Self-Modeling and Children's Cognitive Skill Learning

By: Dale H. Schunk and Antoinette R. Hanson

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Article:

Bandura (1982, 1986) contended that psychological procedures change behavior in part by creating and strengthening perceived self-efficacy, or personal beliefs about one's performance capabilities in a given domain. Self-efficacy influences choice of activities, effort expended, persistence, and task accomplishments. Individuals acquire information about their self-efficacy through their actual performances, vicarious (observational) experiences, forms of persuasion, and physiological indexes (e.g., heart rate, sweating).

Observation of models is an important vicarious source of efficacy information. The effect on observers depends in part on perceived similarity to models (Schunk, 1987). Festinger (1954) hypothesized that, where objective standards of behavior are unclear or unavailable, observers evaluate themselves through social comparisons with others. The most accurate self-evaluations derive from comparisons with those similar in the ability or characteristic being evaluated. Observing similar others succeed raises observers' self-efficacy and motivates them to try the task. Model attributes (e.g., age, perceived competence) often are predictive of performance capabilities (Bandura, 1986). Similarity is especially influential when individuals are uncertain about their capabilities, as when they lack task familiarity and have little information on which to base efficacy judgments or when they have experienced difficulties and possess doubts about performing well.

Given that ability-related behaviors are highly susceptible to peer influence (Davidson & Smith, 1982), an adult's flawlessly modeled demonstration may not promote self-efficacy in students who have experienced learning difficulties and who view the teacher as superior in competence. Peer models who students believe are similar in competence to themselves may better promote students' self-efficacy for learning. Schunk and Hanson (1985) found that children who observed a peer model learn to solve subtraction problems developed higher self-efficacy for learning than did children who observed an adult model the same operations.

Model–observer attribute similarity is heightened when one is one's own model (Bandura, 1986). Self-modeling refers to behavioral change that derives from observing oneself on videotapes that portray only desired (target) behaviors (Dowrick, 1983; Hosford, 1981). In a typical experiment, subjects are videotaped individually as they perform behaviors, after which they view their own tapes. Tapes can capture existing behaviors by having subjects role play or perform previously learned skills or can portray behaviors created with editing (deleting errors) and illusory techniques (using camera angles that obscure aid from others). Self-modeling has been used to train physical, vocational, communication, teaching, and social–personal skills (Carroll & Bandura, 1982; Davis, 1979; Dowrick & Dove, 1980; Dowrick & Hood, 1981; Dowrick & Raeburn, 1977; Fuller & Manning, 1973; Hosford & Mills, 1983; Miklich, Chida, & Danker-Brown, 1977; Pigott & Gonzales, 1987).

The purpose of the present three experiments was to determine the effects of self-model treatments on children's achievement beliefs and behaviors during mathematical skill learning (fractions). We expected that self-model procedures would raise self-efficacy and achievement behaviors among our subjects, who had encountered mathematical difficulties. Observing a self-model tape allows one to rehearse mentally the skills portrayed. Observing oneself performing well also raises observers' self-efficacy for further learning and leads them to expend effort and persist at the task. Self-modeling is enhanced by increases in self-efficacy even when subjects are given erroneous skills information (Dowrick, 1983).

Experiment 1

In Experiment 1 we compared self-modeling with the effects of observing peer models. We expected that these treatments would be equally effective in enhancing children's achievement behaviors. Observing peer models solve problems enhances children's self-efficacy for learning, which subsequently is substantiated as children solve problems themselves (Schunk & Hanson, 1985). We believed that children's observations of themselves performing well would enhance their perceptions of progress in learning and their self-efficacy for further learning.

Method

Subjects

The initial subject pool of 54 children from three elementary schools previously had been classified by the school district as working below grade level in mathematics. During the preceding academic year, children had been administered the California Achievement Tests (CTB/McGraw-Hill, 1977). Children were assigned to below-level classes if their mathematics total score was below the 35th percentile and if their previous year's teacher approved. At the time of this study, no subject received special education services.

Six children were excluded: Three were absent and missed some instructional sessions, one was accidentally shown the wrong videotape, and two were randomly excluded from the appropriate cells to equate cell sizes. Ages of the 48 children in the final sample (27 girls, 21 boys) ranged from 9 years, 3 months to 12 years, 11 months (M = 10.9 years). Various socioeconomic backgrounds were represented, but children were predominantly middle class. Ethnic composition was 46% White, 42% Black, and 12% Mexican American.

