidelines (Texas Education Agency, 1983). The district followed a two-stage evaluation sequence. Initially, the student's physical condition, typical behavior, intelligence, and emotional stability were assessed with a teacher referral form, parent form, behavior rating, hearing and vision tests, and the Wechsler (1974) Intelligence Scale for Children: Form R. During the second stage, the student's academic achievement was assessed (Woodcock & Johnson, 1977). A student was classified as learning disabled in mathematics when his or her mathematical achievement score was more than one standard deviation (at least 16 points) lower than his or her intelligence score. The intelligence scores of students in this sample ranged from 80 to 115 (M = 93);

mathematical achievement scores ranged from 65 to 90 (M = 75). All subjects received daily special education services in mathematics; 48% of the subjects also received reading instruction in resource rooms.

Students' resource-room mathematics teachers initially identified 100 students who had encountered difficulties learning subtraction with regrouping skills. This selection procedure was followed because this study focused on processes whereby self-efficacy and skills could be developed when they were low. Five students were excluded from this initial sample due to absences, and five others were randomly excluded to equalize the cell sizes.

Materials

Attributions

The attribution measure consisted of four scales on a sheet of paper (Schunk, 1984). Each scale ranged in 10-unit intervals from not at all (0), through intermediate values (40–60), to a whole lot (100). The four scales were labeled good at it (i.e., ability), worked hard (effort), easy problems (task), and lucky (luck). Label order was counterbalanced on four different forms.

This attributional assessment is an example of a structured unidimensional scale (Elig & Frieze, 1979). Such scales assume independence of ratings and allow attributions to be assessed separately. A structured scale was chosen because children seem to understand it more readily than an unstructured assessment (Diener & Dweck, 1980). Structured unidimensional scales yield attributional dimensions similar to those of structured ipsative scales, in which an individual judgment influences other judgments (Maruyama, 1982).

In previous research with students younger than those in the present study (Schunk, 1984), students readily understood the meaning of the scales and experienced no difficulties completing the instrument. Prior to the Schunk (1984) study, a separate reliability assessment was conducted with 15 students who did not participate in that study. The test-retest reliability coefficient was .80.

Self-efficacy

The self-efficacy test assessed students' perceived capabilities for correctly solving different types of subtraction problems. For this assessment, 25 scales were portrayed on five sheets of paper (5 scales per page). Each scale ranged in 10-unit intervals from not sure (10), through intermediate values (50–60), to really sure (100). The stimulus materials comprised 25 sample pairs of subtraction problems; each pair of problems was shown on a separate index card. The two problems constituting each pair were similar in form and operations required and corresponded to one problem on the ensuing skill test, although they involved different numbers. Reliability was assessed in conjunction with previous research by using 17 children who did not participate in that study (Bandura & Schunk, 1981). The test-retest reliability coefficient was .82.

Subtraction skill

The skill test comprised 25 problems ranging from two to six columns. The problems tapped various regrouping operations, ordered from least to most difficult as follows: regrouping once, regrouping caused by a zero, regrouping twice, regrouping from a one, and regrouping across zeros (Friend & Burton, 1981). Of these 25 problems, 12 were similar to some of the problems that subjects solved during the ensuing training sessions, whereas the other 13 were more complex. For example, during training, students solved problems that required regrouping twice; some problems on the skill test required regrouping three times.

There were two forms of the skill test (pretest and posttest) to eliminate possible effects due to problem familiarity. These parallel forms were developed in previous research (Bandura & Schunk, 1981); the two forms correlated highly (r = .87) in a reliability assessment conducted in conjunction with that study.

Training materials

Six sets of instructional material were used. Each set incorporated one subtraction with regrouping operation ordered from least to most difficult as follows: regrouping once in two-column problems, regrouping once in three-column problems, regrouping caused by a zero, regrouping twice, regrouping from a one, and regrouping across zeros (Friend & Burton, 1981).

The format of each instructional set was identical. The first page of each set contained a full explanation of the relevant regrouping operation and two examples illustrating the application of the solution strategy. The following six pages each contained several similar problems to be solved using the designated strategy. The problems portrayed on these six pages did not become progressively more complex but rather required that students use the solution strategy exemplified on the first (explanatory) page. Students worked on one set of material during each training session (e.g., during Session 1, students solved problems requiring regrouping once in two-column problems). Each set included sufficient problems so that students could not finish it during the session.[2]

Procedure

Pretest

Children were administered the pretest individually by one of six female adult testers drawn from outside the school. In administering the pretest, tests followed a script to ensure standardization across subjects. For the attributional assessment, the tester showed the paper to the student and explained that it showed four things that can help students work problems. The tester pointed out the numerical and verbal designators on each scale and explained that the higher the number a student marked on a scale, the more important he or she felt that factor was in helping him or her solve problems. The tester also provided two examples of how hypothetical students might mark the scales (e.g., a student marked 90 for worked hard because he thought that was very important, 70 for lucky because he thought that was pretty important, 40 for easy problems because he felt that was somewhat important, and 10 for good at it because he did not think that was important).

