Influencing Student Mathematics Self-Efficacy Through Teacher Training[1]

Del Siegle
Neag School of Education -- University of Connecticut
2131 Hillside Road Unit 3007
Storrs, CT 06250
860-486-0616
del.siegle@uconn.edu
www.delsiegle.info

Why are some students eager to learn and willing to tackle new challenges while others seem uninterested or unmotivated? Why do some students demonstrate high levels of confidence in their abilities, while others seem unsure of themselves? Self-efficacy refers to individuals' judgments about being able to perform a particular activity. It is an individual's "I can" or "I can't" belief. Bandura (1977) first introduced the construct of self-efficacy in the late '70s. Research over the past 25 years has revealed a positive relationship between self-efficacy beliefs and academic performance and persistence (Multon, Brown, & Lent, 1991). The relationship exists across a wide variety of subjects, experimental designs, and assessment methods. Those with high self-efficacy are not only more likely to attempt tasks, they also work harder and persisted longer in the face of difficulties (Bandura, 1986; Lyman, Prentice-Dunn, Wilson, & Bonfilio, 1984; Schunk, 1981).

The purpose of this study was to assess changes in students' mathematics self-efficacy after staff development on classroom self-efficacy strategies had been conducted with their teachers. This study differed from previous studies on self-efficacy in four ways. First, it attempted indirectly to influence students' self-efficacy through teacher training. Previous studies traditionally involved researchers working directly with students (Skinner, Wellborn, & Connell, 1990). Second, the instructional modifications suggested for teachers in the treatment groups in this study occurred in classroom environments with all students. Prior studies often focused on laboratory settings or pullout situations involving subgroups of students (Schunk, 1989b). Third, this study implemented a package of instructional techniques that had been found to influence self-efficacy. Finally, an attempt was made to increase students' self-efficacy and subsequently, student achievement, not merely establish a relationship between self-efficacy and academic performance. Therefore, the problem addressed in this study was whether training teachers in ways to enhance self-efficacy could influence students' mathematics self-efficacy and mathematics achievement.

Theoretical Framework

Relevant research related to this study includes Bandura's theory of self-efficacy and research on school staff development. Self-efficacy judgments are based on four sources of information: an individual's own past performance, vicarious experiences of observing the performances of others, verbal persuasion that one possesses certain capabilities, and physiological states from which individuals judge their capability (Bandura, 1986). Teachers' instructional presentations and interactions with students can include information designed to capitalize on the influence of these sources (Schunk, 1989a). Extensive research in the late '70s and '80s found that modifying instructional techniques increased self-efficacy (Bandura & Schunk, 1981; Dweck, 1975; Kazdin, 1975; McAuley, 1985; Meece, Blumenfeld, & Hoyle, 1988; Meichenbaum, 1971; Schunk, 1985;

[1] Siegle, D. (2003, April). *Influencing student mathematics self-efficacy through teacher training.* Paper presented at the Annual Meeting of the American Research Association, Chicago, IL.

Schunk & Hanson, 1985; Schunk & Rice, 1984; Wood & Locke, 1987). Collins (1984) noted that although increases in self-efficacy were a by-product of a number of instructional tactics, research was needed on specifically designed strategies to increase self-efficacy in classroom settings. Later, Schunk (1989b) called for research on methods that promote students' self-efficacy in the context of regular classroom instruction.

Joyce and Showers (1982) proposed four elements of inservice training that "virtually guarantee the successful implementation of almost any approach" (p. 5). These elements are:

- Study of the theoretical basis or rationale of the teaching method;
- Observation of demonstrations by persons who are relatively expert in the approach;
- Practice and feedback in protected conditions (such as trying out the strategy on each other and then on children who are relatively easy to teach); and
- Coaching one another as they work the new approach into their repertoire and providing one another with ideas and feedback.

They found that the first three, when they are of high quality, are sufficient to enable teachers to implement an approach appropriately. When the last element is included, nearly all teachers will begin using the approach.

The key factor in maintaining any change in instructional practice is demonstrated student learning according to Guskey (1986). Teachers change their beliefs and attitudes about an instructional modification only after they observe positive changes in student learning outcomes as a result of change in the teachers' classroom practices.