Materials and procedures

The pretest on fractions self-efficacy and skill was administered to children individually by one of four adult testers from outside the school. The self-efficacy test assessed children's perceived capabilities for correctly solving types of problems. The scale ranged in 10-unit intervals from not sure (10) to really sure (100). The stimulus materials comprised 31 sample pairs of problems. The two problems constituting each pair were similar in form and operations required and corresponded to one problem on the skill test, although they involved different numbers. The reliability of the efficacy test was assessed in conjunction with a previous study (Schunk, Hanson, & Cox, 1987), test-retest r = .79.

After receiving practice using the self-efficacy scale, children were shown the 31 pairs of fraction problems (about 2 s for each pair). This brief duration allowed assessment of problem difficulty but not actual solutions; children judged their certainty of solving different types of problems rather than their certainty of solving any particular problem. After privately making each judgment, children covered it with a blank sheet of paper to minimize influence from prior judgments. The 31 scores were summed and averaged.

The fraction skill test was administered after the efficacy assessment and comprised 31 problems that tapped addition and subtraction as follows (examples in parentheses): addition, like denominators, no carrying (1/6 + 4/6); addition, like denominators, carrying (9/10 + 5/10); addition, unlike denominators, no carrying (5/16 + 2/4); addition, unlike denominators, carrying (11/15 + 37/45); subtraction, like denominators, no regrouping (7/9 − 3/9); and subtraction, unlike denominators, no regrouping (21/36 - 8/18). Approximately 70% of these problems were similar to those children solved during the instructional sessions; the others were more complex. For example, during the sessions students solved problems with two terms, whereas some skill test problems included three terms (1/3 + 2/12 + 1/4). Different forms of the skill test were used on the pretest and posttest to eliminate effects due to problem familiarity (parallel forms r = .90; Schunk et al., 1987).

The tester presented problems to children one at a time on separate sheets of paper and verbally instructed them to place each page on a completed stack when they finished solving the problem or chose not to work on it any longer. Children were given no feedback on solution accuracy. The measure of skill was the number of problems solved correctly.

After the pretest, children were assigned randomly within sex and school to one of four treatment conditions: peer-model, self-model, peer- + self-model (combined), or videotape control. During a special session prior to the instructional program, peer-model and peer- + self-model subjects viewed a 45-min videotape that presented each of the six fraction skills in 7- to 8-min blocks. The videotape, which ensured standardized presentation across subjects, portrayed a female adult teacher and three peer (child) models ranging in age from 10.0 to 11.1 years (M = 10.5 years). Multiple peer models were used to enhance the likelihood of subjects perceiving themselves as similar to at least one of the models and because multiple models promote self-efficacy better than a single model (Schunk et al., 1987; Thelen, Fry, Fehrenbach, & Frautschi, 1979). There were two versions of the tape; they portrayed three male (female) peer models and were shown to male (female) subjects. A female teacher was used because most elementary teachers in the school district were women. Teachers and models were unfamiliar to subjects.

Each videotape initially showed the teacher at a chalkboard explaining and demonstrating how to add fractions with like denominators (no carrying). After this 2- to 3-min demonstration, the teacher wrote a comparable problem on the board for the model to solve. The model worked at an average rate while verbalizing the problem-solving operations. After finishing the problem, the model was told that the solution was correct, after which the teacher erased the work and wrote another problem on the board. The model solved problems for the remainder of the block (5–6 min). The teacher then explained and demonstrated the next fraction skill, gave the model problems to solve, and so on. Each peer model in each of the tapes participated in two of the six blocks.

Children viewed the appropriate videotape in small groups. An adult trainer stated that it showed a teacher and some boys (girls) who were learning to solve fractions but did not comment while children were watching the videotape. On completion of the tape, the trainer administered the self-efficacy for learning measure, which was identical to the pretest efficacy assessment except that children judged their certainty of learning to solve different types of problems rather than their certainty of being able to solve them. Self-model and videotape control children completed the self-efficacy for learning measure at this time.