The tester then said to students, “I'd like you to think about the work you do in math. For example, suppose you did really well in math; that is, you worked a lot of problems correctly or you got a high score on a test. Why do you suppose that might happen?” The tester explained that marks did not have to add to a certain number (e.g., 100). Students privately recorded their ratings. Subjects understood these directions and did not experience difficulties completing their four judgments.

Students next received the self-efficacy assessment. They initially received practice with the scale by judging their certainty of successfully jumping progressively longer distances. In this concrete fashion, students learned the meaning of the scale's direction and the different numerical values.

Following this practice, students were briefly shown the 25 sample pairs of subtraction problems for about 2 s each. This brief duration allowed assessment of problem difficulty but not actual solutions; thus, students judged their capability to solve different types of problems rather than whether they could solve any particular problem. The tester advised students to be honest and mark the efficacy value that corresponded to their level of certainty for being able to correctly solve the type of problem depicted. After privately making each judgment, students covered it with a blank sheet of paper to preclude observation of prior efficacy ratings from affecting subsequent judgments. The 25 judgments were summed and averaged.

The skill test was administered immediately following the efficacy assessment. Each of the 25 problems was portrayed on a separate sheet of paper. The tester presented the problems to students one at a time and verbally instructed students to examine each problem and to place the page on a completed stack when they finished solving the problem or chose not to work on it any longer. Students were given no performance feedback on the accuracy of their solutions. The measure of skill was the number of problems solved correctly.

Training sessions

Following the pretest, we randomly assigned students within gender and school to one of nine experimental conditions. All students received the program of subtraction training during 45-min sessions on 6 consecutive school days.

Training sessions were conducted by one of six adult female proctors drawn from outside the school. For any given child, the same proctor administered all six training sessions. The child's training proctor had not administered the pretest to the child and was unaware of the child's pretest performance. At the start of each session, students met in groups of four to five with their proctor. Each proctor administered the different treatments to preclude confounding proctors with treatments. Proctors followed a script to ensure standardized implementation of treatments across subjects.

Except as noted here, the format of each training session was identical. The proctor initially reviewed the explanatory page by verbalizing aloud the solution steps and their application to the sample problems. Following this instructional phase (about 5 min), the proctor gave the appropriate verbalization instructions. All students in each small group received the same verbalization instructions; had students in the same small group been assigned to different verbalization conditions, they might have wondered why some were not instructed to verbalize. Students then solved the practice problems while the proctor observed (about 5 min); students assigned to the verbalization treatments verbalized aloud while solving these problems. The proctor then stressed the importance of performing the steps as shown on the explanatory page, seated subjects at individual desks that were separated from one another, and moved out of sight. Students solved problems alone during the remainder of the session (about 35 min). If they were baffled on how to solve a problem, they could consult the proctor, who reviewed the troublesome operation.[3]

Treatment conditions

The experimental design was a 3 × 3 (Verbalization: continuous, discontinued, or none × Effort Feedback: first half, second half, or none) crossed factorial (N = 10 in each of the nine experimental conditions). At the start of the first training session, the proctor told students assigned to the continuous-verbalization treatment the following:

> I'm really interested in knowing what students think about as they solve problems. So as you're working problems I'd like you to think out loud; that is, say out loud what you're thinking about, just like I did while I was solving problems. You'll probably be thinking about what to do next, what numbers to use, how much is one number minus another, and so on. Remember, say out loud what you're thinking about, just like I did.

Students were not instructed to verbalize any specific words because we did not want to constrain the nature of their verbalizations (Schunk, 1982). Rather, the instructions were designed to convey that students should freely verbalize while solving problems. The proctor asked students to verbalize aloud while solving the practice problems to ensure that they understood these instructions. At the start of each of the five subsequent training sessions, the proctor reminded students to verbalize aloud while solving problems.

Students' verbalizations were not continuously monitored during the sessions (e.g., tape recorded). We felt that such monitoring could prove distracting and thereby alter the nature of the verbalizations. Two sources of evidence indicated that subjects verbalized aloud while solving problems and that their verbalizations focused on the application of regrouping steps to the problems they solved. One source was the periodic proctor monitoring to deliver the attributional feedback. A second source was brief questioning by the proctor at the end of each training session (e.g., “What kinds of things did you say out loud while solving problems?”).

Students assigned to the discontinued-verbalization condition received the same instructions and postsession questioning as those in the continuous-verbalization condition during the first three training sessions. At the start of the fourth session, the proctor asked these subjects to discontinue overt verbalization as follows:

> You've been talking out loud while solving problems for quite a while, and I've appreciated it because it's helped me learn what students think about as they solve problems. From now on, I'd like you to solve problems without talking out loud. I'm sure that you'll be thinking and working just like before, but now please don't talk out loud as you solve problems.

At the start of the next two training sessions, the proctor reminded subjects not to verbalize aloud. The proctor continued to emphasize that while solving problems, students should follow the solution steps portrayed on the explanatory page so that students would not interpret the nonverbalization instructions to mean that they were to abandon the solution strategy. At the end of the second three training sessions, the proctor questioned subjects about their work (e.g., “What kinds of things did you think about while solving problems?”).