Methods

Subjects

A pretest-posttest control group quasi-experimental design (Borg & Gall, 1989), using a voluntary sample of intact groups, was used. The sample included 872 fifth grade students (n=435 males; n=432 females; n=5 gender not provided) from a volunteer sample of 10 school districts with a total of 15 schools and 40 fifth grade classrooms. The 10 school districts were located in 6 states across the midwest, central, south, and east. School participation in each district was voluntary; however, all of the fifth grade mathematics teachers were required to participate in the study if the school elected to participate. Of the students, 92% were Caucasian and 23% were enrolled in special programs.

The largest district was located in a midwestern city of 100,000 with 11 classrooms and 206 5th-grade students. The smallest district was located in a rural midwestern town of 150 with 1 fifth grade class of 6 students. Class size ranged from 6 students to 30 students and the mean class size was 21 students. A summary describing the school districts is provided in Table 1.

Each of the 15 schools was randomly assigned to either the treatment or the control group. Eight schools, with a total of 19 classrooms and 442 students, were assigned to the control group and 7 schools, with a total of 21 classrooms and 430 students, were assigned to the treatment group. One control group teacher taught the mathematics for the three classes in her school. Students in both the experimental and control group classrooms completed the *Student Mathematics Survey* and the *Math Achievement Test* prior to, and after receiving instruction in the mathematics measurement unit.

Table 1.
Data on Participating Districts

District	State	Community Type	Number of Schools	Number of Classrooms	Number of Students
1	MI	Rural	1	5	122
2	NC	Rural	1	3	80
3	MI	Suburban	1	1	30
4	MA	Suburban	2	4	82
5	MD	Suburban	1	4	88
6	MT	Urban	5	11	206
7	MT	Suburban	1	6	138
8	MI	Suburban	1	2	59
9	NE	Rural	1	3	61
10	MT	Rural	1	1	6

Procedures and Materials

This study consisted of two phases. In the first phase, the treatment group teachers were trained in the self-efficacy construct and self-efficacy strategies to use in their classroom. In the second phase, the treatment group teachers implemented the self-efficacy strategies while teaching a 4-week mathematics unit in measurement that was developed by the researcher. The control group teachers taught the same 4-week mathematics measurement unit; however, they did not receive self-efficacy training.

Phase One: Treatment Group Teacher Training

The teachers assigned to the treatment group received approximately 2 hours of training. The training was based on the first three elements of Joyce and Showers' (1982) staff development principles. The material for the treatment group training consisted of a 35-page handbook developed by the researcher and a 1-hour training videotape, which included material from the handbook in a workshop format and filmed segments of a classroom teacher implementing the self-efficacy strategies. The handbook contained a rationale and supporting research for the strategies the teachers were expected to use. The teachers were able to observe other teacher on the videotape implement the strategies with her students. The teachers read the handbook individually prior to watching the videotape as a group. Following the training, the teachers completed a questionnaire to assess their understanding of the strategies they were expected to implement. The teachers indicated on the questionnaire how they would apply the strategies in various situations. Upon completion of the questionnaire, they received feedback from the researchers on their responses.

The treatment group training focused on teaching strategies in three areas: goal setting, which included activities designed to draw students' attention toward their successful performances; teacher feedback, which included complimenting students on the specific skills they had acquired; and modeling, which involved students observing fellow students successfully implementing learning tasks. Previous research reported that self-efficacy was most strongly influenced by past performances, vicarious experiences, and verbal persuasion (Bandura, 1986); therefore, the treatment strategies utilized these strategies.

Phase Two: Student Mathematics Measurement Unit

A 4-week mathematics unit about measurement was developed for use in this study. The unit was based on measurement concepts covered in fifth grade mathematics textbooks (Eicholz et al., 1993) and used Shaw and Cliatt's (1989) principles for teaching measurement. The unit consisted of 20 days of 30-minute lessons. The first 10 days' material was developed with the assistance of a university mathematics specialist. The concepts of inches, feet, yards, miles, and Fahrenheit temperature measurement units; reading rulers and thermometers; and map scale and ratios were developed in these lessons. The final 10 days involved the first four of eight activities developed by The Middle Grades Mathematics Project (Shroyer & Fitzgerald, 1989). This material covered surface area and volume.