All children received the fractions instructional program during 45-min sessions on 6 school days. Sessions were conducted by adult trainers from outside the school. For any given child, the same trainer administered all six sessions but had not administered the child's pretest or videotape and was unaware of the child's experimental assignment.

Each of the six sets of instructional material incorporated one of the six fractions operations. In each set, the first page contained an explanation of the relevant operations, along with two examples illustrating their application. Each of the following pages contained several similar problems to be solved using the designated strategy. Students worked on one set during each instructional session. Each set included sufficient problems so that children could not complete all of them during the session.

At the start of each session, children met in small groups with their trainer, who verbally reviewed the explanatory page. After this instructional phase (about 5 min), children solved two practice problems. The trainer stressed the importance of performing the steps as shown on the explanatory page, seated subjects at desks separated from one another, and moved out of sight. Children solved problems alone during the remainder of the session (about 30 min). If they were baffled about how to solve a problem they could consult the trainer, who reviewed the troublesome operation.[1]

All children were videotaped during a special session following the third session, which gave children experience in working fractions and allowed for potential self-modeling effects in subsequent sessions. Each child was escorted to a private room by an adult who had not served as his or her tester or trainer. Initially, each child practiced solving three problems with corrective instruction as necessary. Once the trainer was satisfied that children could solve the problems, he or she wrote 12 problems on a chalkboard that involved addition of fractions and were similar to those covered during the first three sessions. Children verbalized while solving problems so that verbalizations could serve as self-model cues. They were given no feedback during taping; when they finished a problem they began solving the next one. Children were prompted verbally when they failed to verbalize or when they made a computational error (e.g., "How much is seven times four?"). Taping lasted approximately 15 min per child. No child experienced conceptual difficulties.[2]

Each self-model and peer- + self-model subject viewed his or her videotape the next day in a private room. The trainer did not comment until after the tape, when children were administered a measure of perceived progress. This 10-unit scale ranged in 10-unit intervals from not better (10) to a whole lot better (100). Children were asked to think about their problem solving and judge how they were in working fractions compared with when the project began. Subjects in the other two conditions completed the progress measure at this time but did not view their videotapes until after the posttest.

Children received the posttest (self-efficacy, skill) on the day after the last instructional session. For any given child, the tester was unaware of the child's experimental assignment and performance during the instructional program. Tests and instructional materials were scored by an adult who had not participated in the data collection and was unaware of children's experimental assignments.

Results

Means and standard deviations are shown in Table 1. Preliminary analyses of variance (ANOVAS) yielded no significant between-conditions differences on pretest self-efficacy or skill. There also were no significant differences on any measure due to tester, school, or sex of student.

Table 1
Means and Standard Deviations: Experiment 1

Measure/phase	Experimental condition			
	Peer-model	Self-model	Peer- and self-models	Videotape control
Self-efficacy[a]				
Pretest				
M	52.0	52.2	46.8	51.2
SD	15.7	14.5	15.8	19.1
Posttest				
M	85.2	87.3	86.2	66.7
SD	11.6	10.2	10.4	13.6
Skill[b]				
Pretest				
M	6.1	5.8	4.8	5.4
SD	5.2	5.5	4.2	3.9
Posttest				
M	14.8	15.3	14.2	9.1
SD	5.4	3.7	4.2	4.9
Self-efficacy for learning[c]				
M	83.3	61.9	80.3	59.8
SD	12.9	17.5	11.3	20.1
Instructional performance[d]				
M	168.2	161.8	150.0	120.7
SD	18.6	25.2	23.2	28.2
Perceived progress[e]				
M	74.2	80.0	78.3	50.0
SD	26.1	26.6	22.5	16.5

Note. $N = 48$; n per condition = 12.
[a] Average judgment per problem; 10 (low) to 100. [b] Number of correct solutions on 31 problems. [c] Average judgment per problem; 10 (low) to 100. [d] Number of problems completed. [e] 10 (*not better*) to 100 (*a whole lot better*).

Self-efficacy and skill

Intracondition changes (pretest to posttest) on each measure were evaluated using the t test for correlated scores (Winer, 1971). All four conditions showed significant increases (ps < .01 except videotape control p < .05 on self-efficacy).