Students assigned to the no-verbalization treatment received the same training procedures as the previous two groups but were never instructed to verbalize. This treatment was comparable to students' regular resource-room mathematics instruction, and no student assigned to this treatment verbalized aloud while solving the practice problems. Prior to students' solving problems on their own, the proctor remarked, “For the rest of this period you'll be working problems on your own. As you work problems, remember to follow the steps shown on this first page.” During the periodic monitoring of these students, proctors did not observe any instances of overt verbalization. At the end of each training session, the proctor questioned students about their work (e.g., “What kinds of things did you think about while solving problems?”).

All students who participated in this study received periodic monitoring by their proctor while individually solving problems during each of the six training sessions. Each proctor monitored the performance of her students five times (about every 6–7 min) during each of the six training sessions (30 times total) by walking up to each student and asking, “What page are you working on?” Students then replied with the page number. The attributional treatments were distinguished by the proctor's statement following the student's reply.

During the first three training sessions, the proctor remarked, “You've been working hard,” to students assigned to the first-half-effort-feedback treatment. The proctor delivered this statement rather matter-of-factly and without accompanying social reinforcement (e.g., smiles or pats), after which the proctor immediately departed. During the last three sessions, the proctor did not deliver effort feedback but, instead, acknowledged the student's reply with performance feedback (e.g., “That's fine,” or “OK.”) and then departed. Performance feedback was delivered during the second half of training to preclude students from interpreting the discontinued effort feedback to mean that they were not performing as well as before, which could have influenced self-efficacy and skill development and thereby masked potential effects of the effort feedback (Schunk, 1984). In summary, students assigned to this treatment received 15 statements of effort feedback spread over the first three training sessions.

Subjects assigned to the second-half-effort-feedback treatment received only performance feedback during the first three sessions. During the second half of the training program (Sessions 4–6), the proctor delivered effort feedback instead. These students, therefore, also received 15 statements of effort feedback, but the statements were spread over the last three training sessions. Students assigned to the no-effort-feedback treatment received performance feedback during all six training sessions. The proctor never delivered effort feedback.

Posttest

Each student received the posttest from the same tester who had administered his or her pretest. The tester was not aware of the student's treatment assignments for verbalization and effort feedback or of how the student performed during the training program. Tests and training materials were scored by an adult who had not participated in the data collection and who was unfamiliar with the purpose of the study.

Students' attributions for their problem solving during training were assessed after the last session. The procedures were similar to those of the pretest except that the tester asked subjects to think about their work during the training sessions and mark how much they thought each factor helped them solve problems. Self-efficacy and subtraction skill were assessed on the next day. The instruments and procedures were identical to those of the pretest except that the parallel form of the skill test was used to eliminate possible problem familiarity.

Results

Means and standard deviations of all measures are presented by treatment condition in Table 1 . Preliminary analyses of variance were conducted by using two experimental factors, verbalization (continuous, discontinued, or none) and effort feedback (first half, second half, or none). These analyses revealed no significant between-conditions differences on any pretest measure or on any subject measure (gender, age, standardized mathematical achievement scores, intelligence scores). There also were no significant differences on any pretest or posttest measure due to tester or school.