All of the participating teachers were provided with instructions for each lesson, as well as all of the necessary materials and handouts for their students. The first 2 weeks of the unit consisted of daily instructions attached to classroom packets of materials. The instructions for the treatment group also included suggestions for implementing self-efficacy strategies into the lessons. The control group's lesson plans did not include self-efficacy strategies. Each day the treatment teachers recorded on a checklist which of the eight self-efficacy strategies they used during the instruction of the measurement unit (see Table 2). The last 2 weeks of the unit consisted of The Middle Grades Mathematics Project's instructions for each of four activities (Shroyer & Fitzgerald, 1989). The teachers extended the four activities of this math project across the last 10 days of the study. No special self-efficacy instructions were included with the last four activities; however, the treatment group teachers were reminded to continue applying the self-efficacy techniques they had been using during the first 2 weeks.

Table 2

Summary of Self-Efficacy Strategy Implementation by Treatment Teachers

Strategy	Percentage of Days Successfully Implemented
Goals	
1. Reviewed previous day's goals	92
2. Posted today's goals	94
3. Reviewed success of today's goals	92
4. Students recorded daily progress on calendars	92
5. Reviewed students' daily progress calendars	75
Feedback	
6. Complimented class four times on specific skills	88
7 Complimented five students on specific skills	83
Models	
8. One student successfully demonstrated (modeled) the skill during the lesson	76

Data Sources

Two student instruments were constructed to assess the impact of the teacher training. The first, the *Student Mathematics Survey*, was developed to assess students' self-efficacy related to their ability in measurement. It consisted of 35 statements, and students judged their self-efficacy on a 7-point scale ranging from "not good" to "super good." The same version of the instrument was administered pre and post. The pre and posttest self-efficacy instrument Cronbach alpha reliability estimates were .96 and .97, respectively.

The second instrument, the *Math Achievement Test*, consisted of 32 questions and was designed to assess mathematics achievement in measurement. Two versions of the test were developed. Separate versions were used for pre and posttests, and both versions tested the same concepts. The K-R 20 reliability estimates were .78 and .83, respectively. Panels of five content experts evaluated the content validity of both instruments.

Prior to beginning the study, the classroom teachers rated their students' mathematics skills on a scale from 1 to 7. The teachers used a scale from 1=poor to 7=superior.

Results

Phase One: Teacher Training

The treatment group teachers demonstrated a clear understanding of the self-efficacy strategies that they were asked to implement and expressed confidence in their ability to implement the strategies during the study. The mean response, based on the 7-point scale (1 = very little confidence; 7 = extremely high confidence), for the two subscales of confidence in using the self-efficacy strategies with students and confidence in using the self-efficacy strategies in the classroom was 5.1 and 5.7, respectively. Based on this information, the teacher-training component of this study was considered effective.

Phase Two: Teaching the Measurement Unit

Strategy Implementation. The second phase of the study investigated how well the teachers implemented the self-efficacy strategies and what impact the strategies had on student mathematics self-efficacy and student mathematics achievement. The treatment group teachers indicated on a *Daily Strategy Form* which of the eight self-efficacy strategies (see Table 2) they used each day during the instruction of the measurement unit.

Analysis of Student Data

To examine the effect of the intervention on student mathematical measurement self-efficacy, I conducted a multi-level analysis. Since the 15 schools were randomly assigned to either the treatment (n=7) or control (n=8) group, to analyze the data at the student or classroom level would violate the assumption of independence (Kenny & Judd, 1986). Some relationship among student scores within a classroom exists, since the students share a common environment and teacher. Similarly, classrooms within the same school are not independent of each other. I first developed a hierarchical linear model using student gender, treatment or control group membership, teachers' rating of student mathematical ability, and pre student mathematical measurement self-efficacy as predictors of post student mathematical measurement self-efficacy.

Because gender was not statistically significant, it was eliminated from the final model. There were no cross-level interactions between group and the level-1 variables so they the level 1 variables were also removed for the final model. Following the suggestion of Raudenbush and Bryk (2002), the random effect for group was set to zero because little or no variance in the slopes remained to be explained. Table 3 reports the results of the final model. After controlling for pre self-efficacy and student mathematics ability, the average self-efficacy in control schools was .15 points lower than self-efficacy in the treatment schools. After controlling for pre self-efficacy and treatment group membership, for each point higher on a seven-point scale of mathematics ability, post self-efficacy rose .06 points. After controlling for mathematics ability and treatment group membership, post self-efficacy rose .20 for each one-point increase in pre self-efficacy.