Posttest self-efficacy and skill were analyzed with a 2 × 2 (Peer-Model: Yes/No × Self-Model: Yes/No) multivariate analysis of covariance (MANCOVA), the corresponding pretest measures were covariates. This analysis yielded significant effects for peer-model, Wilks's lambda = .818, $F(2, 41) = 4.56$, $p < .05$, and for self-model, lambda = .729, $F(2, 41) = 7.61$, $p < .01$; the peer-model × self-model interaction also was significant, lambda = .746, $F(2, 41) = 7.00$, $p < .01$. Univariate analyses of covariance (ANCOVAS) revealed significant effects on self-efficacy for peer-model, $F(1, 43) = 6.58$, $p < .05$, and for self-model $F(1, 43) = 10.22$ $p < .01$, as well as a significant peer-model × self-model interaction, $F(1, 43) = 8.67$, $p < .01$ ($MSe = 134.96$) . The skill measure yielded a significant effect for self-model, $F(1, 43) = 6.06$, $p < .05$, and a significant interaction, $F(1, 43) = 6.35$, $p < .05$ ($MSe = 18.09$) .

Posttest means were evaluated using Dunn's multiple comparison procedure (Kirk, 1982). The peer-model, self-model, and peer- + self-model conditions did not differ on either measure, but each condition scored higher than the videotape control condition (self-efficacy $ps < .01$; skill $ps < .05$ except $p < .01$ for the self-model/videotape control comparison).

Instructional session measures

A 2 × 2 ANCOVA applied to the self-efficacy for learning measure using pretest efficacy as the covariate yielded a significant peer-model effect, $F(1, 43) = 27.71$, $p < .001$ ($MSe = 207.28$) . The peer-model and the peer- + self-model conditions did not differ, but each condition judged self-efficacy significantly higher than the self-model and videotape control conditions ($ps < .01$ except $p < .05$ for the self-model/peer- + self-model comparison). The self-model and videotape control conditions did not differ.

The progress measure was analyzed with a 2 × 2 ANOVA, which yielded a significant self-model effect, $F(1, 44) = 6.46$, $p < .05$ ($MSe = 542.24$) . Subjects assigned to the self-model and to the peer- + self-model conditions judged perceived progress significantly ($ps < .05$) higher than did videotape control subjects.

The number of problems completed during the instructional sessions was analyzed with a 2 × 2 ANOVA, which yielded a significant peer-model effect, $F(1, 44) = 6.63$, $p < .05$, and a significant peer-model × self-model interaction, $F(1, 44) = 18.21$, $p < .001$ ($MSe = 578.29$) . Peer-model ($p < .01$), self-model ($p < .01$), and peer- + self-model ($p < .05$) children solved significantly more problems than did videotape control subjects. More rapid problem solving was not attained at the expense of accuracy; similar results were obtained using the proportion of problems solved correctly (number correct divided by number completed).

Correlational analyses

Product-moment correlations were computed among self-efficacy for learning, perceived progress, instructional session performance (number of problems completed), posttest self-efficacy, and skill. All correlations were positive and significant ($ps < .05$ except $p < .01$ for progress/posttest self-efficacy and instructional performance/posttest self-efficacy).

Experiment 2

In Experiment 2 we investigated the timing of self-model videotaping and tape review—early or later in the instructional program. We expected that exposure to self-model tapes would be more important than timing, despite Dowrick's (1983) suggestion that greater behavioral change occurs from viewing self-model tapes later in an experimental intervention. We thought that observing early successes would enhance children's self-efficacy for continued learning, motivation, and skill development throughout the instructional program. We also believed that the late self-model treatment would result in high task motivation during the remaining instructional sessions, because viewing personal successes on difficult tasks builds a strong sense of efficacy (Bandura, 1986).

Method

Subjects

Subject selection procedures were identical to those of Experiment 1. The final sample included 40 children (24 boys, 16 girls) enrolled in below grade level classes for mathematics in two elementary schools. Ages ranged from 10 years, 0 months to 12 years, 3 months (M = 11.0 years). Socioeconomic and ethnic backgrounds of subjects were similar to those in Experiment 1.