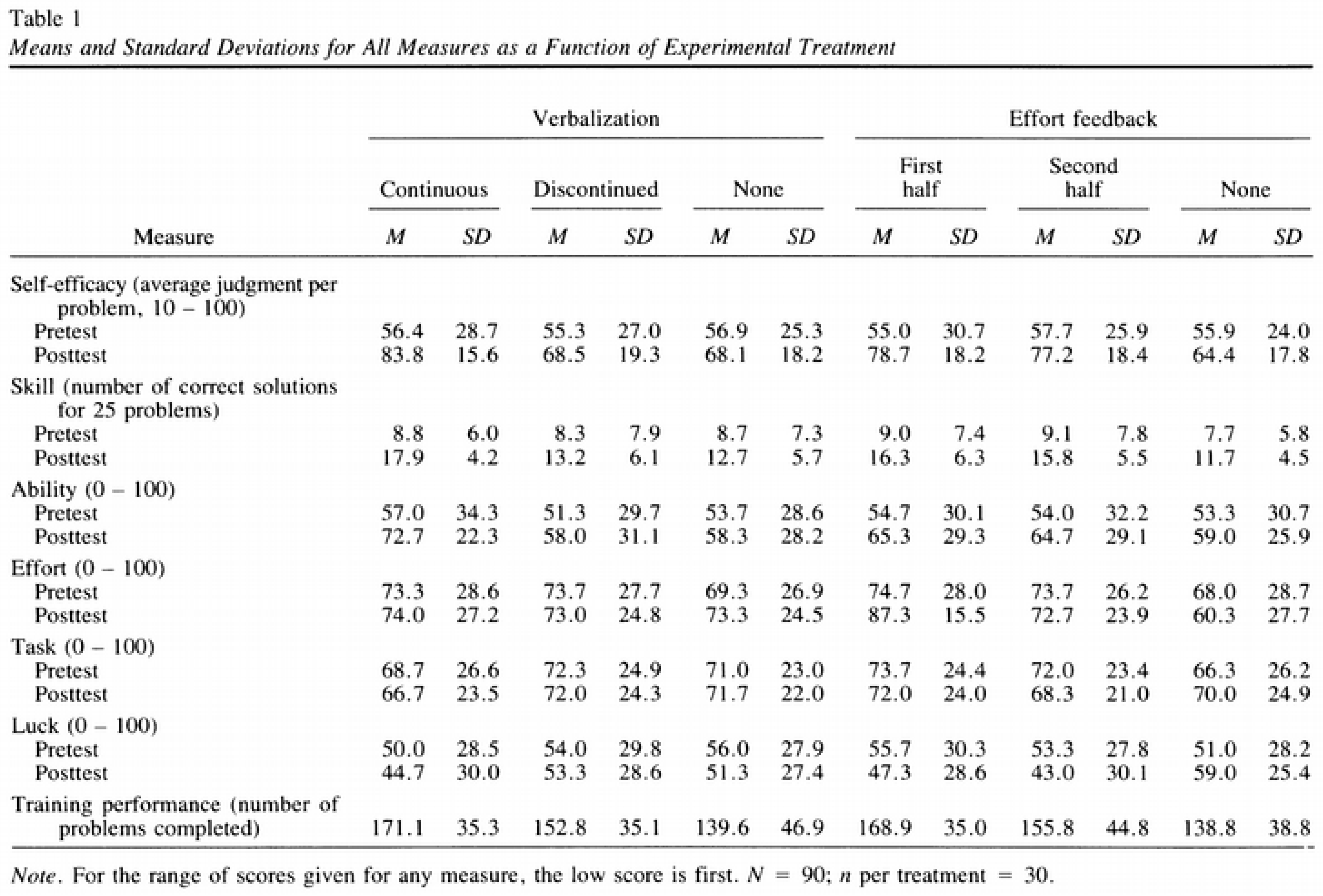

Table 1

Means and Standard Deviations for All Measures as a Function of Experimental Treatment

	Verbalization						Effort feedback					
	Continuous		Discontinued		None		First half		Second half		None	
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Self-efficacy (average judgment per problem, 10 – 100)												
Pretest	56.4	28.7	55.3	27.0	56.9	25.3	55.0	30.7	57.7	25.9	55.9	24.0
Posttest	83.8	15.6	68.5	19.3	68.1	18.2	78.7	18.2	77.2	18.4	64.4	17.8
Skill (number of correct solutions for 25 problems)												
Pretest	8.8	6.0	8.3	7.9	8.7	7.3	9.0	7.4	9.1	7.8	7.7	5.8
Posttest	17.9	4.2	13.2	6.1	12.7	5.7	16.3	6.3	15.8	5.5	11.7	4.5
Ability (0 – 100)												
Pretest	57.0	34.3	51.3	29.7	53.7	28.6	54.7	30.1	54.0	32.2	53.3	30.7
Posttest	72.7	22.3	58.0	31.1	58.3	28.2	65.3	29.3	64.7	29.1	59.0	25.9
Effort (0 – 100)												
Pretest	73.3	28.6	73.7	27.7	69.3	26.9	74.7	28.0	73.7	26.2	68.0	28.7
Posttest	74.0	27.2	73.0	24.8	73.3	24.5	87.3	15.5	72.7	23.9	60.3	27.7
Task (0 – 100)												
Pretest	68.7	26.6	72.3	24.9	71.0	23.0	73.7	24.4	72.0	23.4	66.3	26.2
Posttest	66.7	23.5	72.0	24.3	71.7	22.0	72.0	24.0	68.3	21.0	70.0	24.9
Luck (0 – 100)												
Pretest	50.0	28.5	54.0	29.8	56.0	27.9	55.7	30.3	53.3	27.8	51.0	28.2
Posttest	44.7	30.0	53.3	28.6	51.3	27.4	47.3	28.6	43.0	30.1	59.0	25.4
Training performance (number of problems completed)	171.1	35.3	152.8	35.1	139.6	46.9	168.9	35.0	155.8	44.8	138.8	38.8

Note. For the range of scores given for any measure, the low score is first. $N = 90$; n per treatment = 30.

Self-Efficacy and Skill

Intracondition changes (pretest to posttest) on each measure were evaluated by using the t test for correlated scores (Winer, 1971). Each of the three conditions of verbalization and the three for effort feedback made significant improvements in both self-efficacy and subtraction skill (all p s < .01 except p < .05 on self-efficacy for the no-feedback condition).

Posttest self-efficacy and skill were analyzed with a 3 × 3 (Verbalization × Effort Feedback) multivariate analysis of covariance (MANCOVA), with the corresponding pretest measures as covariates. The MANCOVA yielded significant main effects for verbalization, Wilks's lambda = .642, F (4, 156) = 9.69, p < .001 , and effort feedback, Wilks's lambda = .740, F (4, 156) = 6.34, p < .001 ; the Verbalization × Effort Feedback interaction was nonsignificant. Planned orthogonal comparisons (Kirk, 1982) applied to the posttest self-efficacy measure showed that verbalization conditions led to higher self-efficacy than the no-verbalization condition, t (80) = 2.46, p < .05 ; continuous verbalization led to higher self-efficacy than discontinued verbalization, t (80) = 4.03, p < .01 ; and providing effort feedback promoted self-efficacy more than not providing feedback, t (80) = 4.11, p < .01, $MS_e = 218.04$.