Table 3
Student Post Self-Efficacy

Fixed Effect	Coefficient	*se*	*t*-ratio
Model for treatment/control group			
INTERCEPT, G_{00}	4.89	0.04	136.8*
GROUP, G_{01}	-0.15	0.05	-3.19*
Model for ability slopes			
INTERCEPT, G_{10}	0.058	0.01	4.860*
Model for pre self-efficacy slopes			
INTERCEPT, G_{20}	0.20	0.02	9.61*

Random Effect	Variance Component	*df*	Chi-square	*p*-value
INTERCEPT, U_0	0.01	13	53.17	<0.001
Ability slope, U_1	0.00097	14	27.93	0.015
Pre Self-Efficacy Slope, U_2	0.00401	14	43.54	<0.001
Level-1 effect, R	0.34			

* $p < .05$.

I also developed a hierarchical linear model using student gender, treatment or control group membership, teacher rating of student mathematical ability, and pre student mathematical measurement achievement as predictors of post student mathematical measurement achievement. Achievement was measured as the percentage of correct answers on a measurement skills test. Group membership (control or treatment) did not influence posttest achievement and there was no interaction between ability level and achievement by group. Ability level was related to posttest achievement. On average, students correctly answered 39% of the questions. For each point they were rated higher in ability by their teachers (7-point scale), they answered about 4% more questions correctly. I did not develop the model further since none of the fixed effects were significant. Therefore, the model with non significant predictors is shown in Table 4.

An examination of the relationships between pre and post assessments revealed similar relationships for control and treatment students except for one pair. The relationship for posttest achievement and posttest self-efficacy was stronger for the treatment students than for the control students (see Table 5).

Table 4
Student Post Achievement

Fixed Effect	Coefficient	*se*	*t*-ratio
Model for treatment/control group			
INTERCEPT, G_{00}	0.392	0.03	15.634
GROUP, G_{01}	-0.05	0.03	-1.370
Model for ability slopes			
INTERCEPT, G_{10}	-0.010	0.11	-.893
GROUP, G_{11}	0.026	0.02	1.688
Model for pre achievement slopes			
INTERCEPT, G_{20}	0.039	0.01	6.064*
GROUP, G_{21}	0.007	0.01	0.846

Random Effect	Variance Component	*df*	Chi-square	*p*-value
INTERCEPT, U_0	0.004	13	172.45	<0.001
Ability slope, U_1	0.014	13	42.96	<0.001
Gender Slope, U_2	0.012	13	12.468	>.500
Level-1 effect, R	0.010			

* $p < .05$.

Table 5
Correlations Between Variables

	PreSE		PostAch		PostSE	
	Control	Treat	Control	Treat	Control	Treat
Pretest Achievement	.307	.278	.666	.699	.346	.402
Pretest Self-Efficacy			.189	.276	.607	.521
Posttest Achievement					.330	.528

** All correlations were significant at the 0.01 level (two-tailed).

Educational Importance of the Study

This study demonstrated that teachers can modify their instructional strategies with minimal training, which can result in increases in student self-efficacy. These increases carry across ability levels and gender. Controlling for other variables in the model, having a teacher trained in self-efficacy raised students' self-efficacy scores more than a one point increase in mathematics ability (as rated by teachers on a 7-point scale). These increases can be achieved during a short period of time with minor changes in instructional style.

Teacher Training

Several factors contributed to the success of the teacher-training module used in this study. The training followed Joyce and Showers' (1982) suggestions and provided a rationale for the strategies, gave participants the opportunity to observe a teacher implementing the strategies on videotape, provided feedback from the researcher under protected conditions. It also provided an opportunity for teachers to observe changes in student behavior. The treatment group students recorded daily accomplishments on student calendars, which the teachers reviewed individually with them. By requiring the treatment teachers to continually review the calendars, the teachers were constantly being bombarded with positive feedback from their students. The training also prompted the teachers to expect that the strategies would produce useful outcomes. The handbook and videotape featured positive outcomes from a variety of previous self-efficacy research.

Teaching Strategies

The goal strategies were designed to draw students' attention toward their progress. The strongest source of efficacy information is past experience (Bandura, 1993), and the activities in this study provided opportunities for students to see the progress they were making. Each day, the training group teachers reviewed goal accomplishments from the previous day, posted the current lesson's goals prior to instruction, and reviewed the daily goal accomplishments at the end of the current lesson with their classes. Although many teachers were aware that sharing objectives was an “instructional set” to help students organize their learning, the teachers were not cognizant that it also provided an opportunity for students to evaluate their growth. The student calendar writing used in this study resembles the popular practice of journal writing, which also allows students to reflect on their academic growth. Students recorded on a calendar each day something new they had learned or something at which they had excelled.