Materials and procedure

The pretest, instructional session, self-model videotape session, and posttest materials and procedures of Experiment 1 were used with the following modifications. After pretesting, children were assigned randomly within sex and school to one of four treatments—early self-model, late self-model, videotape control, or instructional control. Children in the first three conditions were videotaped during the experiment. The instructional control condition was included to disentangle effects of being videotaped from those due to receiving instruction. Instructional control children were told that they would be videotaped later (after the posttest). Children value the opportunity to be videotaped, and we did not want these subjects to become discouraged.

Table 2
Means and Standard Deviations: Experiment 2

	Experimental condition			
Measure/phase	Early model	Late model	Videotape control	Instructional control
Self-efficacy[a]				
Pretest				
M	43.8	41.0	37.4	44.1
SD	9.9	15.3	16.8	12.3
Posttest				
M	74.8	80.9	52.4	54.8
SD	14.2	15.3	13.9	14.6
Skill[b]				
Pretest				
M	2.8	2.5	2.4	2.8
SD	2.7	2.1	1.8	2.3
Posttest				
M	14.2	14.3	8.4	9.4
SD	2.7	2.5	2.3	2.8
Self-efficacy for learning[c]				
M	75.9	77.9	51.3	58.1
SD	11.7	13.4	15.0	11.9
Instructional performance[d]				
First half				
M	147.2	119.6	123.7	114.8
SD	22.9	45.8	28.5	39.6
Second half				
M	83.2	82.6	57.1	58.4
SD	18.1	11.3	26.0	18.3
Perceived progress[e]				
M	81.0	83.0	54.0	56.0
SD	13.7	8.2	12.6	15.8

Note. $N = 40$; n per condition = 10.
[a] Average judgment per problem; 10 (low) to 100. [b] Number of correct solutions on 31 problems. [c] Average judgment per problem; 10 (low) to 100. [d] Number of problems completed. [e] 10 (*not better*) to 100 (*a whole lot better*).

The videotaping procedure of Experiment 1 was used with the following modifications. Early self-model subjects were videotaped after the second instructional session, which gave children experience with fractions but allowed for self-modeling effects in later sessions. Children solved 15 problems (about 15 min) comparable to those included in the first two instructional sessions. Late self-model subjects were videotaped after the fourth session, which permitted self-modeling effects during the two remaining sessions. These children solved 12 problems (about 15 min) comparable to those included in the third and fourth sessions. No child experienced conceptual difficulties while being taped. All subjects privately viewed their tapes on the day after taping and completed the perceived progress and self-efficacy for learning measures. Videotape control subjects were videotaped either after the second or fourth instructional session. They completed the progress and efficacy measures on the day following taping but did not view their tapes until after the posttest. Instructional control subjects completed the progress and efficacy measures either after session two or four.[3]

Results

Means and standard deviations are shown in Table 2. Preliminary ANOVAS yielded nonsignificant results.

Self-efficacy and skill

Each condition demonstrated significant ($ps < .01$) pretest-to-posttest increases in self-efficacy and skill except for instructional control subjects, who showed no change in self-efficacy. Posttest self-efficacy and skill were analyzed with a MANCOVA; the four treatments constituted the treatment factor. This analysis was significant, $\lambda = .422$, $F(6, 66) = 5.94$, $p < .001$. There were significant treatment effects on self-efficacy, $F(3, 35) = 9.35$, $p < .001$ ($MSe = 215.68$) , and skill, $F(3, 35) = 14.51$, $p < .001$ ($MSe = 6.65$) . The early and late self-model conditions did not differ on either measure, but each condition outperformed the videotape and instructional control conditions ($ps < .01$ except $p < .05$ for the early self-model/videotape control and early self-model/instructional control comparisons on self-efficacy).

Instructional session measures

The self-efficacy for learning measure yielded a significant treatment effect, $F(3, 35) = 10.03$, $p < .001$ ($MSe = 173.81$) . The early and late self-model conditions did not differ, but each judged self-efficacy higher than the videotape control ($ps < .01$) and instructional control ($ps < .05$) conditions. The progress measure yielded a significant treatment effect, $F(3, 36) = 14.71$, $p < .001$ ($MSe = 166.11$) . Self-model conditions judged progress higher ($ps < .01$) than did the videotape and instructional control conditions.