On the measure of posttest skill, planned orthogonal comparisons revealed that the verbalization conditions demonstrated higher subtraction performance than the no-verbalization condition, t (80) = 3.37, $p < .01$; continuous verbalization promoted skill more than discontinued verbalization, t (80) = 4.81, $p < .01$; and effort feedback enhanced skillful performance more than no feedback, t (80) = 5.14, $p < .01$, $MS_e = 14.30$.

Attributions

Within-condition changes (pretest to posttest) on each attribution revealed a significant increase in effort attributions for the first-half-effort-feedback treatment ($p < .05$). The four posttest attributions were analyzed with a MANCOVA having pretest attributions as covariates. This analysis yielded a significant main effect for effort feedback, Wilks's lambda = .746, F (8, 148) = 2.92, $p < .01$; both the verbalization main effect and the Verbalization × Effort Feedback interaction were nonsignificant. Planned comparisons applied to the posttest measure of effort attribution showed that providing effort feedback led to higher effort attributions than not providing feedback, t (80) = 4.15, $p < .01$; students who received effort feedback during the first half of training judged effort as a more important cause of success than did subjects who received feedback during the second half, t (80) = 2.68, $p < .01$, $MS_e = 450.05$.

Training Performance

To determine whether treatments differentially affected students' rate of problem solving during the training sessions, the total number of problems that students completed was analyzed with planned orthogonal contrasts. These comparisons showed that verbalization treatments led to higher performance than the no-verbalization condition, t (81) = 2.61, $p < .05$, and that effort feedback led to more rapid problem solving than did no effort feedback, t (81) = 2.74, $p < .01$, $MS_e = 1470.01$. These differences were not attained at the expense of accuracy; identical results were obtained by using the proportion of problems solved correctly (i.e., number solved correctly divided by total number completed).

Planned orthogonal comparisons applied to the number of problems that students completed during the first half of training revealed that subjects in the verbalization conditions solved problems more rapidly did those in the noverbalization condition, t (81) = 2.55, $p < .05$; that effort-feedback treatments enhanced the rate of problem solving, compared with no feedback, t (81) = 2.29, $p < .05$; and that first-half effort feedback led to more rapid problem solving than did second-half feedback, t (81) = 2.05, $p < .05$, $MS_e = 551.26$). The same pattern of results was obtained when the proportion of problems solved correctly was used.

The number of problems that students completed during the second half of training was also analyzed with planned comparisons, which yielded the following significant results: The verbalization conditions outperformed the noverbalization condition, t (81) = 2.18, $p < .05$; continuous-verbalization students completed more problems than discontinued verbalization subjects, t (81) = 2.51, $p < .05$; and effort-feedback students demonstrated more rapid problem solving than the no-feedback students, t (81) = 2.79, $p < .01$, $MS_e = 340.31$. Identical results were obtained when the proportion of problems solved correctly was used.

Correlational Analyses

Product-moment correlations were computed among posttest self-efficacy, posttest skill, the four posttest attributions, and training performance (number of problems completed). Self-efficacy was positively related to skill, ability and effort attributions, and training performance (ps < .01). Skill was positively correlated with ability and effort attributions and with training performance (ps < .01). The more problems that children completed during training, the higher were their ability ($p < .01$) and effort attributions ($p < .05$), but the lower were their luck attributions ($p < .05$). Ability attributions and effort attributions were positively related ($p < .05$).

Discussion

The present study shows that overt verbalization of the steps of problem solution and their application to problems facilitates task performance, self-efficacy, and skills. These findings are consistent with previous work demonstrating that verbalization often is beneficial for students who typically perform in a deficient manner (Denney & Turner, 1979 ; Meichenbaum, 1977 ; Schunk, 1982) and support the idea that private speech can help to regulate task performance (Vygotsky, 1962 ; Zivin, 1979). Learning disabled students often are inattentive to task instructions and display lackadaisical efforts while working at tasks (Licht, 1984 ; Torgesen & Licht, 1983). It has been suggested that verbalization might assist these students to work in a more systematic manner (Hallahan et al., 1983).

Although this study shows that overt verbalization is beneficial for training students to use a strategy, it does not specify the process by which verbalization promotes achievement outcomes. One possibility is that verbalization helps to focus students' attention on important task features and, as a form of rehearsal, assists strategy encoding and retention (Schunk, 1982) It is also possible that verbalization conveys to students a sense of personal control over learning outcomes because verbalization makes salient a strategy that can facilitate problem solving (Schunk, 1982). As students effectively use the strategy, they are apt to develop higher self-efficacy for continuing to perform well (Bandura, 1982a ; Schunk, 1985).