The second set of self-efficacy strategies involved teacher feedback. Teacher feedback can function as verbal persuasion, as in the case of attributing failure to lack of effort and encouraging students to try harder, and as past performance awareness, as in the case of complimenting students on their specific skills. The latter, drawing students' attention to their growth, was a major emphasis of the teacher training component. Middleton and Spanias (1999) noted that students should be encouraged to attribute their successes to a combination of ability and effort and their failures to lack of effort or to confusion or reliance on inappropriate strategies.

Another feature of the teacher feedback was the specificity of the compliments. Just as specific goals are more effective (Rosswork, 1977; Schunk, 1989a), specific compliments are more effective at drawing students' attention to their skills, and subsequently, their past performance. A comment such as, "Good work!" provides a student with very little information about his or her ability. However, a compliment such as, "You're good at using a ruler" lets the student know what skill he or she has mastered. Such a comment gives the student more information to cognitively appraise his or her ability. Pajares and Miller (1995) found that self-efficacy specific to a mathematics task was more related to later performance in that task than a general mathematics self-efficacy.

The third strategy involved using student models. The treatment group teachers were asked to use student models early in the lessons that they conducted. The purpose of utilizing student models was to demonstrate to students that others, like themselves, are mastering the task and they, therefore, can master it also. A second benefit is the vicarious experience the model provides for the observer.

The nature of the lessons encouraged teachers to organize the students into groups, which may have actually decreased self-efficacy differences between the treatment and control students. One benefit of group work may be that it provided students with an opportunity to observe a variety of peer models from whom they could learn. With the group work, both treatment and control group students benefited from modeling.

Some earlier research involving attempts to increase student self-efficacy through successful completion of projects reported no increase in self-efficacy (Schack, 1986; Starko, 1986). Although these studies provided students with successful experiences, they did not incorporate a key factor in self-efficacy theory, which is the cognitive appraisal of the performance. Students who successfully complete a very difficult project may not report higher self-efficacy if they fail to recognize the skills they have developed and mastered during the successful process, or if the amount of effort necessary to complete the project overshadows the skills they developed and used in the process. The academic progress students made in this study was continually being drawn to their attention.

Limited Achievement Differences

The lack of difference that was found on mathematics measurement achievement tests between treatment and control students may be due to the length of the study or the variety of topics covered during the study. A wide variety of measurement topics were covered in the 4-week unit. Most of the topics were limited to 1 or 2 days of instructional time. Using this format, increases in self-efficacy would have had a limited opportunity to influence achievement. High self-efficacy contributes to achievement through additional effort and persistence on the students' part. The students in this study were not presented with additional tasks beyond those found in the initial lesson, which would have required the perseverance associated with high self-efficacy. If one or two concepts had been explored for several weeks, the measurement achievement may have been different between the two groups.

This study also found a significant relationship between self-efficacy and achievement. This supports the large body of research revealed from meta-analysis (Multon et al., 1991) that positive, significant relationships exist between self-efficacy and achievement. Students whose teachers were training in self-efficacy showed a stronger relationship between posttest self-efficacy and posttest achievement than students of teachers who were not trained. Since we know that self-efficacy is related to achievement, this may indicate that the treatment students reported a more realistic rating of their self-efficacy.

Suggestions for Further Research

This study needs to be replicated with a more culturally diverse population. Although the students in this study benefited from feedback complimenting their skills, students from other cultural backgrounds may not. For example, American Indian students may react very differently to skill feedback in light of the value placed on community in their culture. Furthermore, the emphasis placed on effort by the Asian culture may influence how Asian-American students react to the strategies.

In conclusion, this study demonstrated that teachers can implement new instructional strategies with minimal training. It also showed that significant increases in student self-efficacy can be achieved during a short time period with minor changes in instructional style. Accordingly, professional development groups should consider exposing teachers to self-efficacy theory as well as teaching the rationale for, and the benefits of, these self-efficacy strategies. Educators need to be aware that students of all abilities benefit from a learning environment where growth and progress at all achievement levels are recognized

References

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84,* 191-215.

Bandura, A. (1986). *Social foundations of thought and action: A social cognition theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*, 117-148.

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.

Borg, W. R., & Gall, M. D. (1989). *Educational research: An introduction.* New York: Longman.