Experimental conditions did not differ in the number of problems completed during the instructional sessions. To determine whether self-model timing influenced problem solving, we analyzed the number of problems that children completed during the first three instructional sessions and during the second three. First-half performance yielded non-significant results. A significant treatment effect was obtained on second-half performance, $F(3, 36) = 4.01$, $p < .05$ ($MSe = 367.61$) . Early and late self-model children completed more problems ($ps < .05$) than did videotape and instructional control subjects. Identical results were obtained using the proportion of problems solved correctly.

Correlational analyses

Correlational results were similar to those of Experiment 1. In addition, second-half performance was positively and significantly related to self-efficacy for learning, first-half performance, perceived progress, posttest self-efficacy, and skill.

Experiment 3

In Experiment 3 we examined how the content of self-model tapes influenced children's achievement beliefs and behaviors, where the content indicated either progress in skill development or complete mastery. As originally conceptualized, self-model tapes portray no errors (Dowrick, 1983; Hosford, 1981); however, viewing errors exerts beneficial effects on self-perceptions and behaviors when people believe that they have improved their skills or when they receive information on how to perform more productively (Hung & Rosenthal, 1981; Trower & Kiely, 1983). We believed that both the mastery and progress self-model treatments would lead children to believe that they had made progress in skill development and thereby enhance self-efficacy and achievement behaviors.

Method

Subjects

The final sample included 60 children (30 girls, 30 boys) enrolled in below grade level classes in two elementary schools. Ages ranged from 8 years, 7 months to 11 years, 5 months ($M = 10.2$ years). Socioeconomic and ethnic backgrounds were similar to those in Experiment 1.

Materials and procedure

The pretest, instructional session, videotape session, and posttest materials and procedures of the preceding experiments were employed with the following modifications. After pretesting, children were assigned randomly within sex and school to one of three conditions: mastery self-model, progress self-model, or videotape control. All subjects were videotaped on the day following the fourth instructional session. Children participated in a 45-min session during which they worked on addition of mixed numbers with and without carrying (e.g., 5 4/7 + 7; 4 5/8 + 2/8; 5 4/6 + 1 1/6; 10 8/9 + 9 7/9). This material was not included in the instructional program, but there were three problems with mixed numbers on the skill test.

Each child was videotaped privately solving 12 problems (about 15 min) involving addition of mixed numbers with carrying (e.g., 7 9/11 + 3 9/11). The trainer initially solved two problems while verbalizing the steps involved. Children solved their problems at a chalkboard and were asked to verbalize as they proceeded. The trainer prompted children if they failed to verbalize or if they made computational errors. If children were unsure of what to do or made a conceptual error, the trainer responded with a prompt or provided corrective instruction.

Mastery and progress self-model conditions were distinguished by the timing of videotaping. Progress self-model subjects were videotaped during the first half of this instructional session; children were learning how to solve fractions with mixed numbers while they were being videotaped. Mastery self-model subjects were videotaped during the second half of this session; problem solving during videotaping constituted a review because they had solved comparable problems during the first half of the session. Self-model subjects viewed their videotapes the following day and completed the perceived progress measure. Videotape control children were videotaped during either the first or second half of this session. These children completed the progress measure the following day but did not view their tapes until after the posttest.

Table 3
Means and Standard Deviations: Experiment 3

	Experimental condition		
Measure/phase	Mastery model	Progress model	Videotape control
Self-efficacy[a]			
Pretest			
M	49.5	47.4	49.0
SD	20.2	22.8	18.4
Posttest			
M	85.7	82.1	67.6
SD	9.4	10.4	12.3
Skill[b]			
Pretest			
M	4.8	3.9	4.1
SD	4.0	2.7	2.6
Posttest			
M	15.0	14.1	8.3
SD	4.6	4.3	2.6
Instructional performance[c]			
M	181.4	180.4	158.7
SD	21.1	13.1	12.8
Perceived progress[d]			
M	73.0	68.0	53.0
SD	19.2	16.4	16.6

Note. $N = 60$; n per condition = 20.
[a] Average judgment per problem; 10 (low) to 100. [b] Number of correct solutions on 31 problems. [c] Number of problems completed. [d] 10 (*not better*) to 100 (*a whole lot better*).