Contrary to our prediction, discontinued verbalization did not enhance achievement outcomes as well as continuous verbalization. A lower level of problem solving during the second half of training, relative to that experienced by continuous-verbalization students, should not have promoted self-efficacy or subtraction skills as well. It is possible that, despite proctor instructions to the contrary, discontinued-verbalization students abandoned the strategic approach to problem solving when instructed to no longer verbalize aloud. They may have had difficulty internalizing the strategy; that is, they may not have produced or utilized covert instructions to regulate their performances (Wilder et al., 1984). They also may have believed that although the strategy was useful, other factors (e.g., effort) were more important for solving problems. Children often have naive ideas about when a strategy may be useful (Wellman, 1983).

Brown and her colleagues have emphasized that cognitive-skill training needs to include the following three components: instruction and practice in applying a strategy, training in self-regulated implementation and monitoring of strategy use, and information on strategy value and on the range of tasks to which the strategy can be applied (Brown, Campione, & Day, 1981 ; Brown & Palincsar, 1982 ; Brown, Palincsar, & Armbruster, 1984). When students receive only the first (skill-training) component, as in the present study, they may not use the strategy on their own because they do not fully understand how and when to apply the strategy or that strategy use greatly improves their performance (Baker & Brown, 1984). Regarding the latter point, explicitly linking strategy use with better performance may enhance the effects of strategy training. For example, the trainer could remark after a student correctly solved a problem, “That's correct. You got it right because you applied the steps in the right order.”

One suggestion for facilitating students' self-regulated strategy use is to have them cognitively transform the strategy (Borkowski & Cavanaugh, 1979). Greater cognitive activity can lead to better strategy encoding, retention, and retrieval. A procedure that has been effectively employed to develop self-regulation is self-instructional training , which comprises modeling, guided practice, faded self-guidance (i.e., verbalizations faded to whispers), and covert (silent) self-instruction (Meichenbaum, 1977). There is evidence that this procedure can help students with cognitive deficits (e.g., educable mentally retarded, learning disabled, and remedial), who may not make proper use of verbal mediators to regulate their task performances (Harris, 1982 ; Johnston et al., 1980 ; Whitman & Johnston, 1983 ; Wilder et al., 1984).

This study also demonstrates that effort-attributional feedback for students' problem-solving successes led to higher self-efficacy and subtraction skills. As students solve problems, they begin to develop self-efficacy for performing well. Telling them that effort is responsible for their successes conveys that they are developing skills and that they can continue to perform well with hard work (Schunk, 1984). The perception of skill improvement can raise self-efficacy and lead to greater skill development (Schunk, 1985).

It is somewhat surprising that there was no difference in self-efficacy or skill between the two conditions of effort feedback. We thought that effort feedback for early successes would be viewed as credible by students but that discontinuing effort feedback would decrease the salience of effort as a cause of success. The perception of less effort for success raises self-efficacy more than greater effort being required does (Bandura, 1982b). Conversely, effort feedback for later successes might lead students to question their capabilities because they could wonder why they still had to work hard to succeed (Schunk, 1984). Such self-doubts should not result in high self-efficacy (Schunk, 1985).

One possible explanation for these results is that because students had a learning disability in mathematics, they probably had to expend effort to solve problems throughout the training program. Receiving effort feedback for later successes may have seemed just as credible to these students as early effort feedback seemed to subjects receiving it during the first half of training. Rather than questioning their capabilities, students who received later effort feedback may have interpreted it as indicating that they were becoming more skillful.

It is interesting that only students in the first-half-effort-feedback treatment showed a significant gain in effort attributions, which suggests that early effort feedback served to highlight the role of effort as a cause of success. This finding is noteworthy because researchers have demonstrated that learning disabled students are less likely to attribute outcomes to effort than are their nondisabled peers (Butkowsky & Willows, 1980 ; Licht, 1984 ; Pearl et al., 1980). Training procedures that help learning disabled students attribute outcomes to effort have important teaching implications.

No Verbalization × Effort Feedback interactions were obtained on any measure. Given the difficulty of the task for the present sample, only limited gains in subtraction skills and self-efficacy may have been possible. Had the study been conducted over a longer period, it is possible that continuous verbalization plus second-half effort feedback might have led to the largest increases in self-efficacy and skills, assuming that students still needed to expend effort to succeed.

The lack of interactions should not imply that verbalization and effort feedback are interchangeable procedures. Verbalization is useful for training students to systematically use a task strategy, whereas effort feedback can motivate students to continue working diligently at the task. No amount of effort feedback will promote self-efficacy and skills if students do not understand how to apply a task strategy. Effort feedback is useful as an adjunct to a sound instructional program.

To sound a precautionary note, however, we believe that effort feedback for the same task over an extended period is not necessarily desirable, even with learning disabled students. The present task likely engendered a self-focus; students worked alone and could have compared their present performance to how they had performed previously. As students become more skillful over time, they ought to solve problems with less perceived effort. In a resource room, students also could compare their performances with those of their peers. Students actually might feel less efficacious if they continually received effort feedback because they might wonder why they had to work hard to succeed when their peers demonstrated comparable performance but did not receive effort feedback.