Collins, J. L. (1984). *Self-efficacy and ability in achievement behavior.* Unpublished doctoral dissertation, Stanford University.

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.

Eicholz, R. E., O'Daffer, P. G., Charles, R. I., Barnett, C. S., Young, S. L., Fleenor, C. R., Clemens, S. R., Gilmer, G. F., Reeves, A., Renfro, F., Soniat-Thompson, M. M., Thornton, C. A., & Westley, J. E. (1993). *Addison-Wesley Mathematics c. 1993: Teacher's edition grade 5*. Menlo Park, CA: Addison-Wesley Publishing.

Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational Researcher, 15,* 5-12.

Joyce, B., & Showers, B. (1982). The coaching of teaching. *Educational Leadership, 40*(1), 4-10.

Kazdin, A. E. (1975). Covert modeling, imagery assessment, and assertive behavior. *Journal of Consulting and Clinical Psychology, 43,* 716-724.

Kenny, D. A., & Judd, C. M. (1986). Consequences of violating the independence assumption in analysis of variance. *Psychological Bulletin, 99,* 422-431.

Lyman. R. D., Prentice-Dunn, S., Wilson, D. R., & Bonfilio, S. A. (1984). The effect of success or failure on self-efficacy and task persistence of conduct-disordered children. *Psychology in the Schools, 21,* 516-519.

McAuley, E. (1985). Modeling and self-efficacy: A test of Bandura's model. *Journal of Sport Psychology, 7,* 283-295.

Meece, J. L., Blumenfeld, P. C., & Hoyle, R. H. (1988). Students' goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology, 80,* 514-523.

Meichenbaum, D. H. (1971). Examination of model characteristics in reducing avoidance behavior. *Journal of Personality and Social Psychology, 17*, 298-307.

Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics: Findings, generalizations, and criticism of the research. *Journal for Research in Mathematics Education, 30,* 65-88.

Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology, 38,* 30-38.

Pajares, F., & Miller, D. M. (1995). Specificity of self-efficacy assessment. *Journal of Counseling Psychology, 42,* 190-198.

Rosswork, S. G. (1977). Goal setting: The effects on an academic task with varying magnitudes of incentive. *Journal of Educational Psychology, 69,* 710-715.

Schack, G. D. (1986). *Creative productivity and self-efficacy in children.* Unpublished doctoral dissertation, University of Connecticut, Storrs.

Schunk, D. H. (1981). Modeling and attributional effects on children's achievement: A self-efficacy analysis. *Journal of Educational Psychology, 73,* 93-105.

Schunk, D. H. (1985). Participation in goal setting: Effects on self-efficacy and skills of learning-disabled children. *The Journal of Special Education, 19,* 307-317.

Schunk, D. H. (1989a). Self-efficacy and cognitive achievement: Implications for students with learning problems. *Journal of Learning Disabilities, 22,* 14-22.

Schunk, D. H. (1989b). Self-efficacy and cognitive skill learning. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (pp. 13-44). San Diego, CA: Academic Press.

Schunk, D. H., & Hanson, A. R. (1985). Peer models: Influence on children's self-efficacy and achievement. Journal of Educational Psychology, 77, 313-322.

Schunk, D. H., & Rice, J. M. (1984, August). *Strategy self-verbalization: Effects on remedial readers' comprehension and self-efficacy.* Paper presented at the annual meeting of the American Psychological Association. Toronto, Canada.

Shaw, J. M., & Cliatt, M. F. P. (1989). Developing measurement sense. In P. R. Trafton (Ed.), *New directions for elementary school mathematics* (pp. 149-155). Reston, VA: National Council of Teachers of Mathematics.

Shroyer, J., & Fitzgerald, W. (1989). *Middle grades mathematics project: Mouse and elephant: Measuring grow.* Menlo Park, CA: Addison-Wesley Publishing.

Skinner, E. A., Wellborn, J. G., & Connell, J. P. (1990). What it takes to do well in school and whether I've got it: A process model of perceived control and children's engagement and achievement in school. *Journal of Educational Psychology, 82*, 22-32.

Starko, A. J. (1986). *Effects of the revolving door identification model on creative productivity and self-efficacy.* Unpublished doctoral dissertation, University of Connecticut, Storrs.

Wood, R. E., & Locke, E. A. (1987). The relationship of self-efficacy and grade goals to academic performance. *Educational and Psychological Measurement, 47*, 1013-1024