Results

Children's videotapes were scored for conceptual errors by an adult who had not participated in the data collection. Conceptual errors included children not knowing how to solve a problem (e.g., asking the trainer for assistance) or performing an erroneous operation (adding denominators). The criteria for retaining subjects were no conceptual errors for mastery self-model subjects and no conceptual errors during the second half of the problem solving (i.e., last six problems) for progress self-model subjects. The mean numbers of conceptual errors made were 4.1 (progress self-model) and 2.7 (videotape control), which were not significantly different.[4] Means and standard deviations are presented in Table 3. Preliminary ANOVAS yielded nonsignificant differences on all measures.

Self-efficacy and skill

Each experimental condition showed significant increases in self-efficacy and skill from pretest to posttest (ps < .01). MANCOVA applied to posttest self-efficacy and skill was significant, lambda = .481, F(4, 108) = 11.93, p < .001. Univariate ANCOVAS revealed significant treatment effects on self-efficacy, F (2, 56) = 20.65, p < .001 (MSe = 89.56) ; and skill, F (2, 56) = 21.29, p < .001 (MSe = 11.49) . The two self-model conditions did not differ, but each condition scored higher on each measure than did the videotape control condition (ps < .01).

Instructional session performance

Analysis of the progress measure yielded a significant treatment effect, F (2, 57) = 7.11, p < .01 (MSe = 304.56) . Mastery (p < .01) and progress (p < .05) self-model subjects judged progress higher than videotape control children; the former two conditions did not differ.

The ANOVA applied to the number of problems completed during the instructional sessions was significant, F (2, 57) = 8.12, p < .01 (MSe = 260.83) . Self-model conditions did not differ, but each completed more problems than did the videotape control condition (ps < .01). Similar results were obtained using the proportion of problems solved correctly.

Correlational analyses

Product-moment correlations computed among progress, instructional performance (number of problems completed), posttest self-efficacy, and skill were significant and positive (ps < .05 except p < .01 for self-efficacy/skill and self-efficacy/progress).

General Discussion

These studies support the idea that self-model treatments promote children's achievement behaviors during cognitive skill learning. Children who observed their successful problem solving judged their skill acquisition progress greater and demonstrated higher instructional performance, self-efficacy, and skill than did children who were videotaped but did not observe their tapes and those who were not videotaped. In Experiment 1 we found that the benefits of observing self-model tapes are comparable to those of videotaped peer models. In Experiment 2 we showed that observing a self-model tape is more important than the timing of the observation. In Experiment 3 we demonstrated that self-model tapes portraying progress in skill acquisition are as effective as tapes portraying mastery.

Children who have learning difficulties often doubt their capabilities and are unsure of how well they are developing skills (Schunk, in press). Videotape feedback showing their skillful performance conveys that they have made progress in skill development and that they can continue to improve their skills. Higher self-efficacy instated by such self-observation enhances motivation and further skill acquisition. In the absence of this efficacy information, children might wonder whether they have improved their skills and whether they possess the requisite learning capability. Such doubts do not instill positive achievement beliefs or behaviors.

Experiment 1 supports the idea that observing peer models promotes children's self-efficacy for learning, which is substantiated later as children successfully solve problems (Schunk et al., 1987). Peer models raise self-efficacy in part through perceived model-observer similarity (Bandura, 1986). By observing similar peers, children may believe that if peers can learn to solve fractions, they, too, can improve their skills. Multiple models increases the likelihood that children will perceive themselves as similar to at least one of the models (Thelen et al., 1979).

In Experiment 2 we found that exposure to a self-model tape was beneficial but that timing made no difference. The effects of timing might depend in part on how difficult the task is for the subjects. Performing difficult tasks builds stronger self-efficacy than does success on easier tasks (Bandura, 1986). Given that our subjects had encountered prior arithmetic difficulties, the skills covered early in the instructional program probably were difficult for them. The timing issue could be investigated further by including tasks of varying difficulty and by determining whether repeated videotaping produces added benefits.

Experiment 3 revealed comparable benefits of mastery and progress self-model tapes. Both of these treatments portrayed successful problem solving, which raises self-efficacy (Bandura, 1986). Progress self-model children viewed some errors, but they judged their progress as high as did mastery self-model subjects. Showing errors, however, is not always desirable. Errors can have deleterious effects on subjects who already possess negative self-beliefs (Hosford & Mills, 1983; Trower & Kiely, 1983). Subjects who perceive little progress in learning are likely to believe that they are not capable of much improvement (Schunk, in press). When errors are portrayed, they need to be used as the basis for progress (i.e., making fewer errors now) or accompanied by information on how to perform more productively (Dowrick, 1983). Observing oneself overcome errors and master a task shows that one is capable of learning, which raises self-efficacy.