Future research needs to explore what effort-attributional feedback means to students. In school, the meaning of attributional feedback stems largely from interactions with teachers. Teachers often combine effort with praise in hopes of encouraging learning disabled students to persevere at tasks (e.g., “That's good. You're really working hard.”). Praise can convey how the teacher views student abilities (Weiner, Graham, Taylor, & Meyer, 1983). Especially when students believe that a task is easy, praise combined with effort information signals low ability. The present results suggest that students did not interpret effort feedback as indicating low ability; first-half-feedback students did not place less emphasis on ability as a cause of success. Effort feedback over an extended period might imply lower ability among learning disabled students if they believed that their skills had improved considerably.

Consistent with previous similar research, this study supports the idea that although self-efficacy is influenced by prior performances, it is not merely a reflection of them (Schunk, 1982, 1984). Students who received effort feedback during the first half of training solved more problems during the first half of training than students who received effort feedback during the second half of training; students in these two conditions did not differ, however, in their self-efficacy judgments. This finding is not surprising. Efficacy appraisal is an inferential process that involves judging the relative contributions of factors such as attributions, amount of external aid received, situational circumstances under which the performances occurred, and changes in performance patterns (Bandura, 1982b ; Schunk, 1985).

The present results have implications for teaching. Learning disabled students who were deficient in subtraction skills benefited from verbalizing aloud while solving problems and from receiving feedback that linked their successful problem solving with their efforts. Both procedures can easily be implemented in resource rooms. At the same time, the utility of verbalization as a remedial procedure will be enhanced if research demonstrates that verbalizations can effectively be faded to a covert level; many students verbalizing simultaneously could prove distracting to some. Teachers also need to know how other forms of attributional feedback (e.g., ability) affect students' self-efficacy. For example, Schunk (1984) found with children in regular classes that ability feedback for early successes enhanced self-efficacy and skillful performance better than effort feedback did. Understanding how learning disabled students use private speech and interpret attributional feedback would have important implications for teaching.

Footnotes

[1] We decided not to include a condition in which students verbalized only during the second half of the training program. Although this condition would have created a more balanced experimental design, we felt that the best way to determine the effects of continuity of verbalization was to compare these effects with those due to discontinued verbalization. Theory and research on verbalization suggest that it may be beneficial as a means of instilling strategic behaviors and that once these behaviors have been acquired, students can regulate their performances covertly (Meichenbaum, 1977 ; Zivin, 1979). We also felt that asking students to begin verbalizing after they had been silently solving problems for three sessions might prove confusing and actually disrupt their performances. From an applied perspective, knowing the effects of discontinued verbalization is important; an entire class verbalizing aloud would undoubtedly prove distracting to some students.

[2] Copies of all test instruments and training materials are available from the first author.

[3] Students who were having difficulty solving problems could also consult the proctor during the periodic monitoring conducted in conjunction with the attributional feedback. Of the 90 students in the final sample, 10 consulted the proctor at various times during the training program; they were proportionately distributed throughout the treatment conditions.

References

Andrews, G. R., & Debus, R. L. (1978). Persistence and the causal perception of failure: Modifying cognitive attributions. Journal of Educational Psychology, 70, 154–166.
Asarnow, J. R., & Meichenbaum, D. (1979). Verbal rehearsal and serial recall: The mediational training of kindergarten children. Child Development, 50, 1173–1177.
Baker, L., & Brown, A. L. (1984). Metacognitive skills and reading. In P. D.Pearson (Ed.), Handbook of reading research (pp. 353–394). New York: Longman.
Bandura, A. (1982a). The self and mechanisms of agency. In J.Suls (Ed.), Psychological perspectives on the self (Vol. 1, (pp. 3–39). Hillsdale, NJ: Erlbaum.
Bandura, A. (1982b). Self-efficacy mechanism in human agency. American Psychologist, 37, 122–147.
Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. Journal of Personality and Social Psychology, 41, 586–598.
Boersma, F. J., & Chapman, J. W. (1981). Academic self-concept, achievement expectations, and locus of control in elementary learning-disabled children. Canadian Journal of Behavioural Science, 13, 349–358.
Borkowski, J. G., & Cavanaugh, J. C. (1979). Maintenance and generalization of skills and strategies by the retarded. In N. R.Ellis (Ed.), Handbook of mental deficiency, psychological theory and research (2nd ed., (pp. 569–617). Hillsdale, NJ: Erlbaum.
Brown, A. L., Campione, J. C., & Day, J. D. (1981). Learning to learn: On training students to learn from texts. Educational Researcher, 10(2), 14–20.

Brown, A. L., & Palincsar, A. S. (1982). Inducing strategic learning from texts by means of informed, self-control training. Topics in Learning & Learning Disabilities, 2, 1–17.

Brown, A. L., Palincsar, A. S., & Armbruster, B. B. (1984). Instructing comprehension-fostering activities in interactive learning situations. In H.Mandl, N. L.Stein, & T.Trabasso (Eds.), Learning and comprehension of text (pp. 255–286). Hillsdale, NJ: Erlbaum.