Self-model tapes allow one to review skills, but we do not believe that the obtained effects are due to instructional factors. Children in each condition received the same instructional program. Before self-model subjects observed their tapes, their performance did not differ from those of children not assigned to a self-model treatment (videotape or instructional control). The peer- + self-model subjects in Experiment 1 had two extra videotape skill reviews, yet they differed from self-model children only on the self-efficacy for learning measure administered immediately afte exposure to peer models. Self-model subjects in Experiments 1 and 2 were videotaped solving problems they learned to solve prior to the taping; videotape review had little, if any, impact on their skill acquisition.

This is not to suggest that instruction is unimportant. Our self-model tapes were employed during a fractions instructional program. Videotaping children while they work on tasks and showing them their tapes will not raise self-efficacy if their skills are not well established and they receive no instruction or feedback. In therapeutic settings, the effectiveness of videotaped feedback depends on the presence of a comprehensive treatment program (Hung & Rosenthal, 1981).

We want to emphasize that the present results were obtained with children who had experienced mathematical difficulties and who had few prior successes with fractions. Many schoolchildren are confident about their learning abilities, including some with learning problems (Licht & Kistner, 1986). Children typically receive multiple cues that indicate they are learning and that raise their efficacy for continued learning (e.g., actual task successes, observation of successful peers, positive teacher feedback). For such children, observing a self-model tape may have no benefit because it would merely confirm what they already know. As a means of building self-efficacy and motivating students, self-model tapes seem most effective with students who typically experience problems or who doubt their capabilities to master skills.

Consistent with previous research (Schunk & Hanson, 1985; Schunk et al., 1987), these studies support the idea that self-efficacy is not merely a reflection of prior performances. In Experiments 1 and 2, for example, self-model and videotape control subjects did not differ in their problem solving prior to or during videotaping, yet observation of the tape raised self-model children's self-efficacy. The perception of progress is an important cue in gauging self-efficacy (Schunk, in press). This research also shows that capability self-perceptions bear an important relation to achievement. Personal expectations for success are viewed as important influences on behavior by various theories (Bandura, 1986; Corno & Mandinach, 1983; Covington & Beery, 1976; Weiner, 1985).

These results have implications for educational practice. Videotaping is common in schools, but it rarely is used to portray cognitive skill acquisition. Teachers have neither the time for videotaping nor the technical and editing skills. The present results suggest a target population for self-model tapes and a way to make tapes that requires little technical skill. Students who have experienced learning difficulties can be taped while they practice a recently acquired skill or while they are learning a skill. Videotapes of students' successful performances can serve as a useful adjunct to a sound instructional program in developing their skills and self-efficacy for applying them.

Footnotes

1 Of the 48 students in the final sample, 8 (17%) consulted the trainer of various times during the instructional program; they were equally distributed across experimental conditions. Comparable percentages were obtained in Experiments 2 (22%) and 3 (15%).

2 As Dowrick (1983) observed, between-conditions comparisons of videotape treatments are problematic if the quality of the interaction is not controlled. In the present studies, the trainers present with children during the videotape sessions followed a standard set of instructions. With the exception of the progress self-model treatment of Experiment 3, interactions between the trainers and children were comparable across the various treatments of the three studies.

3 The self-efficacy for learning measure is not too meaningful for subjects in the late self-model condition, because when these subjects completed this measure they had learned to solve more than half of the problems portrayed. We administered this measure at this point to determine whether exposure to a self-model tape influenced self-efficacy. Self-efficacy for learning was not assessed in Experiment 3 because all subjects were videotaped late in the instructional program.

4 From the original sample we dropped 3 students whose problem-solving behaviors did not match their treatment assignments. Two children were dropped from the mastery self-model treatment, and 1 was excluded from the progress self-model condition. The criteria for retaining subjects also were applied to videotape control subjects, but no child in this condition had to be excluded.

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