Butkowsky, I. S., & Willows, D. M. (1980). Cognitive-motivational characteristics of children varying in reading ability: Evidence for learned helplessness in poor readers. Journal of Educational Psychology, 72, 408–422.

Denney, N. W., & Turner, M. C. (1979). Facilitating cognitive performance in children: A comparison of strategy modeling and strategy modeling with overt self-verbalization. Journal of Experimental Child Psychology, 28, 119–131.

Diener, C. I., & Dweck, C. S. (1980). An analysis of learned helplessness: II. The processing of success. Journal of Personality and Social Psychology, 39, 940–952.

Dweck, C. S. (1975). The role of expectations and attributions in the alleviation of learned helplessness. Journal of Personality and Social Psychology, 31, 674–685.

Elig, T. W., & Frieze, I. H. (1979). Measuring causal attributions for success and failure. Journal of Personality and Social Psychology, 37, 621–634.

Friend, J., & Burton, R. (1981). Teacher's guide: Diagnostic testing in arithmetic: Subtraction. Palo Alto, CA: Xerox Palo Alto Research Center.

Grimm, J. A., Bijou, S. W., & Parsons, J. A. (1973). A problem-solving model for teaching remedial arithmetic to handicapped young children. Journal of Abnormal Child Psychology, 1, 26–39.

Hallahan, D. P., Kneedler, R. D., & Lloyd, J. W. (1983). Cognitive behavior modification techniques for learning disabled children: Self-instruction and self-monitoring. In J. D.McKinney & L.Feagans (Eds.), Current topics in learning disabilities (Vol. 1, (pp. 207–244). Norwood, NJ: Ablex.

Harris, K. R. (1982). Cognitive-behavior modification: Application with exceptional children. Focus on Exceptional Children, 15, 1–16.

Johnston, M. B., Whitman, T. L., & Johnson, M. (1980). Teaching addition and subtraction to mentally retarded children: A self-instructional program. Applied Research in Mental Retardation, 1, 141–160.

Kelley, H. H., & Michela, J. L. (1980). Attribution theory and research. Annual Review of Psychology, 31, 457–501.

Kirk, R. E. (1982). Experimental design: Procedures for the behavioral sciences (2nd ed.). Monterey, CA: Brooks/Cole.

Licht, B. G. (1984). Cognitive-motivational factors that contribute to the achievement of learning-disabled children. In J. K.Torgesen & G. M.Senf (Eds.), Annual review of learning disabilities (Vol. 2, (pp. 119–126). New York: Professional Press.

Maruyama, G. (1982). How should attributions be measured? A reanalysis of data from Elig and Frieze. American Educational Research Journal, 19, 552–558.

Meichenbaum, D. (1977). Cognitive behavior modification. New York: Plenum Press.

Pearl, R., Bryan, T., & Donahue, M. (1980). Learning disabled children's attributions for success and failure. Learning Disability Quarterly, 3, 3–9.

Schunk, D. H. (1982). Verbal self-regulation as a facilitator of children's achievement and self-efficacy. Human Learning, 1, 265–277.

Schunk, D. H. (1984). Sequential attributional feedback and children's achievement behaviors. Journal of Educational Psychology, 76, 1159–1169.

Schunk, D. H. (1985). Self-efficacy and classroom learning. Psychology in the Schools, 22, 208–223.

Texas Education Agency. (1983). State Board of Education rules for handicapped students. (TEA Document No. AD4 710 01). Austin, TX: Author.

Torgesen, J. K., & Licht, B. G. (1983). The learning disabled child as an inactive learner: Retrospect and prospects. In J. D.McKinney & L.Feagans (Eds.), Current topics in learning disabilities (Vol. 1, (pp. 3–31). Norwood, NJ: Ablex.

Vygotsky, L. S. (1962). Thought and language. Cambridge, MA: MIT Press.

Wechsler, D. (1974). Wechsler Intelligence Scale for Children: Form R. New York: Psychological Corporation.

Weiner, B. (1979). A theory of motivation for some classroom experiences. Journal of Educational Psychology, 71, 3–25.

Weiner, B., Graham, S., Taylor, S. E., & Meyer, W. (1983). Social cognition in the classroom. Educational Psychologist, 18, 109–124.

Wellman, H. M. (1983). Metamemory revisted. In M. T. H.Chi (Ed.), Trends in memory development research (pp. 31–51). Basel, Switzerland: S. Karger.

Whitman, T., & Johnston, M. B. (1983). Teaching addition and subtraction with regrouping to educable mentally retarded children: A group self-instructional training program. Behavior Therapy, 14, 127–143.

Wilder, L., Draper, T. W., & Donnelly, C. P. (1984). Overt and covert verbalization in normal and learning disabled children's problem solving. Perceptual and Motor Skills, 58, 976–978.

Winer, B. J. (1971). Statistical principles in experimental design (2nd ed.). New York: McGraw-Hill.

Woodcock, R., & Johnson, M. (1977). Woodcock-Johnson Psycho-Educational Battery. Boston: Teaching Resources.

Zivin, G. (1979). The development of self-regulation through private speech. New York: Wiley.

Submitted: May 9, 1985 Revised: January 13, 1986